ENVIRONMENTAL ASSESSMENT REPORT

Deltaport Terminal

Road and Rail Improvement Project

Prepared for:
Port Metro Vancouver
100 The Pointe, 999 Canada Place
Vancouver, BC V6C 3T4

Prepared by:
Hemmera
250 – 1380 Burrard Street
Vancouver, BC V6Z 2H3

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EXECUTIVE SUMMARY

INTRODUCTION

As part of the Container Capacity Improvement Program (CCIP), Port Metro Vancouver is working with the Province of British Columbia (including the BCR Properties, Ltd., a subsidiary of the British Columbia Railway Company, a Crown Corporation [BCR]) and TSI Terminal Systems Inc. (TSI), the Deltaport container terminal operator, to design and implement the Deltaport Terminal, Road and Rail Improvement Project (DTRRIP or the 'Project') in Delta, British Columbia.

The existing Deltaport container terminal is the largest container terminal in Canada, with a capacity of 1.8 million twenty-foot equivalent units (TEUs). Current road and rail constraints limit the capacity of Deltaport to meet forecast demand for additional container movements. Container traffic through Canada's Pacific Gateway is expected to double over the next 10 to 15 years, and nearly triple by 2030 (Port Metro Vancouver, 2011a). The primary purpose of the Project is to provide the most immediate and cost effective capacity increase by making road and rail improvements at Roberts Bank that will increase container capacity at Deltaport by 600,000 TEUs to 2.4 million TEUs.

PROJECT DESCRIPTION

The proposed DTRRIP consists of the following four key components:

1. **DTRRIP Overpass:** An overpass on the existing Roberts Bank causeway to separate road and rail traffic. The DTRRIP Overpass will consist of elevated roadways connecting Deltaport Way to Roberts Bank Way (North and South) east of the intermodal yard, and entirely within the footprint of the existing Roberts Bank causeway.
2. **Terminal Improvements:** Reconfiguration of intermodal yard rail track and additional container handling equipment at the Deltaport container terminal. Improvements include the addition of two intermodal rail track and the realignment of six other rail tracks to increase the capacity of the terminal within the existing intermodal yard footprint.
3. **Railway Improvements:** A total of 78,300 feet (ft) of new track (non-continuous) within the existing BCR Rail Corridor and a portion of the Option Lands[1]. Two existing tracks do not require relocation.
4. **Road Improvements on and adjacent to Deltaport Way:** Road Improvements to improve the movement of container trucks at Deltaport include weigh-in-motion scales, and vehicle access control system (VACS) gate.

[1] The Province of B.C.'s Option Lands are a 60-metre-wide strip of land from Arthur Drive west to the neck of the Roberts bank causeway and are within the Agricultural Land Reserve. In 2008, the Agricultural Land Commission approved the acquisition of the Option Lands to create new rail rights-of-way.

The estimated total Project construction duration from award of contract through to commissioning of major equipment is approximately 2.5 years. The main construction phase activities include:

- Site preparation and clearing
- Site pre-loading
- Soil densification
- Overpass construction
- Rail track construction
- Terminal improvements, including intermodal yard track construction and realignment.

Project construction will not interrupt rail and road operations to Deltaport and Westshore Terminals other than isolated scheduled outages for construction activities that would create an operational or safety conflict. The Project will be implemented mostly within the existing terminal, road and rail footprint. Construction work will not occur within the marine environment.

COMMUNICATIONS AND CONSULTATION

Port Metro Vancouver has, and continues to engage communities, stakeholders and the public regarding DTRRIP. Communications and consultation to date have focused on initial outreach with stakeholders and providing opportunities for public participation in the review of the Project Description. Consultation activities to date have focused on raising public awareness about the scope, necessity, and benefits of the Project; and engaging the public and key stakeholders in identifying initial issues and interests pertaining to potential environmental, social, economic effects and/or benefits of the Project.

Port Metro Vancouver is committed to continued and active engagement with First Nations who may have interests that may be potentially affected by DTRRIP. The goal of Port Metro Vancouver's consultation and engagement program to-date has been to further identify aboriginal interests and potential Project-related effects, to design and implement appropriate mitigation measures and to identify additional First Nation issues, benefits and Project-related opportunities as they may arise.

ENVIRONMENTAL ASSESSMENT REQUIREMENTS

A screening-level environmental assessment, under the *Canadian Environmental Assessment Act* (CEAA) was commenced for the Project on October 14, 2011. As part of the federal government's plan for Responsible Resource Development, which seeks to modernize the regulatory system for project reviews, the *CEAA* was repealed when the *Canadian Environmental Assessment Act, 2012* (*CEAA 2012*) came into force on July 6, 2012. As a result of this regulatory change, DTRRIP is no longer subject to a federal environmental assessment since the scope of the project does not include any activities, described within regulations associated with CEAA 2012 (i.e., Regulation Designating Physical Activities), that would trigger an environmental assessment.

While the project is no longer subject to review under federal environmental assessment legislation (i.e., *CEAA 2012)*, Port Metro Vancouver is continuing the environmental review as per the Port Metro Vancouver`s Project Environmental Assessment Procedure (PEAP) under their Environment Policy. The assessment of the project under the PEAP is based on the same environmental assessment document previously issued to support review of the project under CEAA.

Upon completion of the review of the project under the PEAP, Port Metro Vancouver will post information to the company website pertaining to the review of the project. Such materials will include: Port Metro Vancouver decision; final environmental assessment report, summary of comments and Port Metro Vancouver responses associated with the review of the environmental assessment document, and conditions of approval, including mitigation.

SUMMARY OF ENVIRONMENTAL EFFECTS ASSESSMENT

Environmental studies were undertaken as part of the screening-level environmental assessment (EA) report to assess the potential environmental effects associated with the proposed DTRRIP.

Key conclusions for each of the biophysical effects assessments are as follows:

- With the implementation of mitigations measures described in **Section 5.1**, no residual adverse effects on vegetation and wildlife VECs are anticipated as a result of Project construction and operation.
- With the implementation of mitigation measures described in **Section 5.2**, no residual adverse effects on water resources are anticipated as a result of construction and operation.
- With the implementation of mitigation measures described in **Section 5.3**, no residual adverse effects on fish and fish habitat are anticipated as a result of construction and operation.
- Construction will not occur within the marine environment, and therefore the construction phase of the Project will have no effect on the marine environment. With the implementation of mitigation measures described in **Section 5.4**, no residual adverse effects on marine vegetation or marine invertebrates are anticipated as a result of operation. The residual environmental effect of acoustic disturbance from increased vessel traffic is considered to be not significant for marine and anadromous fish, coastal birds, and marine mammals. The residual environmental effects of vessel strike on marine mammals are considered to be not significant (**Section 5.4**).
- With the implementation of mitigation measures described in **Section 5.5**, no residual adverse effects on air quality are anticipated as a result of construction. With the implementation of mitigation measures, as well as ongoing initiatives described in **Section 5.5**, the residual environmental effect of changes in air quality is considered to be not significant during operation. All maximum concentrations predicted for Project operation, including 98th percentile background values, are below the applicable Canada-wide Standards and the most stringent BC AAQO's.

Key conclusions for each of the socio-community effects assessments are as follows:

- With the implementation of the proposed mitigation measures described in **Section 6.1**, no residual effects of noise and vibration associated with construction are anticipated. With the implementation of noise mitigation measures proposed, as well as Port Metro Vancouver's ongoing initiatives to manage port-related noise, residual effects of noise during operation are not considered to be significant. There are no residual effects of vibration associated with DTRRIP operations.
- As described in **Section 6.2**, Port Metro Vancouver will work with communities adjacent to the Project to identify the need for mitigation of visual effects. If any mitigation measures are identified and implemented, it is anticipated that the residual effects after mitigation may be marginally reduced from the estimated initial effects concluded in this report. It is anticipated that residual effects would be considered to be not significant.
- Lighting during Project construction and operation is anticipated to have minimal effects on local residents, and with the implementation of mitigation measures described in **Section 6.3**, no residual effects are anticipated.
- Employment and economic opportunities are considered to be positive during both Project construction and operation. There will likely be some increase in population in Delta associated with more long-term job opportunities as a result of DTRRIP, but this effect is generally considered to be a positive outcome and estimated to be low in magnitude. Some transportation and traffic related effects are anticipated during both construction and operation however, with implementation of mitigation measures described in **Section 6.4**, no residual adverse effects are anticipated.
- Direct effects will occur within the Project footprint on agricultural lands, resulting in the loss of 8.33 ha of Agricultural Land Reserve (ALR) lands. However, following implementation of proposed mitigation and compensation measures, no residual effects to agriculture are anticipated.
- Studies indicate minimal potential for archaeological resources within the Project footprint. As such, following mitigation measures described in **Section 6.6**, no residual effects on archaeology resources are anticipated to result from DTRRIP. Monitoring is recommended during construction, and is not required during operation as no ground disturbances will occur outside of the Project construction footprint.

CUMULATIVE EFFECTS ASSESSMENT

A cumulative effects assessment undertaken as part of the environmental assessment considered residual effects (i.e., effects remaining after the application of mitigation) carried forward from the environmental assessment. The scope of the cumulative effects assessment focused on:

- Marine and anadromous fish – Disturbance or displacement from habitat as a result of underwater noise from increases in vessel calls during the operations phase.
- Coastal seabirds – Disturbance or displacement from habitat as a result of in-air acoustic emissions from increases in vessel calls during the operations phase.

- Marine mammals – Physiological and behavioural changes as a result of acoustic disturbance from increases in vessel calls during operations phase and physical injury/direct mortality as a result of vessel strikes from increases in vessel calls during operations phase.
- Air quality – Increases in ambient concentrations of air contaminants.
- Noise – Increases in noise level at sensitive receptors adjacent to the Project.

With the implementation of Project related mitigation and additional measures no significant cumulative effects are predicted as a result of the potential interactions between the Project and other projects and activities.

FIRST NATIONS CONSIDERATIONS

The potential for direct effects on the current use of lands and resources for traditional purposes by aboriginal people was evaluated in **Section 11.0**. Findings from studies conducted for this document suggest that there are no residual effects to biophysical resources (**Table 11-1**), and hence no residual adverse effects to traditionally used resources within the study area. First Nations have indicated an interest in ensuring that any archaeological resources within the Project area are protected. Accordingly, the archaeological assessment conducted suggests no residual adverse effects to archaeological resources are anticipated. Input from First Nations with respect to the environmental studies and current use of lands and resources for traditional purposes will be sought through ongoing consultation in an effort to confirm these findings and related understandings.

SUSTAINABLE DEVELOPMENT

Sustainable development objectives will play a key role in the detailed design, construction, and operation of DTRRIP. **Section 10.0** considers the range of social, economic and environmental costs and benefits associated with the proposed Project and present an overview of how DTRIPP meets the intent and definition of sustainable development, as defined in the CEAA.

Based on the review of potential impacts to the sustainability considerations and the legislated definition of sustainability stated in the CEAA, it is not anticipated that there will be Project-related effects that compromise the ability of future generations to meet their own needs. Similarly, sustainability initiatives, which consist of works over and above legislative requirements, will likely have a long-term positive net benefit to the community.

CONCLUSION

Based on the environmental assessment undertaken, the proposed Project is predicted to have low biophysical and social-economic effects on the environment, while providing economic benefits in local communities, throughout the Lower Mainland, and across the country. This EA report documents the process undertaken to meet or exceed regulatory requirements and concludes that, with the implementation of proposed mitigation measures, the Project is not likely to cause significant adverse environmental, socio-economic / community or cumulative effects.

LIST OF ACRONYMS

%	Percent
AAQO	Ambient Air Quality Objectives
AIA	Archaeological Impact Assessment
AIA	Agriculture Impact Assessment
ALC	Agricultural Land Commission
ALR	Agricultural Land Reserve
AMS	Adaptive Management Strategy
ANSI	American Nations Standards Institute
AOA	Archaeological Overview Assessment
AQMP	Air Quality Management Plan
BC	British Columbia
BCR	BCR Properties Ltd., a subsidiary of British Columbia Railway Company, a Crown Corporation
BCWQG	British Columbia Water Quality Guidelines
BNSF	BNSF Railway
CAC	Common Air Contaminants
CCIP	Container Capacity Improvement Program
CCME	Canadian Council of Ministers of the Environment
CD	Chart Datum
CDC	Conservation Data Centre
CDFmm	Moist Maritime Coastal Douglas-fir subzone
CEA	Cumulative Effects Assessment
CEAA	*Canadian Environmental Assessment Act*
CEAR	Canadian Environmental Assessment Registry
CH_4	Methane
CHE	Cargo Handling Equipment
cm	Centimetres
CN	Canadian National Railway
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CoD	Corporation of Delta
ColRegs	Regulations for the Prevention of Collision at Sea
COSEWIC	Committee on the Status of Endangered Wildlife in Canada

CPA	Canada Port Authority
CPAEAR	Canada Port Authority Environmental Assessment Regulations
CPR	Canadian Pacific Railway
CSR	Corporate Social Responsibility
CWS	Canada Wide Standard
dB	Decibel
dBA	A-weighted decibel
DFI	Delta Farmer's Institute
DFO	Department of Fisheries and Oceans Canada
DFWT	Delta Farmland and Wildlife Trust
DIEP	Delta Irrigation Enhancement Project
DO	Dissolved Oxygen
DP3	Deltaport Third Berth Project
DPU	Distributed Power Unit
DTL	Direct to Locomotive
DTRRIP	Deltaport Terminal, Road and Rail Improvement Project
DWSM	Delta Watershed Model
EA	Environmental Assessment
ECA	Emissions Control Area
EMP	Environmental Management Plan
FISS	Fish Inventory Summary System
ft	Feet
FTA	US Federal Transit Administration
GHG	Greenhouse Gases
GPS	Global Positioning System
ha	Hectare
HAZMAT	Hazardous Material
HC	Hydrocarbons
HTG	Hul'qumi'num Treaty Group
Hz	Hertz
IBA	Important Bird Area
ICS	Incident Command System
ID	Identification
IDF	Intensity-Duration Frequency
IES	Illuminating Engineering Society

IESNA	Illuminating Engineering Society of North America
IR	Indian Reserve
ISPS	International Ship and Port Facility Security
kg	Kilograms
km	Kilometres
kV	Kilovolt
L	Litres
Ld	Daytime Equivalent Sound Level
Ldn	Day-night Equivalent Sound Level
Leq	Equivalent Sound Level
LFV	Lower Fraser Valley
Ln	Nighttime Equivalent Sound Level
LSA	Local Study Area
m	Metres
MARPOL	International Convention for the Prevention of Pollution from Ships
MARSEC	Marine Security
MCTS	Marine Communications and Traffic Services Centre
mm	Millimetres
mm/s	Millimetres per second
MoE	Ministry of Environment
MoTI	Ministry of Transportation and Infrastructure
MWLAP	Ministry of Water, Land and Air Protection
NAAQO	North American Air Quality Objectives
N_2O	Nitrous Oxide
NH_3	Ammonia
NO_x	Nitrogen Oxides
O_3	Ozone
OCP	Official community Plan
PEP	Provincial Emergency Program
PM	particulate matter
PMV	Port Metro Vancouver
PPV	Peak particle velocity
PVC	Polyvinyl chloride
PWS	Pacific Water Shrew
RA	Regulated Authority

RBRC	Roberts Bank Rail Corridor
RCMP	Royal Canadian Mounted Police
RESL	Robertson Environmental Services Ltd.
RISC	Resource Inventory Standards Committee
RMG	Rail-mounted Gantry Crane
RMS	Root Mean Square
RSA	Regional Study Area
RTG	Rubber-tired Gantry Crane
RV	Recreational Vehicle
SARA	*Species At Risk Act*
SEI	Sensitive Ecosystems Inventory
SFPR	South Fraser Perimeter Road
SO_2	Sulphur Dioxide
SRKW	Southern Resident Killer Whale
SRY	Southern Railway of British Columbia
T	Tonne
TAC	Transportation Association of Canada
TDG	*Transportation of Dangerous Goods Act*
TEUs	Twenty-Foot Equivalent Units
TFN	Tsawwassen First Nation
TLS	Truck Licensing System
TSI	Terminal Systems Incorporated
US	United States
VACS	Vehicle Access Control System
VEC	Valued Ecosystem Component
VFPA	Vancouver Fraser Port Authority
VOC	Volatile Organic Compounds
VSC	Valued Social Component
VSU	Visual Sensitivity Units
W	Watt
YVR	Vancouver International Airport

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1.0 INTRODUCTION

Vancouver Fraser Port Authority (conducting business as Port Metro Vancouver) is a non-shareholder, financially self-sufficient corporation, established by the Government of Canada in January 2008, pursuant to the *Canada Marine Act*, and accountable to the federal Minister of Transport.

As part of the Container Capacity Improvement Program (CCIP), Port Metro Vancouver is working with the Province of British Columbia (including the BCR Properties, Ltd., a subsidiary of the British Columbia Railway Company, a Crown Corporation [BCR]) and TSI Terminal Systems Inc. (TSI), the Deltaport container terminal operator, to design and implement the Deltaport Terminal, Road and Rail Improvement Project (DTRRIP or the 'Project') in Delta, British Columbia (**Figures 1-1**). This Project would increase Deltaport's container capacity by 600,000 twenty-foot equivalent units (TEUs), for a total of 2.4 million TEUs.

The Deltaport container terminal, Road and Rail Improvement Project is a series of improvements to the existing Deltaport container terminal at Roberts Bank and the BCR Rail Corridor in Delta, British Columbia (BC). As an upgrade to existing infrastructure, Port Metro Vancouver has identified the Project as the most efficient and cost-effective way to increase container capacity. The Project is expected to achieve minimal environmental effects as the Project would be constructed mainly within the existing Deltaport terminal and BCR's rail corridor footprint. Work will not occur within the marine environment.

This proposed increase in Deltaport's container capacity has been planned and accounted for in road and rail improvements that are currently underway, including the South Fraser Perimeter Road (SFPR) and the Roberts Bank Rail Corridor (RBRC) Program.

1.1 PROPONENT IDENTIFICATION

The Project is a partnership between Port Metro Vancouver, the Province of BC, and TSI Terminal Systems Inc. Port Metro Vancouver is coordinating the Project, and is responsible for Project design, staging, and scheduling. The Province of BC is responsible for rail improvements, and TSI Terminal Systems Inc. is responsible for improvements within the Deltaport Terminal.

Project enquiries should be directed to:

Cliff Stewart – Director, Infrastructure Development

Port Metro Vancouver

100 The Pointe, 999 Canada Place

Vancouver, BC V6C 3T4

604.665.9044

Communications to Port Metro Vancouver with respect to the CEAA screening report should be directed to:

Carrie Brown – Manager, Environmental Programs

Port Metro Vancouver

100 The Pointe, 999 Canada Place

Vancouver, BC V6C 3T4

604.665.9081

1.2 PROJECT OVERVIEW

1.2.1 General Project Description

The Project consists of four main components:

1. An overpass on the existing Roberts Bank causeway to separate road and rail traffic.
2. Reconfiguration of intermodal yard rail track and additional container handling equipment at the Deltaport Terminal.
3. Additional rail track within the existing BCR Rail Corridor and a portion of the Option Lands[2].
4. Road Improvements on and adjacent to Deltaport Way to improve the movement of container trucks at Deltaport.

The Project Site is shown on **Figure 1-1**. A detailed Project description is provided in **Section 2.0** Project Description.

1.2.2 Project Rationale

In keeping with Port Metro Vancouver's mission to facilitate the growth of Canadian trade, and in direct response to the growing needs of Canadian industry and consumer demand, Port Metro Vancouver is planning potential infrastructure improvements to enhance container capacity and strengthen Canada's Pacific Gateway. The CCIP is an important initiative in delivering the projects and required infrastructure to meet anticipated growth in the container sector. As an integral component of the program, Port Metro Vancouver is assessing potential efficiency gains throughout Lower Mainland container facilities.

The Deltaport Terminal, Road and Rail Improvement Project is the next in a series of improvements to existing terminals. Roberts Bank is well-positioned to accommodate future trade growth and offers several competitive advantages, including an established international shipping route with excellent access to important domestic markets and major North American road and rail transportation corridors.

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[2] The Province of BC's Option Lands are a 60-metre-wide strip of land from Arthur Drive west to the neck of the Roberts bank causeway and are within the Agricultural Land Reserve. In 2008, the Agricultural Land Commission approved the subdivision and acquisition of the Option Lands to create a new rail right-of-way.

1.2.3 Capital Cost and Job Creation

The economics specific to the Project include an estimated capital cost of approximately $280 million. This cost estimate is subject to final design. Employment opportunities associated with the Project include approximately 400 construction jobs per year for a 2.5 year construction period, and estimated 800-900 direct jobs once the terminal reaches capacity. Further discussion on socio-community and economic effects of the Project are included in **Section 6.4**.

1.3 REGULATORY CONTEXT AND ENVIRONMENTAL ASSESSMENT OBJECTIVES

1.3.1 *Canadian Marine Act* and Canada Port Authority Environmental Assessment Regulations (CPAEAR)

Port Metro Vancouver is a Canada Port Authority (CPA), as defined under Section 8 of the *Canada Marine Act*, and has responsibility under the Section 3.(1) of CPA Environmental Assessment (EA) Regulations of the *Canadian Environmental Assessment Act* (CEAA) to carry out an EA of this Project in accordance with the Regulations before exercising a power or performing a duty or function referred to in section 9 of CEAA.

1.3.2 *Canadian Environmental Assessment Act (CEAA)*

Under section 9(2)(b) of the CEAA, an environmental assessment is required because Port Metro Vancouver will contribute funding for the Project.

Port Metro Vancouver will act as the Regulated Authority (RA) as a Canada Port Authority under the Canadian Port Authority Environmental Assessment Regulations (CPAEAR). No Federal Authorities have identified a requirement to issue a permit or authorisation for the Project, however Port Metro Vancouver will seek expert advice from federal authorities including Transport Canada, Canadian Transportation Agency, Environment Canada, Health Canada, and Fisheries and Oceans Canada as an additional level of oversight to the review process. Should environmental studies identify additional CEAA triggers, further authorisation will be pursued to satisfy the appropriate requirements.

As the RA, Port Metro Vancouver, is required to conduct a “screening” type of environmental assessment under Section 10(1) of CPAEAR where a project is not described in the comprehensive study list. Port Metro Vancouver is also responsible for determining the scope of the environmental assessment and for determining if the project is likely to result in any significant adverse effects.

A screening-level environmental assessment, under the *Canadian Environmental Assessment Act* (CEAA) was commenced for the Project on October 14, 2011. As part of the federal government’s plan for Responsible Resource Development, which seeks to modernize the regulatory system for project reviews, the *CEAA* was repealed when the *Canadian Environmental Assessment Act, 2012* (*CEAA 2012*) came into force on July 6, 2012. As a result of this regulatory change, DTRRIP is no longer subject to a

federal environmental assessment since the scope of the project does not include any activities, described within regulations associated with CEAA 2012 (i.e., Regulation Designating Physical Activities), that would trigger an environmental assessment.

While the project is no longer subject to review under federal environmental assessment legislation (i.e., *CEAA 2012)*, Port Metro Vancouver is continuing the environmental review as per the Project Environmental Assessment Procedure (PEAP) under the Port Metro Vancouver Environment Policy. The assessment of the project under the PEAP is based on the same environmental assessment document previously issued to support review of the project under CEAA.

While the project is no longer subject to environmental assessment under federal environmental assessment legislation, the content of this environmental assessment report remains consistent with the requirements of previous and existing legislation.

1.3.3 *BC Environmental Assessment Act*

The Project does not require review under the *BC Environmental Assessment Act* as the Project does not exceed any of the thresholds described below under the *Reviewable Projects Regulation*:

- Marine Port Facilities (other than Ferry Terminals): The modification of the existing facility does not require dredging, filling or other direct physical disturbance of the foreshore or submerged land, below the natural boundary of the marine coastline or estuary.
- Public Highways: Road improvements do not result in the addition of greater than two lanes of paved public highway to an existing paved public highway over a continuous distance of greater than 20 kilometres.
- Railways: Rail modifications do not result in the addition of more than 20 kilometres of continuous track, and they have not been designed to accommodate high speed trains. The longest segment of continuous track will be less than ten kilometres in length. The majority of the new track will be located within the Gulf Yard and include a total length of 16.6 kilometres (approximately 54,500 ft[3]) divided into smaller segments to accommodate lead tracks and storage tracks as described in **section 2.4.3**.

1.3.4 Other Applicable Environmental Legislation and Policy

Based on the Project type and location, as well as input from federal, provincial, and local governments, a list of other environmental approvals and permits confirmed or potentially required prior to DTRRIP construction are listed in the subsections below.

[3] Rail measurements are described in imperial measurements (the conventional units used by the rail industry).

1.3.4.1 BC Water Act

The BC *Water Act* is the primary provincial statute regulating the use of water resources in British Columbia. Section 9 of the *Water Act* requires that a person may only make "changes in and about a stream" under an Approval or Notification where required, in accordance with Part 7 of the Water Regulation.

A *Water Act* Approval or Notification will need to be in place prior to any modification or relocation of agricultural ditches or drainage channels or instream works.

1.3.4.2 BC Wildlife Act

A fish salvage program, permitted under the provincial *Wildlife Act*, would need to be conducted in conjunction with any ditch relocation if fish are present.

1.3.4.3 Agricultural Land Commission Approval

Rail improvements east of Arthur Drive will take place in the existing rail right-of-way, and rail improvements west of Arthur Drive, will take place in the existing rail right-of-way and a portion of the Option Lands (**Figure 2-1**).

In 2008, the Agricultural Land Commission (ALC) approved the acquisition of the Option Lands to create new rail right-of-way. The Commission's approval was subject to two conditions: a plan showing the area to be dedicated as rail right-of-way and the ability to keep farming activities going until the rail construction has been approved and the land is needed for construction.

Port Metro Vancouver is undertaking a consultation process with the ALC and other key stakeholders regarding proposed mitigation and compensation for the loss of agricultural land as a result of the Project. Based on initial assessments, the amount of agricultural land required for the Project rail improvements is expected to be approximately 8.33 hectares (ha).

Further details on the ALC process are provided in **Section 6.5** of this report.

1.3.4.4 Municipal

Port Metro Vancouver will work with the Corporation of Delta to determine which Delta Community Bylaw and Standards are applicable to the Project and how they can be addressed.

2.0 PROJECT DESCRIPTION

The following section provides a description of the Project, including construction and temporary works necessary for the Project to proceed.

2.1 PROJECT RATIONALE AND BACKGROUND

Canada's Asia-Pacific Gateway is a world-class transportation network of airports, seaports, railways, roadways and border crossings that connect Canada and North American markets to Asia and the world. Containerized trade increases the efficiency, reliability and cost-effectiveness of moving goods around the world.

In keeping with Port Metro Vancouver's mission to facilitate the growth of Canadian trade, and in direct response to the growing needs of Canadian industry and consumer demand, Port Metro Vancouver is planning potential infrastructure improvements to enhance container capacity and strengthen Canada's Asia-Pacific Gateway and Corridor Initiative. The CCIP is an important initiative in delivering the projects and required infrastructure to meet anticipated growth in the container sector. As an integral component of the program, Port Metro Vancouver is assessing potential efficiency gains throughout Lower Mainland container facilities.

Port Metro Vancouver achieved record container volumes in 2011, handling slightly more than 2.5 million TEUs. Port Metro Vancouver's August 2012 preliminary container traffic statistics show a 8.2% increase over the same period in 2011 exceeding the forecasted cargo demonstrating that existing container capacity on the west coast generally and in the Lower Mainland particularly will soon become significantly constrained.

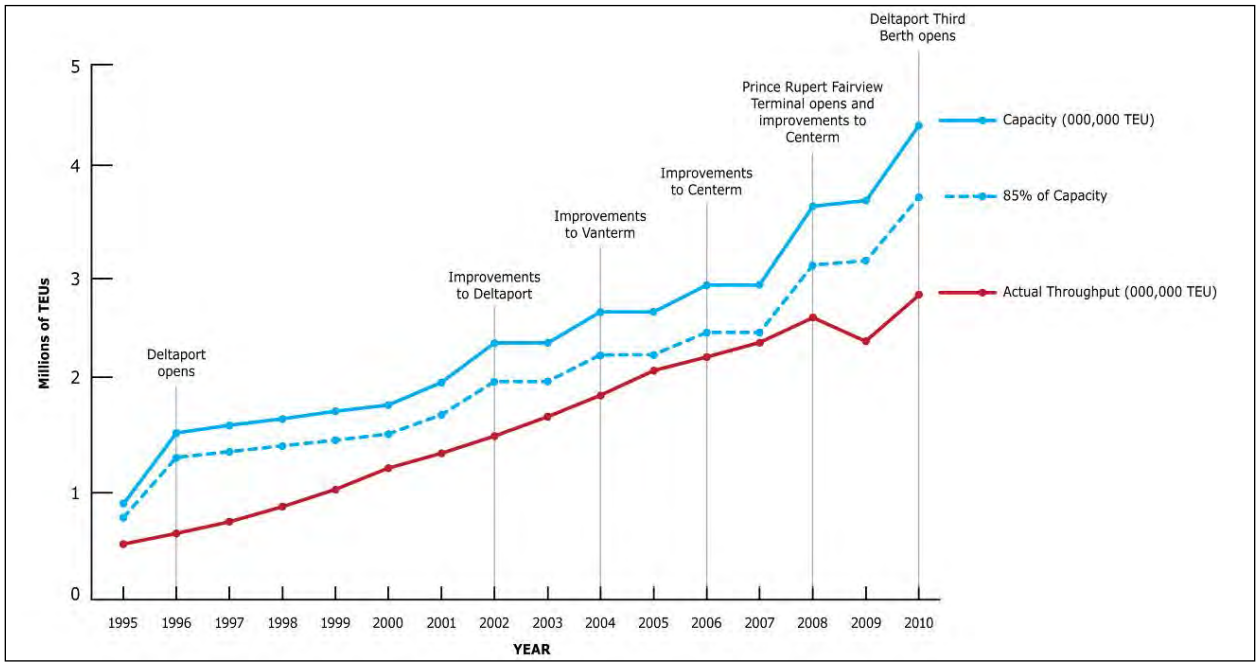
Roberts Bank is extremely well positioned to accommodate future trade growth and offers several competitive advantages, including a well-established international shipping route with excellent access to important Lower Mainland markets and major North American road and rail transportation corridors. Without substantive improvements, a 'gap' in capacity is expected to emerge as early as 2015 when Port Metro Vancouver will no longer be able to reliably and efficiently meet the anticipated import and export container demand.

Container traffic through BC's west coast is expected to double over the next 10 to 15 years and nearly triple by 2030 (Seaport, 2011).

Port Metro Vancouver's Deltaport Container Terminal (Deltaport) at Roberts Bank in Delta, BC, is the largest container terminal in Canada, handling approximately 45 percent of the containerized cargo that moves through Canada's west coast, and approximately 60 percent of the containerized cargo through the Port of Vancouver.

The consequences of failing to provide additional capacity when demand reaches 85 percent of existing capacity on a consistent basis can be far reaching. Productivity at the constrained facility suffers, delays occur, and existing plant and equipment is prone to breakdown. As well, the import and export markets force diversions of cargo to less constrained facilities, and repatriation of this lost business is slow to occur (**Graphic 2-1**).

Graphic 2-1 BC West Coast Container Capacity and Throughput



Source: Seaport, 2011

In terms of regional capacity to meet the anticipated growth in container traffic, the terminal and infrastructure improvements will coordinate with other recent and ongoing infrastructure improvements in the Lower Mainland, such as the South Fraser Perimeter Road (SPFR) and the Roberts Bank Rail Corridor (RBRC) Program, which are likewise intended to improve safety, decrease traffic congestion, and increase efficiency of the movement of goods on Canada's most significant intermodal rail and road corridor to North American markets.

Port Metro Vancouver supports Canadian trade by providing the necessary container handling infrastructure that connects Canada's markets to trading economies around the world, particularly those in the Asia-Pacific region. Container handling activities generate more than 11,100 person-years of direct employment, while the handling and distribution of containerized cargoes supports nearly 27,200 person-years of employment and generates $2.6 billion in economic value.

The import and export trade activity made possible by the increased container capacity adds about $600 million per year to Canada's gross domestic product (GDP), and $1.3 billion in economic output. These economic benefits will be lost by limiting throughput at Deltaport.

DTRRIP is an efficient and cost effective project to increase container capacity through improvements to existing port infrastructure. The Project works have a low potential for causing environmental effects because the Project will be implemented mostly within the existing terminal, road, and rail footprints (**Figure 2-1**). Construction work will not occur within the marine environment.

2.2 SITE LOCATION

The existing Deltaport container terminal is located at Roberts Bank in Delta, BC, and is comprised of Pods 3, 4, and 5. The Deltaport intermodal yard straddles Pods 3 and 4 and extends northward on the Roberts Bank causeway (**Figure 2-1**). The causeway connects the terminal to the mainland, and is comprised of Deltaport Way, Roberts Bank Way (North and South), and railway tracks. It extends from the intersection of Deltaport Way and 27B Avenue westward into the terminal. The BCR rail corridor has several rail tracks and designated yards within the corridor that will be improved as part of DTRRIP. The Gulf Yard is located in the upland area on the south side of Deltaport Way between the Deltaport Way overpass and west of 53rd Street (Arthur Drive). The Fisher Yard is located east of 64th Street and runs until 72nd Street (**Figure 2-1**).

For clarity, the orientation of the causeway is referred to as east-west along Deltaport Way. For this Project, the causeway therefore has a north shoreline and a south shoreline.

2.3 PURPOSE OF THE PROJECT – JUSTIFICATION AND NEED

Container traffic through Canada's Pacific Gateway is expected to double over the next10 to 15 years, and nearly triple by 2030 (Seaport, 2011). This projected increase in Canadian international trade necessitates planning now to meet future demand.

The CCIP is Port Metro Vancouver's long-term strategy to deliver projects to meet anticipated growth and demand in container capacity until 2030. As an integral component of the program, Port Metro Vancouver is assessing potential efficiency gains throughout existing Lower Mainland container facilities.

Following improvements at Vanterm and Centerm in 2005, and the completion of the Deltaport Third Berth Project in 2010, Port Metro Vancouver began evaluating additional terminal improvements, including road and rail improvements at Deltaport (Roberts Bank) in Delta, BC.

Deltaport is the largest container terminal in Canada, with a current capacity of 1.8 million TEUs. Road and rail constraints limit the capacity of Deltaport to meet forecast demand, and the most immediate and cost effective capacity increase can be achieved by making improvements to the road and rail network for

Roberts Bank. Project works proposed as part of DTRRIP could increase the container capacity at Deltaport by 600,000 TEUs to 2.4 million TEUs[4]. Project rationale is discussed in more detail in **Section 2.1**.

2.4 PROJECT COMPONENTS

DTRRIP consists of the following key elements:

1. An overpass on the existing Roberts Bank causeway that will separate road and rail traffic entering the Deltaport Terminal
2. Reconfiguration of intermodal yard rail track and additional container handling equipment within the existing Deltaport Terminal (**Section 2.4.2**).
3. Additional rail track within the existing railway corridor and a portion of the Option Lands (**Section 2.4.3**).
4. Road Improvements on and adjacent to Deltaport Way to improve the movement and control of container trucks at Deltaport (**Section 2.4.4**).

Figure 2-1 illustrates the layout of the Project including the associated road and rail improvements. Each component is discussed in sub-sections below in further detail. Details of the construction phase activities are discussed in **Section 2.6**.

2.4.1 DTRRIP Overpass

Road-rail traffic conflicts occur daily at the intersection on Deltaport Way and the rail entrance to Deltaport, and lead to delays in both traffic types and to some serious safety and operational issues. An overpass on the Roberts Bank causeway will remove these conflicts, improving both operational efficiency and safety. The net result of the DTRRIP Overpass will be a 20 percent increase in rail switching availability for the intermodal yard.

The DTRRIP Overpass will consist of an elevated roadway connecting Deltaport Way to Roberts Bank Way (North and South) east of the Intermodal Yard, and entirely within the existing footprint of the causeway. In addition, the existing Deltaport Way road right-of-way requires widening on the north side of the existing road to create sufficient width for the DTRRIP Overpass ramps, which will require relocation of utilities and rail tracks. The location of the DTRRIP Overpass was chosen to minimise the effect to rail tracks. However, some rail tracks leading to the intermodal yard will be relocated. The overall storage yard capacity will be increased as new and longer storage tracks will be constructed in Gulf Yard on the mainland portion of the RBRC. New repair and bad-order set-out tracks will be built as part of the Project with minimal rail maintenance facilities retained on the intermodal yard to facilitate on-terminal repairs where possible.

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[4] TEUs are presented as the annual thoughput of a facility. It does not reflect the peak seasonal periods in which the average container volume increases. Typically, the peak season is from July through September and the volume averages about a 20% increase over the average annual monthly volume.

Construction will not significantly interrupt rail and road operations to Deltaport and Westshore Terminals other than isolated scheduled outages for construction activities that would create an operational or safety conflict.

2.4.2 Terminal Improvements

Deltaport operates on Pods 3, 4, and 5 at Roberts Bank, as shown in **Graphic 2-2**.

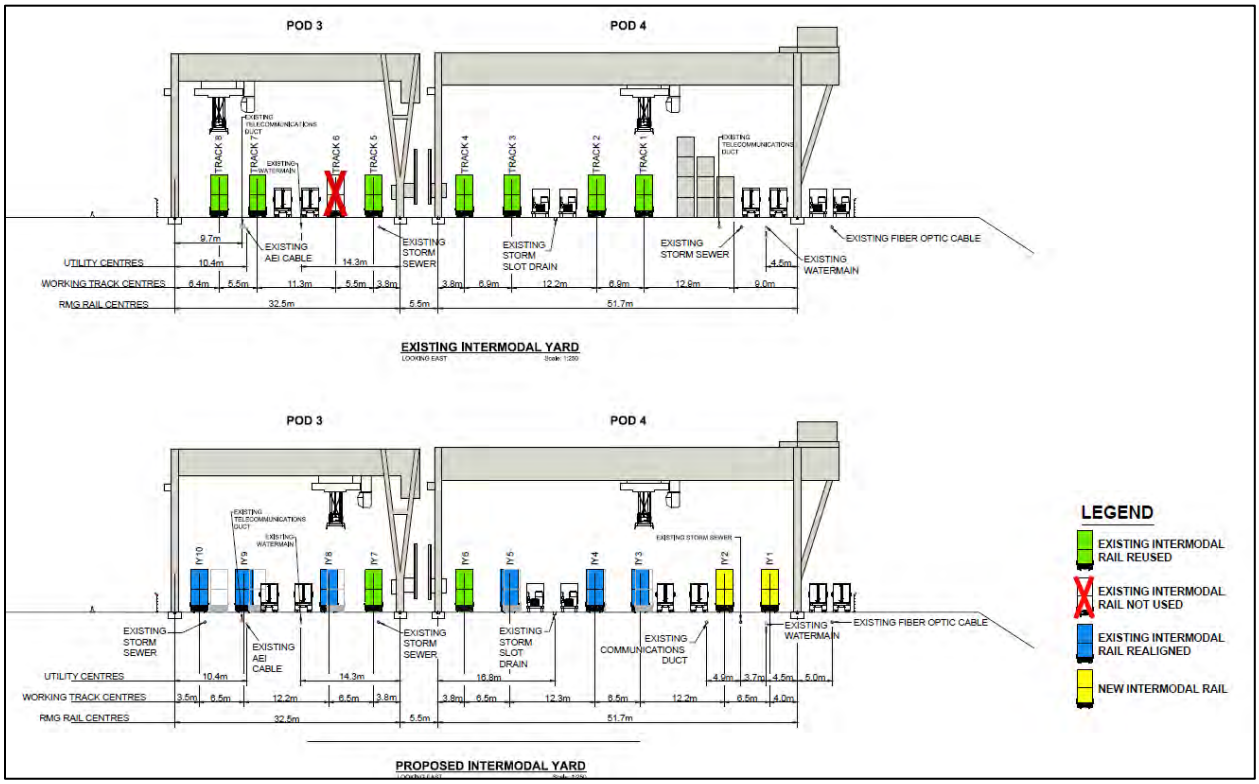
Graphic 2-2 Deltaport Pods and Gates

The intermodal yard separates Pod 3 from Pods 4 and 5 and extends in an east-west direction on the causeway. The intermodal yard consists of two parallel rail-mounted gantry (RMG) crane runways, each servicing four intermodal rail tracks within the terminal. The southern runway, Pod 4, is currently serviced by three long span RMGs while the northern runway, Pod 3, is being serviced by three shorter span units (**Graphic 2-3**).

Graphic 2-3 Existing Deltaport Intermodal Yard – View Looking West

To achieve the additional capacity within the existing intermodal yard footprint (without having to relocate the RMG crane rails), a combination of additional rail mounted gantry cranes (RMGs) and rail track modifications will be required. Improvements include the addition of two intermodal rail tracks and the realignment of six rail tracks to increase the capacity of the terminal within the existing intermodal yard footprint. Two existing tracks do not require relocation. This reconfiguration would increase the number of working intermodal tracks in the intermodal yard from seven to ten (one track is currently unusable). **Graphic 2-4** shows the proposed realignment of tracks in the Deltaport intermodal yard.

Graphic 2-4 Cross Section of Existing Intermodal Yard and Reconfigured Intermodal Yard



Terminal improvements will also involve the procurement of additional RMGs as needed, requiring additional power supply and trench space, and container handling equipment for within the existing container yard, including rubber-tired gantry (RTG) cranes, reach stackers, top picks, side picks, hostlers, and bombcarts.

To achieve the incremental 600,000 TEUs of capacity Deltaport will require two additional ship-to-shore gantry cranes (for a total of twelve cranes) and related electrical infrastructure along the berth face.

2.4.3 Railway Improvements

Rail infrastructure improvements include:

- An additional rail track (Fisher Yard siding track and M3 track) within the existing rail corridor and a portion of the Option Lands between the existing Deltaport Way overpass and 72nd Street to act as a passing track.
- Additional lead tracks (M1 and M2) between the existing Deltaport Way overpass and 64th Street.

- Additional support tracks at Gulf Yard (four – 6,000ft tracks[5]).
- Rail support facilities on the causeway Distributed Power Unit (DPU) and bad-order set-out tracks and in the Gulf Yard.

Figure 2-2 provides the schematic layout of the existing rail tracks on the RBRC and causeway, and **Figure 2-3** incorporates the rail infrastructure improvements in schematic form.

A total of 78,300 ft of new track (non-continuous) is being developed for the Project. **Table 2-1** provides a summary of the existing rail infrastructure and proposed rail improvements in DTRRIP.

Table 2-1 Existing and Proposed Rail Infrastructure Improvements

			Deltaport Intermodal Yard	South Yard		Gulf Yard		Fisher Yard	
Existing	No. of Tracks		8 (with 1 unused)	7		3		1	
	Lead Tracks	Support Tracks	-	1	6	2	1	1	0
DTRRIP	No. of Tracks		10	7		8		2	
	Lead Tracks	Support Tracks	-	1	6		4	2	0

2.4.3.1 Lead Track Improvements

Although the "M" designation normally refers to a mainline track, all tracks with the "M" designation in DTRRIP are referred to as lead tracks, as they lead to either a yard or to the mainline track. Mainline tracks end at the limits of rail yards. In this document, the mainline track is considered to end at 64th Street, where the limits of Gulf Yard begin.

Under DTRRIP, the following lead tracks will be constructed or relocated:

- A new lead track (M1) from east of the existing Deltaport Way overpass to 64th Street.
- A new lead track (M2) that connects the existing South Yard storage tracks and extend east to the 64th Street. M2 can also be used in parallel to M1 for the arrival and departure of trains into and out of the Gulf Yard storage tracks.
- A new siding track (Fisher Yard) from 64th Street to 72nd Street.

The terminal configuration plan has four arrival and departure lead tracks between the existing Deltaport Way overpass and 64th Street. One of the four tracks will be primarily dedicated to trains delivering coal to Westshore Terminals (M4), one will be used for arriving container trains (M3), and one will be used for building departing container trains and setting out bad order railcars (M1). The remaining through-track (M2) can be used to move cars from Gulf Yard to South Yard, move repaired cars between the Gulf set

[5] Rail measurements are described in imperial measurements (the conventional units used by the rail industry).

out tracks and Gulf Yard or South Yard, handle locomotive moves to or from the Distributed Power Unit (DPU) tracks, and other ancillary movements. While there are a number of rail movements many are short in duration. Once reconfigured, this track can also be used as a secondary departure track.

2.4.3.2 Railcar Repairs In Gulf Yard and on the Causeway (P Yard)

Under DTRRIP, the objective of achieving 920,000 rail lifts[6] per year means there will be limited ability to make major railcar repairs (such as railcar wheel changes) within the intermodal yard as is done under existing operations. These rail maintenance works need to be relocated out of the intermodal yard to the existing railcar repair facilities on the causeway (P Yard) and in the bad order set out tracks in the Gulf Yard.

Both repair facilities will have the capability to operate continuously. Two DPU set-out tracks (DPU1 and DPU2) will be located south of the Gulf storage tracks (**Figure 2-3**). The new lead track (M1) that will be constructed will serve as the lead track for both the DPU set-outs and bad order set-out tracks.

The relocation of the bad order repair[7] and maintenance operations out of the intermodal yard will require a shift from existing maintenance and repair procedures. The existing operation performs most maintenance and repair activities on the intermodal yard without breaking the train or moving the railcars. While highly efficient from a rail operations perspective, the space required to safely perform this work affects adjacent intermodal yard loading and unloading operations. TSI has determined that repairs need be conducted outside the intermodal yard during critical operations to make efficient use of the space within the intermodal yard and achieve required throughput capacity.

The existing repair tracks (P1, P2, P3 and P4) on the causeway will remain in operation to provide maintenance activities (**Figure 2-3**).

The P yard will be equipped with the following ancillary facilities all of which currently exist on the causeway:

- Employee facility building including washrooms, change facilities and showers, offices for each railway, a lunchroom, and small parts storage.
- Limited parking area for employees.

Storage for wheels and heavy parts will be located in both the P yard and Gulf yard. Service vehicular access to the yard will be via maintenance roads with no public access provided.

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[6] The lifting of one container onto, or off of a railcar.
[7] Rail car with a mechanical defect.

2.4.3.3 Gulf Yard

Currently, Gulf Yard handles set-outs and westbound and eastbound rail movements on three tracks: a north lead track, a south lead track, and a storage track that was recently expanded to 12,000 ft. in length. Unit coal trains (8,500 ft. in length) are temporarily stored in this yard as they await direction either to proceed west to the coal terminal or to move east on the RBRC. Arriving container trains are split into either 5,000 ft. or 6,000 ft. lengths at Gulf Yard before they are moved into South Yard on the causeway. Container trains leaving Roberts Bank are built into 8,000 ft. to 12,000 ft. lengths in Gulf Yard for transcontinental movements. Trains leaving Roberts Bank are not altered (lengthened or shortened) at other terminals or yards in BC.

Gulf Yard will include storage tracks between the BCR dispatch office and 53rd Avenue and lead tracks east of Arthur Drive. Lead track M1 will be constructed along the south side of Gulf Yard storage tracks. In the storage track area of Gulf Yard, the existing track (12,654 ft. in length) will be reconfigured into a 6,890 ft. storage track (G1) between the BCR office and 46th Street. The remaining length will be increased to a total of 15,270 ft. east of 46th Avenue as the initial section of the new M2 track. The existing south lead track that runs from the existing Deltaport Way overpass to east of Highway 17 will form the new M3 track and be extended to 64th Street (by approximately 1,300 ft.). The north lead track will become M4. In addition to the reconfigured storage track (G1), three new storage tracks will be added between the BCR office and 46th Avenue (G2, G3, and G4). The new storage tracks will be approximately 6,185 ft. to 6,000ft. in length. The new lead track M1 will run along the southern edge of the storage tracks. The expanded Gulf Yard and new lead track M1 will occupy a portion of the Option Lands between the Deltaport Way Overpass and Arthur Drive (**Figure 2-4** and **2-5**). East of Arthur Drive, the M1 through M4 tracks are within the existing rail right-of-way (**Figure 2-5**).

2.4.3.4 Fisher Yard

The area designated for the future Fisher Yard currently includes only a single mainline track that ends at the Gulf Yard limits near 64th Street. DTRRIP will add an additional 12,725 ft. siding track between 64th Street and 72nd Street that connects to the M3 track at 64th Street (**Figure 2-5**). The existing mainline and new siding track are both within the existing rail right-of-way.

2.4.3.5 Other Works Associated with Railway Improvements

46A Street Farmer Overpass

As part of the overall Project works, the existing private farmer overpass at 46A Street will be demolished (**Figure 2-5**), waste materials will be removed from the site, and the site will be rehabilitated on the north side of Deltaport Way such that it can be used for agricultural purposes in the future. The south side will be developed as part of the expanded Gulf Yard.

The removal of the 46A Street overpass, which is triggered by DTRRIP (specifically the expansion of rail infrastructure), is consistent with the South Delta Transportation Network Improvement Agreement (the "Agreement"), which indicates that the 46A overpass could be removed once other improvements to the local road network were completed. These improvements include:

- Completion of 41B Overpass
- Completion of 36th St. Overpass
- Completion of 64th St. Overpass
- Completion of 28th Ave. Overpass.

The removal of the farmer's overpass is subject to the ALC approval, as part of the plan to develop the Option Lands into a rail yard (see **Section 6.5**).

Drainage Ditches

Preliminary design has indicated various locations along the upland portion of the Project where extension or replacement of existing culverts and realignment/relocation of existing watercourses (ditches) will be required to allow for the construction of the proposed rail tracks.

The realignment of the existing ditches to accommodate the Project will require detailed hydraulic assessments and close coordination with the local farmers and the Corporation of Delta.

During detailed design, the locations of upgraded (extension or replacement) culverts and ditch realignment will be confirmed. Culverts will be designed to sizes and as per standards required to carry flows and will meet the requirements of the BC *Railway Safety Act* and other applicable regulations and standards. See **Section 5.2** for further information on existing watercourses.

2.4.4 Road Improvements on and adjacent to Deltaport Way

The following road improvements are proposed to improve traffic flow to and from the Deltaport container terminal and reduce the effect of container truck movements on local residents.

2.4.4.1 Weigh-in-Motion Scales

The ability to weigh trucks and count axles has been identified as a requirement to enforce weight restrictions for trucks departing from Deltaport. A weigh-in-motion station will be installed on by the BC Ministry of Transportation and Infrastructure (MoTI) as part of the DTRRIP project within the Lower Mainland highway network to identify outbound overweight trucks with an instantaneous display of weight.

The weigh-in-motion system will integrate with BC MoTI's Commercial Vehicle Safety and Enforcement System (Weigh2Go Initiative) and conform to the configuration and operation standards of BC MoTI's existing weigh-in-motion stations.

2.4.4.2 Vehicle Access Control System (VACS) Gate

The addition of VACS gates will allow only authorised, Port-licensed trucks and other vehicles to access both existing terminals on Roberts Bank, and will prevent interference from unauthorised vehicles in terminal and gate operations. VACS will be integrated with the port pass system and drivers will be required to scan an ID card to gain access to Deltaport.

2.4.5 Other Project Components

The following additional Project components are also part of DTRRIP:

- Lighting
- Electrical distribution systems
- Civil works including storm water management
- Maintenance and improvements to existing drainage, including agricultural drainage
- Locomotive fuelling
- Fencing and security

2.4.5.1 Lighting

Based on preliminary design, two areas of DTRRIP will require new lighting, and the lighting design requirements vary for each based on the different activities that will occur in each area. These include:

- DTRRIP Overpass – The lighting requirements for the roadway are defined by the BC MoTI. Approximately 13 street light poles, 11 metres tall, each with 250W high pressure sodium halide luminaires (average illumination level 20 Lux[8])will be required.
- Gulf Yard (at switching points only) – 22 street light poles, each with 400W metal halide luminaires, 11 metres tall (average illumination level 20 Lux)

Additional task lighting will also be available in both railcar repair areas via portable lighting sources attached directly to the service vehicles which will be performing the repairs. The lighting will be aimed down and directly towards the area where the work is taking place.

No new lighting is required on the terminal, and it is anticipated the lighting from the two new quay-cranes would match that of the existing cranes.

Detailed design has yet to be determined, however an assessment of the potential effects of Project related lighting and lighting effects is provided in **Section 6.3**.

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[8] Luminous flux per unit area.

2.4.5.2 Electrical Distribution and Communications Systems

The existing terminals at Roberts Bank are serviced by an overhead 69 kV (kilovolt) powerline that runs from the BC Hydro Arnott substation, located by Ladner Trunk Road, in Ladner, to the causeway and Deltaport and Westshore Terminals. The Deltaport portion of the powerline terminates in an existing switchyard where the voltage is transformed down to terminal distribution voltages. The existing switchgear line-up has equipped spaces available for use, room space for additional switchgear, and overall capacity for the additional loads. No power line improvements are required for the Project.

BC Hydro will be relocating poles along the causeway to accommodate the DTTRIP Overpass and rail relocations.

Power to the new ship-to-shore gantry cranes will be delivered via cables installed in underground concrete encased PVC ducts to cable pits similar to the existing installations.

Existing electrical and control systems for the terminal will be utilised in the reconfigured intermodal yard. Any new electrical and control systems for DTRRIP will be designed to meet the following functional requirements:

- Terminal power distribution will be underground. Lighting intensities and illumination levels will be in accordance with IES (Illuminating Engineering Society) standards.
- It is assumed that the existing controls methodology will be expanded for the modified intermodal yard. The terminal operator will define any requirements.
- Underground ducting will be provided for communication and data services to all buildings. Services will be located around the site to suit the terminal operator's requirements.

2.4.5.3 Civil Works

In general, the existing drainage configurations and patterns within the intermodal yard are adequate to meet Project needs and will therefore be maintained as is. Grades parallel to the tracks will be 0.2 percent or less. Grades perpendicular to the tracks will be one percent or less, but these criteria will be overridden to match existing grades.

Collected storm water will be passed through existing oil-water separators within the intermodal yard. All storm pipe crossings under rail tracks will meet the requirements of the BC *Railway Safety Act* and other applicable regulations and standards.

The roads on the causeway and road modifications on the upland will be graded for storm water to drain and infiltrate into the gravel shoulder. Storm water runoff from the DTRRIP Overpass will be collected and discharged directly to the ground via a standpipe, and allowed to infiltrate into the gravel.

The following design criteria will be used for storm drainage:

- Storm drainage systems will be designed using Ladner Intensity-Duration Frequency (IDF) data to accommodate the rainfall flows generated from a one-in-100-year rainstorm, with a 15 minute time of concentration.
- All catch basin manholes and trench drain gates will be rated for the design loadings for the intermodal yard, and other facilities.
- Minimum covers in the intermodal yard will be 1.22 metres.
- All storm sewers in the intermodal yard will be reinforced concrete, Class IV.

Existing on-site sanitary treatment facilities will be utilised if required. Sanitary pipe crossings under rail tracks, if required, will also meet the requirements of the BC *Railway Safety Act* and other applicable regulations and standards.

2.4.5.4 Agricultural Drainage

Drainage and irrigation systems for adjacent lands will be maintained as existing capacity requirements as part of the Project and will be tied in with relocation/realignment of existing ditches, sub-surface drains, and irrigation systems. See **Section 6.5** for further discussion on agricultural land and drainage.

2.4.5.5 Locomotive Fuelling

Currently, about eight to ten trains per day, including intermodal and bulk coal, operated by Canadian National Railway (CN), Canadian Pacific Railway (CPR) and BNSF Railway (BNSF), arrive and depart at Roberts Bank. Only one of CPR container trains is normally fuelled per day at Roberts Bank, with all other road locomotives being fuelled elsewhere on the CN, CPR and BNSF rail lines. There are presently two yard locomotives permanently stationed at Roberts Bank, one owned by CN and one owned by CPR. These yard locomotives always remain at Roberts Bank and need to be fuelled there, typically once or twice per week each. There are presently two designated locomotive fuelling locations on the causeway at Roberts Bank where fuelling is normally performed, with in-track absorbent mats, signage, and adjacent spill kits.

All fuelling is carried out as DTL (Direct to Locomotive) fuelling by DTL fuelling contractors, operating *Transportation of Dangerous Goods Act* (TDG) regulated fuel trucks under contract to CN and CPR. The fuel truck contractors must comply with CN and CPR DTL Fuelling Policy and Procedures. Any spill response would be provided under CN or CPR Spill Response Plans, under the co-ordination of BCR's Emergency Response Plan.

DTRRIP will provide a single designated fuelling track location with positive spill containment infrastructure in the Gulf Yard (**Figure 2-4**). All DTL fuelling procedures and protocols will remain as-is, but will be done at the designated location with spill containment, except in instances where operational circumstances make it impracticable.

2.4.5.6 Fencing and Security

All Port Metro Vancouver terminals are required to meet the International Ship and Port Facility Security (ISPS) Code (July 1, 2004). Existing fencing and security gates will be utilised wherever possible and where new sections of fence are required they will be designed to meet the latest security standards.

BCR Properties provides security fencing for the majority of the rail facilities and any additional security requirements will meet or exceed existing BCR standards for fencing.

2.5 PROPOSED PROJECT SCHEDULE

Graphic 2-5 below outlines the proposed Project schedule.

Graphic 2-5 Proposed Project Schedule

Proposed Project Schedule	2012			2013				2014			
	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Pre-Construction Permitting and Approvals											
Post of Draft EA Report											
Submission of ALC Application											
Submission of BC *Water Act* Notification											
Agricultural Land Commission Approval											
BC *Water Act* Notification Approval											
PMV Planning Permit Review & Approval											
Project Environmental Assessment Permit											
Construction – Causeway Overpass											
Award Construction Contract											
Detailed Engineering											
Construction											
Construction – Railway Improvements											
Detailed Engineering											
Construction - Gulf Yard											
Construction - Fisher Yard											
Construction – Intermodal Yard Improvements											
Detailed Engineering											
Construction											
Other											
BC Hydro Pole Relocation (By BC Hydro)											
Remove Farmers' Overpass											

2.6 CONSTRUCTION PHASE

The estimated total Project construction duration from award of contract through to commissioning of major equipment is approximately 2.5 years. The construction sequencing of DTRRIP will provide for existing terminal, road, and rail operations to continue with minimal disruption.

The main construction phase activities include:

- Site preparation and clearing
- Site pre-loading
- Soil densification
- DTRRIP Overpass construction
- Rail track construction
- Intermodal yard track construction and realignment.

Table 2-2 below describes the construction works, associated equipment and duration.

Table 2-2 Description of Construction Works and Construction Equipment

Description of Works	Construction Equipment		Duration (Days)
Clearing, grubbing, and placing preload at South, Gulf and Fisher Yards	30 – 40 ton (T) rock trucks 45T excavators Highway trucks (50 per day)	Dozer Compactor Crane Truck	270
Removing preload at South, Gulf and Fisher Yards	30 - 40T rock trucks 45T excavator		135
Geotextile and ballasting for South, Gulf and Fisher Yards	Small excavator Highway trucks Small dozer		220
Building new tracks – South, Gulf and Fisher Yards	Track laying equipment		110
Soil densification	Track mounted crawler crane with attachment		75
DTRRIP Overpass and Associated roads	Highway trucks Concrete Trucks 2 - 3 large cranes Grader	Roller Paving machine with trucks Excavator Dump trucks	255
Removal of farmer's overpass	Rubber tire crane 45T excavator	Loaders Highway trucks	20
Intermodal Yard Improvements	Asphalt cutter 20T excavator	Track laying equipment Large Crawler crane	176

These activities are described in more detail in the following sections. Construction sequencing is identified in **Figures 2-4**, and **2-5**.

2.6.1 Site Preparation and Clearing

Clearing and site preparation works will involve:

- Clearing and grubbing existing foliage and vegetation; and
- Stripping the top surface of organics from the grading limits.

As part of DTRRIP, topsoil removed from the area required for Project related works will be salvaged and spread over adjacent farm fields where the property owner is amenable (refer to **Section 6.5**) and improvements are deemed feasible.

2.6.2 Site Pre-loading

Gulf Yard and Fisher Yard will need to be preloaded, for approximately 16 weeks, to remove most of the long-term settlement. The yards in general and the Gulf Yard in particular, with over 350,000 cubic metres, will have considerable strip, preload, and soil consolidation programs.

Rail operations and the requirement for repair areas, wheel storage and switching operations will require close coordination and scheduling with the mainline railroads and the marine terminal (TSI). The ability to bring the Gulf Yard into operation as soon as practicable will greatly facilitate operational scheduling for rail activities.

It is assumed that preload activities will require approximately 50 trucks per day to deliver preload materials. Routes to/from the site will be set and truckers forced to comply with approved routes. Preloading of the entire Project area is anticipated to take place from April 2013 to May 2014.

2.6.3 Soil Densification

Based on preliminary design, it is proposed to found the DTRRIP Overpass structure on steel pipe piles. This will be confirmed during the detailed design stage following a full geotechnical investigation. Due to soft underlying soils, some form of ground improvement to improve the soil stability for the abutment and approach spans will be required. A series of stone columns around each of the pile groups will likely be required for seismic performance.

Based on preliminary design, ground improvements under the proposed DTRRIP Overpass approach structure on both the north and south sides would take approximately 4 months. Additional ground improvements on the south side near the existing tracks would take an additional 1.5 months.

The foundation concept assumes that the piles will be 1,500 millimetre piles driven to a depth of approximately 80 metres. The design engineers anticipate that stone columns will be placed in a 30 x 30 metres squared, roughly centred on the pile groups. The stone columns are anticipated to be approximately 14 metres in depth. Assuming 1.5 metres on centre, one stone column will be required for

each 2.25 metres squared or 400 per pile group. At 17 pile groups there would be roughly 7,000 stone columns. This will be confirmed during the detailed design stage following a full geotechnical investigation.

All waste material generated during ground improvements (i.e., slurry, waste water) will be contained and disposed of according to appropriate guidelines and best management practices.

2.6.4 DTRRIP Overpass Construction

The DTRRIP Overpass will be built using a steel support structure with a concrete deck to reduce the overall height, and will be constructed on a foundation of steel pipe piles. Ground improvements, probably stone columns, will be required in the foundation area due to the presence of soft underlying soils. The overpass will be built entirely within the existing footprint of the existing Roberts Bank causeway.

The DTRRIP Overpass structure is based on MoTI bridge design standards. The clearances and geometry will be designed to standards set out in the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads, the BC MoTI Supplement to TAC Geometric Design Guide, and the American Railway Engineering and Maintenance-of-Way Association standards. BC MoTI engineers will provide oversight for construction of the DTRRIP Overpass.

The DTRRIP Overpass clearance will be a minimum of 7.2 metres over rail tracks in accordance with American Railway Engineering and Maintenance-of-Way Association standards to allow double-stacked container trains to travel under the overpass structure, and a minimum of 5.2 metres over roadways. The DTRRIP Overpass has also been designed to accommodate a TAC WB36 design vehicle (turnpike double), capable of transporting two containers. The use of this vehicle has the potential to reduce the number of truck trips between local distribution centres and Deltaport by up to 50 percent.

The construction of the DTRRIP Overpass will require the relocation of overhead transmission lines and poles, water mains, and fibre optic cable. BC Hydro will be undertaking the actual physical works of the transmission line relocation (**Figure 2-6**), and the works will be conducted in accordance with best practices identified through BC Hydro's environmental review process and meets the requirements of BC Hydro's protocol agreement with Fisheries and Oceans Canada for work in and around water (**Appendix A**). Port Metro Vancouver will have the opportunity to review BC Hydro's environmental protocols prior to the start of the relocation works.

A traffic management plan will be implemented during the construction of the north and south sides of the overpass to avoid effects to truck traffic. Preliminary design indicates that the key to the sequencing of the DTRRIP Overpass is the early modification of the tracks in the throat to allow for continued car repair operations (including parts and materials storage) without effects to container traffic movements to and from the terminals. This will allow the railways to maintain operations much as they are today, while the road and structural work is completed.

2.6.5 Rail Track Construction

Rail infrastructure improvements include an additional lead rail track (M1) within the existing railway right-of-way and a portion of the Option Lands to act as a passing track between 72nd Street and the causeway, additional storage tracks at Gulf Yard, and railcar repair facilities on the causeway (P Yard) and in Gulf Yard. East of Arthur Drive, rail works take place within the existing rail right-of-way; west of Arthur Drive, rail works take place partially within the existing rail right-of-way and partially within the Option Lands. **Figure 2-2** provides the schematic layout of the existing rail tracks.

In addition to the site preparation and preloading described above, building of the individual rail yards will require the completion of the following sequence:

1. Strip and preload (see **sections 2.6.1** and **2.6.2** above)
2. Remove preload after consolidation (see **section 2.6.2** above)
3. Geo textile and sub-ballast
4. Ballast
5. Rail track work and turnouts

The majority of the ballast and track material will be delivered by rail and the construction will be from the rail (versus truck) as this is the existing state-of-the-art construction practise.

Following detailed design and *Water Act* approval for extension or replacement of existing culverts, and realignment of existing ditches, instream works will follow requirements of the BC Ministry of Water, Land, and Air Protection Standards and Best Practices for Instream Works (MWLAP, 2004a), including those regarding temporary diversion, sediment control, work around the reduced risk timing window with fish salvaging (if fish are present), vegetation management, and site rehabilitation.

The rail components on the mainland are estimated to take approximately 12 to 18 months to complete.

2.6.5.1 Removal of 46A Street Farmer's Overpass

The existing private farmer overpass at 46A Street will be demolished, waste materials will be removed from the site, and the site will be rehabilitated such that it can be used for agricultural purposes in the future on the north side of Deltaport Way. The south side will be developed as part of the expanded Gulf Yard.

The following provides a brief description of the tasks and procedures that will be followed in reclaiming the 46A St. overpass:

- Construction access to both approaches will be via the existing north/south farm roads within the overpass alignment and the east/west gravel road along the south side of the existing right-of-way. If any access is required that would affect the adjacent farm fields or drainage ditches, a mitigation plan will be prepared.
- All demolition pavement, concrete and steel will be removed from the site and recycled.
- All suitable fill materials removed from the overpass approaches will be re-used, either as pre-load for the new rail tracks or as base material for the new east/west gravel road that will be constructed on the north side of Deltaport Way.
- The portions of the approach areas that will be returned to cultivated field use will be excavated to just below the surrounding field grade. The area will then be deep tilled to relieve compaction. Topsoil from the material excavated from field areas along the new right-of-way will be applied to a depth of about 40 centimetres. The reclaimed areas will be graded into the adjacent field.
- The existing north/south farm access roads will be tied in to the new BCR east/west gravel access road on the south side of Deltaport Way and in to the new east/west gravel access road on the north side of Deltaport Way.
- The existing east/west drainage ditch on the north side of Deltaport Way will be maintained and a new east/west drainage ditch will be constructed along the south side of the new BCR right-of-way. All reclaimed areas will be graded to achieve surface drainage to the ditch system, as appropriate.
- Any damage to the farm access roads caused during decommissioning and reclamation work will be repaired in a timely manner.

It is anticipated removal will take three weeks to complete and will start in Spring 2013.

2.6.6 Road Improvements on and adjacent to Deltaport Way

Proposed road improvements on the causeway east of the DTRRIP Overpass (Deltaport Way) and west of the DTRRIP Overpass (Roberts Bank Way [North and South]) are limited to:

- New roadways required to tie the DTRRIP Overpass into the existing road system, modifications to existing lane lines and shoulders.
- Minor modifications to the road network on the causeway to improve operations for both Roberts Bank terminals.

No changes are proposed for the existing Deltaport Way overpass and no increase in capacity on Deltaport Way is required as part of DTRRIP.

2.6.6.1 Vehicle Access Control System (VACS) Gate

The construction of the VACS gate will require the installation of electrical and communication utilities prior to the placement of the concrete foundations. Upon completion of the foundations, the pedestals and gate equipment will be installed.

2.6.6.2 Weigh-in-Motion Station

The construction of the weigh-in-motion station will require concrete pads on both the eastbound and westbound lanes on Deltaport Way, load cells, digital cameras for scanning container numbers and truck license plates, lighting, access to power and communications (fibre optics), and a small building to house computer equipment.

2.6.7 Terminal Improvements

2.6.7.1 Intermodal Yard Improvements

To achieve the additional capacity in the intermodal yard, a combination of additional RMGs and rail track modifications are part of the Project.

For rail track expansion, it will be necessary to adjust the location of six existing tracks and to add two new ones. To accommodate this, one of two water mains servicing this area will need to be relocated, as will a telecommunications duct bank. New or relocated tracks, the watermain relocation, and the communications duct bank relocation will need to occur over the full length of the intermodal yard, a distance of approximately 3,000 ft. In addition, a short length of storm sewer will need to be adjusted.

The changes above will be designed so as not to affect grading. Areas previously occupied by rail tracks will be paved to existing elevations and new tracks will be cut into the pavement surface to match existing grades. Collection and disposal of storm water will be as currently exists. There will be no change in the impervious area. During construction, best management practices will be utilised to control sediment.

The intermodal yard is serviced by an existing electrical sub-station. There is sufficient room inside this sub-station to accommodate the electrical switchgear necessary to supply up to five new RMGs, without a need to expand the building or build a new one. Presently, power for the existing RMGs is extended to the power pits in the intermodal yard by an existing duct bank. This duct bank is at capacity and cannot accommodate any additional cabling. As a result, a new or expanded duct bank will be necessary. The recommended approach to providing this additional capacity is for a new duct bank on a separate alignment.

To accommodate RMG power cabling, it will be necessary to increase the number of shallow cable slots cast into the surface alongside the RMG rails. These will be installed parallel to the existing cable slots matching the existing installation.

Except for a portion of the new duct bank and additional switchgear at the substation, all infrastructure work can be carried out within the confines of the existing intermodal yard, with the existing perimeter security fencing remaining unchanged.

The working area of the intermodal yard will be unchanged and lighting will not require any adjustment.

Intermodal yard capacity can be immediately increased by the addition of one new RMG to Pod 4. Procurement, assembly, and commissioning of a single RMG will take 12-15 months, so this is the earliest that additional capacity can be realised. Within the same time frame, all the rail track modifications and associated works can be completed.

Construction will be sequenced such that the number of operational rail tracks and RMGs will never fall below today's inventory, allowing for continued operation of the intermodal yard at today's capacity. Detailed discussions with the intermodal yard operator will be required to properly coordinate the exact details during construction to minimise any effects on intermodal yard operations.

It is anticipated that all rail track modifications and associated works can be completed in 12 months.

2.6.7.2 Container Handling Equipment

Terminal improvements will also involve the procurement of additional container handling equipment for both the intermodal yard and the container yard. Equipment includes two ship-to-shore gantry cranes at the berth, RMG cranes in the intermodal yard, and container handling equipment within the intermodal yard and container yard, including RTG cranes, reach stackers, top picks, side picks, hostlers, and bombcarts.

Large equipment such as ship-to-shore cranes and possibly RTGs and RMGs will arrive by specially designed crane transport vessels.

2.6.8 Construction Traffic

The number of vehicles required for transporting equipment, materials, and components at any given time will be dependent on delivery schedules. Delivery of equipment and construction materials is expected to be highest during the preload and delivery phase commencing in April 2013 with approximately 2,640 deliveries per month for a twelve-month period. These deliveries are anticipated to be made with trucks and would take place throughout the normal daytime work shift (7am until 4pm). Using an average of 22 work days per month, the average number of deliveries has been estimated to be approximately 200 deliveries per day. These trucks will use Deltaport Way as the primary access route and use the 41B overpass, and Arthur Drive overpass to deliver the preload.

After the preload placement phase, equipment and material deliveries are anticipated to decrease to a very small number of supply and personal vehicles as all of the rail and ballast will be delivered via train.

During construction of the DTRRIP Overpass, Deltaport and Westshore Terminals will both be accessed as they are currently via the existing at-grade rail crossing to Deltaport Gate 2 (departures) and Westshore Terminals.

A specific analysis of the queuing was conducted, and it was determined that the assumed traffic volumes utilising the truck staging area via the 41B Street overpass between 2012 and 2014 (Project construction) would not exceed the traffic volume estimates predicted as a result of the land use plan for the Tsawwassen First Nation (TFN) lands.

There will be no change in marine activities during the construction of DTRRIP, and no changes to the rail traffic volumes are expected during construction.

2.7 OPERATIONS PHASE

2.7.1 Terminal Operation

Deltaport operations consist of the loading and unloading of container ships, container storage, and container transfers to and from rail and road transport. The container ships are loaded and unloaded by electric powered ship-to-shore gantry cranes that are rail mounted at the berth face.

After the containers are unloaded from the ships, the containers are moved by tractor trailers to the container storage yard and stacked by RTG or reach stacker/top pick. The tractor trailers (also referred to as “hostlers”) the RTGs, and the reach stackers / top picks are powered by diesel engines. After a brief storage period, the containers are loaded onto trucks for road transport or onto yard based tractor trailers, which move the containers to the existing Deltaport intermodal yard for rail transport. Electrified RMGs are used in the intermodal yard to load the containers onto the rail cars.

As discussed in earlier sections, terminal improvements will involve the procurement of three or four new rail-mounted gantry cranes, and container handling equipment for within the existing container yard, including RTGs, reach stackers, top picks, side picks, hostlers, and bombcarts.

2.7.2 Operation Traffic

2.7.2.1 Road Traffic

In 2010, approximately 2,404 truck trips per day (1,202 inbound and 1,202 outbound) supported the movement of containers into and out of the Deltaport container terminal. Without the Project, truck traffic is forecasted to increase to approximately 2,716 two-way truck trips per day by 2014, and DTRRIP could result in an additional increase in truck trips of up to 1,000 truck trips per day (less than 500 inbound and 500 outbound), for a total of approximately 3,692 two-way truck trips per day once the terminal reaches capacity in 2017 (**Table 2-3**).

Table 2-3 Two-way Daily Traffic Trips

Year	Two-way Average Daily Truck Trips	Two-way Average Daily Vehicle Trips
2010 (actual)	2,404	1,427
2014 (projected)	2,716	1,586
2017 (projected)	3,692	2,131

2.7.2.2 Rail Traffic

In 2010, the RBRC carried approximately six container trains per day (three into the Deltaport container terminal and three out). Additionally, an average of ten coal trains (five in and five out) arrived and departed daily from Westshore Terminals. By 2014, rail container traffic is forecasted to increase to an average of six to eight container trains per day with a further increase to eight to ten trains per day at full build-out (**Table 2-4**). The key issue for container trains is having two different railroads (CN and CP) with differing market and operational models which equates to different train lengths and schedules.

Table 2-4 Average Daily Train Trips – Deltaport and Westshore Terminals

Year	Average Container Trains (trains/day)	Average Coal Trains (trains/day)
2010 (actual)	6	10
2014 (projected)	6-8	10-12
2017 (projected)	8-10	12-14[9]

Modelling indicated that DTRRIP rail network will operate at build-out at an acceptable service level and with few delays.

2.7.2.3 Marine Traffic

Marine traffic is predicted to increase at the Deltaport container terminal following the completion of the Project. By 2017, when throughput reaches 2.4 million TEUs, vessel traffic is anticipated to increase by less than 30 percent, while handling almost 1.5 times the existing (2010) TEUs. This is due, in part, to the forecasted increase in size of container ships (**Table 2-5**).

Projections indicate that smaller vessels (less than 4,000 TEU) are projected to be phased out in the next few years and that the smaller post-Panamax ships are projected to disappear around 2025. Vessels of more than10,000 TEUs are projected to become of increasing importance in line with the numbers of large ships on order today (Seaport, 2011).

In 2010, Deltaport had a split service that called twice at the terminal: the first call to discharge import containers and the second call to load export containers. Between the Deltaport calls, the vessel visited a U.S. Pacific Northwest port. The split service adds 104 ship movements for 2010. Although unusual, this practice was assumed to persist at Deltaport for all horizon years. The ship movements in **Table 2-5** reflect this service, but the ship calls are those of a standard service (for example, five services result in 245 calls but 594 ship movements).

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[9] Tonnage increase from 25 to 35 million tons/year from 2014 to 2017 at Westshore Terminals. That equates to approximately 1/2 train per day on average. While the throughput of the terminal is increased by 40%, the average length of train is expected to increase (up to 9,000 ft) during this period thus fewer, but longer, trains will be experienced.

Table 2-5 Actual and Projected Vessel Traffic and Volumes at Deltaport (2010 – 2025)

Item	Actual	Projected			
	2010	2014	2017	2020	2025
Container Traffic (Million TEU)	1.54	1.74	2.40	2.40	2.40
TEU / Ship Call	6,250	7, 050	7,550	8,000	8,750
Number of Calls	245	260	312	312	260
Number of Movements[1]	594	594	728	728	624
Number of Ships by Size Class					
<= 2,000	0	0	0	0	0
2,000 - 3,000	8	0	0	0	0
3,000 - 4,000	0	0	0	0	0
4,000 - 5,000	29	13	3	0	0
5,000 - 6,000	74	62	56	37	5
6,000 - 7,000	38	42	44	34	16
7,000 - 8,000	23	36	47	47	39
8,000 - 9,000	66	81	106	109	91
9,000 - 10,000	0	10	28	44	44
> 10,000	7	16	28	41	65
Total	**245**	**260**	**312**	**312**	**260**

Notes: [1] Number of ship movements reflects the Deltaport split service.

Table 2-6 shows the forecasted vessel traffic for the Roberts Bank terminal complex.

Table 2-6 Actual and Projected Traffic Volumes at Deltaport and Westshore Terminals

Year	Deltaport Container Terminal		Westshore Terminals		Totals	
	Ships	Movements[1]	Ships	Movements	Ships	Movements
2010 (actual)	245	594	246	492	491	1,086
2014	260	624	250	500	510	1,124
2017	312	728	280	560	592	1,288
2020	312	728	310	620	622	1,348
2025	260	624	350	700	610	1,324

Notes: [1] Number of ship movements reflects the Deltaport split service.

The potential effects of the forecasted increase in road, rail, and marine operations associated with the Project are described in each of the respective areas of study (i.e., marine, air quality, noise etc.).

2.8 DECOMMISSIONING PHASE

Infrastructure improvements are permanent structures; therefore, decommissioning of the Project is not anticipated and is not discussed further in the EA.

3.0 COMMUNICATIONS AND CONSULTATION

Port Metro Vancouver is engaging communities, stakeholders, First Nations, and the public regarding the proposed Deltaport Terminal, Road and Rail Improvement Project to receive input into the Project as it develops. The following chapter summarises activities undertaken to communicate the objectives of the DTRRIP, consult on Project elements, and address related concerns.

3.1 PROJECT STAKEHOLDERS

The stakeholder categories and groups with a potential interest in DTRRIP are summarised below in **Table 3-1**. Stakeholders were identified due to their proximity to the Project area, because they are potentially affected by the Project, could potentially benefit from the Project, or because they have previously expressed an interest in port development at Roberts Bank. Stakeholders which Port Metro Vancouver have engaged with during Project planning include funding partners, terminals and tenants, railways, governments, regulators, local communities, First Nations, industry, business and agricultural organisations.

Table 3-1 Stakeholder Categories and Groups

Stakeholder Category	Stakeholder Groups	
Funding Partners	Port Metro Vancouver Province of British Columbia TSI Terminal Systems Inc.	
Tenants and Terminals	Westshore Terminals TSI Terminal Systems Inc.	
Railways	British Columbia Railway Company Canadian Pacific Railway	Canadian National Railway BNSF Railway
Government	Environment Canada Transport Canada Fisheries and Oceans Canada Canadian Environmental Assessment Agency Ministry of Environment Agricultural Land Commission	BC Environmental Assessment Office Health Canada Port Metro Vancouver Canadian Transportation Agency Ministry of Transportation and Infrastructure Metro Vancouver
Local Government	Corporation of Delta Tsawwassen First Nation City of Richmond City of Surrey	City of Langley Township of Langley City of New Westminster City of Vancouver
Local Communities and Residents	Delta Richmond Surrey Langley Township and City	New Westminster Vancouver Other Metro Vancouver communities

Stakeholder Category	Stakeholder Groups	
First Nations	Tsawwassen First Nation Musqueam Indian Band Tsleil-Waututh Nation Semiahmoo First Nation	Sto:lo Nation Hulquminum Treaty Group Katzie First Nation
Industry	BC Trucking Association Chamber of Shipping of BC BC Maritime Employers Association	Shipping Lines Trucking Companies International Longshore and Warehouse Union
Agricultural	Agricultural Land Commission Delta Farmers' Institute	
Business Organisations	Delta Chamber of Commerce BC Chamber of Commerce Business Council of BC	Greater Vancouver Gateway Council Vancouver Board of Trade

3.2 COMMUNITIES, STAKEHOLDERS, AND PUBLIC – COMMUNICATIONS AND CONSULTATION

3.2.1 Overview

Port Metro Vancouver has, and continues to engage communities, stakeholders and the public regarding DTRRIP and understands and respects that port communities and their leadership want meaningful and ongoing input in the operation and expansion of port facilities and related transportation services.

Port Metro Vancouver's community engagement approach is based on open two-way communication and meaningful public participation.

3.2.2 Objectives

3.2.2.1 Project Communications

Communications regarding DTRRIP has been designed to:

- Demonstrate the need for DTRRIP, and the benefits of increased capacity at Deltaport.
- Demonstrate that Port Metro Vancouver has heard the public and acted on community concerns.
- Communicate the benefits associated with DTRRIP for local, provincial and national economies, stakeholders, and the public.
- Provide clear and timely information about Project-related activities and ensure efficient response to inquiries from the community, media, and other stakeholders.
- Demonstrate Port Metro Vancouver's commitment to leadership in sustainability.

3.2.2.2 Project Consultation

Consultation regarding DTRRIP has been designed to:

- Discuss with communities, stakeholders, and the public the effects, benefits, and features of DTRRIP.
- Consider input received from communities, stakeholders, and the public along with technical, environmental, and economic information.
- Report on community, stakeholder, and public input.

3.2.3 Scope

As Port Metro Vancouver understands the level of interest in port development at Roberts Bank is high, a number of communications and consultation mechanism have been employed to engage communities, stakeholders and the public. These mechanisms include:

- Initial meetings regarding the Project with local government, agricultural, business, and community stakeholders (October 2011).
- Web posting of a Project description, including a list of studies to be completed as part of the environmental assessment, for public comment (October 24 to November 10, 2011).
- A series of stakeholder meetings (eight), and open houses (two) regarding proposed mitigation and compensation for potential Project effects (November 25, 2011 to January 6, 2012).
- The web posting of a CEAA Screening Level environmental assessment report, including results of studies, for a 45-day public comment period (spring 2012).
- Consideration of comments on the draft CEAA screening report prior to making the EA decision.

Each of these stages includes documentation of how input received was considered.

Section **3.2.4** below describes the activities conducted, and **section 3.2.6** discusses proposed future consultation and communication activities.

3.2.4 Consultation Activities

Stakeholder engagement regarding the Project began in October 2011 with a series of meetings with local governments, community, and agricultural and business groups. In addition, as a preliminary part of the screening level environmental assessment, the public and stakeholders were invited to review and provide comments on a description of the Project and scope of the environmental studies.

Port Metro Vancouver undertook public consultation for the Project from November 21, 2011 to January 6, 2012. Multiple opportunities were provided for gathering input from communities, stakeholders, and the public, including:

- A series of eight multi-stakeholder meetings (December 6 – 8, 2011)
- Open houses in Delta on December 7 and 10, 2011

- Web-based consultation via an online feedback form.

A Consultation Discussion Guide and Feedback Form was developed and served as the primary source of information for consultation participants. The Discussion Guide and Feedback Form document was posted online and used at multi-stakeholder meetings and open houses.

Table 3-2 outlines consultation activities undertaken for DTRRIP between October and December 2011.

Table 3-2 DTRRIP Consultation Activities

Activity	Description	Dates	Stakeholders
Project Introduction	Meetings with key stakeholders regarding Project, using draft project brief as basis of discussion.	October 3, 2011 – October 19, 2011	• Municipalities • Agricultural stakeholders • Business stakeholders • Community stakeholders
Notice of Commencement	As required under the CEAA, a project notice of commencement was posted to the Canadian Environmental Assessment Registry.	October 14, 2011	• Municipalities • Agricultural stakeholders • Business stakeholders • Community stakeholders • Public
Review of Project description	Public and stakeholders were invited to review and provide comments on a description of the Project and scope of the environmental studies.	October 24, 2011 – November 10, 2011	• Municipalities • Agricultural stakeholders • Business stakeholders • Community stakeholders • Public
Public Consultation	A discussion guide was developed and used as the primary source of information for this consultation period. A feedback form attached to the discussion guide served as the main mechanism for gathering input. Activities included six stakeholder meetings and two open houses.	November 25, 2011 – January 6, 2012	• Municipalities • Agricultural stakeholders • Business stakeholders • Community stakeholders • Public

3.2.5 Issues Identification

Open houses held in late 2011 provided an opportunity to identify issues, including potential Project-related effects, to be considered in the environmental assessment. Additional input was provided through public comment on the Project description.

The key issues and themes identified from the consultation and communications activities have been summarised in a Consultation Summary Report. A Consideration Memo will also be produced, showing how input was considered in refining Project designs or in mitigations and compensation measures as the Project advances.

Input received has been considered, along with technical and economic information, in the EA document, as well during engineering work on the Project.

3.2.6 Future Proposed Engagement – Communities, Stakeholders, and Public

Building on communications activities that occurred have already occurred, including the preparation of a Project Brief, the following activities will be undertaken as the Project advances:

- Ongoing municipal liaison, particularly with:
  - Corporation of Delta
  - City of Langley
  - Township of Langley
  - City of Surrey
  - City of Richmond
  - City of Vancouver.
- Ongoing community engagement, including meetings with:
  - Port Community Liaison Committee (Delta)
  - Deltaport Container Truck Traffic Working Group
  - South Fraser Perimeter Road Community Liaison Committee.
- Ongoing communications with stakeholders and the public, including:
  - Inquiry-response (email, mail, phone)
  - Regular updates sent to email distribution list and posted on Project website
  - Regular updates regarding field studies or construction activities
  - Presentations and meetings with stakeholders and community groups
  - Traffic communications during construction
  - Communications support for announcements at key Project milestones.

In addition, as appropriate and required, Port Metro Vancouver will undertake consultation with property owners and other stakeholders who may be affected by DTRRIP.

3.3 FIRST NATIONS – COMMUNICATIONS AND CONSULTATION

3.3.1 Overview

Port Metro Vancouver is committed to continued and active engagement with First Nations who may have interests that may be potentially affected by DTRRIP. The goal of Port Metro Vancouver's consultation and engagement program is to further identify aboriginal interests and potential Project-related effects, to design and implement appropriate mitigation measures and to identify additional First Nation issues,

benefits, and Project-related opportunities as they may arise. Both the federal and provincial governments require that project proponents make reasonable efforts to engage potentially affected First Nations in accordance with a range of legal and procedural requirements as established by the respective governments. Port Metro Vancouver is fully committed to meeting these requirements, and to seeking additional opportunities for proactively engaging First Nations in relation to DTRRIP.

First Nations consultation for DTRRIP is being conducted in a manner consistent with the goals and objectives of Port Metro Vancouver's Aboriginal Engagement Strategy and in the spirit of existing agreements and/or commitments between certain First Nations and Port Metro Vancouver. This section of the CEAA report provides a summary of the consultation objectives, communications and consultation activities carried out to date, identification of key issues raised so far in the process, and a summary of the consultation plan proposed to resolve any outstanding issues or issued raised upon review of the CEAA screening report.

3.3.2 First Nations Consultation and Engagement Program Objectives

Key objectives of the consultation program are to:

- Consult with potentially affected First Nations in the DTRRIP area regarding their existing use of lands and resources for traditional purposes.
- Demonstrate, through consultation, that DTRRIP will have no direct or indirect adverse effects on the existing use of land and resources in the area by First Nations.
- Demonstrate that DTRRIP will have no direct or indirect adverse effects on any treaty right or contractual rights of the TFN.
- Ensure timely and productive First Nations engagement that builds understanding and support for DTRRIP.
- Identifies potential for delivery of Project related benefits/opportunities as appropriate.

3.3.3 Project Communications

To date, communications activities have been designed to:

- Demonstrate the need for DTRRIP, and the benefits of increased efficiencies at the existing Deltaport container terminal.
- Demonstrate that Port Metro Vancouver has effectively consulted and solicited input from First Nations and acted on concerns.
- Communicate the benefits associated with DTRRIP for local, provincial, and national economies; First Nations; stakeholders; and the public.

- Demonstrate Port Metro Vancouver's and other Project partners' commitment to leadership in sustainability.
- Provide clear and timely information about Project-related activities and efficient responses to inquiries or concerns from First Nations.

3.3.4 Scope of Consultation

DTRRIP falls within or is in close proximity to the traditional territories, either asserted, or in the case of TFN, settled by treaty, of the following First Nations:

- Tsawwassen First Nation
- Musqueam Indian Band
- Semiahmoo First Nation
- Sto:lo Nation
- Hulquminum Treaty Group
- Tsleil-Waututh Nation
- Katzie First Nation.

3.3.5 Consultation Activities to Date

First Nations consultation meetings for DTRRIP commenced in the fall of 2011. Project-related materials, including the DTRRIP Project Description, Discussion Guide, and archaeological overview assessment, were used at introductory meetings with copies provided to First Nations for their information and review.

Initial meetings were designed to meet the following objectives:

- Provide an overview of the proposed Project, its key components, benefits, and schedule.
- Outline the environmental studies undertaken in support of the CEAA screening level assessment, and discuss the opportunity for First Nations review.
- Initiate discussions regarding existing use of lands and resources for traditional purposes within the Project area and the potential for effect.
- Initiate discussions with the TFN regarding the potential for effects on any treaty or contractual rights and on TFN community/business development plans.
- Discuss any preliminary questions, interests, and/or concerns with respect to the Project and how meaningful consultation can be facilitated.

Table 3-3 summarises key items discussed at initial meetings with First Nations, materials used and provided for review, and preliminary topics/issues of interest. Port Metro Vancouver acknowledges that the topics/issues of interest listed below represent initial feedback in response to information provided during the introductory meetings and that further consultation is required to ensure consultation requirements and objectives are met. It is anticipated that, upon review of the CEAA screening report and through continued consultation, additional topics/issues of interest will be raised.

Table 3-3 Meetings to Date

First Nation	Dates	Description	Topics/Issues of Interest
Tsawwassen	October 27, 2011	Sharing Project Description and Project Brief	• Traffic • Light, noise and air quality • Economic opportunities • Access to TFN lands
	December 6, 2011	Sharing DTRRIP Consultation Discussion Guide, and Archaeological Overview Assessment	
	December 22, 2011	Discussion regarding economic opportunities and rail access	
	January 19, 2012 February 22,2012	Discussion regarding economic opportunities	
Musqueam	December 5, 2011	Sharing Project Description DTRRIP Consultation Discussion Guide Archaeological Overview Assessment	• Marine and fisheries effects • Economic opportunities and community benefits • Cumulative effects • Participation funding • Archaeology
Tsleil-Waututh	December 12, 2011 February 21, 2012	Sharing Project Description DTRRIP Consultation Discussion Guide Archaeological Overview Assessment	• Economic Opportunities • Cumulative effects • Environmental monitoring Marine effects • Emergency response and transportation of hazardous materials • Participation funding
Katzie	December 13, 2011	Sharing Project Description DTRRIP Consultation Discussion Guide Archaeological Overview Assessment	• Economic opportunities
Semiahmoo	January 16, 2012	Sharing Project Description DTRRIP Consultation Discussion Guide Archaeological Overview Assessment	• Rail traffic • Archaeology

3.3.6 Issues Identification

The key issues identified through the consultation and communications activities conducted to date include:

- Access issues related to TFN lands
- Potential traffic-related effects
- Potential noise effects
- Potential air quality effects
- Potential light effects

- Potential marine and fisheries effects
- Potential archaeological effects
- Cumulative effects from Port Metro Vancouver expansion/development
- Economic opportunities associated with DTRRIP
- Participation funding.

As noted above, Port Metro Vancouver anticipates that upon review of the CEAA report and as a result of continued consultation activities, this list will change and currently represents feedback from discussions held to date.

Many of the above issues are addressed in this CEAA screening report, including:

- Traffic (Section 6.4)
- Noise (Section 6.1)
- Air Quality (Section 5.5)
- Economic Opportunities (Section 6.4)
- Cumulative Effects (Section 8.0)

For any remaining issues of concern, Port Metro Vancouver will continue to work with participating First Nations to further discuss any questions, concerns, and the mitigation options available with respect to DTRRIP. **Section 3.3.7** provides additional details with respect to plans for continued DTRRIP consultation and communication with First Nations.

3.3.7 Future Proposed Engagement – First Nations

CEAA requires consideration of "the current use of lands and resources for traditional purpose by aboriginal persons" as specified under CEAA, Section 2(1) and Section 16(1)(a). CEAA requires the Project to demonstrate that there will be no significant adverse effects on the existing traditional use of land and resources in the area. **Section 11.0** provides a preliminary discussion of potential effects, based on the results of relevant bio-physical assessments, on lands and resources that are understood by Port Metro Vancouver, based on information made available to date, to be used for traditional purposes in the Project area. Further consultation with First Nations will be required to confirm this understanding and/or further identify potential effects on the traditional use of land and resources in the Project area. To do so, Port Metro Vancouver is committed to ongoing consultation with respect to the DTTRIP to review, discuss and identify potential mitigation options should further effects be identified.

To ensure that First Nations consultation requirements and objectives for DTRRIP are met, proposed consultation activities as of include:

- Project specific meetings and provision of related information, as required.
- Provision of participation funding where appropriate.
- Provision of DTRRIP CEAA screening report to participating First Nations.
- First Nations review of draft screening report.
- Discussions regarding potential effects on the existing use of lands and resources for traditional purposes by First Nations in the DTRRIP area.
- Discussions regarding the potential for effects on any treaty right or contractual rights of the TFN.
- The identification of appropriate mitigation for potential Project effects.
- Ongoing monitoring and response to address any unidentified effects.
- Further discussion related to potential Project benefits.

Port Metro Vancouver anticipates conducting follow up meetings with the Tsawwassen First Nation, Musqueam Indian Band, Semiahmoo First Nation, Katzie First Nation, and the Tsleil-Waututh Nation. Additional efforts will be made to inform the Hulquminum Treaty Group and Sto: Lo Nation about the Project and to share related information for review and input. These consultation efforts will focus on additional opportunities to meet to discuss the Project, the CEAA screening report and to seek information with respect to the potential for effects on existing use of lands and resources for traditional purposes within the Project area. The following table summarises consultation activities planned.

Table 3-4 First Nations Consultation Activities Proposed for Spring 2012

First Nation	Description of Consultation Activities Planned or Underway in 2012
Tsawwassen	• DTRRIP TFN Open House • Sharing of CEAA screening report • Review of CEAA screening report • Meetings as required • Discussion regarding potential effect on treaty and/or contractual rights • Discussion regarding Project-related benefits • Discussion of mitigation measures if required
Musqueam	• Discussion and provision of participation funding • Sharing of CEAA screening report • Review of CEAA screening report • Meetings as required • Discussion regarding potential effect on existing lands and resources for traditional purposes • Discussion of mitigation measures if required • Discussion regarding Project-related benefits

First Nation	Description of Consultation Activities Planned or Underway in 2012
Tsleil-Waututh	• Discussion and provision of participation funding • Sharing of CEAA screening report • Review of CEAA screening report • Meetings as required • Discussion regarding Project-related benefits • Discussion regarding potential effect on existing lands and resources for traditional purposes • Discussion of mitigation measures if required
Katzie	• Sharing of CEAA screening report • Review of CEAA screening report • Meetings as required • Discussion regarding potential effect on existing lands and resources for traditional purposes • Discussion of mitigation measures if required • Discussion regarding Project-related benefits
Semiahmoo	• Sharing of CEAA screening report • Review of CEAA screening report • Meetings as required • Discussion regarding potential effect on existing lands and resources for traditional purposes • Discussion of mitigation measures if required
Sto:lo Nation	• Sharing of CEAA screening report • Review of CEAA screening report • Offer to meet / meetings as required (Additional activities may occur depending on level of engagement.)
Hulquminum Treaty Group	• Sharing of CEAA screening report • Review of CEAA screening report • Offer to meet / meetings as required (Additional activities may occur depending on level of engagement.)

3.3.7.1 Planned Future Communications Activities

Building on activities that occurred in late 2011, communications activities from January 2012 through to the end of the construction phase in December 2014 will include:

- Ongoing liaison and meetings, as required or appropriate. Scope to be further defined dependent on issues raised over course of screening review;
- Inquiry response (e-mail, mail, phone);
- Regular updates made in person, sent by email, and posted on Project website;
- Regular updates regarding field studies or construction activities;
- Traffic communications during construction;
- Communications support for announcements at key Project milestones; and
- Implementation and monitoring of any EA commitments made.

3.4 FEDERAL COORDINATION

As a CPA, Port Metro Vancouver will act as the regulated authority for the Project and will seek expert advice from other Federal Authorities including Transport Canada, Environment Canada, Fisheries and Oceans Canada, and Health Canada, and the Canadian Transportation Agency, within their respective areas of expertise.

In accordance with the Federal Coordination Regulation established under the Act, Port Metro Vancouver is required to distribute a description of the proposed works to federal departments. A federal coordination referral letter (**Appendix B**) was sent on November 15th, 2011 to the above agencies with respect to the Project.

Table 3-5 Federal Coordination Summary

Department/ Agency	Date of Letter Sent	Date of Response	RA	Response	Comments
Department of Fisheries and Oceans (DFO)	November 15, 2011	November 18, 2011	No	Can provide specialist advice	N/A
Transport Canada	November 15, 2011	November 24, 2011	No	No	Transport Canada has not identified a responsibility under Section 5(1) nor will provide specialist advice under S12(3) of CEAA
Health Canada	November 15, 2011	December 5, 2011	No	Can provide specialist advice	Health Canada provided a list of areas of which they can provide specialist expert advice. Health Canada requires a written request prior to providing any expertise in its possession or actively participating in the Project review team.
Environment Canada	November 15, 2011	December 23, 2011	No	Can provide specialist advice	N/A

3.4.1 Department of Fisheries and Oceans (DFO)

In an email dated November 17, 2011, DFO commented on a drainage swale south of and parallel to the existing rail tracks that may be disturbed. Port Metro Vancouver responded via email on November 17th, 2011 and clarified that, based on preliminary design, the existing swale will be relocated to the south of the new rail and road corridor and that BC *Water Act* permits will be obtained where required. Additional information regarding watercourse classifications in the Project area and preliminary results of 2011 field work were also communicated to DFO.

3.5 AGRICULTURAL LAND COMMISSION (ALC) PROCESS

In 2008, the Agricultural Land Commission (ALC) approved the acquisition of the Option Lands by BCRC (**Figure 2-1**) as additional right-of-way for railway purposes. The Commission's approval was subject to two conditions: a plan showing the area to be dedicated as rail right-of-way and the ability to keep farming activities going until the rail construction has been approved and the land is needed for construction.

Separate to the communication and consultation activities described above, Port Metro Vancouver is undertaking a consultation process with the ALC, affected farmers, and other key stakeholders regarding proposed mitigation and compensation for the loss of agricultural land.

Starting in October 2011, Port Metro Vancouver and BCR initiated dialogue with the ALC and indicated the intention to pursue development of the Option Lands for rail purposes. An overview of the Project objectives, consultation planned with key stakeholders including the Delta Farmer's Institute (DFI) and affected tenants/farm operators, and an overview of the related environmental work, including timing of the EA report were discussed.

During October and November 2011, Port Metro Vancouver, conducted field reconnaissance and farm operator interviews in support of the Application being prepared for submission to the ALC. The Application will be submitted to the ALC in Spring 2012.

Table 3-6 below is a summary of the ALC Process activities to date.

Table 3-6 ALC Process to Date

Activity	Description	Date	Stakeholders
Initiate dialogue with ALC	Provided overview of DTRRIP objectives. Provided overview of consultation planned with stakeholders including DFI and land owner/operators Provide overview of related environmental work, including timing of CEAA Screening report	October 19, 2011	Agricultural Land Commission
Field reconnaissance and farm operator interviews	Conducted necessary inventory and interviews with agricultural stakeholders: • Interviews with fee simple land owners and lessees • Confirm resource mapping • Conduct farmer interviews • Complete field inventory	October – November 2011	Farm lessees
Initiate dialogue with Corporation of Delta	Discussion regarding lead contact	December 2011	Corporation of Delta

In spring 2012 Port Metro Vancouver and BCR will meet with the ALC to discuss the draft ALC Application. It is anticipated that compensation plans will be finalised in April 2012, followed by finalisation of the ALC Application and sign-off by the ALC in fall 2012.

4.0 ENVIRONMENTAL ASSESSMENT METHODOLOGY

The assessment methodology is based on the approach for a CEAA screening-level EA, including establishing the existing conditions of the study areas as the baseline, residual adverse effects determined after applying mitigation, documentation of engagement and consultation, identification of environmental effects associated with accidents and malfunctions, and assessment of cumulative effects.

4.1 SCOPE OF THE PROJECT

Generally, the scope of the Project includes the physical works related to the construction, and operation and related undertakings. The scope of the Project for the environmental assessment of DTRRIP is outlined below, and described in detail in **Section 2.0**.

The principal components are as follows:

- An overpass on the existing Roberts Bank causeway that will separate road and rail traffic.
- Reconfiguration of rail track and additional container handling equipment within the existing Deltaport Terminal.
- Additional rail track within the existing railway corridor and a portion of the Option Lands.
- Road Improvements on and adjacent to Deltaport Way to improve the movement and control of container trucks at Deltaport.

4.2 SCOPE OF THE ASSESSMENT

The scope of the assessment focuses on effects for which a causal link can be demonstrated between some aspect of the Project and the resulting effect. Where a causal link cannot be established between the Project and some aspect of the receiving environment, this report will not address the issue.

The scope of assessment for this Project is based on a review of the Project construction and operation activities; the existing environmental and social values identified through public consultation, First Nations engagement and agency review; and through professional judgement. The public and First Nations values have been informed by the consultation and engagement process for this Project.

The DTRRIP screening-level EA has been developed to meet the requirements of section 16(1) of the CEAA, and also includes consideration the following additional factors (section 16.1(b) of the CEAA):

- The purpose of the Project
- The need for, and the requirements of, any follow-up program in respect of the Project.

The biophysical and social components included in the scope of this assessment, were determined based on knowledge of the Project setting, the potential for effects from the Project as proposed and through dialogue and engagement process described in **Section 3.0**. The following biophysical components are addressed in **Section 5.0**:

- vegetation and wildlife
- water resources
- fish and fish habitat
- marine environment (including marine mammals, and coastal seabirds)
- air quality

The following social components are addressed in **Section 6.0**:

- noise
- light and visual resources
- socio-community (including Project related increases in road, rail and vessel traffic)
- agriculture
- archaeology
- First Nation considerations

4.3 SPATIAL AND TEMPORAL BOUNDARIES

4.3.1 Spatial Boundaries

Local and regional spatial boundaries were determined for biophysical and social components based on their respective characteristics and anticipated interactions with the proposed Project. Local and regional (if applicable) study areas are defined below for each component of the assessment:

- **Local study area (LSA):** the spatial area within which local effects are assessed (i.e., within close proximity to the action where direct effects are anticipated).
- **Regional study area (RSA):** the spatial area within which regional effects are assessed (i.e., extending a distance from the Project footprint in which both direct and indirect effects are anticipated to occur). Some valued components do not require a regional study area (e.g., visual, lighting).

4.3.2 Temporal Boundaries

Potential effects specific to the proposed Project were assessed based on the two main phases of the Project:

- The short-term construction phase (approximately 2.5 years including pre-construction).
- The long-term operation phase.

Decommissioning and abandonment is not addressed at this time as DTRRIP is an improvement project to an existing permanent structure.

In addition to the direct Project-environment effects, the EA also includes a Cumulative Effects Assessment (CEA). The CEA defines specific spatial and temporal boundaries for CEA, which are defined in **Section 8.0**.

4.4 GENERAL METHODOLOGY

Environmental assessments are used to examine potential effects and benefits during early planning stages of a project, allowing for refinements in project design and development of mitigation measures to manage the environmental and social effects.

The environmental assessment was conducted through completion of the following steps:

1. Description of the Project activities.
2. Identification and description of the existing environment that will be affected (existing conditions). Criteria for determining valued ecological and social components for assessment are detailed in **Section 4.5**.
3. Identification and description of the potential effects of Project-environment interactions (construction and operation phases).
4. Description of the mitigation measure(s) and, where required, compensation for potential effects.
5. Identification of any residual environmental effects after mitigation measures are applied.
6. Determination of the significance of residual adverse effects after mitigation measures.

Section 5.0 assesses the potential effects of the Project on the biophysical environment. Potential effects of the Project on social, economic, and archaeological components are assessed in **Section 6.0**.

Accidents and Malfunctions are described in **Section 7.0.** Potential cumulative environmental effects are addressed in **Section 8.0**), and potential effects of the environment on the Project are discussed in **Section 9.0**.

4.5 SELECTION OF VALUED ECOSYSTEM AND SOCIAL COMPONENTS

Valued Ecosystem Components (VECs) are defined as environmental features which have importance in the study area or which may be at-risk in the study area, or may serve as indictors for environmental components as a whole. VECs were identified through consideration of the following:

- Presence in the local and regional study areas (based on the literature and field investigations)
- Ecological (conservation) importance
- Vulnerability to Project-specific effects
- Local, First Nations, and/or socio-economic importance.

Valued Social Components (VSCs) are cultural, social, economic, and health aspects that, are of concern to local communities and/or government regulators. The VSCs were identified through consideration of the following:

- Presence in the local and regional study areas (based on the literature and field investigations)
- Vulnerability to Project-specific effects
- Local, First Nations, cultural, and/or socio-economic importance.

The following list of VECs (**Table 4-1**) and VSCs (**Table 4-2**), were the focus of this effects assessment.

Table 4-1 Selected Valued Ecosystem Components

Biophysical Component	Likely Presence in Study Area[1]	Conservation / Ecological Importance in the Study Area	Potential for Project-specific Effects	Assessed in the EA	Rationale
Vegetation and Wildlife					
Vegetation (in general)	Yes	Yes	Yes	Yes	Habitat loss
At-risk Vegetation	Potential	Yes	Yes, if present	Yes	Potential presence of species at- risk
Small Mammals	Yes	Yes	Yes	Yes	Habitat loss/prey species
Medium/Large Mammals	Yes	Yes	Yes	Yes	Habitat loss
At-risk Mammals	Potential	Yes	Yes, if present	Yes	Potential presence of species at- risk
Native Herpetiles	Potential	Yes	Yes	Yes	Potential effects from sedimentation in aquatic habitat/Introduced species as habitat competitors/habitat loss
At-risk Herpetiles	Potential	Yes	Yes, if present	Yes	Potential effects from sedimentation in aquatic habitat/Introduced species as habitat competitors/Potential presence of species at-risk
Songbirds	Yes	Yes	Yes	Yes	Habitat loss
Raptors	Yes	Yes	Yes	Yes	Potential presence of species at-risk Potential risk of collisions with traffic
Waterfowl and Shorebirds	Yes	Yes	Yes	Yes	Potential presence of species at-risk Habitat loss
Bird Species at-risk	Yes	Yes	Yes	Yes	Potential presence of species at-risk Habitat loss Potential risk of collisions with traffic
Invertebrates	Yes	Yes	Yes	Yes	Potential effects from sedimentation in aquatic habitats Food source/habitat loss
Water Resources					
Surface Water Quality	Yes	Yes	Yes	Yes	Potential effects to water quality from sedimentation and accidental spills during construction activities
Groundwater	Yes	Yes	Yes	Yes	Potential effects from accidental spills during construction

Biophysical Component	Likely Presence in Study Area[1]	Conservation / Ecological Importance in the Study Area	Potential for Project-specific Effects	Assessed in the EA	Rationale
Fish and Fish Habitat					
Fish	Yes	Yes	Yes	Yes	Potential effects related to habitat effects and mortality during instream works
Fish Habitat	Yes	Yes	Yes	Yes	Potential effects to fish habitat from sedimentation and accidental spills during construction activities
Marine Environment					
Marine Vegetation	Yes	Yes	Yes	Yes	Potential operation effects from vessel wake and ballast
Marine Invertebrates	Yes	Yes	Yes	Yes	Potential operation effects from vessel wake and ballast
Marine and Anadromous Fish	Yes	Yes	Yes	Yes	Potential operation effects from underwater noise and its ability to disrupt/mask natural behaviours
Coastal Seabirds	Yes	Yes	Yes	Yes	Potential operation effects from in-air noise and its ability to disrupt/mask natural behaviours
Marine Mammals	Yes	Yes	Yes	Yes	Potential operation effects from underwater noise and its ability to disrupt/mask natural behaviours Potential for vessel strike
Air Quality					
Air Quality	Yes	Yes	Yes	Yes	Baseline established by existing data. Ambient air quality levels will be compared to real-time air quality monitoring data being collected by the Metro Vancouver Air Quality Monitoring Station in Tsawwassen.

Note: [1] Based on literature and field investigations.

Table 4-2 Selected Valued Social Components

Social Component	Likely Presence in Study Area	Local, First Nations and/or Socio-economic Importance in the Study Area	Potential for Project-specific Effects	Assessed in the EA	Rationale
Noise and Vibration					
Acoustic and Vibration Effect on Receptors	Yes	Yes	Yes	Yes	Community concerns about noise and vibration during Project construction and operations
Visual					
Visual Sensitivity Units from Viewpoints	Yes	Yes	Low	Yes	Community concerns about visual effects
Lighting					
Light Trespass	Yes	Yes	Low	Yes	Light trespass effects on adjacent residents
Socio-Community					
Employment and Economic Opportunities	Yes	Yes	Yes	Yes	Potential for short-term and long-term economic benefits as a result of construction and operation
Population and Demographics	Yes	Yes	Low	Yes	Low potential for changes in local population to meet short-term labour requirements during construction.
Housing	Yes	Yes	Low	Yes	Potential for increased demand for housing as a result of population change related to employment opportunities during construction.
Community Service	Yes	Yes	Low	Yes	Potential for increased demand for community services as a result of population change related to employment opportunities.
Land Use and Land Use Planning	Yes	Yes	Low	Yes	Project is aligned with the Corporation of Delta's Official Community Plan.
Traffic and Transportation	Yes	Yes	Yes	Yes	Potential for increase in construction related vehicles and workers travelling to and from the site. Potential for increased truck and rail movements as a result of increased capacity at Deltaport during operation.

Social Component	Likely Presence in Study Area	Local, First Nations and/or Socio-economic Importance in the Study Area	Potential for Project-specific Effects	Assessed in the EA	Rationale
First Nation Considerations					
Existing Use of Lands and Resources for Traditional Purposes	Yes	Yes	Low	Yes	Potential for indirect effects on lands and resources due to direct environmental effects of the Project.
Agriculture					
Agricultural Land	Yes	Yes	Yes	Yes	Project components including the additional rail track within the Option Lands and road improvements on Deltaport Way will effect existing agricultural operations
Archaeology					
Heritage and Archaeological Resources	Low	Yes	Low	Yes	Protected under the *BC Heritage Conservation Act.* Applies to any newly discovered resources.

4.6 RESIDUAL EFFECTS AND CHARACTERISATION

Residual environmental effects are those which remain after mitigation measures have been put in place. Within each component section of the EA, a summary of residual environmental effects is presented. In addition, a summary of all residual environmental effects of the proposed Project is provided in **Section 12.0** Summary of Mitigation and Residual Effects.

4.6.1 Characteristics

Potential residual effects of the Project are described using effects characteristics, which include direction of the effect (positive, neutral or adverse), geographic extent, magnitude, duration and frequency, reversibility, and ecological context (Federal Environmental Assessment Review Office, 1994). The level of confidence in the assessment of the significance of the effects is also presented. The potential effects are described in the text within each component section.

Definitions for the effects characteristics are used for each VEC/VSC. Typical definitions are provided below:

- **Magnitude:** The amount of change to the existing condition of a VEC/VSC, giving consideration to factors such as the uniqueness of the effect, and the change relative to natural or background variation. Magnitude may be described as negligible (detectable within standards), low (detectable within standards), moderate (detectable approaching exceedance), and high (exceedance of criteria or threshold),
- **Geographic Extent:** The geographic area over which Project-related changes from the proposed Project will occur. The geographic extent of effects may be negligible (site), low (local study area), regional, or provincial.
- **Duration and Frequency:** The period of time for a VEC/VSC to return to its existing condition and the number of times that an effect might occur. The duration of an effect may be short term, medium term, long (irreversible). The frequency of an effect may be rare, uncommon, common, or continuous.
- **Reversibility:** The degree to which existing conditions can be regained after the factors causing the effect are removed. Effects can be reversible or permanent.
- **Ecological Context:** The ability of the environment to accept change or additional change. For example, does the Project affect an area that has already been adversely affected by human activities or one that is ecologically sensitive, with little resilience to imposed stresses. The categories typically include intact, developed (modified), and well developed (highly disturbed).

- **Level of Confidence (Scientific Certainty):** The confidence in the assessment of the residual effect based on the understanding of cause - effect relationships and available data (baseline and predictive):
  - **High:** Determination of significance base on good understanding of cause - effect relationships and data pertinent to the Project area.
  - **Medium:** Determination of significance based on good understanding of cause - effect relationships using data from outside the Project area or incompletely understood cause - effect relationships using data pertinent to the Project area.
  - **Low:** Determination of significance based on incomplete understanding of cause - effect relationships and incomplete understanding of cause - effect relationships using data pertinent to the Project area.

4.6.2 Assigning Significance

The significance of an residual adverse effect is determined for each of the potential effects to a VEC/VSC. The significance of an effect is assessed after mitigation measures have been applied. The rationale for the determination of significance is typically based on:

- **Criteria or Standards:** A published regulatory or industry standard or criteria; or
- **Thresholds:** A range of values or standards, not regulated, but used in the absence of criteria or standards; or
- **Applied Process:** Guidance established from a review of literature, precedents, subject matter experts, panels etc., applied in the absence of criteria or standards and accepted thresholds.

An overall assessment of the significance of residual adverse effects was determined as a qualitative judgement from the results of the above criteria, taking into account the level of effect for each characteristic. Typically, a “residual effect” is a permanent effect that remains after mitigation measures have been applied. The assessment of the significance of the residual effects is discussed in the text for each VEC/VSC.

Significance is generally defined as follows:

- **Not Significant**: effects are those that, after taking into consideration applicable mitigation measures, have been assessed to result in a slight to moderate measurable change in a resource during the life of the Project, but no loss in productive capacity (stable level in the Project area during and after Project). Monitoring and/or recovery initiatives may or may not be required.

  This generally includes effects that are at the level of the Project footprint or local study area, of negligible or moderate magnitude, of long duration, reversible, and/or apply within a range of development scenarios (i.e., undeveloped to highly developed).

  The rationale for the determination of significance is typically based on criteria or standards, thresholds and applied process as described above.

- **Significant**: adverse effects are those that, after taking into consideration applicable mitigation (including compensation) measures, are expected to result in a threat to the sustainability of the resource and should be considered a management concern (e.g., change in populations of, or habitat for, wildlife species such that population level effects are anticipated).

  This generally includes effects that include or exceed the regional study area, are of high magnitude, of long term duration, not reversible, have a high level of confidence, and/or apply to an undeveloped environment. The rationale for the determination of significance is typically based on criteria or standards, thresholds, and applied process as described above.

4.7 CUMULATIVE EFFECTS

The cumulative effects assessment presented in **Section 8.0** identifies reasonably foreseeable projects and activities that could interact with Project residual adverse effects. All residual adverse effects identified in the DTRRIP effects assessment are carried forward into the cumulative effects assessment. Interactions of each Project residual adverse effect and each reasonably foreseeable project or activity are identified and any cumulative effects considered. Where an interaction is identified and there is a potential for a level of effect that could be significant, a cumulative effects assessment is carried out using the assessment methods described above.

5.0 BIOPHYSICAL EFFECTS ASSESSMENT

5.1 VEGETATION AND WILDLIFE

5.1.1 Introduction

This section discusses the findings of the vegetation and wildlife assessment for the Project. The objectives of the assessment were to:

- Describe existing vegetation and wildlife resources along the DTRRIP study area through desktop study, literature review, and field surveys.
- Document the occurrence of individual vegetation and wildlife species, available wildlife habitat, and evidence of use within the study area through observations made during the field surveys.
- Assess the potential occurrence of at-risk plant communities and at-risk plant and wildlife (vertebrate and invertebrate) species that could be affected by the Project.
- Present mitigation measures to avoid, minimise, or reduce effects that can occur as a result of the Project.
- Describe potential residual adverse effects as a result of the Project.

The scope of the assessment includes all wildlife and vegetation components of the study area described below (**Section 5.1.2**).

5.1.2 Study Area

5.1.2.1 Local Study Area

The local study area (LSA) focused on vegetation, wildlife, and wildlife habitat within a 400 metres wide corridor (approximately 376 ha) centred on the Project footprint (**Figure 5.1-1**). The LSA is composed mainly of agricultural land, ditches, and existing infrastructure, and is similar to the existing conditions within the regional study area (RSA, see **Section 5.1.2.2**).

5.1.2.2 Regional Study Area

The RSA for the Project includes a one-kilometre buffer on each side of the Project area from the base of the Roberts Bank causeway to 72nd Street (**Figure 5.1-1**). The area of the RSA is approximately 1,878 ha and is composed mainly of agricultural land, ditches, and existing infrastructure.

5.1.3 Methodology

5.1.3.1 Literature Review

Existing information from previous work conducted in the study areas was used to determine existing conditions of vegetation and wildlife species and habitats. Unless otherwise noted, existing data and information discussed in this section is derived from the previous studies listed below:

- Technical Volume 7: Deltaport Third Berth (DP3) Project Terrestrial Wildlife and Vegetation Assessment (RESL, 2004).
- South Fraser Perimeter Road Vegetation and Wildlife Impact Assessment Technical Volume 12 (RESL, 2006).
- 41B Street Overpass at Deltaport Way Environmental Assessment Screening Report (Hemmera, 2009a).
- 28th Avenue Overpass Project, Delta, BC, Environmental Assessment Screening Report (MoTI, 2010).
- DP3 Adaptive Management Strategy 2007 Annual Report (Hemmera, 2008).
- DP3 Adaptive Management Strategy 2008 Annual Report (Hemmera, 2009b).
- DP3 Adaptive Management Strategy 2009 Annual Report (Hemmera, 2010).

Delta Farmland and Wildlife Trust (DFWT) provided information on the location of grassland set-asides in southwest Delta (DFWT, 2010) to aid in identifying existing wildlife habitat. The BC Conservation Data Centre's (CDC) Species and Ecosystems Explorer was accessed to find provincially and/or federally listed species and plant communities that have been documented within the RSA or have the potential to occur within the RSA. The federal Species at Risk Public Registry list of Schedule 1 at-risk species was also accessed. The above data sources were reviewed prior to conducting field surveys (July to September 2011) to gain an understanding of the vegetation and wildlife that have been identified in the LSA and RSA, and those that have the potential to occur in the study areas, as well as the types of surveys that were previously conducted. The literature review helped identify locations within the LSA that required additional field study.

Previous work conducted by Robertson Environmental Services Ltd. (RESL) for the DP3 and SFPR projects included comprehensive field studies for aquatic insects, butterflies, rare plants, amphibians and reptiles, birds, and mammals. These field studies, in addition to vegetation and wildlife surveys completed for 41B Street Project (Hemmera, 2009a) and 28th Street Overpass Project (MoTI, 2010) include the entire vegetation and wildlife LSA for the Project. The area encompassed by these studies has not changed since they were conducted. Therefore, results from these studies are considered to be relevant to the existing conditions within the LSA and RSA. The types of surveys previously conducted include:

- Ecosystem mapping (RISC, 1998a)
- Rare plants surveys
- Land cover surveys to identify agricultural crops/resources for wildlife

- Aquatic and terrestrial insect sampling surveys
- Amphibian surveys
- Diurnal and nocturnal surveys of water associated birds
- Breeding bird surveys
- Raptor/heron nest surveys
- Habitat assessments for selected species at-risk
- Trapping programs for small mammals including at-risk species: Pacific water shrew (*Sorex bendirii*) and southern red-backed vole (*Myodes gapperi occidentalis*).

The review of background information for the RSA and LSA indicated that vegetation and wildlife resources were limited by existing agricultural and urban practices. No at-risk insect or other invertebrate fauna were found within the LSA or RSA during 2003 to 2005 surveys. No listed vegetation or ecosystems had been previously identified in the study area; however, one at-risk plant has a high potential of occurring within the RSA – streambank lupine (*Lupinus rivularis*). Five wildlife species at-risk were noted to have the high potential to occur within the LSA. These species are great blue heron (*Ardea heroidias fannini*), short-eared owl (*Asio flammeus*), barn swallow (*Hirundo rustica*), barn owl (*Tyto alba*), and peregrine falcon (*Falco peregrinus*).

Field Visits

A six-day field program to confirm vegetation and wildlife resources was completed during the summer of 2011. Wildlife and vegetation resource maps from previous studies were ground-truthed during the field surveys. Vegetation, agricultural crops, observed wildlife and/or wildlife features (i.e., nests, wildlife corridors), and wildlife habitat were documented and the existing mapping was updated (**Appendix C**).

The field surveys were conducted over nine person days in July (July 19 – 22), six person days in August (August 17 – 18), and one person day on September 19. While the field program was shorter than field studies completed for previous studies, an abbreviated field program was justified, as much information for the study area was available from existing reports.

Considering the developed nature of the area surrounding the Project, the vegetation and wildlife field assessment focused on locations within 200 metres on either side of the Project footprint (400 metres wide corridor centred on the Project footprint) with wildlife habitat potential, such as agricultural fields, existing infrastructure (including buildings and overpasses) that provide potential nesting and roosting habitat, agricultural ditches and hedgerows, and ditch side/riparian vegetation.

Vegetation

An assessment of existing vegetation (plants, plant communities and agricultural crops) within the LSA was completed on July 20 to 21 and August 17 to 18, 2011 as part of the field study. The vegetation assessment consisted of delineating crop fields and documenting crops within the LSA. Three encounter transect surveys were conducted to document existing vegetation (agricultural and non-agricultural plants) within the LSA (41B Street to Highway 17; 36th Avenue to 64th Street; 72nd Street to 36th Avenue). The encounter surveys involved documenting plants and agricultural crops while walking linear paths parallel to the existing rail right-of-way. Encounter transect surveys were completed along the entire length of the LSA adjacent to the existing rail right-of-way.

Plant Species at-Risk

A desktop review, query of provincial databases, and field visits were completed to assess the likelihood of at-risk plant species occurring within the LSA.

Four rare plant surveys were completed between July and September 2011 and led by a qualified rare plant biologist (**Appendix D**). The survey met guidelines generally established for such work (e.g., Alberta Native Plant Council, 2000) which are applied by botanists in Western Canada (Fairbarns, 2012).

The initial survey was conducted on July 19, 2011 to identify areas within the LSA where rare plants have the potential to occur. The two additional surveys were conducted on July 22 and August 17, 2011 using the encounter transect technique to search for streambank lupine. Binoculars were used to identify seasonally moist depressions where streambank lupine can occur during the late summer as moisture levels decline. Any potential habitat found during the surveys was examined in detail by conducting searches at intervals of approximately 5 metres.

A subsequent survey was completed on September 19, 2011 to determine the presence of late summer species.

Wildlife

Field surveys to assess existing wildlife values, including wildlife species at-risk, were completed as part of the field program on July 20 to 22 and August 17 to 18, 2011 to fill information gaps identified during the desktop review. These field surveys were conducted in conjunction with the vegetation and rare plant assessments. Agricultural fields, hedge rows, ditch habitats, roads, and existing buildings within the LSA were assessed for the presence of wildlife and wildlife habitat. Incidental observations of wildlife and wildlife sign including tracks and scat, stick nests, den and roosting locations, nest sites, and carcasses were also documented. The potential for areas within the LSA to funnel wildlife and facilitate wildlife movement (i.e., wildlife corridors) were also assessed and documented.

Wildlife Species at-Risk

Sufficient information was available from previous studies, as summarised in **Section 5.1.3.1**,and therefore habitat suitability assessments for at-risk wildlife with the potential to occur within the LSA (small mammals and amphibians), small wildlife trapping, aquatic and terrestrial invertebrate surveys were not completed as part of the DTRRIP field program.

Previous studies rated habitat suitability in the LSA for at-risk wildlife (e.g., Pacific water shrew, southern red-backed vole, red-legged frog) as low (RESL, 2006; RESL, 2004). Given that the existing land use practices within the RSA have not changed since they were previously assessed, habitat suitability ratings for at-risk wildlife were not re-assessed for DTRRIP.

Bird distribution and abundance, including at-risk birds, have been assessed as part of previous studies through breeding bird surveys, raptor/heron surveys, and water-associated bird surveys (nocturnal and diurnal) and were therefore not re-assessed for DTRRIP.

5.1.4 Existing Conditions

5.1.4.1 Vegetation

The RSA is located within the moist maritime subzone of the Coastal Douglas-fir (CDFmm) biogeoclimatic zone, and is characterised by warm dry summers and mild, wet winters. Prior to extensive dike construction in the late 1800s, the study area was composed mostly of tidal marshes and wet meadows with narrow bands of deciduous and/or coniferous trees occurring in raised areas (RESL, 2004). Over the last 100 years, the natural vegetation in the study area has been extensively modified. The study area is now characterised by cultivated fields, agricultural ditches, road and rail infrastructure, farm and residential infrastructure, and power lines (RESL, 2004; Hemmera, 2009a).

The 2011 surveys found the diversity of vegetation within the LSA to be consistent with existing conditions reported for previous studies. A total of 62 vegetation species were documented (**Appendix E**).

The habitat adjacent to Deltaport Way and the existing rail right-of-way consists of agricultural fields and agricultural ditches. Vegetation bordering the agricultural ditches, roads and rail right-of-way within the study area are dominated by non-native species such as Himalayan blackberry (*Rubus armeniacus*), Scotch broom (*Cytisus scoparius)*, evergreen blackberry *(Rubus laciniatus)*, reed canary grass (*Phalaris arundinacea*), common hawthorne *(Crataegus monogyna)*, and non-native grasses. Native vegetation along the ditch network include hardhack (*Spiraea douglasii)*, Pacific crab apple (*Malus fusca)*, black cottonwood (*Populus balsamifera ssp. trichocarpa)*, and red elderberry (*Sambucus racemosa L*.). Duckweed *(Lemna* sp.*)* has been documented in the ditches. Cattail *(Typha* sp.*)* and bulrush *(Scirpus* sp.*)* were also observed intermittently within all ditches.

5.1.4.2 Rare Plants

A search of the BC CDC generated a total of 41 plant species that can occur in the CDFmm biogeoclimatic zone within the Metro Vancouver region (**Table 2**, **Appendix E**).

Of the 41 listed species, only two rare plants have a known occurrence within five kilometres of the LSA (CDC, 2011): Vancouver Island beggarticks (*Bidens amplissima*) and streambank lupine (**Appendix F**). To assess the likelihood that a species at-risk could occur in the LSA, a three-rank scale was applied based on a species' known geographic range and habitat association:

- A **high likelihood** of occurrence was assigned to a species if it was previously documented in the LSA or if the LSA was within a species geographic range; and existing habitat conditions within the LSA were optimal for the species.
- A **moderate likelihood** of occurrence was assigned to a species if it was known to occur within the LSA but existing habitat conditions within the LSA were sub-optimal for the species.
- A **low likelihood** of occurrence was assigned to a species if the LSA did not overlap with the species known geographic range or if low quality habitat for the species was present.

Based on the quality and availability of suitable habitat, streambank lupine and Vancouver Island beggarticks were assessed as having a high potential of occurring within the LSA.

Streambank Lupine: is an endangered species identified in Schedule 1 of the *Species at Risk Act* (SARA) and is a provincially red-listed species. This species prefers wet to moist meadows and riverbanks; however, it has been recorded growing in gravel substrate along railroad right-of-ways. The closest known occurrence of streambank lupine comes from a section of rail track in the Tilbury Island area, approximately five kilometres north of the LSA (CDC, 2011).

Vancouver Island beggarticks: is a species of special concern identified in Schedule 1 of SARA and is provincially blue-listed. This species is found in the Lower Mainland region in wet habitats including ditches, wetlands, river beds, pond and stream edges, and tidal and non tidal river edges (Klinkenberg and Klinkenberg, 2001 *in* CDC, 2011). This species is known to occur along rail and road right-of-ways. The closest occurrence record from CDC is in the Tilbury Slough area approximately five kilometres north of the RSA.

Rare plant surveys conducted in July, August, and September 2011 did not record any at-risk plant species within the LSA (**Appendix D**).

Fairbarns 2012 (**Appendix D**) notes there is a confirmed presence of Vancouver Island beggarticks at two locations in the RSA. The first location is 500 metres south of the footprint in a wet depression on a farmer's field, shown on **Appendix C, Sheet 1**. A second population, to the south of the first population on another agricultural field, was noted presumably in the RSA but no geographic coordinates were

available for mapping. Frank Lomer, rare plant specialist who conducted the rare plant survey, notes the first population was comprised of a dense 40x40m patch of approximately 2,000 plants, all affected by *Calligrapha californica coreopsivora*, a *Bidens* beetle that defoliates Vancouver Island beggarticks (M. Fairbarns, pers. comm., Oct 20, 2011). The second population to the south was comprised of approximately 100 plants unaffected by the *Bidens* beetle.

5.1.4.3 At-risk Plant Communities

Twenty-six at-risk plant communities have the potential to occur within the CDFmm in the Metro Vancouver region (CDC, 2011; **Table 3** in **Appendix E**). Information from previous studies indicates that all habitat in the RSA has been previously modified through urban development and agriculture and does not contain at-risk plant communities (RESL, 2004; RESL, 2006). As the RSA has been modified for human use (i.e., agriculture, road, and rail infrastructure), the potential for at-risk plant communities to occur is considered unlikely.

5.1.4.4 Sensitive Ecosystems

The BC Ministry of Environment (MoE) Sensitive Ecosystems Inventory (SEI) website (MoE, 2011a) was consulted to determine if sensitive ecosystems occur in the RSA. To date, an SEI inventory project has not been undertaken in the RSA or in the Lower Mainland. Given existing land use practices within the LSA and RSA, the presence of sensitive ecosystems was considered unlikely.

5.1.4.5 Wildlife

Wildlife occurring in the RSA includes invertebrates, amphibians, reptiles, birds, and mammals.

Results from the query of the CDC, SARA public registry and information obtained through the review of results from previous studies yielded a total of 34 listed wildlife species (nine mammal, three amphibians and reptiles, 18 birds, four fish) with potential to occur within the RSA (**Appendix F**). Previous studies did not find any at-risk invertebrate fauna in the RSA (RESL, 2004 and 2006). A low, moderate or high-rank potential for wildlife species at-risk occurrence was applied based on species' known geographic ranges and habitat association (see **Section 5.1.4.2**).

5.1.4.6 Mammals

Fourteen mammal species were previously documented in the LSA (Hemmera, 2009a; RESL, 2004 and 2006). Species documented include beaver (*Castor canadensis*), common muskrat (*Ondatra zibethicus*), and North American river otter (*Lontra canadensis*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), coast mole (*Scapanus orarius*) and eastern cottontail (*Sylvilagus floridanus*); yellow-bellied marmot (*Marmota flaviventris*); and small mammals (RESL, 2004).

Small mammal species captured in the LSA during the previous studies included common shrew (*Sorex cinereus*), Trowbridge's shrew (*Sorex trowbridgii*), creeping vole (*Microtus oregoni*), deer mouse (*Peromyscus maniculatus*), black rat (*Rattus rattus*), and Townsends vole. Habitat within the LSA was assessed as moderate to high suitability for Townsend's vole. Townsend's voles inhabit farm fields and are an important prey item for raptors and owls (RESL, 2004).

Mammal Species at-Risk

Based on known geographic ranges and habitat availability, nine at-risk mammals have potential to occur within the LSA and RSA (**Appendix F**):

- Pacific water shrew (PWS) (SARA Schedule 1 endangered species)
- Keen's myotis (*Myotis keenii*), (provincially red-listed)
- Townsend's big-eared bat (*Corynorhinus townsendii*) (provincially blue-listed)
- Southern red-backed vole (*Myodes gapper occidentalisi*)
- Snowshoe hare-*washingtoni* subspecies (*Lepus americanus washingtoni*) (provincially red-listed)
- Trowbridge's shrew (provincially blue-listed)
- Olympic shrew (*Sorex rowheri*) (provincially red-listed)
- Long-tailed weasel-*altifrontalis sub*species (*Mustela frenata altifrontalis*) (provincially red-listed)
- Mountain beaver-rufa subspecie*s (Aplodontia rufa rufa*) (SARA Schedule 1 species of special concern)

Although the CDC database does not identify PWS occurring within the CDFmm, this species was added to the list of at-risk mammals because the LSA is within its known distributional range (Lindgren, 2004).

Habitat suitability assessments for seven of the eight at-risk species (i.e., all species listed above except mountain beaver) were completed during previous studies. A habitat suitability assessment was not completed for mountain beaver as no suitable habitat exists within the study area to support this species (Port Metro Vancouver, 2005).

Pacific water shrew: is listed under Schedule 1 of SARA as endangered. This semi-aquatic species often found within 60 metres of a water feature is associated with mature coniferous or mixed forests with an abundance of coarse woody debris (Lindgren, 2004; COSEWIC, 2006). The likelihood of occurrence of PWS within the RSA was considered low because of the lack of mature forest within the LSA. The closest mature forest habitat is in Burns Bog, approximately 1.5 kilometres north of the DTRRIP footprint at 72nd Street, which is outside the RSA (EBB, 2009). No high or moderate-rated suitable habitat exists for PWS within the RSA.

Keen's myotis: is a forest species with a preference for mature and coastal forests (COSEWIC, 2003a). Natural roost sites include tree cavities and loose bark, but southwest facing rock crevices and buildings can also provide roost locations for this species. The closest known colonies of Keen's myotis are on Vancouver Island and on the Queen Charlotte Islands. It is possible for Keen's myotis to occur in mature forest stands in Burns Bog, which is outside of the RSA. Other possible locations where this species may be found are farm buildings in the LSA. The CDC (2011) notes it is possible for Keen's myotis to occur in Delta; however, there are no known occurrences or colonies in Delta. The likelihood of occurrence of this species in the LSA is considered to be low.

Townsend's big-eared bat: is found in forested regions and buildings, and in areas with a mix of woodland, grassland, and/or shrubland on the west coast (CDC, 2011). This species prefers cold places for hibernation, often near entrances and in well-ventilated areas such as caves and mine tunnels (CDC, 2011). The closest known occurrence of this species was at Fisherman's Cove near Horseshoe Bay in 1948. The LSA and RSA have areas of foraging habitat potential for Townsend's big eared bat such as grassland, and outside the RSA in forest within Burns Bog; however, the lack of suitable hibernacula suggest a low likelihood of occurrence for this species in the RSA.

Southern red-backed vole: is associated with mature coniferous and mixed forests with shore pine, salal, and Labrador tea (*Ledum groelandium*). No suitable habitat occurs within the study area for this species. The potential for southern red-backed vole occurrence is low.

Snowshoe hare: is associated with young coniferous forest with dense understory. No suitable habitat for this species is available within the RSA. The likelihood of occurrence for this species is low.

Trowbridge's shrew: was captured during SFPR studies in the ditch habitat paralleling the existing rail right-of-way between Highway 17 and 72nd Street. This shrew is found south of the Fraser River in riparian, mixed, and deciduous forest habitats such that it is expected to occur in many riparian and wetland locations (Zuleta and Galindo-Leal, 1994 *in* RESL, 2006). Although a Trowbridge's shrew has been captured within the LSA, the habitat suitability for this species was rated as low in the SFPR study area because of the lack of riparian, mixed, and deciduous forest habitat (RESL, 2006). Considering that a specimen was caught near the Fisher Yard in sub-optimal habitat between 2004 and 2005, the likelihood of occurrence of this species in the LSA is considered moderate.

Olympic shrew: is a forest dependent species associated with mixed deciduous and shorepine forests of various seral stages. This species has also been found in reed canary grass (*Phalaris arundinacea*) bordering a ditch approximately 15 metres from a mixed forest (Nagorsen, 2007 *in* CDC, 2011). The likelihood of occurrence for this species is low because of the absence of forest habitat in the LSA.

Long-tailed weasel: is a forest species found in old coniferous or mixed forest with closed canopy, sparse understory, abundant woody debris, roots, and logs for dens. No suitable habitat for this species is available within the RSA. The likelihood of occurrence for this species is low because of the lack of mature forest in the LSA.

Mountain beaver: is listed as a species of special concern under Schedule 1 of SARA and can be found in forested areas and are associated with watercourses in early to mid-seral stages in second growth forest stands. No suitable habitat for this species is available in the RSA. The likelihood of occurrence for this species is low because of the lack of forest within the LSA.

No other mammalian species at-risk have been documented and no masked occurrence records pertaining to threatened or endangered species have been identified in the RSA (CDC, 2011).

Habitat quality in the RSA for Pacific water shrew, Keen's long-eared myotis, southern red-backed vole, snowshoe hare, and long-tailed weasel was assessed as low or nil during previous studies (RESL, 2004 and 2006). The likelihood of any of the nine species, except Trowbridge's shrew (rated moderate), occurring within the LSA is low due to the lack of suitable habitat.

5.1.4.7 Herpetiles

Three amphibian and one reptile species (collectively called "herpetiles") have been documented in the LSA (Hemmera, 2009a; RESL, 2004; CoD, 2001). The three amphibian species documented were breeding Pacific chorus frog (*Pseudoacris regilla*), green frog (*Rana clamitans*), and bullfrog (*Rana catesbeiana*). Green frog and bullfrog are non-native species. One reptile species was documented - western terrestrial garter snake (*Thamnophis elegans*). Bullfrog tadpoles were documented during the 2011 field studies.

Herpetile Species at-Risk

No herpetile species at-risk have been documented, nor have there been any masked occurrence records pertaining to threatened or endangered species in the RSA (CDC, 2011). Based on known distributions and habitat availability, three herpetile species at-risk have potential to occur in the LSA (**Appendix F**):

- Western toad (*Anaxyrus boreas*) (SARA Schedule 1 species of special concern)
- Western painted turtle (*Chrysemys picta*) (SARA Schedule 1 endangered species)
- Red-legged frog (*Rana aurora*) (SARA Schedule 1 species of special concern).

Western toad: this SARA Schedule 1 species of special concern uses a diversity of aquatic and terrestrial habitat. This species is known to breed in shallow, littoral zones of lakes, temporary and permanent pools and wetlands, bogs and fens, and roadside ditches (CDC, 2011). Adult toads can also be found in all forest and woodland types, cropland/hedgerow, grassland, old fields, and in suburban lands in BC. Loose soils and burrows are ideal locations for hibernacula. There are no documented occurrences of western toads within the LSA (CDC, 2011).

While suitable breeding habitat is present in the LSA, there is a lack of suitable locations for hibernacula for this species. In addition, the absence of upland forest in the LSA limits the potential for occurrence. Fish and amphibian studies conducted between 2000 and 2003 by the Corporation of Delta (CoD) did not document any occurrence of western toad in the LSA (CoD, 2001). The absence of upland forest and hibernacula habitat, in addition to the results of the CoD (2001) fish and amphibian study, suggest the occurrence of western toad in the LSA to be low.

Red-legged frog: this SARA Schedule 1 endangered species can use a diversity of water bodies and wetlands for breeding and during aquatic life-stages (CDC, 2011). This species appears to prefer water bodies with a complexity of microhabitats with low flow and/or standing water such as bogs, fens, and cattail marshes. Swamp or shallow open water habitats are less preferential for red-legged frog. Adult red-legged frogs are often found in deciduous forests of various seral stages. There are no known occurrences of red-legged frog in the LSA (CDC, 2011).

Habitat suitability assessments conducted for red-legged frog during previous studies (RESL, 2004 and 2006) that overlap with the LSA were assessed as low. The likelihood of occurrence of this species in the LSA is considered to be low because of the lack of suitable breeding habitat and the absence of upland forest which is preferred habitat for adult red-legged frogs in the non-breeding season.

Western painted turtle: is a SARA Schedule 1 endangered species that is water-dependent and prefers habitat with a muddy substrate and abundant aquatic emergent vegetation. The presence of cattail mats, logs, open banks, and water bodies less than three metres deep are suitable habitat features for this species. These habitat features, in addition to the lack of emergent aquatic vegetation in the ditch network in the study area suggest there is no suitable habitat to support this species. There are no known occurrences of western painted turtle within the RSA (CDC, 2011). The likelihood of this species occurring in the study area is low.

5.1.4.8 Birds

The RSA is in a region of high bird diversity. Roberts Bank, located to the west of the RSA, is an overwintering ground for many duck and geese species. In addition, it is a major stopover location for shorebirds during spring and fall migration. Many of the cultivated fields within the RSA provide roosting and foraging habitat for dabbling duck species including mallard (*Anas platyrhynchos*), gadwall (*Anas strepera)*, northern shoveler *(Anas clypeata)*, green-winged teal *(Anas crecca)*, northern pintail (*Anas acuta*), and American wigeon (*Anas americana*). Snow geese (*Chen caerulescens*) have also been observed using these fields. In the summer months many songbird species, including barn swallows, are observed flying over these fields. Sparrows, finches, blackbirds, crows, and swallows are commonly observed in the general area.

Previous studies documented 116 avian species in and adjacent to the RSA (Hemmera 2006; 2008; 2009b and 2010a). Forty-three species of passerines, 37 species of waterfowl and seabird, 15 species of shorebird, 11 raptor species, and nine gull / tern species, as well as great blue heron were recorded (**Appendix G**). Many bird species were documented using multiple habitat types within and adjacent to the RSA. Forty-nine percent (57/116) of species were documented using marine habitat associated with the intercauseway (**Table 5.1-1**). Many of these species have been observed to use the foreshore above the high water mark, as well as agricultural fields adjacent to Deltaport Way. Ninety-one percent of these species (52 of 57) were gulls, terns, waterfowl, seabirds, or shorebirds.

Agricultural fields were dominated by songbirds (37 species), waterfowl (15), and raptors (ten) species. While only four species of shorebirds were documented during DP3 studies (January to February 2004), a total of 18,093 individuals were recorded. RESL (2004) note that the number of waterfowl (ducks, geese, and swans) observed in the same timeframe was 10,589 individuals.

The ditch vegetation bordering agricultural fields was solely used by songbird (29 species), while the agricultural ditches were used by 14 bird species. **Appendix G** provides a summary of birds that occur in the RSA and notes the type of habitat in which the species occurs.

The 2011 field studies documented 22 avian species within and adjacent to the LSA: 12 passerines, one waterfowl species, two species of shorebird, four raptor species, two species of gull and great blue heron (**Table 5.1-2**). Passerines were observed in hedgerows, on the existing rail right-of-way, near the shrubs on the existing overpasses and in nests built under the overpasses (**Appendix C, Sheet 2**), around existing buildings and on agricultural fields.

Mallards were seen in the agricultural ditches, and one nest was found near the base of the Roberts Bank causeway (**Appendix C, Sheet 1**). Mallards are a common resident waterfowl species in the Lower Mainland. No other waterfowl species was observed, likely because most waterfowl had not yet migrated from summer breeding grounds. Waterfowl are commonly seen roosting in wet depressions on agricultural fields in the winter months.

Killdeer (*Charadrius vociferus*) were observed on agricultural fields. One Wilson's snipe (*Gallinago delicata*) carcass, possibly struck by a passing train, was documented on the existing rail right-of-way (**Appendix C, Sheet 1**). There are resident dunlin (*Calidris alpine*) and black-bellied plover (*Pluvialis squatarola*) in the Roberts Bank inter-causeway area, though none were documented within the LSA during the field visit. No other shorebird species was observed during the field visits.

Raptors were observed flying over agricultural fields, perched on power poles or power lines, and in trees within the LSA. Raptor species observed included red-tailed hawk (*Buteo jamaicensis*), bald eagle (*Haliaeetus leucocephalus*), northern harrier (*Circus cyaneus*), and American kestrel (*Falco sparverius*). No raptor nests were found in the LSA during the 2011 surveys.

Gulls were observed flying over agricultural fields. Gulls are also known to roost in wet depressions on agricultural fields (Sheet 5 and 6 in **Appendix C**).

Great blue heron were observed on agricultural fields and in agricultural ditches within the LSA in 2011.

Table 5.1-1 Number of Bird Species Documented Using Habitat Types Found within and adjacent to the RSA*

Group	Habitat Type				
	Agricultural Ditches	Agricultural Fields	Ditch Vegetation	Causeway Shoreline	Marine Inter-causeway Area
Gulls and Terns	1	3		3	9
Heron	1	1		1	1
Passerine	6	37	29	8	3
Rails and Coots		1			
Raptor		10		6	1
Shorebird		4		13	11
Waterfowl and Seabirds	6	15		7	32
Number of Species	14	71	29	38	57

Source: RESL 2004; RESL 2006; Hemmera, 2008, 2009b, and 2010.

Table 5.1-2 Birds Species Documented within the LSA in 2011

English Name	Latin Name
Mallard	*Anas platyrhynchos*
Great blue heron ssp. *fannini**	*Ardea Herodias ssp. fannini*
Northwestern crow	*Corvus caurinus*
Savannah sparrow	*Passerculus sandwichensis*
Common yellowthroat	*Geothlypis trichas*
American goldfinch	*Carduelis tristis*
Northern harrier	*Circus cyaneus*
Red-tailed hawk	*Buteo jamaicensis*
Bald eagle	*Haliaeetus leucocephalus*
Red-winged blackbird	*Agelaius phoeniceus*
Wilson's snipe	*Gallinago delicate*
Barn swallow*	*Hirundo rustica*
Tree swallow	*Tachycineta bicolour*
Song sparrow	*Melospiza melodia*
House finch	*Carpodacus mexicanus*
House sparrow	*Passer domesticus*
American robin	*Turdus migratorius*

English Name	Latin Name
European starling	*Sturnus vulgaris*
Killdeer	*Charadrius vociferous*
American kestrel	*Falco sparverius*
Ring-billed gull	*Larus delawarensis*
Glaucous-winged gull	*Larus glaucescens*

Note: * Denotes at-risk bird species

Bird Species at-Risk

Seventeen bird species at-risk have the potential to occur within the CDFmm biogeoclimatic zone in the Metro Vancouver region (CDC, 2011; **Appendix F**).

Of the seventeen at-risk bird species, and based on known distributions and habitat availability, nine bird species at-risk have potential to occur within the LSA (**Appendix F**). Five species were determined to have a high potential to occur within the LSA:

- Great blue heron (SARA Schedule 1 species of special concern)
- Short-eared owl (SARA Schedule 3 special concern and provincially blue-listed species)
- Barn swallow (provincially blue-listed species)
- Peregrine falcon (SARA Schedule 1 threatened and provincially red-listed species)
- Barn owls (SARA Schedule 1 special concern and provincially blue-listed)

Great blue heron: are provincially blue-listed and SARA-listed Schedule 1 species of special concern). Great blue herons are locally abundant in the Roberts Bank because of a great blue heron colony Tsatsu Bluffs located approximately three km south of the LSA at the base of the BC Ferries causeway. Great blue herons were documented roosting and foraging in the agricultural ditches in the LSA during the 2011 field visits. Herons are present year-round in the RSA.

Short-eared owl: are provincially blue-listed and SARA-listed Schedule 3 species of special concern. Short-eared owls are a diurnal owl with documented occurrences on the salt marshes behind the dyke bordering Tsawwassen First Nation lands within five km of the LSA. This species occurs on open land with low vegetation suitable for nesting and foraging and where small mammals occur (CDC, 2011). Short-eared owls often occur in saltwater and fresh water marshes, bog habitat, and old fields. This species is present year-round in the RSA.

Barn swallow: are provincially blue-listed and have a threatened status under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Barn swallows are known to construct their nests on human structures (e.g., barns, under overpasses) and are likely present where suitable foraging

habitats, such as agricultural fields, are in close proximity to nesting structures. Two barn swallow nests were observed under the existing overpass at Arthur Drive within the LSA during the July 2011 site visit (**Appendix C, Sheet 2**). Barn swallows were observed flying over agricultural fields throughout the LSA. This species is migratory and present in the RSA during the bird breeding season (March –July).

Peregrine falcon: Peregrine falcons (provincially red-listed, SARA Schedule 1 threatened species) are known to hunt prey within the LSA. They hunt shorebirds along the causeway and are known to hunt waterfowl within agricultural fields. Rock cliffs are preferred breeding habitat for this species in the Lower Mainland (CDC, 2011). There is an absence of suitable breeding habitat for peregrine falcon in the LSA. This species is present year-round in the RSA.

Barn owl: are provincially blue-listed and listed as a species of 'special concern' under Schedule 1 of the SARA. There are known barn owl nests in the RSA, and barn owls have been observed within one kilometres of the LSA. Barn owls forage along roadside verges and in agricultural fields where small mammal prey can be found. Barn owls nest in human structures such as barns and abandoned buildings with an opening the owls can access. This nocturnal species is present year-round in the RSA.

5.1.4.9 Invertebrates

A minimum of fifty-seven invertebrate species have been documented in the LSA (RESL, 2004). These include seven dragonfly and damselfly species, 22 aquatic or semi-aquatic water bugs, 15 butterfly species and 24 aquatic beetle species (**Appendix H**).

Invertebrate Species at-Risk

No at-risk invertebrate species were found during previous studies (RESL, 2004 and 2006).

Six at-risk molluscs and one at-risk beetle are known to occur in the CDFmm (CDC, 2011). Five of the six molluscs are terrestrial forest specialists and have a very low potential of occurring in the LSA or RSA because of a lack of suitable habitat. One at-risk mollusc, black gloss (*Zonitoides nitidus*), is associated with marshes and the edges of ponds, sloughs, rivers (CDC, 2011) but there are no known occurrences in the RSA. The likelihood of black gloss occurring in the study area is very low.

Auduoin's night-stalking tiger beetle is a provincially red-listed beetle species that is associated with undisturbed grassland habitat. Twelve specimens were captured in grassland habitat that had been undisturbed for more than 40 years south of the Boundary Bay Airport in 1989 (CDC, 2011). These specimens were found approximately 2.5 kilometres east of the LSA and 200 metres from the coast line. This species has a low likelihood of occurrence in the LSA because undisturbed grassland habitat is lacking.

5.1.5 Selection of Valued Ecosystem Components

For DTRRIP, vegetation and wildlife VECs include the following:

- Vegetation and at-risk plants
- Mammals (small and medium sized) and at-risk mammals
- Native herpetiles and at-risk herpetiles
- Birds (songbirds, raptors, waterfowl, gulls, and shorebirds) and at-risk birds
- Invertebrates and at-risk invertebrates.

Table 5.1-3 shows where there is potential interaction of vegetation and wildlife VECs and DTRRIP construction and operation. Potential wildlife habitat and wildlife movement corridors were also included in the scope of effects assessment, and are discussed within respective wildlife sections.

Table 5.1-3 Potential for Interaction between Project Activities and Vegetation and Wildlife VECs

Project Phase	Project Component/Activity	Vegetation	At-risk Vegetation	Mammals	At-risk Mammals	Native Herpetiles	At-risk Herpetiles	Songbirds	Raptors	Waterfowl and Gulls	Shorebirds	At-risk Birds	Invertebrates	At-risk Invertebrates
Construction	Site preparation and clearing activities	X	X	X	X	X	X	X	X	X	X	X	X	X
	Site preloading	X	X			X	X	X	X	X	X	X		
	Ditch relocation /realignment			X	X	X	X	X	X	X	X	X	X	X
	Overpass removal at 46A Street			X	X	X	X	X	X	X	X	X		
	Additional rail track within the existing railway right-of-way and a portion of the Option Lands			X	X	X	X	X	X	X	X	X		
	Construction staging and laydown areas			X	X	X	X	X	X	X	X	X		
	Terminal Improvements									X				
	DTRRIP Overpass construction									X	X	X		
Operation	Rail and truck traffic			X	X	X	X	X	X	X	X	X		
	Rail and road maintenance	X	X	X	X	X	X	X		X		X	X	X
	Effects of new lighting			X	X					X	X	X		
	DTRRIP Overpass road traffic (including lighting)							X	X	X	X	X		
	Transmission line relocation							X	X	X	X	X		

5.1.6 Potential Effects and Proposed Mitigation

This section assesses the potential effects on vegetation and wildlife VECs that can occur from the construction and operation of DTRRIP. This section also identifies mitigation measures, best management practices, and standard operating procedures that are recommended to be implemented to minimise potential effects that can result from a construction or operational activity.

The scope of the effects assessment includes the VECs listed in **Section 5.1.5.**

5.1.6.1 General Description of Potential Effects

Construction and operational activities listed in **Table 5.1-3** have the potential to have direct and/or indirect effects on VECs. Direct effects include habitat loss and habitat fragmentation; habitat degradation; changes in wildlife movement and wildlife mortality (e.g., collision resulting from increased road and/or rail traffic). Indirect effects include sensory disturbance such as noise, olfaction, vibration, and visual (e.g., artificial lighting, presence of construction crews).

Effects on vegetation and at-risk vegetation are direct effects only. These include habitat loss, fragmentation, and degradation. The introduction of invasive species to the study area is not considered an effect for this Project because invasive species are already widely distributed throughout the LSA.

Effects on wildlife and at-risk wildlife are both direct and indirect. These include habitat loss, fragmentation and degradation, changes in wildlife movement, wildlife mortality, and sensory disturbance.

Habitat Loss

Habitat loss is a direct effect in which a Project activity requires the removal of a specified area within the study area that is judged to have ecological value for vegetation and wildlife. Habitat loss is likely to occur for vegetation and wildlife within the footprint of the Project. The frequency of habitat loss within the study area will generally occur once for a specified area, but the location of habitat loss will differ. Habitat loss can vary in size and spatial configuration. The magnitude of habitat loss is variable depending on the ecological and habitat requirements of the species. Habitat loss may be permanent or reversible. If habitat loss is reversible, the length of time needed for the habitat to become suitable will vary between species.

Habitat loss can also affect the microclimates of habitat on the periphery of previously contiguous habitat type (e.g., deciduous forest). The creation of peripheral or “edge habitat” can result in a change of physical attributes such as soil moisture, ambient temperature of air and soil, and light filtration, all of which can alter vegetation composition and wildlife use over a period of time.

Habitat Fragmentation

Habitat fragmentation is a direct effect in which a Project activity bisects a contiguous tract of habitat that is judged to have ecological value for vegetation and wildlife. This effect has consequences for a species' survival and reproductive capability. Habitat fragmentation can also impede a species' movement across a landscape. Habitat fragmentation can create edge habitat. The magnitude of effect on a species' survival and reproductive capability is highly dependent on a species' ecological requirements and population status.

The nature of habitat fragmentation is also similar to habitat loss with respect to duration, frequency, geographic extent, and likelihood of effect.

Habitat Degradation

Habitat degradation is a direct effect in which a Project activity reduces the quality of an area that has ecological value for vegetation and wildlife. Habitat degradation can occur through an accidental spill of hazardous material, sedimentation, and erosion. Edge habitat can be considered habitat that has reduced ecological value because of altered environmental conditions.

Changes to Wildlife Movement

Changes to wildlife movement across the Project area can occur if a wildlife species is disturbed by construction or operation. This is a direct effect on wildlife. The magnitude of effect varies between species. A low magnitude disturbance may result in an animal temporarily changing its movement pattern to avoid certain Project activities that can cause changes in wildlife movement include, but are not limited to, active construction overpass decommissioning and/or increased rail and/or road traffic during operation. These activities are loud and visually disturbing which can disrupt their daily activity. A high magnitude of disturbance may include, in the instance of a species with seasonal migration patterns, an obstruction which permanently impedes access to an area that is vital for species survival (e.g., breeding, foraging, denning habitat). The level of effect of a change to wildlife movement will vary in terms of frequency, duration, geographic extent, and likelihood of effect depending on the ecological requirements of each species.

Wildlife Mortality

Wildlife mortality is a direct effect which has an effect on an individual and depending on the species may have an effect at a population level. For example, the population of a species may be highly affected by an individual mortality if the species occurs at low abundance within the region or is long-lived and reproduces every few years. There is less effect at the population level if a species population is at a healthy density or breeds yearly and has a short life span.

Project-related mortalities may occur as a result of collision with a train or other vehicle during operation, or as a result of collision with the existing transmission lines. In the absence of mitigation, increased road and rail traffic can increase the incidence of wildlife collision mortality. Mortality may also result from exposure to toxic substances (e.g., oil, lubricant, dust suppressants) from the Project.

Sensory Disturbance

Sensory effects include noise, visual, and olfactory disturbance originating from Project activities. Sensory disturbance is a reversible effect, as ambient conditions are expected to return once the disturbance is removed. The level of effect of a sensory disturbance will vary between species. Ecological context, frequency, and duration as well as the geographic extent of a disturbance will affect the level of sensory effect. It is expected that wildlife occurring in the LSA are relatively habituated to sensory disturbance because of existing land use and human presence in agriculture, transportation, and port-related activity.

5.1.6.2 Construction – Vegetation (including at-risk species)

Construction effects have been identified for vegetation and at-risk vegetation resulting from Project activities. These effects include:

- Loss of ditch-side and hedge vegetation from site preparation and clearing activities.
- Loss of agricultural land with the Option Lands site preparation and clearing activities.
- Sedimentation of existing vegetation from preload and aggregate material beyond the existing boundaries of construction activities.
- Accidental clearing of at-risk plants, potentially Vancouver Island beggarticks or streambank lupine, during clearing activities.

As shown on **Table 5.1-3**, effects to vegetation are anticipated for a number of construction activities (i.e., 46A St overpass removal, ditch relocation, construction in rail right-of-way and Option Lands, etc.) and the potential effects of those activities are covered under the construction effects identified in the bulleted list above. Other activities (i.e., works with the intermodal yard, DTRRIP Overpass construction) are not anticipated to effect vegetation as these works will occur on developed lands with little to no native vegetation.

5.1.6.3 Operation – Vegetation (including at-risk species)

Operational effects on vegetation and vegetation species at-risk can occur during roadside or rail maintenance activities, specifically mowing and/or hedge trimming. There is a negligible level of effect associated with these activities.

There is a possibility that at-risk species may colonise within the maintenance right-of-way during the life of the Project. Management plans to avoid potential effects to at-risk plant species within the LSA should coincide with existing programs conducted by the rail operator.

5.1.6.4 Proposed Mitigation Measures for Vegetation (including at-risk species)

During construction, best management practices and mitigation measures to minimise and/or avoid potential effects to vegetation and at-risk plants will be applied. The following mitigation measures are proposed:

- Minimising vegetation clearing and footprint. Demarcate locations where vegetation is to be retained on both construction drawings and on the ground prior to the start of construction.
- Replanting denuded areas with native vegetation, or native plant species (such as black cottonwood, willow or red alder) that improve bank stabilisation and reduce the incidence of soil erosion. This activity should be completed after the construction activity has ceased. Spring is an optimal period for replanting.
- Removal and appropriate disposal of any invasive plants encountered during site clearing and preparation.
- Installing sediment and erosion control silt fencing to reduce the chance of preload or aggregate spill beyond the boundaries of Project construction works.
- If at-risk vegetation is found, relocate the plants to areas not affected by the Project if seasonal conditions are favourable (spring), or collect seed for future propagation if seeds are available (late summer to early fall). The location of the at-risk vegetation should be reported to the appropriate personnel, (i.e., Environmental Monitor, and appropriate government agencies). Qualified environmental personnel should conduct the relocation activity.
- Identifying vegetation clearing boundaries on Project design plans/maps and flag boundaries before heavy equipment access, clearing and site preparation to avoid construction encroachment outside areas where clearing is required.
- Implementing standard spill prevention and contingency measures (to be included in a construction Environmental Management Plan (EMP)).
- The construction EMP will include vegetation management measures necessary to control invasive species.

A low level of effect on vegetation and at-risk vegetation is expected from Project construction activities. A low rating indicates there is a minimal negative effect on existing plant species' habitat, survival or reproductive function. The effects to vegetation and at-risk plants are considered to be reversible within one year after construction is complete.

The effects on vegetation and at-risk plants during construction have been assessed as low because existing vegetation within the entire footprint is comprised mainly of invasive plant species and agricultural crops. The extent of vegetation clearing is not planned to go beyond the Project footprint. Documented vegetation within the LSA are species commonly found in the region, and a number of species are invasive (**Appendix E**). Natural and at-risk ecosystems are not found within the Project footprint.

Agricultural land (8.33 ha) within a portion of the Option Lands will also be cleared of vegetation and crops where it overlaps the Project footprint. The estimate of vegetation lost (ditch and hedgerow vegetation) to site clearing activities is approximately 3.75 ha over the entire 9.4 kilometres length of the Project, where the average width of vegetation is four metres.

There is a possibility that Vancouver Island beggarticks, a Schedule 1 SARA species of special concern and provincially blue-listed species, is present within the footprint of the Project, as two populations have been found within the RSA (**Appendix C, Sheet 1**). Neither of the documented populations is within the Project footprint and therefore will not be directly affected by the proposed construction activities.

Prior to the start of operation, an operational EMP with relevant measures to manage vegetation during operations will be developed. Such mitigation measures may include:

- Removal of any invasive plants encountered during normal and routine maintenance activities.
- Grubbing and clearing of right of way.
- Implementing vehicle and equipment inspection and cleaning protocol to avoid invasive plant species reestablishment.

With the implementation of mitigation measures and best management practices outlined above, the effects on vegetation and vegetation species at-risk are expected to be low and reversible during operation.

No residual adverse effects to vegetation (including species at-risk) are as a result of DTRRIP.

5.1.6.5 Construction – Mammals (including at-risk species)

Construction effects have been identified for the VECs that occur or have the potential to occur within the Project LSA and RSA. Such effects include:

- habitat loss and/or fragmentation
- changes in wildlife movement
- wildlife mortality
- sensory disturbance

The effects associated with habitat loss, habitat fragmentation and wildlife mortality are confined to the Project footprint, whereas habitat degradation, sensory disturbance, and changes in wildlife movement extend to the LSA and RSA.

The mammals most likely to be affected during construction activities include small (e.g., shrews, voles and mice) and medium-sized mammals (e.g., coyote, beaver, and muskrat).

The removal of hedgerow and ditch vegetation is expected during site clearing and preparation activities. The estimated loss of this type of vegetation is 3.75 ha over a length of 9.4 kilometres. Similar habitat in equal areal extent is available on the north side of the existing rail line, and along the ditches that transect the Project footprint. Hedgerow and ditch vegetation provide ecological value for small mammals as movement corridors and as refugia during inclement weather conditions. This habitat may also provide foraging and possible breeding habitat for small mammals. The loss of this vegetation can be mitigated through replanting with native vegetation along newly constructed ditches that provide similar value to these wildlife species.

Habitat loss, associated with the loss of agricultural land, is estimated to be 8.33 ha. This type of habitat is used by small and medium-sized mammals (e.g., coyotes) as travel corridors. The effect of 8.33 ha of habitat loss on wildlife movement is not considered an adverse environmental effect because similar habitat is widely available in the RSA and beyond.

Additional habitat fragmentation effects on mammals in the RSA and LSA are not expected because the Project is proposed to be built alongside the existing rail line. Hedgerow and ditch vegetation will be replanted after ditch relocation and/or realignment activities.

All Project activities may have sensory effects on mammal and any at-risk mammal species within the LSA and RSA. Sensory effects include noise, visual, and olfactory disturbance that may cause temporary changes in wildlife use of the LSA. Avoidance of the construction activities by changing travel routes may also occur and is the most likely outcome resulting from sensory disturbance.

Wildlife mortality may also occur as a direct effect from Project construction activities. Construction activities that can potentially cause wildlife mortality include vegetation clearing as part of site preparation, ditch relocation/realignment activities or accidental spills of deleterious substances (including petroleum hydrocarbons). Site preloading can fatally affect mammal species that burrow beneath the ground for nesting by soil compaction.

Mortality may result from collision with construction vehicles and equipment. Dewatering, backfilling, and earth works during ditch relocation and realignment may fatally affect mammals using ditch habitat. Destruction of burrows may fatally affect burrowing species during backfilling and other earth works.

5.1.6.6 Operations – Mammals (including at-risk species)

Operational effects on mammals and at-risk mammals include:

- Roadside or rail maintenance activities, specifically mowing and/or hedge trimming.
- Noise and visual effects from maintenance and rail operations will likely cause temporary changes in movement and/or avoidance of the area.

- Mortality may also occur if small mammals are not able to leave the area before the start of mowing and hedge trimming.
- Collision with road and/or rail traffic may occur from an increase in rail and road traffic accessing the terminal.

5.1.6.7 Proposed Mitigation Measures – Mammals (including at-risk species)

During construction, best management practices and mitigation measures to minimise and/or avoid potential effects to mammals and at-risk mammals will be applied. These will include:

- Minimise vegetation clearing and Project footprint to minimise habitat loss.
- Minimise interactions between wildlife and the work site. Store garbage, fuel, oil, and lubricant appropriately to minimise odour and access.
- Avoid, where possible, instream works between May 1 and August 15 as per Schedule 'C' Corporation of Delta timing window (CoD, 2003).
- Conduct ditch relocation/realignment work in the dry, where possible.
- Install sediment and erosion control fencing on the banks of watercourses and on the preload boundaries to prevent encroachment of aggregate and materials onto potential wildlife habitat and to prevent accidental mortality.
- Minimise maintenance activities, such as the removal of accumulated material and debris, in ditch and associated riparian habitat to reduce the incidence of wildlife mortality.
- Prior to construction, conduct site surveys to mark specific wildlife habitat features/environmentally sensitive areas within the footprint identified in this assessment. These sites are to be included in design drawings.
- The construction EMP will include a Wildlife Habitat Management Plan to outline site-specific avoidance and mitigation measures that are to be addressed during construction, including fueling procedures and appropriate storage and secondary containment of petroleum hydrocarbons
- Monitoring of the efficacy of mitigations will be completed by an environmental monitor and guided by the EMP.

The effects of construction activities on wildlife from the Project are rated as low. There is a temporary loss of foraging and refugia habitat for small mammals from the clearing of hedgerow and riparian habitat alongside ditches within the footprint prior to its re-establishment post-construction. The permanent loss of agricultural fields also reduces foraging habitat for small and medium-sized mammals; however, the area of affected agricultural land represents only a small amount of agricultural habitat contained within the RSA, this effect is considered negligible.

Sensory disturbance is expected for mammals present within the area. Normal behaviour and movement patterns are expected to return to pre-Project conditions once construction is complete because these species are considered to be habituated to the surrounding environment. Therefore, the effect of sensory disturbance on mammals is considered to be low.

Trowbridge's shrew was assessed as having moderate likelihood of occurring because of a previous capture in 2004 in the Fisher Yard footprint; however, there has been a considerable level of development within the area of the Fisher Yard for the overpass at 36th Avenue and SFPR construction since 2009. The level of activity that is present in the area of the Fisher Yard makes it unlikely for Trowbridge's shrew to be present. Therefore, the effect of construction on at-risk mammals (i.e., Trowbridge's shrew) is considered low.

During operation, the following mitigation measures will be applied to minimise effects on mammals and at-risk mammals:

- Minimise interactions between wildlife and the work site. Store garbage, fuel, oil, and lubricant appropriately to minimise odour and access.
- Minimise maintenance activities, such as accumulated material and debris removal, in ditches and associated riparian habitat to reduce the incidence of wildlife mortality.
- Avoid, where possible, instream works (i.e., maintenance activities) between May 1 and August 15 as per Schedule 'C' Corporation of Delta timing window (CoD, 2003).

There is a low level of effect associated with normal and routine roadside and rail maintenance activities to mammalian species. Noise and visual effects from maintenance will likely cause temporary changes in movement and/or avoidance of the area. Mortality may also occur if small mammals are not able to leave the area before the start of mowing and hedge trimming. Small mammals present in mowed areas may be exposed to predation from raptors or larger carnivorous mammals (e.g., coyotes).

An increase in traffic has the potential to increase road and train collisions with mammals (e.g., coyotes, small mammals) during operation. By 2017, road and rail traffic is expected to increase by approximately 2,400 two-way vehicle (truck and car) trips per day, and eight to ten container trains trips per day. Mammals documented in the RSA are generally disturbance tolerant species that are habituated to human presence. These species co-exist with traffic, and utilise the riparian habitats that parallel the road and rail rights-of-way as movement corridors. Wildlife mortality from rail and road collision has been rated as low given that the Project is proposed to be built next to, and within the existing rail right-of-way in which existing mammals are familiar with, and the likelihood of at-risk mammalian occurrence is generally low.

With the implementation of the above-noted mitigation measures during construction and operation activities, the effects to mammals are expected to be low and reversible once activities cease.

No residual adverse effects on mammals and at-risk mammals are expected as a result of DTRRIP.

5.1.6.8 Construction – Herpetiles (including at-risk species)

Construction effects have been identified for the native herpetiles and at-risk herpetiles that may occur within the Project LSA and RSA. Such effects include:

- Loss of aquatic ditch habitat, hedgerow and ditch vegetation from site preparation and clearing activities or during ditch relocation/alignment, limiting the opportunity for amphibians and reptiles to seek refuge from predation and desiccation.
- Loss of agricultural land from site preparation and clearing activities, or from construction staging and laydown areas, which may be used by amphibians where there is water ponding. Garter snakes may also use farm fields as travel corridors.
- Sedimentation of watercourses and accidental spills of deleterious substances including hydrocarbons from any Project construction works that are planned near existing watercourses have a negative effect on amphibians which are sensitive to changes in ambient water conditions.

Effects to native herpetiles, including species at-risk may occur from the following Project activities:

- Site preparation and clearing
- Site preloading
- Ditch relocation and/or realignment
- Overpass removal at 46A Street
- Construction staging and laydown areas
- Rail track construction within a portion of the Option Lands and the existing rail right of way

5.1.6.9 Operation – Herpetiles (including at-risk species)

Operational effects on herpetiles (including species at-risk) can occur from:

- Normal and routine roadside or rail maintenance activities, specifically mowing and/or hedge trimming.
- Noise and visual disturbance from maintenance and operations.
- Mortality from road and/or rail traffic or maintenance activities.

5.1.6.10 Proposed Mitigation Measures – Herpetiles (including at-risk species)

During construction and operation, best management practices and mitigation measures to minimise and/or avoid potential effects to native herpetiles (including species at-risk) will be applied. Such mitigation measures and Best Management Practices (BMPs) include:

- Adopt of MoE's *Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments* (MWLAP, 2004b).
- Avoid, where possible, instream works (i.e., maintenance activities) between May 1 and August 15 as per Schedule 'C' Corporation of Delta timing window (CoD, 2003).

- Conducting instream works in the dry, where possible.
- Where instream works take place during herpetile breeding periods, egg mass and tadpole searches should be carried out prior to any works occurring to ensure native and/or at-risk herpetiles species are not affected. Fish and amphibian salvage and relocation efforts should be implemented if native and/or at-risk species are positively identified.
- Obtaining BC *Wildlife Act* permit if salvage and relocation efforts are required.
- Minimising ditch and vegetation clearing activities.
- Re-planting native vegetation along banks of relocated and realigned ditches to provide amphibians and reptiles with refuge from predation and high temperatures.

Project construction is considered to have a low effect on herpetiles because the ditches in the LSA are considered low value habitat for native amphibians. The presence of competitive non-native species (green frog and bullfrog) suggests the occurrence of native amphibians in the ditch network is low within the footprint. No at-risk amphibians are likely to occur within the LSA or be affected by Project activities.

Mitigation measures such as amphibian salvage, conducting instream works in the dry, and where possible, avoiding instream works during CoD Schedule C work windows, will minimise and avoid amphibian mortality as a result of ditch relocation and/or realignment such that effects to herpetiles are expected to be low.

During operation, a low level of effect on native and at-risk amphibians is expected. The effects during operation are associated with road and rail maintenance activities. Noise and visual effects from maintenance will likely cause temporary changes in movement and/or avoidance of the area. Mortality may also occur if amphibians or reptiles are not able to leave the area prior to the start of mowing and hedge trimming operations.

Collision from road and/or rail traffic has been rated as low given that the Project is proposed to be built next to the existing BC rail line. Herpetiles within the Project LSA are more likely to be present in or near riparian vegetation and ditches as opposed to roads and rail lines where they are more exposed to predation and desiccation.

Construction and operation effects from DTRRIP on herpetiles in the LSA is expected to be low considering the existing effects from adjacent agricultural and urban practices; the low likelihood of species at-risk occurrence; the implementation of the mitigation measures and best management practices described above and in **Sections 5.1.6.4** and **5.1.6.7**. No residual adverse effects are expected on native and at-risk herpetiles as a result of DTRRIP.

5.1.6.11 Construction – Birds (including at-risk species)

Songbirds, raptors, waterfowl and gulls, shorebirds and species at-risk are the VECs assessed. Potential effects during construction include:

- Habitat loss from site preparation and clearing activities resulting in the removal of larger trees and/or hedgerow vegetation that can be used as perch locations for raptors.
- Habitat loss (nesting, roosting and foraging habitat) from a variety of construction activities including railcar repair yard, laydown, and staging areas.
- Noise and visual sensory disturbance from all construction activities, including locations on the causeway and within the terminal footprint.
- Mortality from vegetation and site clearing activities or collision with construction vehicles.

Habitat loss (approximately 3.75 ha) will occur from the removal of hedgerow and riparian vegetation along ditches within the Project footprint, and shrubby vegetation located on the slopes of the 46A Street overpass. These types of habitat are used mainly by songbirds, including migratory species, as nest sites or perch locations. Raptors will use larger hedgerow vegetation (such as the *Larix* sp. at 57B Street) as perch locations when hunting along the rail right-of-way, adjacent farm fields, or on roadside verges. The loss of hedgerow, shrubs and riparian vegetation along the rights-of-way and ditches is temporary and reversible. Upon the completion of construction, vegetation replanting will occur in areas that were previously cleared for site preparation, along relocated/realigned ditches and next to rights-of-way, where possible (See **Section 5.1.6.4**).

Agricultural fields are used by raptors foraging for prey species such as small mammals and songbirds. Waterfowl and gulls use these fields as roost locations during the winter months, in addition to foraging for harvested crops and winter cover crops (RESL, 2006). Killdeer occur in the LSA and may nest on farm fields in the spring. At-risk species, including great blue heron, barn owl, short-eared owl, and peregrine falcon, may also forage for small mammals and smaller birds on farm fields in the LSA.

Up to 8.33 ha of agricultural land is required for Project rail improvements, resulting in habitat loss for birds. This area within the Option Lands is small when compared to all agricultural land contained within the RSA (up to 500 ha), and negligible when compared to similar habitat (agricultural land) within southwest Delta (6,300 ha). Given that suitable roosting and foraging habitat is available for bird VECs within the RSA, the loss of habitat effect is considered to be low.

Project construction activities may be visually and audibly disruptive to bird populations. Birds that are typically present in the terrestrial RSA (e.g., waterfowl, gulls, raptors, songbirds, herons, and shorebirds) are tolerant of some level of disturbance from agricultural, port and transportation activity given their presence in Roberts Bank and southwest Delta. Noise disturbance from construction activities, particularly loud, random, infrequent, or intermittent noise may temporarily affect bird behaviour. Noise

that is loud, but constant may have less effect on bird behaviour because it is not sudden and unexpected. Great blue heron have been documented foraging in the ditches within the LSA and can be disturbed by sudden and unexpected noise.

The construction of the DTRRIP Overpass on the causeway may have sensory effects on birds that use Roberts Bank. Noise and visual disturbance from construction of the DTRRIP Overpass may cause temporary avoidance of marine habitat north and south of the causeway as well as changes in flight pattern to avoid flying over the causeway.

The effect of causeway construction on inter-causeway habitat use and cross-causeway flight patterns may affect different species groups depending on the time of year:

- During spring and fall migration migratory species such as waterfowl, black-bellied brant (*Branta bernicla*), and other coastal seabirds and shorebirds (e.g. western sandpiper, *Calidris mauri*) use Roberts Bank as a stopover location before migrating to breeding grounds in the spring, or wintering grounds in the fall (Environment Canada, 2011a).
- During summer when great blue heron access the intercauseway tidal mudflats and eelgrass beds to feed on fish and crustaceans (COSEWIC, 2008; Butler, 1997);.
- During winter when overwintering waterfowl are most abundant in Roberts Bank (Bird Studies Canada, 2011).

During construction, the effect of sensory disturbance to birds using the intercauseway area is expected to be low. Further, as shown in Deltaport Third Berth bird studies[10], construction activities have not resulted in adverse disturbance effects. (Hemmera, 2010; Hemmera, 2009b and Hemmera, 2008).

Bird mortality can occur from the destruction of active nests during site preparation and clearing of hedgerow, riparian, and shrub vegetation. Riparian and emergent ditch vegetation that is scheduled to be cleared may also contain active nests of songbirds and waterfowl. Active killdeer nests may be present on farm fields, and waterfowl nests may be present in ditch vegetation that will be prepared for future construction.

At-risk barn swallows are known to nest in a number of habitats, including overpasses (CDC, 2011). Swallows have high site fidelity and often return to the same nesting area in successive years (Turner and Rose, 1989; Shields, 1984 *in* CDC, 2011). Active barn swallow nests were documented under the overpass at Arthur Drive during 2011 field studies. Though not documented during 2011 field studies, barn swallows may nest under the 46A Street overpass which is proposed to be decommissioned as part of this Project.

Bird mortality in the LSA may also result from collision with construction equipment and vehicles.

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[10] The objectives of the DP3 bird studies, conducted as part of the Port Metro Vancouver DP3 Adaptive Management Strategy, were to determine any effects on brant geese and great blue heron from construction and operation, and coastal seabirds and shorebirds from construction. This study began in 2007 at the start of DP3 construction and has continued into operation.

5.1.6.12 Operation – Birds (including at-risk species)

Operational effects on birds and at-risk birds can occur from:

- Roadside or rail maintenance activities associated with vegetation and brush clearing.
- Sensory effects from lighting of the Gulf Repair Yard and DTRRIP Overpass.
- Collision with existing transmission line along the causeway.
- Collision with road and/or rail traffic, including truck traffic on the DTRRIP Overpass.

Birds that nest in rights-of-way are susceptible to direct mortality resulting from mowing and maintenance (Jacobsen, 2005). Roadside or rail maintenance activities, such as vegetation clearing or dredging of ditches, have the potential to effect nesting song birds and waterfowl in the LSA. This effect can be avoided by scheduling these activities outside of the breeding bird window (March 15 to August 15) and avoiding instream works between May 1 and August 15 as per the Schedule C timing window (CoD, 2003).

Sources of light (e.g., street lights, greenhouses, etc.) may be a visual disturbance to barn owls and waterfowl that use adjacent agricultural fields for hunting (barn owl) and roosting (waterfowl). Such sources of lighting can also increase collision risk for coastal birds, especially during periods of low visibility and poor weather. Shell (2011) notes that taller light structures exceeding 60 metres are implicated in bird collisions, especially during periods of low visibility. Birds can be disoriented by, and attracted to lighting which can potentially cause injury or mortality if a collision occurs (Teikari, 2007). For nocturnal foragers, additional lighting is an attractant because foraging is enhanced, but also potentially increases their risk of predation (Santos *et al.,* 2010).

Street light poles will be required to illuminate the switching yards and DTRRIP Overpass during operation (DMD, 2012). The lights will be on only after dark, and will be installed in a manner (e.g., full cut-off optics and source brightness/intensity) to reduce spill lighting and visual effects to local residents. Portable task lighting (mounted on the service vehicle) will also be used during repair works and will be positioned very close to repair works to minimise the effects of spill lighting (DMD, 2012). The lighting footprint or brightness zone for DTRRIP is narrow and does not extend further than 150 metres past the light source or the LSA (**Figure 6.3-1**).To detract birds from the lighted areas, hedgerows and shrub vegetation can be strategically planted as a way to diffuse light and reduce light spill in the area of the new railcar repair yard and switching yards.

Thirteen lights (11 metres tall) are proposed to be installed on the DTRRIP Overpass. To reduce lighting effects to migratory and marine birds, the lights will be aimed in a downward position to minimise light spill. The height of the installed light poles on the DTRRIP Overpass are anticipated to be approximately

20-25 metres above ground, and takes into account the height of the light pole (11 metres) and the maximum elevation of the DTRRIP Overpass (ten metres)[11]. Given these factors, the potential for collision resulting from light effects on the DTRRIP Overpass are expected to be low.

Car and truck traffic on the DTRRIP Overpass may result in fatal collision of marine birds and other species flying over the DTRRIP Overpass. Multi-taxa studies on wildlife mortality report that birds are more likely to be killed than any other taxa (Forman *et al.,* 2003). A study on bird collision from overhead transmission wires along the Deltaport causeway found that the incidence and probability of collision differed between species, and that birds generally flew between five and 50 metres above the top wire (Next, 2005). The study found that herons, shorebirds, ducks and gulls were at greatest risk of collision because of their type of approach to crossing (abrupt versus gradual climb), and the height at which they crossed (within five metres). The differences in collision probability and flight height were attributed to morphology (specifically associated with agility and flight pattern) and weather (wind and visibility). Jacobsen (2005) notes that changes in wind pattern over bridge decks can cause birds to slam into oncoming vehicles.

A preliminary review of bird strike data between 1994 and 2004 suggests an 80% decrease in mortality associated with bird strikes of transmission lines along the causeway. The construction of the DTTRIP overpass requires the relocation of hydro poles from the middle of the P Yard to the north side of the causeway (**Figure 2-6**). The overall length of the existing transmission line will not change, and existing bird diverters (spiral vibration dampers) on portions of the relocated line will be retained.

Visual cues, such as the installation of bird diverters on the overhead wires (as is present at Roberts Bank) or diversion poles spaced at intervals on bridge decks, can help to reduce collision (Next, 2005; Bard *et al.,* 2002). Installing fencing on the sides of the DTRRIP Overpass can help to force birds to fly higher over the structure thereby reducing the chance of collision with vehicles (Jacobsen, 2005). Bard *et al.* (2002) found diversion poles to be effective at reducing direct mortality of birds from vehicle collision because birds adjusted their flight to fly above the poles.

5.1.6.13 Proposed Mitigation Measures – Birds (including at-risk species)

To mitigate for effects to birds during the construction and operation of DTRRIP, the following measures and best management practices are recommended:

- Adopt MoE's *Best Management Practices for Raptors in Urban and Rural Environments* (LGL and Biolinx, 2005a).
- Avoid vegetation clearing during the breeding bird window which occurs between March 15 and August 15. If vegetation clearing is scheduled within the bird breeding window, nest surveys must be completed by a qualified environmental professional to ensure that no active nests are present in the area that is scheduled to be cleared.

[11] Port Metro Vancouver DRAFT Preliminary Design Drawings for CCIP DTRRIP Overpass. Prepared by Delcan. Version April 17, 2012.

- Reduce light spill by pointing lights downward and place task lighting as close to the repair work as possible. Only use additional task lighting when necessary.
- Where possible, schedule DTRRIP Overpass construction to avoid or minimise activities during spring and fall migration to reduce effects on shorebirds and waterfowl.
- Potential to install fencing prior to the commissioning of the DTRRIP Overpass to force birds to fly high and minimise the incidence of bird collision with vehicles. Alternatively, light poles and additional diversion poles may be installed to encourage a higher flight path for birds.
- Install signage to indicate an environmentally sensitive and/or biodiverse area.
- Retain existing bird diverters (spiral vibration dampers) on portions of the transmission line that is to be relocated.

Effects to birds and bird species at-risk are considered to be low for DTRRIP. The loss of approximately 8.33 ha of agricultural fields is a permanent loss for birds and at-risk birds that occur in the LSA and RSA; however, this loss accounts for two-to-five percent of similar habitat within the RSA. Similar habitat adjacent to the Project footprint is still available as suitable roost, foraging, and hunting habitat.

Effects to breeding birds are also considered to be low. Vegetation clearing and site preparation activities during construction and road/rail maintenance during operation are restricted during the breeding season, thereby avoiding nest mortality.

Sensory disturbance (noise and visual) from construction is temporary. Given that many bird groups in the LSA are habituated to human presence and can tolerate some level of disturbance from surrounding land use and urban practices, effects are considered to be low and reversible upon construction completion.

The effect from lights at the switching yards and on the DTRIRP Overpass are low-level effects which are mitigated by the number and type of installed lights, the brightness of the lights, and the angle at which the lights are pointed. Controlling the brightness and angle of lights on the DTRRIP Overpass, as well as restricting the height of the light poles is expected to detract from a low flight path of marine birds and reduce risk of collision. In addition, the installation of diversion poles, discussed below, minimise the risk of collision.

Collisions with the existing transmission lines are not anticipated to change as a result of DTRRIP (i.e., no increase in incidence of mortality as a result of the relocation of the transmission line). Existing bird diverters will be retained, and the overall length of the transmission line will not change. Port Metro Vancouver is undertaking more quantitative research to determine current collision and mortality rates and the effectiveness of the existing mitigation measures (i.e., spiral vibration dampers), and to provide additional information to guide efforts to further avoid bird mortality.

Bird collision is expected to occur during Project construction and operation from increased road and rail traffic, but this has been rated as a low-level effect because birds are habituated to pre-existing road and rail traffic conditions. The increase in road and rail traffic during operation can also be mitigated to reduce collision. For barn owl and other raptors, planting hedgerows force a higher flight pattern when crossing the rail line. For marine birds, the installation of light poles and diversion poles on the DTRRIP Overpass are effective at reducing the incidence of collision with vehicles.

With the implementation of the above-noted mitigation measures during construction and operation activities, the effects to birds in the LSA are low. No residual adverse effects on birds and at-risk species are expected from DTRRIP.

5.1.6.14 Construction – Invertebrates (including at-risk species)

Invertebrates and at-risk invertebrates are the VECs assessed. Site preparation and vegetation clearing activities are the main construction activities that may have a potential negative effect on invertebrate species (including species at-risk) that occur or have the potential to occur within the LSA and RSA. Such effects include:

- Loss of aquatic ditch habitat, ditch side and hedge vegetation.
- Loss of agricultural land from site preparation and clearing activities.
- Sedimentation of watercourses and accidental spills of deleterious substances including hydrocarbons from any Project construction works that are planned near existing watercourses.

5.1.6.15 Operation – Invertebrates (including at-risk species)

Operational effects on invertebrates can occur from roadside or rail maintenance activities, specifically mowing and/or hedge trimming. Operational effects can also occur from the accidental introduction of deleterious material, such as oils, gas and lubricant, into the watercourses.

5.1.6.16 Proposed Mitigation Measures – Invertebrates (including at-risk species)

Many of the invertebrate species previously documented during previous EAs are commonly found in the region. Five of six at-risk mollusc species are forest specialists and have a very low likelihood of occurrence because of the absence of forest habitat. Black gloss, an at-risk mollusc, has been associated with wetland habitat, but there are no known occurrences in the LSA or RSA. The likelihood of black gloss occurring in the LSA is low.

In 1989, 12 Auduoin’s night-stalking tiger beetle (Auduoin’s beetle) were detected outside of the RSA and south of the Boundary Bay Airport in grassland habitat that had been undisturbed for more than 40 years (CDC, 2011). The likelihood of Auduoin’s beetle occurring in the LSA is low.

During construction and operation, best management practices and mitigation measures to minimise and/or avoid potential effects to invertebrates (including species at-risk) will be applied. Such mitigation measures include:

- Conducting instream works in the dry, where possible.
- Minimising vegetation clearing activities. Mark vegetation clearing limits on design drawings and in the field to avoid over clearing.
- Minimising dredging and maintenance activities to reduce disturbance to riparian and emergent ditch vegetation.

Construction and operation effects from DTRRIP on invertebrates and at-risk invertebrates in the LSA is expected to be low considering the existing effects from adjacent agricultural and urban practices; the low likelihood of species at-risk occurrence; the implementation of the mitigation measures and best management practices described above and in **Section 5.1.7**. No residual adverse effects are expected for invertebrates and at-risk invertebrates from DTRRIP.

5.1.7 Summary of Proposed Mitigation Measures for Vegetation and Wildlife VECs

During construction and operation, best management practices and mitigation measures to minimise and/or avoid negative effects to wildlife and at-risk species should be applied. A summary of proposed mitigation measures is provided in **Section 12.0**. Management and mitigation measures for potential environmental effects of accidents and malfunctions will be included in the EMPs for the Project. The EMP will be written and implemented prior to construction.

5.1.8 Residual Effects and Determination of Significance

With the implementation of the mitigation measures described above, the vegetation and wildlife assessment has concluded that there are no residual adverse effects associated with construction and operation of the Project.

Vegetation, herpetiles, invertebrate, and at-risk species VECs were assessed as having a low level of effect from construction and operation activities. Mitigation measures described above are expected to offset any effect associated with these VECs such that no residual adverse effects are expected.

Effects to mammals, birds, and at-risk mammals/birds were assessed as low for construction activities. While there is a permanent loss of agricultural land that provides foraging, roosting, and hunting habit for these species, this is a small loss when compared with the total area of the RSA. Habitat loss associated with hedgerow, ditch, and riparian habitat are expected to be replaced through replanting upon completion of construction. Nest mortality of songbirds, waterfowl and killdeer will be mitigated through restrictions against vegetation clearing during the bird breeding window.

Given that similar habitat within the ALR is available for use directly adjacent to the Project footprint, residual adverse effects to mammals, birds and at-risk mammal/bird species are not expected.

5.2 WATER RESOURCES – SURFACE WATER AND GROUNDWATER

5.2.1 Introduction

This section assesses the potential environmental effects of the DTRRIP on surface and groundwater resources in the study area. The objectives of the following assessment are to:

- Characterise surface water quality of the study area through field sampling, desktop study and literature review.
- Characterise groundwater in the study area through desktop study and literature review.
- Assess the potential effects to the surface water quality and groundwater from Project construction and operation.
- Present mitigation measures to avoid, minimise or reduce potential Project effects.
- Describe potential residual effects as a result of the Project.

The scope of the assessment includes all surface water and groundwater components within the study area.

5.2.2 Study Area

The study area for water resources is defined as a 200 metre corridor centred on the existing rail right of way from the base of the existing Roberts Bank causeway to 72nd Street. The study area is shown on **Figure 5.2-1**.

5.2.3 Methodology

The study methodology was developed from a review of data sources that includes previous studies and government databases listed below. The information collected from background review helped to focus the field study on geographic areas in need of additional field assessment.

5.2.3.1 Review of Existing Data Sources

Existing water quality information from previous assessment work and government sources was used to determine the existing conditions of surface water quality and groundwater in the study area. Baseline information was sourced from:

- South Fraser Perimeter Road Environmental Assessment Screening Report Prepared for the Ministry of Transportation and Infrastructure (Hemmera, 2006).
- South Fraser Perimeter Road Water Quality Impact Assessment Prepared for the Ministry of Transportation (Golder Associates, 2006).
- 41B Street Overpass at Deltaport Way Environmental Assessment Screening Report (Hemmera, 2009a).

- Land Capability Assessment Deltaport Way Overpass Area 41B Street at Deltaport Way (Madrone Consultants, 2009).
- iMap BC (Ministry of Forest, Lands and Natural Resources Operations).

Based on a review of the above noted documents it was determined that surface water quality sampling was needed between 41B Street and Highway 17, as the background review showed no information on surface water quality for this area. Existing information available on groundwater was sufficient to provide a characterisation of the groundwater resources in the study area.

5.2.3.2 Field Surveys

Water quality sampling was conducted at nine locations within the study area between 41B Street and Highway 17 (**Figure 5.2-1**). Water quality sampling took place using *in-situ* apparatus in an agricultural ditch parallel to, and five metres set back from, the existing railway access road and in three tributaries to the existing railway ditch (running parallel to Deltaport Way on the south side of the road). The existing railway ditch is considered ephemeral, and was largely dry at the time of the 2011 field visits and discontinuous over its length.

A team of two biologists and one field technician conducted a preliminary walk-through alongside the BC Rail ditch on July 20, 2011 to determine the feasibility of testing water quality every 200 metres to cover the four-kilometre (approximate) study area from 41B Street to Highway 17. Sampling every 200 metres was determined not feasible since many locations along the ditch were dry at the time of the field visit. Given this limitation, the team took opportunistic *in-situ* samples where sufficient depth of water was present on July 20 and 21, 2011. Two measurements were taken at each of the nine sampling locations (**Figure 5.2-1**) on consecutive days to determine if water parameters differed between high and low tide.

A calibrated YSI multi-parameter handheld instrument was used to assess *in-situ* surface water quality during the field visits. Turbidity was estimated visually due to equipment malfunction during the field visit. The following parameters were chosen for testing because they provide a general characterisation of existing surface water quality and they are measurement variables used in considering the protection of aquatic life (CCME, 2006):

- Dissolved oxygen (DO) concentration
- pH
- Water temperature (ºC)
- Turbidity
- Specific conductivity (µS/cm^{c}).

The Ministry of Environment's *Guidelines for Interpreting Water Quality Data* (RISC, 1998b), and *Water Quality Guidelines (Criteria) Reports,* were used to interpret water quality results.

5.2.4 Existing Conditions

5.2.4.1 Surface Water

The DTRRIP study area is located within the Fraser River watershed which has been altered by anthropogenic influences. Watercourses in the footprint are typical of other ditches in Delta which receive runoff from nearby agricultural and transportation activities, with low concentrations of dissolved oxygen and elevated levels of turbidity, temperature and dissolved solids (inferred from measurements of specific conductivity). Hemmera 2006 and 2009 (see Section 5.2.3.1) noted poor water quality in the ditches and swales found within the study area.

Exceedances of British Columbia Water Quality Guidelines (BCWQG) and Canadian Council of Ministers of the Environment (CCME) guidelines for aquatic life were reported for surface water associated with DTRRIP in Hemmera (2006). Hemmera (2006) notes that surface water quality south of Highway 99 in the SFPR study area, including surface water associated with DTRRIP, was dominated by sodium and chloride, had neutral pH and ranged from fresh (total dissolved solids <1000 mg/l) to brackish (total dissolved solids from 1000 mg/l to 10,000 mg/l). Total dissolved solids, nitrates, fluoride, chloride, total and dissolved metals, chemical oxygen demand, fecal coliform, and sulphates exceeded BCWQG and/or CCME criteria for surface water associated with DTRRIP.

During the July 2011 field visit, the water quality results showed a negligible difference between the high tide and low tide sampling events. **Table 5.2-1** provides a summary of the water quality results. Surface water quality results were generally poor: high temperature, high specific conductivity, moderately turbid to turbid waters and consistent with previous studies (Hemmera, 2006 and 2009a).

Table 5.2-1 Surface Water Quality Measurements (n=9) for the DTRRIP Study Area between 41B Street and Highway 17 (2011)

	Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm[c])	pH	Turbidity (NTU)[1]
CCME (2006):	Maximum Weekly Average Temperature: *Thermal additions to receiving waters should be such that the maximum weekly average temperature is not exceeded*	Lowest acceptable DO concentration: For warm water biota: early life stages = *6 mg/L* other life stages = *5.5 mg/L* For cold water biota: early life stages = *9.5 mg/L* other life stages = *6.5 mg/L*	-	*6.5 to 9.0*	Clear flow: *Max. increase of 8 NTUs from background levels for a short-term exposure (e.g., 24-h period).* *Maximum average increase of 2 NTUs from background levels for a longer term exposure (e.g., 30-d period).* High flow or turbid waters: *Max. increase of 8 NTUs from background levels at any one time when background levels are between 8 and 80 NTUs. Should not increase more than 10% of background levels when background is > 80 NTUs.*
RISC (1998):	Aquatic life (Salmonids): *18-19°C maximum weekly average for adults and juveniles* *8-10°C maximum weekly average for spawning* *13-15°C maximum weekly average for embryo survival*	Fish: buried embryo and alevin stages for water column data: *9 mg/L (instantaneous min.)* *buried embryo and alevin stages for inter gravel data:* *6 mg/L (instantaneous min.)* Fish: all life stages other than buried embryo and alevin for water column data: *5 mg/L (instantaneous min.)* Invertebrates: *4.0 mg/L is the limit to avoid acute mortality while greater than 8.0 mg/L imparts no production impairment.*	Natural waters vary between *50 and 1500 µS/cm.*	Aquatic life: *6.5-9.0*	Aquatic life : *5 NTU increase when background = 50 NTU* *10% increase when background > 50 NTU*

Tide Level	Low	High	Low	High	Low	High	Low	High	Low	High
Waypoint 291	20.7	19.6	7.44	3.79	9998	10143	8.54	8.49	T	T
Waypoint 293	18.1	17.2	1.72	4	1574	1375	7.03	7.08	T	T
Waypoint 294	19	16.9	9.36	7.75	260	213.1	7.8	7.83	M	M
Waypoint 295	16.9	15.8	13.95	8.66	3035	2988	7.55	7.47	T (39 NTU)	T
Waypoint 296	20	18.8	9.42	6.74	563	487.2	8.29	7.7	M (10 NTU)	T
Waypoint 297	19.4	18.4	5.14	3.05	1866	1833	7.31	7.21	T (12 NTU)	M
Waypoint 299	22.5	18.9	11.82	6.66	552	1118	8.62	7.65	T (21.8 NTU)	M
Waypoint 301	22	19.9	12.04	7.77	4751	4750	8.36	8.32	T (20.9 NTU)	T
Waypoint 302	23.6	19.5	13.03	5.44	2085	1862	8.14	7.93	T (12 NTU)	T
Range of Values	15.8	23.6	1.72	13.95	213.1	10143	7.03	8.62	M (10 NTU)	T (39 NTU)

Note: [1] Turbidity is a subjective measure of the concentration of suspended solids and particulate matter in the water. Turbidity is visually estimated. T= Turbid (muddy, brown water with visibility restricted to a few centimetres from the surface); M = moderately turbid (muddy water with increased visibility in shallow areas; general shapes on the bed surface can be discerned, but deeper areas are not visible) (RISC 1998b).

Water temperatures at all nine sampling locations were above 15°C. Resources Information Standards Committee (RISC) (1998b) considers a maximum daily temperature of 15°C to be the threshold to allow for prolonged survival of aquatic life. The BCWQG criterion for maximum daily temperature for freshwater aquatic life where fish distribution is unknown is 19°C (MoE, 2010). Six of the nine sampling locations had water temperatures, on one or both days, greater than 19°C (**Table 5.2-1**).

Specific conductivity is an indicator of the ability of water to conduct an electrical current by measuring the ion concentration in the water (RISC, 1998b). Ion presence in water is also an indication of the concentration of dissolved solids and other particulates. Therefore, a high specific conductivity reading can be an indication of high levels of dissolved solids such as chloride, nitrate, sulphate, and phosphate.

RISC (1998) describes natural waters in BC as typically varying between 50 and 1500 µS/cm, with coastal streams generally having conductivity values of approximately 100 µS/cm. Specific conductivity for the DTTRIP study area ranged between 213.1 µS/cm[c] and 1.0×10^4 µS/cm[c]. This value range suggests a high concentration of dissolved solids, potentially indicating that the watercourses within the study area are receiving waters from runoff containing these contaminants from adjacent farm fields and transportation corridors.

Turbidity at all nine locations was visually estimated as either turbid or moderately turbid. Turbidity is a subjective measure of the concentration of suspended solids and particulate matter in the water (RISC, 1998b). Turbid water is described by RISC (2008) as muddy, brown water with visibility restricted to a few centimetres from the surface). Moderately turbid water is described as muddy water with increased visibility in shallow areas, and where general shapes on the bed surface can be discerned, but deeper areas are not visible.

Turbidity may be caused by such factors as soil erosion, waste discharge, urban runoff, algal growth, and physical disturbance of bottom sediments. Turbid water is less able to support a diversity of aquatic organisms as the suspended particles block sunlight from reaching the lower water column, inhibiting photosynthesis and therefore depleting oxygen levels which many forms of aquatic life rely on for survival.

Dissolved oxygen concentrations ranged from 1.72 to 13.95 mg/L. Four mg/L is considered the minimum limit to avoid acute mortality in aquatic invertebrates and eight mg/L is the minimum concentration to avoid production impairment (RISC, 1998b). BCWQG note that five mg/L is the instantaneous minimum concentration needed for all aquatic life stages except for buried embryo/alevin salmonids. Eight out of nine sampling locations had values below eight mg/L (except sampling location number 295; see **Table 5.2-1** and **Figure 5.2-1**). Three out of nine sampling locations had values below five mg/L. These low dissolved oxygen values are consistent with high temperature measurements and turbid water observation in the ditch.

Aquatic life guidelines for pH in BC are for a range between six and nine (MoE, 2010). In the study area, pH ranged from 7.08 to 8.62, which is within the acceptable range for aquatic life.

The results from the July 2011 field visit showed the surface water in the watercourses between 41B Street and Highway 17 to be of poor quality for salmonids and other aquatic life based on BCWQG and RISC exceedences in water temperature, turbidity, specific conductivity, and dissolved oxygen values. These results are consistent with results from the previous studies conducted within the DTRRIP study area.

5.2.4.2 Groundwater

The South Fraser River Delta Aquifer is a shallow aquifer located underneath the study area (Hemmera, 2006). The aquifer is unconfined and comprised of sand and gravel deposits of the Fraser River Delta (Madrone, 2009).

The soils in the study area are of Delta and Spetifore soil associations as identified in Luttmerding (1980). Both soil types are poorly drained and have low coarse fragment content. Delta and Spetifore soils are derived from deltaic deposits and are saline at or near the surface (Madrone, 2009). The water table is assumed to be high in the wetter months and during periods of heavy precipitation given the types of soil found in the study area. Water ponding has been observed within and near the study area on agricultural fields which suggests the presence of a high saline water table.

There are no registered water wells in the study area; however, a group of wells (five) is located approximately two kilometres to the southeast. Estimates from these well logs, and field observations from the 41B Street Project (Madrone, 2009), suggest the aquifer is generally between zero and two metres below ground surface. The shallow depth and unconfined nature of the aquifer classify the aquifer as highly vulnerable to contamination. iMap BC (2011) shows this aquifer to be a low demand, high vulnerability aquifer with moderate productivity. See **Figure 5.2-2** for the aerial extent of the aquifer.

All properties are serviced by municipal water for domestic and agricultural use (Hemmera, 2006). Water withdrawn from the aquifer is not used for drinking water and the demand for water is low (Madrone, 2009). Groundwater in the area may be used for agricultural purposes such as irrigation (Hemmera, 2006).

5.2.5 Potential Effects and Proposed Mitigation

This section identifies and analyses potential effects associated with the Project. The analysis of potential effects compares the existing conditions, described above, to the type and scale of Project activities and potential for changes in water resources in relation to the construction and operation of the Project.

5.2.5.1 Construction

Potential effects on water resources from the Project during construction include:

- Alteration to surface water flow
- Effects to surface water quality
- Effects to groundwater

Each potential effect and proposed mitigation measures are discussed below.

Alteration of Surface Water Flows

Changes in surface water flow can result from upgrades of existing culverts, construction of new crossings, and realignment/relocation of ditches in the study area. Based on preliminary design, instream work is limited to existing culvert replacements (extension or replacement), and ditch realignment (or relocation), to accommodate additional rail track within the Option Lands and the existing railway right-of-way.

Maintaining existing drainage during Project construction will mitigate and avoid effects to existing drainage flow in the study area, as well as indirect effects to local farmers (**Section 6.5**). Implementation of sediment and erosion control measures will also avoid potential changes in surface water flows that can lead to sedimentation and surface water quality degradation of ditches and adjacent land within the study area.

During detailed design, locations of upgraded culvert crossings, new culvert crossings locations, and the requirement for ditch realignment/relocation will be confirmed. Culverts will be designed to sizes and in accordance with standards required to carry flows of agricultural drainage, and meet the requirements of the BC *Railway Safety Act* and other applicable regulations and standards.

The realignment/relocation of any of the irrigation ditches in the study area to accommodate the Project will require detailed hydraulic assessments; water quality monitoring at both upstream and downstream locations; and close coordination with the local farmers and the Corporation of Delta. (i.e., the Delta Irrigation Enhancement Project) (**Section 6.5**).

Notification or Approval under Part 7 of the BC *Water Act* will be submitted following detailed design for any instream works.

The implementation of measures such as maintenance of existing drainage, sediment and erosion control practices, pre-construction hydraulic assessments, water quality monitoring and coordination of farm activities are expected to mitigate for any potential effects to surface water flow.

No residual adverse effects are expected once mitigation measures are implemented.

Effects on Surface Water Quality

Effects on surface water quality could result from sedimentation and erosion, or spills and leaks of deleterious materials used by construction equipment and vehicles.

Surface erosion is a naturally occurring process that is a function of slope angle, soil texture, vegetation and precipitation. Vegetation on slopes serves to stabilise soil and banks. Removal of vegetation cover will increase surface erosion. Effects on surface erosion will be localised to areas that are disrupted during construction.

Erosion and the consequent introduction of sediment into the surface water adjacent to the Project footprint may occur as a result of the following activities:

- Site preparation and clearing activities.
- Site preloading.
- Demolition of existing farmer's overpass at 46A Street.
- Construction of a truck turn around within the footprint of the overpass at 41B Street.
- Rail track construction within the Option Lands and existing railway right-of-way.

During construction, appropriate management practices and mitigation measures will be applied to avoid potential effects on surface water quality associated with construction, including:

- Following standard best management practices for erosion and sediment control, such as those outlined in the *Land Development Guidelines for the Protection of Aquatic Habitat* (DFO, 1992).
- Installation of sediment barriers on the banks of watercourses to avoid the introduction of sediment or other deleterious material to the watercourses.
- Locating soil and preload stockpiles away from watercourses and minimising the amount of exposed soil onsite.
- Conducting any instream works "in-the-dry" if possible.
- Revegetating and stabilising watercourse banks as soon as possible following the completion of any instream works.
- Conducting water quality monitoring at discharge sites (locations to be determined once detailed design is complete) and upstream to ensure that sediment control procedures are effective during construction.
- Developing a detailed erosion and sediment control plan as part of the construction EMP prior to construction, based on the final design and contractor plans.
- Monitoring the above measures during construction, with further site-specific mitigation undertaken where required.

Other potential negative effects on surface water quality that can occur during construction include:

- Accidental spills and leaks of fuel, oil, gasoline, or other deleterious materials from construction equipment and vehicles.
- Spills and leaks of deleterious material from on-site storage areas.
- Introduction of debris into the watercourses from the decommissioning of the existing farmer's overpass at 46A Street.

During construction, appropriate management practices will be applied to avoid potential effects as a result of spills and leaks, and debris introduction associated with construction, including:

- Developing and implementing a Spill Prevention Plan for the work site.
- Ensuring that all workers on site are properly trained in spill response and best management practices for handling and storage of hydrocarbons and other chemicals.
- Maintaining construction vehicles and equipment to minimise the incidence of leaks.
- Storing hydrocarbons and other chemicals securely and at a minimum 30 metres distance from any watercourse.
- Locating fuel storage areas (if required) on flat ground and dyking (with impermeable materials or lined) or otherwise containing fuel storage areas within an area width at least 125 percent of the total capacity of the storage containers (would be in the construction staging area). Storage containers should be locked.
- Ensuring spill kits are on site and equipment operators are trained in spill clean up and response procedures.
- Cleaning up any spills immediately.
- Reporting reportable spills to the BC Provincial Emergency Program (PEP) 1-800-663-3456 in accordance with the *Environmental Management Act*, Spill Reporting Regulation.

Implementation of the measures outlined above is expected to mitigate for any effects to surface water quality. No residual adverse effects are expected after implementing mitigation measures.

Effects on Groundwater

Effects on groundwater quality can result from accidental spills of deleterious substances. The mitigation discussed above for spills is intended to protect groundwater quality from potential effects as a result accidental spills. No residual adverse effects on groundwater quality are anticipated if the mitigation measures outlined above are implemented.

Accidents and malfunctions are discussed in detail in **Section 7.0**.

Operations

As DTRRIP is an improvement to existing infrastructure, it is anticipated that the operational phase will have minimal effects on surface water and groundwater in the study area.

Potential effects include spills and leaks during mobile fuelling and maintenance activities such as rail car maintenance track repair along the length of the Project area, and emergency and access road maintenance. Hydrocarbon leaks (oil, fuel, gasoline, lubricant) can be introduced via surface water run-off to watercourses (ditches) and groundwater from truck traffic and rail cars. Surface water runoff can introduce sediment and elevated concentrations of metals and organic compounds into the watercourses adjacent to the footprint.

Mitigation measures described above in **Section 5.2.5.1** will minimise the potential for effects as a result of spills and leaks. In addition, TSI, the terminal operator, and the rail operators have existing environmental management plans in place to ensure the operation of their respective infrastructure is carried out in accordance appropriate environmental regulations and guidelines. No residual effects from operation activities are expected on groundwater or surface water if mitigation measures are implemented.

5.2.6 Residual Effects and Determination of Significance

Effects on water resources are not expected to extend beyond the Project footprint and will not last beyond construction. If the mitigation measures outlined in **Section 5.2.5.1** are implemented, including a sampling program for surface water quality monitoring during construction, it is anticipated that effects on surface water and groundwater resources as a result of construction and operation can fully mitigated. No residual adverse effects are expected following implementation of the proposed mitigation measures.

5.3 FISH AND FISH HABITAT

5.3.1 Introduction

This section discusses the findings of the fish and fish habitat assessment for the Project. The objectives of the assessment were to:

- Describe fish and fish habitat along the DTRRIP study area through desktop study and literature review, and field surveys.
- Document the occurrence of fish species and habitat within the study area through sampling and observations made during the field surveys.
- Assess the potential occurrence of at-risk and resident fish species that could be affected by the Project.
- Present mitigation measures to avoid, minimise or reduce effects that can occur as a result of the Project.
- Describe potential residual effects as a result of the Project.
- Recommend compensation measures to address any identified residual effects.

The scope of the assessment includes all fish and fish habitat components of the study area.

5.3.2 Study Area

The study area is shown in **Figure 5.2-1.** The study area for fish and fish habitat is: a 200 metres corridor centred on the existing rail right-of-way from the base of the existing Roberts Bank causeway to 72nd Street.

5.3.3 Methodology

A review of historical data sources and the federal and provincial species at-risk databases listed in **Section 5.3.3.1** was conducted to help focus field studies on geographic areas deemed to require additional study.

5.3.3.1 Review of Data Sources

Existing fish and fish habitat information was sourced from:

- Technical Volume 9: South Fraser Perimeter Road Fish Habitat Impact Assessment (Coast River Environmental Services Ltd., 2006).
- South Fraser Perimeter Road Environmental Assessment Screening Report Prepared for the Ministry of Transportation and Infrastructure (Hemmera, 2006).
- 41B Street Overpass at Deltaport Way Environmental Assessment Screening Report (Hemmera, 2009a).
- Delta Watersheds: Fish and Amphibian Distributions Map (Corporation of Delta, 2001).
- Delta Fish and Amphibians Study: 2000-2003 Sample Site Locations Map (Corporation of Delta, 2002).
- Delta Timing Schedules for Instream Works Map (Corporation of Delta, 2003).
- Fisheries Information Summary System (Ministry of Environment).
- iMap BC (Ministry of Forests, Lands and Natural Resources Operations).
- BC Species and Ecosystem Explorer (BC Conservation Data Centre).
- Species at Risk Public Registry (Government of Canada).

A review of the background information for the study area showed that fish and fish habitat was limited to existing ditch systems that receive runoff from agricultural and industrial practices in the study area. Within the study area, no at-risk fish and/or salmonids were found during previous studies.

The background review noted a gap in fish habitat information between 41B Street and Highway 17, and a field assessment was undertaken to obtain necessary data.

5.3.3.2 Field Surveys

Based on the review of data sources and given that land use in the area has not functionally changed since previous studies fish sampling was conducted between 41B Street and Highway 17. Fish diversity for the remaining portions of the study area has been well-characterised for previous projects in the region. Information on fish diversity and fish habitat was collected from 41B Street to the base of the existing Roberts Bank causeway in 2009 (Hemmera, 2009a), and collected from east of Highway 17 to 72nd Street between 2003 and 2006 (Coast River, 2006). Fish sampling locations are shown on **Figure 5.2-1.**

Fish sampling was conducted over two days in July 2011. Standards and procedures for fish and fish habitat sampling include:

- Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Site Card Field Guide - Version 2.0 (RISC, 2008).
- Reconnaissance (1:20,000) Fish and Fish Habitat Inventory Standards and Procedures. April 2001. V.2. (RISC, 2001).
- Fish Collection Methods and Standards. Prepared by Ministry of Environment, Lands and Parks. (RISC, 1997).

One watercourse exists within the footprint in this portion of the study area, an agricultural ditch located parallel to the existing rail right-of-way access road on the south side of the existing rail tracks (**Figure 5.2-1**). The channel of the ditch was discontinuous along this stretch at the time of the site visit and interspersed with grass swales. This ditch was set back approximately five metres from the access road.

A team of two biologists and one field technician conducted a preliminary walk-through alongside the ditch to determine the feasibility of setting one minnow trap every 200 metres to cover the approximately four-kilometre ditch length. Setting a trap every 200 metres was determined not feasible since many locations along the ditch were dry at the time of the field visit. Given this, the team set minnow traps where sufficient water and suitable fish habitat was present (**Figure 5.2-1**). A total of nine minnow traps were set for a 24-hour period between July 20 and 21.

5.3.4 Existing Conditions

The following sections present the findings of the fish and fish habitat assessment. Fish sampling locations are shown on **Figure 5.2-1**.

5.3.4.1 Watercourse Classification

The Corporation of Delta, in consultation with DFO and the BC MoE, have defined three categories of watercourses in Delta, based on expected fish and amphibian presence and the associated timing windows for instream works:

- **Schedule A:** Watercourses that have confirmed salmonid presence. Instream works are only allowed between August 1 and September 30.
- **Schedule B:** Watercourses are designated as "sensitive," with resident fish and amphibian species expected to be present (instream works are allowable only between August 15 and February 28).
- **Schedule C:** Watercourses are designated as "standard," with resident fish and amphibian species present (instream works are allowable between August 15 and April 30).

All watercourses (municipally owned and privately owned water courses, **Figure 5.2-1**) within the footprint have been classified by the Corporation of Delta as Schedule "C" watercourses (CoD, 2001).

5.3.4.2 Water Connectivity

Cohilukthan Slough, the only Schedule "A" watercourse, is located outside of the LSA approximately 300 metres to the north of the Project footprint (**Figure 5.2-1**). Cohilukthan Slough flows south and west (CoD, 2003). Two Schedule 'C' watercourses (ditches) bisecting the study area from south to north have culverted water connection to Cohilukthan Slough (CoD, 2003). Both watercourses flow north and are located at Arthur Drive and 46A Street. CoD (2003) shows that salmonids have been documented in Cohilukthan Slough, but salmonid access to the DTRRIP study area is impeded by a physical (flap gate and/or pump) or water quality barrier at two locations north of the study area: 1) Mason Canal (800 metres north), and 2) Monastery Ditch (1,800 metres north) (**Figure 5.2-1**). There is very low potential for salmonids to access watercourses in the study area because of these impediments to passage; however, if access were improved along Cohilukthan Slough, there is potential for the slough and connecting ditches to be used as salmonid rearing and overwintering habitat, early spring rearing habitat but not spawning habitat (J. Roberts 2011 pers. comm, Oct 5; LGL Limited *et al.,* 2009). Agricultural and urban land uses pose pre-existing effects to fish and fish habitat in the study area and Cohilukthan Slough resulting in low quality habitat for salmonids even if accessibility were not an issue. Such effects include water withdrawal, loss of riparian vegetation, dyking and water quality impairments (LGL Limited *et al.,* 2009).

5.3.4.3 Fish Habitat

The watercourses in the study area range in width from one half to two metres. The depth of the watercourses (ditches and swales) ranges from dry (zero centimetres) to approximately 1.5 metres deep. Ditch substrate observed during the July 2011 site visit was mostly void of aquatic vegetation and composed mainly of fine organic material. Cattails and *Juncus* sp. were documented in ephemeral (occasional or seasonal water presence) watercourses. Watercourses in the study area are channelised ditches lacking pools or riffles.

Water quality within the ditch between 41B Street and Highway 17 was poor at the time of the site visit, with high temperatures (15.8°C to 23.6°C), ranging from moderately turbid to turbid[12] (see **Table 5.2-1**). The stream gradient was flat. Riparian vegetation varied from zero to two metres in width on both banks of the ditch. Vegetation was predominantly composed of Himalayan blackberry, reed canary grass, other grasses, common tansy, fireweed or other disturbance tolerant vegetation.

Water quality was not measured in watercourses along the remainder of the study area, from the overpass to 41B Street and Highway 17 to 72nd Street, during the 2011 field visit; however, these watercourses were assessed as having similar riparian and morphological characteristics to the ditch between 41B Street and Highway 17 (Hemmera 2009; Hemmera 2006; Coast River 2006). Surrounding land use practices (agricultural and urban) were similar.

Coast River (2006) and Hemmera (2009) noted poor surface water quality and lack of instream vegetation in study area ditches and concluded there was little to no potential for spawning habitat suitable for salmonids. Observations on anadramous fish passability, surface water quality, and ditch conditions in study area watercourses during the 2011 field visit were consistent with previous fish assessments completed for the previous studies (Coast River, 2006 and Hemmera, 2009a).

5.3.4.4 Fish Presence

Eight resident fish species have been documented within the DTRRIP study area (FISS, 2011; CoD, 2002; **Table 5.3-1**). Of these species, threespine stickleback (*Gasterosteus aculeatus*), brassy minnow (*Hybognathus hankinsoni*), peamouth chub (*Mylocheilus caurinus*), and redside shiner (*Richardsonius balteatus*) were captured during 2011 field studies. Previous fish assessments conducted from the base of the existing Roberts Bank causeway and 41B Street (Hemmera, 2009a), and Highway 17 to 72nd Street (Hemmera, 2006) documented only resident species.

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[12] Turbidity is a measure of suspended sediments in water. Estimates can be made visually, but are subjective. Turbidity, per RISC (2001), is defined as: turbid (T) - muddy, brown water with visibility restricted to a few centimetres; moderately turbid (M) - `muddy,' water with increased visibility in shallow areas; general shapes on bed surface can be discerned, but deeper areas are not visible; lightly turbid (L) - features can be distinguish in shallow areas, and limited visibility in slightly deeper pools (~>1.5 metres); and clear water (C) - excellent visibility except in very deep areas.

Table 5.3-1 Fish Species with Documented Occurrence in the DTRRIP Study Area

English Name	Latin Name
black crappie	*Pomoxis nigromaculatus*
brassy minnow	*Hybognathus hankinsoni*
peamouth chub	*Mylocheilus caurinus*
carp	*Cyprinus carpio*
brown catfish	*Ameiurus nebulosus*
threespine stickleback	*Gasterosteus aculeatus*
redside shiner	*Richardsonius balteatus*
prickly sculpin	*Cottus asper*

Source: CoD, 2002; FISS 2011

5.3.4.5 Species at-Risk

Four fish species at-risk are known to occur within the region according to a search of the BC CDC, but are considered unlikely to be present within the study area given the existing fish habitat conditions. The four species with potential to occur within the study area are: green sturgeon (*Acipenser medirostris*), white sturgeon (Lower Fraser River population) (*Acpenser transmontanus pop. 4*), coastal cutthroat trout (*Onorynchus clarkii clarkii*), and Dolly Varden (*Salvelinus malma*).

Green sturgeon inhabits coastal marine waters, estuaries and the low reaches of large rivers for the majority of their life (CDC, 2011). Spawning and rearing habitats are not well known, but this species has been found in rivers during spawning. The potential occurrence of green sturgeon within the DTRRIP study area was considered to be low because of the lack of anadramous fish access and poor quality rearing habitat present.

White sturgeon (Lower Fraser River population) is only known to be found in the Lower Fraser River below Hell's Gate, BC (CDC, 2011). This population of white sturgeon is not expected within the DTRRIP study area and were assessed as having a low potential for occurrence, for similar reasons to that of green sturgeon (i.e., access and habitat criteria).

Coastal cutthroat trout spawn in streams on clean, small gravel substrates (CDC, 2011). This species is often found in estuarine habitats, remaining close to the coast. The potential for occurrence of coastal cutthoat trout is low because of the lack of anadramous fish access to ditches within the study area and poor quality habitat present.

Dolly Varden is an anadramous fish species that are often found in deep runs and creek pools in small to large rivers (CDC, 2011). The potential for occurrence of Dolly Varden is low because of the lack of anadramous fish access to ditches within the study area and unsuitable habitat.

No fish species at-risk were found during the July 2011 field visits. Only resident fish species were documented during the sampling event.

5.3.5 Potential Effects and Proposed Mitigation

This section identifies and analyses potential effects associated with the Project. The analysis of potential effects compares the existing conditions, described above, to the type and scale of Project activities and potential for changes in fish and fish habitat in relation to the construction and operation of the Project.

5.3.6 Construction

Potential effects on fish and fish habitat from Project construction include:

- Surface water quality effects on fish
- Loss/disturbance of fish habitat
- Accidental mortalities.

5.3.6.1 Surface Water Quality Effects on Fish

Changes to surface water quality can effect fish and fish habitat. Sedimentation from preload or aggregate material into the existing ditches and swales can occur during preload activities, as well as during overpass removal at 46A Street, and rail track construction. Sedimentation reduces the quality of fish habitat and has a negative effect on fish recruitment. Sedimentation can be mitigated through the application of best management practices for erosion and sediment control prior to and during construction.

Introduction of deleterious materials, such as oil, lubricants, or gasoline, resulting from accidental spills into a watercourse can have a negative effect on water quality and fish habitat. The introduction of deleterious materials can lead to fish mortality. To avoid effects, construction vehicles and equipment should be well-maintained. Fuelling stations and deleterious material storage should be set back a minimum of 30 metres from a watercourse, and other best management practices for spill prevention and management followed.

Based on the construction activities, the mitigation discussed in **Sections 5.2.5** is intended to protect fish from potential water quality effects as a result of sedimentation or accidental spills.

5.3.6.2 Loss/Disturbance of Fish Habitat

No watercourses within the footprint are considered suitable salmonid or at-risk species habitat. No salmonid or at-risk species spawning or rearing habitat was identified during previous studies, nor during the 2011 field visit. High water temperature, lack of suitable substrate, turbid water, and existing impediments to salmonid passage on Cohilukthan Slough support the conclusion that there is a low likelihood for salmonid or at-risk species presence in the study area.

Resident fish species will be directly affected by habitat loss. Direct loss of resident fish habitat can occur from site preparation and clearing activities, such as vegetation clearing, and realignment or relocation of existing watercourses and water features that overlap with the Project footprint.

New ditches are proposed to be designed and constructed parallel to the Project footprint for water run-off during operations. These new ditches will replace the existing ditches and swales that will be in-filled during construction. The new ditches will provide equivalent or improved habitat for displaced resident fish. Details on the location of these ditches will be provided during the detailed design phase.

During the detailed design phase, locations of upgraded culvert crossings, new culvert crossings locations, and the requirement for ditch realignment or relocation will be confirmed. Notification or Approval under Part 7 of the BC *Water Act* will be submitted following detailed design for any instream works.

5.3.6.3 Accidental Mortalities

The potential exists for accidental mortalities from instream works during construction. In addition to the mitigation noted above, flows will be maintained on any flowing watercourses during instream works (via pumping around the isolated work area or a similar method) and fish salvage will be conducted where fish may be present. Given existing fish habitat conditions and fish presence, a low level of effect on fish and fish habitat is expected to occur from the Project. There is little to no opportunity for salmonid access to the watercourses that will be affected by the Project. These ditches and swales are considered low quality habitat for fish and are currently affected by agricultural and urban land use practices. Ditches and swales that will be lost during construction will be replaced with similar drainage features (via relocation/realignment) that will support resident fish.

The following is a summary of mitigation measures that will be implemented for Project construction to avoid effects to fish and fish habitat:

- Avoid, where possible, instream works between May 1 and August 15 as per Schedule ‘C’ Corporation of Delta timing window (CoD, 2003).
- Minimise the extent of disturbance to aquatic and riparian areas. Ensure that work proceeds rapidly to minimise disruption to fish habitat.
- Install silt and/or exclusion fencing in key areas to prevent additional riparian effects beyond the permitted area.
- Follow standard best management practices for erosion and sediment control, such as those outlined in the *Land Development Guidelines for the Protection of Aquatic Habitat* (DFO, 1992).
- Install sediment barriers on the banks of watercourses to avoid the introduction of sediment or other deleterious material to the watercourses.

- For instream works, isolate the work site from flow and conduct fish/amphibian salvage, dewater the site and conduct instream works “in-the-dry” where possible. A BC *Wildlife Act* permit will be acquired prior to fish/amphibian salvage.
- Conduct environmental monitoring, with a focus on works that have the potential to affect fish/wildlife habitats and water quality.
- Construct drainage ditches adjacent to the new rail line for the purpose of receiving excess water and run-off during wetter periods. Newly constructed ditches can act as resident fish habitat and be considered compensation for ditch loss during construction.
- Plant native vegetation to replace the riparian vegetation that is to be cleared during construction to promote fish presence.

As part of the construction EMP, environmental monitoring will be conducted and will include monitoring replacement of culvert crossings, new culvert crossing installation, and any ditch realignment. This will include monitoring turbidity levels in watercourses (ditches) and in any discharges to watercourses (ditches) and implementation of mitigation for spill prevention (including fish salvage if required). No monitoring during the operation phase is proposed.

Effects to fish and fish habitat during construction of the Project are expected to be low. With the implementation of the mitigation measures noted above, no residual adverse effects on fish habitat are anticipated.

5.3.6.4 Operations

After construction activities are completed, riparian and ditch vegetation clearing during routine and on-going maintenance activities may affect fish habitat through water quality and habitat degradation. To minimise effects to fish, these activities will be limited to the Schedule “C” instream work window between August 16 and April 30 and standard best management practices for instream works followed.

Effects to fish and fish habitat during the operation of the Project are expected to be low. With the implementation of the mitigation measures noted above, no residual adverse effects on fish habitat area anticipated.

5.3.7 Residual Effects and Determination of Significance

Watercourses in the study area are channelised agricultural ditches, many of which are ephemeral in nature. Water quality is poor, with high temperatures and turbidity, and riparian vegetation is composed mainly of invasive plant species. Watercourse substrate is predominantly composed of fines and does not provide potential spawning habitat. Fish habitat values are Schedule “C” watercourses throughout the study area.

The potential effects of construction activities on fish and fish habitat are anticipated to be infrequent, reversible and localised within the study area. Any potential effects that may occur during operation are anticipated to be infrequent and limited to the duration of the maintenance activity. With the implementation of mitigation measures, including best management practices, there is a low likelihood that Project activities will result in additional effects to fish and fish habitat. No residual adverse environmental effects are expected for fish and fish habitat from DTRRIP.

5.4 MARINE ENVIRONMENT

5.4.1 Introduction

This section describes the existing marine environment, as well as an assessment of the potential Project effects on the marine environment with a focus on ecosystem components that have been identified as present or potentially present in the study area and vicinity.

Since construction does not require any marine works, only activities associated with the operations phase of the Project will be considered in this assessment, specifically potential effects of increased shipping activity on marine vegetation, invertebrates, marine and anadromous fish, coastal birds, and marine mammals.

5.4.2 Study Area

The study area, unless otherwise specified, includes a five-kilometre radius around existing Port facilities. This area encompasses Fraser River influence (including Canoe Pass), the container ship approach from the southwest, and the BC Ferry Terminal causeway in the southeast (**Figure 5.4-1**). A larger regional study area will be used to assess cumulative effects (**Section 8.0**).

5.4.3 Existing Conditions

Existing information from previous work conducted in the study area was used to determine baseline conditions of marine species and habitats. In addition to peer-reviewed and government reports, baseline information was sourced from the following reports:

- Technical Volume 5: Deltaport Third Berth Project Marine Resources Impact Assessment (Triton, 2004).
- Stantec Marine Mammal Monitoring Reports 2007-2009.
- Deltaport Third Berth Adaptive Management Strategy Annual Report, 2007 (Hemmera, 2008).
- Deltaport Third Berth Adaptive Management Strategy Annual Report 2008 (Hemmera, 2009b).
- Deltaport Third Berth Adaptive Management Strategy Annual Report 2009 (Hemmera, 2010).

5.4.3.1 Background

The proposed Project is located along Roberts Bank within the Fraser River Estuary - the fifth largest river basin in Canada and largest estuary on the Pacific coast. Large rivers can have substantial effects on coastal areas, primarily through the formation of large, nutrient-rich plumes, and can have strong seasonal influences on the abundance and distribution of marine species.

Roberts Bank contains a diverse array of marine habitats, including ecologically important eelgrass beds and intertidal marshes, which sustain numerous species of invertebrates and fishes throughout various stages of their life cycle. Several groups of marine mammals are known to frequent the Strait of Georgia and Roberts Bank area, including pinnipeds (seals and sea lions), odontocetes (toothed whales, dolphins and porpoises), and mysticetes (baleen whales). Additionally, large mats of biofilm growing on the area's mudflats sustain significant communities of migratory birds on the Pacific Flyway, notably the Western sandpiper and Pacific dunlin. Due to its role in supporting millions of resident, migrating and/or wintering birds annually, the Fraser River Estuary (encompassing Roberts Bank, Sturgeon Bank, and Boundary Bay) has been designated an Important Bird Area (IBA) by Birdlife International.

Prior studies at Roberts Bank have identified several species of conservation concern. The federal SARA provides for the legal protection of wildlife species and is intended to prevent them from becoming extinct and secure the necessary actions for their recovery. Several marine species listed under SARA occur in the Roberts Bank area, most notably the "Endangered" population of southern resident killer whales (SRKW). The Province of British Columbia currently does not have a legislated Act for the protection of species at-risk, but does maintain a list of at-risk species, which are protected through BC *Wildlife Act* and BC *Forest Range Practices Act*; species are assigned to either a red (extirpated, endangered, or threatened), blue (special concern) or yellow (not at-risk) list. Both southern resident and transient killer whales are on the Provincial red list.

5.4.3.2 Marine Vegetation

Eelgrass, native *Zostera marina* and introduced *Zostera japonica*, form extensive meadows in soft sediments in the lower intertidal and shallow sub-tidal, which are considered vital to local and Georgia Basin ecological productivity. Eelgrass beds perform several ecosystem functions, including providing residence, foraging, breeding, and nursery habitats for many marine invertebrates, fishes, and seabirds. These architecturally important systems also stabilise sediments and contribute to nutrient cycling in both direct and indirect ways (Dunster, 2003; Fargo *et al.,* 2007).

The lower limit of *Z. marina* growth is often determined by light availability while exposure (desiccation) at low tide limits its growth at higher elevations. *Z. japonica* is typically a much smaller plant and its short, narrow leaves enable the species to survive in intertidal areas where *Z. marina* cannot. In the study area *Z. marina* occurs between -0.5 and +2.0 metres chart datum[13] (CD) while *Z. japonica* is common above +2.0 metres (CD) (Triton, 2004). Like *Z. marina*, the upper limit of *Z. japonica* is controlled by desiccation; however, the lower limit is controlled by the density of *Z. marina*.

Eelgrass is locally abundant in the study area, with *Z. marina's* distribution extending from the BC Ferries causeway to approximately 2.5 kilometres northwest of the Roberts Bank causeway and *Z. japonica's* distribution extending from the BC Ferries causeway to Canoe Pass (Triton, 2004). It has been reported that eelgrass beds are likely diminishing in BC, though the beds at Roberts Bank have not followed this trend. Overall, eelgrass populations along Roberts Bank have expanded in response to development (Hemmera, 2004), though there has been some subsequent reduction due to dendritic channel and sand lobe formation (CBA, 2010).

The green filamentous alga *Ulva sp*. occupies the mid intertidal on both sides of the causeway, typically at higher elevation than *Z. marina*. *Ulva* tends to form bands and patches and the alga tops hummocks on the west side of the causeway (Triton, 2004). The distribution of *Ulva* appears to be partially limited by that of *Z. marina*, though there is overlap between the two species at lower elevations**.**

Biofilm is a thin yet dense layer (0.01 to 2.00 millimetres) of micro-algae and bacteria, organic detritus and sediment held in a mucilaginous matrix. Biofilms are common in all ecosystems, but large mats are produced at Roberts Bank due to the local conditions formed by the tidal currents and large amounts of nutrients flowing out of the Fraser River. Biofilm is ecologically very important, as it underpins mudflat food webs and acts to stabilise the sediment. Recent research has shown the biofilm at Roberts Bank to be an important energy source for shorebirds as they migrate between wintering and breeding grounds (Kuwae *et al.,* 2008, Beninger *et al.*, 2011, Kuwae *et al.*, 2012).

5.4.3.3 Marine Invertebrates

Over 200 species of invertebrates live in and around Roberts Bank, with polychaetes (marine worms) and amphipods (small shrimp-like crustaceans) among the most abundant taxa. Octopi, sea urchins, and sea cucumbers were estimated to be present in the study area in low numbers, though not enough to warrant further consideration in this assessment.

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[13] A chart datum is a reference point from which depths, drying heights and heights of tide are measured on a nautical chart. According to the World Geodetic System (WGS 84)It is generally defined to be that level below which tide rarely falls.

Dungeness crab (*Metacarcinus magister*, formerly *Cancer magister*) is the largest shallow water crustacean found in southern BC and is a prised recreational and commercial fishery. Both adult and juvenile crabs are common along Roberts Bank. Adults are typically found in deeper water, but move inshore into shallower water in the spring to mate and then return to deeper water in late summer or early winter (DFO, 2011a). Females are often buried in sand as the eggs develop; and concentrations of adult females were reported in the DP3 ship turning basin (sandy bottom habitat) during field studies for the DP3 EA (Triton, 2004). The eggs hatch in late winter and the larvae are planktonic (distributed by ocean currents) for up to four months (DFO, 2011a). From May to September, the larvae settle in nearshore nursery habitats, and are often associated with seagrass (e.g., eelgrass and Ulva) (DFO, 2009a). Juveniles were collected on both sides of the causeway during field surveys for the DP3 EA (Triton, 2004).

Orange seapens (*Ptilosarcus gurneyi*) are a type of soft coral mainly found in subtidal sandy bottom habitats to depths greater than 100 metres, and range from southern California to Alaska (Gotshall and Laurent, 1979). A continuous to densely distributed population of seapens covering approximately 15 ha exists in the sandy substrate southwest of the coal terminal at Roberts Bank, from 2.5 to 18 metres depth while a larger area (approximately 114 ha) with few to patchy distribution of sea pens surrounds the denser population and extends between 1.5 metres and 35 metres depth (Archipelago, 2009). A follow-up survey completed in 2011 also found sea pens with continuous to dense distribution (approximately 7.6 ha) to the east of the known sea pen bed, indicating that the extent of orange sea pens in the area is greater than previously documented (Archipelago, 2011).

Cockles (*Clinocardium sp*.) are an important traditional food source for First Nations and are found along Roberts Bank in the lower half of the intertidal in very soft shallow substrates such as mud (Lucas, 2007; Pellegrin *et al.,* 2007). They have shallow burrows and large adults are often left exposed.

5.4.3.4 Marine and Anadromous Fish

At least 72 fish species use the Roberts Bank area for all or part of their life cycle. Fish surveys conducted for the previous studies (Port Metro Vancouver, 2005) revealed the most common species recorded in subtidal and intertidal waters around Roberts Bank are: staghorn sculpins (*Leptocottus armatus*), followed by starry flounders (*Platichthys stellatus*), threespine sticklebacks (*Gasterosteus aculeatus*), chum salmon (*Oncorhynchus keta*), and shiner perch (*Cymatogaster aggregata*) (Triton, 2004).

Pacific salmon are widely distributed and of key socio-economic and cultural importance in BC. The group consists of five distinct species: pink (*Oncorhynchus gorbuscha*), chum (*Oncorhynchus keta*), sockeye (*Oncorhynchus nerka*), coho (*Oncorhynchus kisutch*), and Chinook (*Oncorhynchus tschawytscha*), all of which are anadromous (spawning in fresh water) and semelparous (dying immediately after spawning). The Fraser River is one of the most productive salmon rivers in the world, producing more salmon than any other river system in Canada.

Juvenile salmon leave their natal watersheds and rear in the nearshore environment, relying on nursery habitats (e.g., eelgrass) for foraging and protection from predators. Pink, chum, and chinook were the only juvenile salmonids reported in the area immediately adjacent to both sides of the Roberts Bank causeway in the last four years. Chinook juveniles were caught in the summer (June and July), whereas pink and chum abundance peaked in the winter and spring (Triton, 2004).

Pelagic, or “forage”, fish are those that spend most of their adult life near the surface or in the water column (Schweigert *et al.,* 2007). Forage fish have been described as "fuel for the food web" because they are the food that sustains larger predators higher up in the ocean food chain. Their schooling behaviour and superabundance make them ideal food sources for large populations of top predators fish such as large predatory fish (e.g., salmon), marine mammals and seabirds. They are typically small, short-lived species that are susceptible to environmental fluctuations, especially in terms of population size and structure. Surf smelt (*Hypomesus pretiosus*) are considered common in the area, and there were indications of a winter spawning population as two cohorts of surf smelt larvae were caught during surveys for DP3 in August and April respectively; however, attempts at finding spawning sites have been unsuccessful (Triton, 2004).

Lingcod (*Ophiodon elongatus*) populations in the Strait of Georgia have been severely depressed for several decades, with the existing population estimated between one-to-15 percent of historical abundance (Wallace, 2004). A commercial fishery closure was implemented in 1990 and, due to ongoing conservation concerns, a recreational fishery closure was applied in 2002 (Logan *et al.,* 2005). While there is some limited knowledge of an upward trend in the northern parts of the Strait of Georgia, there is no indication of a recovery in the southern statistical regions (Wallace 2004). Lingcod egg mass monitoring by DFO suggests that the spawning stock biomass has not significantly recovered since the commercial Strait of Georgia fishery was closed (Schwarz, 2011). Lingcod were observed in riprap habitat near the port facilities during two DP3 fish surveys (September and January); lingcod egg masses were also observed in the Study area, associated with riprap along the southern edge of the DP3 terminal and artificial reefs (Triton, 2004).

Starry flounder (*Platichthys stellatus*), English sole (*Parophrys vetulus*) and Dover sole (*Microstomus pacificus*) are species of bottom-dwelling flatfish that are abundant in the area. Starry flounder was the most commonly observed (Triton, 2004). Populations of flatfishes in the Strait of Georgia were once thought to be depleted due to overfishing, but recent trends have indicated a rapid increase, resulting in abundances comparable to historical unfished levels (Stewart, 2006).

Several rockfish species, such as copper (*Sebastes caurinus*) and yelloweye (*Sebastes ruberrimus*), were reported near the port facilities (Triton, 2004). Adults are opportunistic carnivores, with crustaceans (including juvenile Dungeness crabs), fish (herring, pile perch) and molluscs their main prey items (Casillas *et al.,* 1998); they have also been reported to consume lingcod spawn (Hart, 1973). In general,

inshore rockfish species are slow growing, late maturing, long-lived, and relatively stationary – life history characteristics that make them vulnerable to anthropogenic disturbances. A 2001 stock assessment of inshore rockfish populations documented low levels of abundance within the Strait of Georgia (Yamanaka and Lacko, 2001); a subsequent stock assessment has not been completed to date.

5.4.3.5 Coastal Birds

Roberts Bank and the coastal wetlands in the study area form an important ecosystem for migrant and wintering waterbirds, providing eelgrass, biofilm, mudflat, and intertidal marsh habitat in which to forage, rest/roost, and breed. The area is a major stopover on the migratory route known as the "Pacific Flyway" and is used by up to five million migratory birds, including a significant portion of the global population of Western sandpipers (*Calidris mauri*). Roberts Bank, and neighbouring Sturgeon Bank and Boundary Bay, together have been designated an "Important Bird Area" by BirdLife International.

Western sandpipers are the most abundant shorebird in the area: the entire world population of 3.6 million Western sandpipers migrate along the British Columbia coast and hundreds of thousands briefly stop in the Georgia Basin (there are one-day estimates of at least 500,000 individuals) (Environment Canada, 2004). The Fraser River delta is one of the six major links in the chain of migration stop-over/refuelling sites in western North America and is an important contributor to sustaining populations of this species (Environment Canada, 2004). Although Western Sandpipers do not presently have any special conservation status, Environment Canada census data show that declines have been occurring in both spring and fall migrants (Environment Canada, 2004). These declines have been significant for spring migrants and for the juvenile southbound fall migrants. Declines have also occurred among the fall migrating adult birds but they are not statistically significant. The Fraser River Estuary is also considered important migratory habitat for Pacific dunlin, and is estimated to annually support ten to 30 percent of the entire Pacific dunlin population each winter (approximately 250,000 birds).

Biofilm (**Section 5.4.3.2**) and the recently discovered phenomena of biofilm grazing by shorebirds has been documented in the vicinity of the existing marine infrastructure at Robert Bank (Kuwae, 2008; Mathot *et al.*, 2010). Biofilm grazing may be critical in ensuring these shorebirds possess sufficient energy stores to successfully reach their Arctic breeding grounds. Biofilm is thought to comprise up to 25 to 60 percent of western sandpiper and Pacific dunlin diets during northward migration (Kuwae *et al*., 2008; Kuwae *et al.*, 2012). The ultimate importance of biofilm habitat to shorebirds is not well understood and needs more study.

The great blue heron (*Ardea herodias ssp. fannini*) are year-round residents in the Roberts Bank area, though surveys conducted for the DP3 Adaptive Management Strategy (AMS) show the birds are most abundant during spring and summer (Hemmera, 2009b). Three breeding colonies occur adjacent to Boundary Bay (at Point Roberts, Nicomekl River and Serpentine River), representing six percent of the

total *A. fannini* population. The great blue heron is listed as "Special Concern" under Schedule 3 of SARA, and is on the provincial blue list, because coastal populations of the subspecies are in decline (Gebauer and Moul, 2001).

Brant geese (*Branta bernicla*) in British Columbia are part of a larger Pacific Flyway brant population, which is made up of several smaller stocks wintering along the Pacific coast from Alaska to Mexico (Sedinger *et al.,* 1994). In the Roberts Bank area, brant occur chiefly as spring migrants, although small numbers overwinter. This wintering population was drastically reduced, namely by hunting and habitat loss, but has increased from being virtually absent in the 1980s to a most recent estimate of almost 2000 birds (Environment Canada, 2005).

Brant feed preferentially on intertidal (or shallow subtidal) eelgrass (*Zostera spp*) from autumn through late spring, and Reed *et al.* (1998) stated that no other goose species relies so heavily on a single food plant. Distributions of brant and eelgrass are closely tied, and changes in the distribution or abundance of eelgrass have had dramatic effects on brant populations (Moore *et al.,* 2004).

5.4.3.6 Marine Mammals

Marine mammals are apex predators in the Southern Strait of Georgia marine ecosystem, with at least 10 species using the area during all or part of the year (**Table 5.4-1**). Peaks in marine mammal abundances appear to coincide with seasonal physical and biological factors in the Strait of Georgia and Fraser River Estuary system that may influence the availability of prey species (Keple, 2002).

Table 5.4-1 Marine Mammal Species Found in the Strait of Georgia and Roberts Bank Area and their Conservation Status

Common Name	Scientific Name	COSEWIC Status	SARA Status	BC Listing[1]
Southern resident killer whale	*Orcinus orca*	Endangered	Schedule 1	Red
Transient killer whale	*Orcinus orca*	Threatened	Schedule 1	Red
Grey whale	*Eschrichtius robustus*	Special Concern	Schedule 1	Blue
Humpback whale	*Megaptera novaeangliae*	Special Concern	Schedule 1	Blue
Steller sea lion	*Eumetopias jubatus*	Special Concern	Schedule 1	Blue
Harbour porpoise	*Phocoena phocoena*	Special Concern	Schedule 1	Blue
Dall's porpoise	*Phocoenoides dalli*	Not at Risk	Not Listed	Yellow
Pacific white-sided dolphin	*Lagenorhynchus obliquedens*	Not at Risk	Not Listed	Yellow
Harbour seal	*Phoca vitulina*	Not at Risk	Not Listed	Yellow
California sea lion	*Zalophus califonianus*	Not at Risk	Not Listed	Yellow
Minke whale	*Balaenoptera acutorostrata*	Not at Risk	Not Listed	Yellow

Notes: [1] Red: Extirpated, Endangered or Threatened
Blue: Special Concern
Yellow: Not at Risk (BC Conservation Data Centre 2010).
Adapted from Stantec, 2010.

Pinnipeds

Among the pinnipeds, harbour seals (*Phoca vitulina richardsi*) are the most abundant marine mammal and are found year-round in the Strait (Everitt *et al.,* 1980; Osborne *et al.,* 1988), unlike Steller and California sea lions that arrive in the fall and depart in spring (Calambokidis and Baird, 1994). Results from a three-year marine mammal monitoring program in the DP3 area, from 2007-2009, supports this observation, with harbour seals documented as the most abundant marine mammal in the Roberts Bank area (Stantec, 2010). The Pacific population is considered above historical levels and is considered not at-risk (Species at Risk Public Registry, 2010).

Cetaceans

Harbour porpoises (*Phocoena phocoena*) were reported as next most abundant species in the area (Stantec, 2010). The species is provincially blue listed and classified as a species of "Special Concern" under Schedule 1 of SARA. They are shy, usually seen alone or in small groups of two to five animals (Gaskin, 1992). Both harbour seals and harbour porpoises were more frequently observed during the summer months (Stantec, 2010).

Two distinct forms, or ecotypes, of killer whale (*Orcinus orca*) may be encountered within the study area: transient and resident. These forms overlap geographically but are socially isolated and differ in their dietary preferences, genetics, morphology, and behaviour (Ford *et al.,* 2000; Barrett-Lennard and Ellis, 2001). Transients feed on marine mammals and travel in small, acoustically quiet groups that rely on stealth to locate their prey (Ford and Ellis, 1999) while residents feed exclusively on fish and cephalopods and travel in acoustically active groups of ten-to–25 or more whales (Ford *et al.,* 2000).

SRKW hold notable cultural (public and First Nations) and economic (tourism) value and are well studied in the Southern Strait of Georgia. SRKWs are a provincially red-listed species and classified as "Endangered" under Schedule 1 of SARA, and thus subject to increased - and potentially stringent - regulation. They are presently considered to be at-risk because of their small population size (as of July 2011 the population totalled 88 individuals), low reproductive rate, and the existence of a variety of anthropogenic threats (e.g., environmental contaminants, physical and acoustic disturbance, reduction in availability and quality of prey) (DFO, 2008). During the DP3 marine mammal monitoring program, killer whales were encountered twice out of nine surveys (27 Sep 2007 and 22 Aug 2008) (Stantec, 2010).

Part of the SRKW population spends up to 12 months per year in the inland waters of British Columbia and Washington, although some members may travel as far north as the Queen Charlotte Islands and as far south as Monterrey Bay off the California coast (Ross *et al.,* 2000). During summer and fall, the SRKW are primarily found in the trans-boundary waters of Haro Strait, Boundary Pass, the eastern side of the Strait of Juan de Fuca, and the southern parts of the Strait of Georgia, including the Study area. Based on their consistent and prolonged seasonal use of the areas, in 2008 these waters were officially designated as "critical habitat" under the recovery strategy for the population (DFO, 2008).

The primary function of this critical habitat is feeding, as the occurrence of SRKW peaks in late summer to coincide with the Fraser River salmon runs (DFO, 2008). Resident killer whales demonstrate a strong preference for chinook salmon (*Oncorhynchus tshawytscha*), and its abundance is known to limit SRKW population dynamics (Ford *et al.,* 2009a). Over 70 percent of the estimated diet of resident killer whales is chinook salmon (Ford and Ellis, 2006; Ford *et al.,* 2009b).

Transient killer whales are year round inhabitants of the BC coast. They are a provincially red-listed species and classified as "Threatened" under Schedule 1 of SARA. Transients are long-lived upper trophic level predators that are considered to be at-risk because of small population size (approximately 250 individuals), low reproductive rate (one calf every five years), high levels of chemical contaminants, and various anthropogenic threats (e.g., physical and acoustic disturbance) (DFO, 2009b). There are significant gaps in our knowledge of transients: their population and social dynamics, as well as their year-round distribution and habitat requirements, remain poorly understood.

Humpback whales (*Megaptera novaeangliae*) migrate seasonally between high-latitude feeding areas in summer and low-latitude breeding and calving areas in winter; Canadian waters are used primarily for feeding. This species is provincially blue listed and classified as "Threatened" under Schedule 1 of SARA, though they were downgraded to "Special Concern" in a recent COSEWIC report (2011). Although the population is no longer considered "Threatened", it is not yet secure; major threats include vessel strikes, entanglement in fishing gear and acoustic disturbance (COSEWIC, 2011).

Based on photo-identification data, the best population estimate for humpbacks in the waters of British Columbia was estimated to be approximately 2,145 in 2006 (not including first-year calves) and the BC population is thought to be growing at a rate of about 4.1 percent annually (COSEWIC, 2011). While humpbacks are recovering and starting to re-occupy areas of their former range, they presently remain relatively uncommon in the Strait of Georgia and other inside waters in this region (COSEWIC, 2003). One humpback was sighted during DP3 marine mammal monitoring surveys (30 June 2008) (Stantec, 2010)

Grey whales (*Eschrichtius robustus*) are the most coastal of all great whales, and spend most of their life within tens of kilometres from the shore. This species is provincially blue listed and was classified as a species of "Special Concern" under Schedule 1 of SARA. The population was estimated at about 27,000 animals in 1998; however, over one-third of the population died from 1998 to 2002 (possibly due to a lack of food in Alaska). The extent of recovery is unknown, though indicators suggest that the decline has ceased and that the population has been stable or increasing since 2002 (COSEWIC, 2004).

Grey whales migrate each year from their winter calving grounds in Mexico to their summer feeding areas in northern Alaska, Russia and Canada. Most of the population passes along the BC coastline, and some individuals repeatedly spend the entire summer feeding in BC (about 80). Summer-resident grey whales

have been sighted in the inside waterways of British Columbia, primarily in Boundary Bay (Deecke, 1996), as well as occasionally in Haro and Georgia Straits (Calambokidis and Baird, 1994; Malcolm, 1999). No grey whales were observed during DP3 marine mammal monitoring surveys (Stantec, 2010).

5.4.4 Selection of Valued Ecosystem Components

Marine vegetation, invertebrates, fish, birds, and mammals listed as occurring or potentially occurring at the site or in the Project vicinity were selected as the appropriate VEC based on literature reviews.

5.4.5 Potential Effects and Proposed Mitigation

The scope of the effects assessment included the VECs listed above. As mentioned in **Section 5.4.1**, the construction of the Project requires no marine works, and therefore the construction phase of the Project will have no effect on the marine environment. Therefore, only activities associated with the operations phase of the Project will be considered in this assessment.

Vessel traffic is expected to modestly increase in the Strait of Georgia as a result of the Project. Currently 245 and 246 ships call at Deltaport and Westshore Terminals respectively on an annual basis and, as a result of the Project, this is projected to increase up to 260 and 350 vessel calls, respectively, by 2025; though it should be noted that 312 vessel calls at Deltaport will actually be reached by 2017 when the terminal is projected to reach capacity of 2.4 million TEUs. Vessel calls are projected to decrease to 260 by the year 2025 as a result of increase in vessel size (see **Section 2.7.2**). Additional vessel traffic has the potential to result in more noise in the marine environment, which can produce physiological, physical and behavioural effects in fishes, coastal birds and marine mammals. In addition to inducing the responses mentioned above, anthropogenic sounds might interfere with a marine mammal's ability to hear natural sounds of similar frequencies, a phenomenon termed "auditory masking"; masking may hinder an animal's ability to communicate, find mates, forage, detect predators and navigate. Increased vessel traffic also heightens the risk of vessel-marine mammal strikes, which may lead to physical injury and even death.

Ambient background noise levels in the marine environment are composed of the noise produced by natural physical processes (e.g., winds, waves, rainfall, seismic activity), biological activities (e.g., noise made by marine organisms such as whales) and human activities (e.g., shipping, industrial activities). The Strait of Georgia is a heavily used marine area with many human activities, including industry, fisheries, transportation, recreation and tourism, occurring in its waters. The main source of human-generated noise in the Strait of Georgia is from vessel traffic; commercial traffic and ferries are steady year-round, while cruise ships, fishing boats and pleasure traffic are subject to seasonal variances. A report by Veirs & Veirs (2005) provides recent ambient noise levels for key areas of the Strait of Georgia and concludes that background noise was dominated by ship noise, with background noise levels increasing by 20-25 decibels (dB) for 10-30 minutes as ships passed.

Increased shipping activity, associated with the operations phase of the Project, may have an effect on the marine environment. Potential effects and associated mitigation measures during operations pertain to:

- Increased frequency of ballast water release incidents (including potential introduction of contaminants and non-native species into the marine environment)
- Increase in underwater acoustic emissions
- Increased frequency of vessel wake
- Increased potential of vessel strikes.

Parameters used to measure potential environmental effects include:

- changes in behaviour
- changes in habitat quality/availability
- injuries to, or death of, marine organisms.

The potential for interaction between Project activities and marine environment VECs is presented in **Table 5.4-2**.

Table 5.4-2 Potential for Interaction between Project Activities and the Marine Environment

VEC	Potential Environmental Effect			
	Increased Frequency of Ballast Water Release	Increase in Acoustic Emissions	Increased Vessel Wake	Increased Vessel Strikes
Marine Vegetation	X		X	
Marine Invertebrates	X	X	X	
Marine and Anadromous Fish	X	X		
Coastal Birds		X		
Marine Mammals		X		X

5.4.5.1 Marine Vegetation

During operations, environmental effects to marine vegetation relate to ballast water release and vessel wake; and the measurable parameters used to assess potential effects are changes in habitat quality and changes in habitat availability.

Operations activities in the marine environment are not necessarily detrimental to marine vegetation communities and, in some cases, can improve habitat quality and/or availability. Eelgrass beds at Roberts Bank, for example, have co-existed (and even expanded) in the presence of industrial development over the last few decades. Studies have shown that the dense, continuous, inter-causeway *Z. marina* meadow

advanced rapidly shoreward following Port and Ferry Causeway development (Durance, 2004; Tarbotton and Harrison, 1996). In some areas it advanced over 100 metres during the six year period from 1975 to 1981. And, the eelgrass meadow south of the BC Ferries Causeway also advanced shoreward at an unusually fast rate during this time period (Precision Identification, 2005).

Further, because the existing Deltaport terminal is located in sub-tidal waters, Project related marine transportation will not alter present wave motion characteristics sufficiently to affect the distribution or growth of the marine vegetation that inhabits nearshore/intertidal areas, such as eelgrass.

There is a very low risk for accidental spills and leaks in the proposed repair yard to affect areas of biofilm, a critical food source for Western sandpipers and Pacific dunlin. Further, the rail repair yard is located approximately 600 metres from shore, and on the other side of the causeway from the identified area of biofilm (**Figure 5.4-2**). It is therefore anticipated that there will be no adverse effects to biofilm due to the distance of land between the two areas, and the physical barrier provided by the causeway. Accidental spills and leaks are discussed further in **Section 7.0**.

Mitigation

While Port Metro Vancouver will not operate the vessels that call at the marine terminal, the Port, nonetheless require that all vessels including container ships are operated to a model of the highest safety standards and in an environmentally responsible manner. Vessels navigating within Canadian waters must be in full compliance with all relevant shipping regulations and safety standards required under the *Canada Shipping Act* and captains must also comply with all international conventions, federal and provincial regulations, and acts pertaining to marine life and their habitat (e.g., *Fisheries Act* and *Species at Risk Act*). When vessels are within Port Metro Vancouver's jurisdiction they must comply with *Port Authorities Operations Regulations, SOR/2000-55*. The following are the most pertinent topics related to marine operations of the Project:

- Ballast – Vessels arriving at the terminal will exchange ballast not less than 200 nautical miles from shore as dictated by the Transport Canada's "*A Guide to Canada's Ballast Water Control and Management Regulations, TP 13617E".*
- Garbage – Vessels arriving at the terminal will adhere to pollution prevention regulations under the *Canada Shipping Act*.
- Sewage – Vessels within Port Metro Vancouver's jurisdiction shall not discharge any sewage or liquid waste and when transiting out of Port jurisdiction the vessel will adhere to Transport Canada's Non-Pleasure Craft Sewage Pollution Prevention Regulations.
- Oily bilge – In accordance with both the Port Authority Operation Regulations and Transport Canada's Oil Pollution Prevention Regulations, no oil or oily mixture shall be discharged from a vessel in waters under Canadian jurisdiction.

Bilge and ballast water will be managed according to the above guidelines and regulations, they are not anticipated to result in any adverse effects and are therefore not discussed further in this assessment. However, bilge release is subsequently addressed in **Section 7.0** Accidents and Malfunctions.

The availability and quality of suitable habitat to support marine vegetation communities is not expected to be affected by Project activities. Since no reasonable mechanisms exist for increased shipping traffic to result in adverse changes to the long-term viability of marine vegetation communities in the Study area, no residual adverse environmental effects are expected.

5.4.5.2 Marine Invertebrates

During operations, environmental effects to marine invertebrates relate to ballast water, vessel wake and acoustic disturbance, and the measurable parameters used to assess potential effects are changes in habitat quality/availability, changes in behaviour and physical injury/death.

Because the existing Deltaport container terminal is located in sub-tidal waters, Project-related vessel traffic is not anticipated to alter present wave motion characteristics sufficiently to affect the distribution or growth of marine invertebrates that inhabit intertidal areas, such as cockles. Marine invertebrates in sub-tidal areas, such as Dungeness crabs and sea pens, are considered too deep to be affected by bow waves. Therefore, effects of vessel wake on marine invertebrates are not considered further in this assessment, and no mitigation measures are proposed.

There is no evidence that underwater noise from transiting or berthing vessels results in effects that will affect the viability of marine invertebrates. Experiments on the effects of seismic energy (which is considerably more intense than underwater vessel noise) on snow crabs did not indicate any long-term adverse behavioural or physical effects, though the authors recommended follow up studies be completed so more definitive conclusions can be drawn. (DFO, 2004). Crabs are often used as environmental indicators, and it is thus reasonable to assume that other marine invertebrate species will not be subject to harmful behavioural and/or physical effects as a result of the Project.

The Strait of Georgia experiences high volumes of marine traffic with co-existing Dungeness crab fisheries, suggesting that routine vessel traffic will not measurably affect the habitat quality/availability for crabs or other invertebrate species. Further, crab populations are far more likely to be adversely affected from the removal of biomass due to commercial and recreational fisheries than Project operations.

Mitigation

Please refer to **Section 5.4.5.1** above for a discussion of mitigation measures relevant to ballast water release.

Project activities are not expected to cause physical injury or death to marine invertebrates, nor produce long-term changes in behaviour. Further, the availability and quality of suitable habitat to support marine invertebrate communities is not expected to be affected by Project activities. Since no mechanisms can be identified for increased shipping traffic to result in adverse changes to the long-term viability of marine invertebrate communities in the Study area, no residual adverse environmental effects are expected.

5.4.5.3 Marine and Anadromous Fish

Environmental effects associated with Project-related increases in vessel calls during the operations phase are primarily linked to underwater noise and its potential to disturb or displace fish from their habitat. Measurable parameters used to assess potential effects are changes in habitat quality/availability, changes in behaviour, and physical injury/death.

It is important to acknowledge the uncertainty surrounding the effects of underwater noise on fish: large numbers of fish are exposed to moderate but widespread low-frequency noise, produced by vessels and other coastal activities, and yet a great deal remains unknown regarding the nature and extent of the behavioural effect of such sounds on fishes (Slabbekoorn *et al.,* 2010).

Fish use sounds in a wide variety of behaviours including feeding, defense and reproduction, and hearing capability is linked to survival (Hastings and Popper, 2005). Evaluating the environmental effects of a particular type of sound on a particular species is difficult due to a lack of scientific information and, in particular, field experiments on fish. However, results from limited studies show potential effects of sound exposure on marine fishes include (LGL, 2005b):

- Temporary threshold shift (temporary hearing loss caused by an upward shift in auditory threshold).
- Physical damage to the ear region.
- Physiological stress responses (e.g., organ or tissue damage, increase in stress hormones).
- Behavioural responses (e.g., startle/alarm responses, avoidance, changes to natural movements, and perhaps lack of response because acoustic cues being masked).
- Mechanical damage to eggs and larvae.

Other environmental assessments (e.g., Northern Gateway Pipeline Project) modeled underwater noise produced by vessels (tankers and tugs), under transit and berthing scenarios (JASCO, 2006). Fish audiograms were then subtracted from the modeled sound levels to show sound levels above the fish hearing threshold. Results showed source levels at values well below the physical damage threshold suggested in the literature (Popper *et al.,* 2006); therefore, the onset of physical damage in marine fish is not expected as a direct result of vessel acoustic emissions.

Behavioural effects and/or effects of stress are difficult to quantify in fish since these responses have not been extensively studied. However, there are few studies that indicate such negative correlations between the presence of noise and the presence of fish. Some studies report an effect of vessel noise on fish flight behaviour in the context of population assessments and catch rates for commercially important fish stocks. For example, horizontal and vertical movements away from vessels have been reported for Atlantic herring (*Clupea harengus*) and Atlantic cod (*Gadus morhua*) presumably in response to ship noise (Vabo *et al.,* 2002; Handegard *et al.,* 2003).

Other studies have demonstrated that exposure to non-traumatic stressors (e.g., rapid environmental changes, etc.) can predispose fish to opportunistic infections (Noga *et al.,* 1998; Wedemeyer *et al.,* 1999) or make them more susceptible to predation (Mesa *et al.*, 1994). While the stimuli in these studies were different from an increase in ambient sound conditions, the results do suggest that if exposure to sound results in highly stressed fish, even if fish do not die as a direct result of stimulation, they may be more susceptible other environmental effects than non-stressed fish (Hastings and Popper, 2005).

While a great deal of uncertainty remains surrounding potential population level consequences of the effects of noise on fish, Roberts Bank supports high volumes of marine traffic with co-existing fisheries, suggesting that routine vessel traffic will not measurably affect the abundance or distribution of marine or anadromous fish species.

Mitigation

No specific mitigation measures are required during operation of the proposed Project for marine and anadromous fish.

5.4.5.4 Coastal Birds

Environmental effects associated with Project-related increases in vessel calls during the operations phase are primarily linked to sensory disturbance and habitat avoidance from in-air acoustic emissions (potential effects of collisions with road and rail traffic are discussed in **Section 5.1.6**). Measurable parameters used to assess potential effects are changes in habitat quality/availability, changes in behaviour, and physical injury/death.

In terrestrial systems, declines in avian diversity and density associated with highways have been attributed at least partly to traffic noise (Reijnen and Foppen, 2006). Ambient noise may be detrimental to birds through direct stress, masking of predator arrival or associated alarm calls, and by interference of acoustic signals in general. The reduction in signal efficiency through rising noise levels may result in direct negative fitness consequences (Slabbekoorn and Ripmeester, 2008), especially if the noise disturbance increases energy demand (i.e., elevated heart rates due to fright; alteration of flight path to avoid noise). An increase in energy demand may result in the depletion of fat reserves required for growth

or successful migration (Mooij, 1992; Madsen, 1994; Riddington *et al.,* 1996), which is of particular concern regarding the large numbers of shorebirds, such as Western sandpipers and Pacific dunlin, that migrate along the Pacific Flyway and stop-over in Roberts Bank area. However, migratory birds are present in the Study area for only a small portion of the year, and therefore won't be exposed to Project-related disturbances continuously.

Coastal birds that are typically present within the Study area year-round (e.g., great blue herons) are habituated to human presence and are assumed to have tolerance for industrial activities, such as marine transportation. Noise from increased vessel traffic, particularly loud, random, infrequent, or intermittent noise will result in behavioural effects, but birds are expected to resume normal activity when the source of disturbance ceases.

Mitigation

No specific mitigation measures are required during operation of the proposed Project for coastal birds.

5.4.5.5 Marine Mammals

Potential environmental effects of increased shipping activity on marine mammals assessed here include acoustic disturbance and vessel strikes. Measurable parameters used to assess potential effects are changes in habitat quality/availability, changes in behaviour, and physical injury/death.

Acoustic Disturbance

Ambient sound levels around the Deltaport container terminal are relatively high, with ferries, fishing vessels, pleasure boats, container ships, coal ships, and tugs and the coal conveyer system at the Westshore terminal all contributing noise to the underwater environment (Stantec, 2010). Vessels will also generate in-air acoustic emissions; however this is will attenuate quickly and is expected to be minimal and is therefore not considered further in this assessment.

Project-related underwater noise mainly relates to tug escorts and the berthing of container ships. While this has not been modeled specifically for the Project, acoustic modeling for DP3 construction activities was conducted by Stantec and JASCO and extrapolation is warranted given that broadband source levels for vibro-densification activities are similar to those of tugs and container ships (~180 dB re: one µPa (micropascal)). Modelling results defined a potential zone of audibility for killer whales that extended approximately ten kilometres south of the construction site into the Strait of Georgia during construction operations (Stantec, 2010).

Marine mammals are highly dependent on their ability to perceive and discriminate underwater sounds. Sound production and audition are critical for important life functions such as spatial orientation, migration, communication, predator and prey detection, courtship displays and mating, and locating members of the same species (Simmonds *et al.,* 2004).

Noting that the effects of sound may vary between and within species due to differences in biology and physiology, potential effects of exposure to elevated sound levels include:

- Permanent Threshold Shift (PTS), defined as an irreversible physiological injury to the auditory apparatus.
- Temporary Threshold Shift (TTS), defined as a temporary increase in auditory threshold; behavioural changes.
- Auditory masking.

These responses, in turn, may lead to the following consequences which may adversely affect marine mammal health (Richardson *et al.,* 1995; Nowacek *et al.,* 2007; Southall *et al.,* 2007):

- Reduced foraging efficiency
- Increased predation
- Reduced fecundity
- Increased energy expenditure
- Chronic stress

According to Stantec (2010), the study area does not appear to be heavily or regularly used by SRKW - marine mammal monitoring surveys conducted for DP3 documented SRKW within ten kilometres of the Study area on only two of nine survey days. While the whales will be able to detect and respond to underwater noise (i.e., temporarily alter swimming patterns to avoid noise), the geographic extent of acoustic disturbance effects is site specific and spatially limited, as is the potential zone of audibility of Project-related noise to killer whales (approximately ten kilometres from the terminal site).

Noise could have indirect effects on marine mammals as the result of changing the distribution of prey species or other aspects of the ecosystem. This is of particular concern for SRKW - a population limited by availability/quality of prey, and whose diet is composed primarily of one species (~70 percent Chinook salmon).

The hearing ability of the killer whale is the most sensitive of any odontocete studied and, by modeling, Erbe (2002) estimated that underwater noise from vessels can mask killer whale calls at distances up to 14 kilometres. The Recovery Strategy for the Northern and Southern Resident Killer Whales in Canada lists acoustic disturbance as a principal anthropogenic threat (DFO, 2008). However, there are currently no studies on population-level effects of shipping noise, such that consequences of increased ambient noise conditions to killer whales was identified as a major data gap (DFO, 2008). Noise is considered biologically significant if it induces long-term abandonment of an area important for feeding, breeding or rearing, as it may lead to reduced fecundity, carrying capacity, or both (Richardson, 1997).

Vessel – Marine Mammal Strikes

While large baleen whales, such as humpback and gray whales, are most at risk of strike from Project related vessels, they do not commonly occur in the Study area, or within in Strait of Georgia in general. They appear to spend the most time along the continental shelf, and are also regularly spotted in Haro Strait and the Strait of Juan de Fuca, though neither Strait was identified as potential critical habitat (Nichol *et al.*, 2010). Further, while the Strait of Georgia is considered part of the historical range of baleen whales, and while sightings in this area have increased in recent years, they remain relatively uncommon such that the risk of a vessel strike in this area is not likely.

Evidence suggests that lethal vessel strikes to whales are infrequent at speeds of less than 14 knots and are rare at speeds of less than ten knots (Laist *et al.,* 2001). Further, toothed whales (e.g., SRKW) and pinnipeds (e.g., sea lions) are rarely struck by vessels as they are fast swimming and agile, enabling them to avoid approaching vessels (Laist *et al.,* 2001; Jensen and Silber, 2004). As vessels will be travelling at speeds less than ten knots within the study area, the risk of vessel collision with marine mammals is therefore assessed as low.

Mitigation

No specific mitigation measures are proposed.

5.4.6 Residual Effects and Determination of Significance

5.4.6.1 Marine Vegetation

No residual adverse environmental effects are anticipated.

5.4.6.2 Marine Invertebrates

No residual adverse environmental effects are anticipated.

5.4.6.3 Marine Fish

While the likelihood of potential environmental effects is high, as marine fish will be able to detect and respond to underwater noise (i.e. temporarily alter swimming patterns to avoid noise), the geographic and temporal extent for such effects is limited. Effects are characterised as short-term in duration and reversible, as fish are expected to return to, and use, affected areas shortly after the noise disturbance has ceased. In terms of ecological context, since Roberts Bank is already a developed marine area with relatively high ambient noise levels, the magnitude of effect can be considered moderate. As no measurable changes in the distribution and abundance of marine fish are expected, nor are any adverse long-term effects on the viability of marine fish populations, the residual adverse environmental effect of acoustic disturbance from increased vessel traffic is considered to be not significant. This prediction is made with a high degree of confidence.

No follow-up monitoring is proposed.

5.4.6.4 Coastal Birds

While the likelihood of potential environmental effects is high, as coastal birds will be able to detect and respond to in-air acoustic emissions (i.e. temporarily alter flight patterns to avoid noise), the magnitude is considered moderate because the zone of influence for such effects is limited both spatially and temporally. Birds are anticipated to return to, and use, affected areas shortly after the noise disturbance has ceased, and so effects are further characterised as short-term and reversible. In terms of ecological context, Roberts Bank is a developed marine area subject to multiple human activities with relatively high ambient noise levels, to which coastal bird populations seem to have habituated. As no adverse long-term effects on the viability of coastal bird populations is anticipated, the residual adverse environmental effect of acoustic disturbance from increased vessel traffic is considered to be not significant. This prediction is made with a high degree of confidence.

No follow-up monitoring is proposed.

5.4.6.5 Marine Mammals

The likelihood and magnitude of potential environmental effects is high, as marine mammals will be able to detect and respond to underwater noise (i.e. temporarily alter swimming patterns to avoid noise). However, the geographic extent of acoustic disturbance effects is site specific and spatially limited, as is the potential zone of audibility of Project-related noise to killer whales (approximately ten kilometres from the terminal site). In terms of ecological context, despite being located within officially designated SRKW critical habitat, the Study area does not appear to be heavily or regularly used by the whales - marine mammal monitoring surveys conducted for DP3 documented SRKW within ten kilometres of the Study area on only two of nine survey days (Stantec, 2010). The use of Roberts Bank is relatively seasonal, with the occurrence of SRKW peaking in late summer to coincide with the Fraser River salmon runs (DFO, 2008). Effects are further characterised as short-term in duration and reversible, as mammals are expected to return to, and use, affected areas shortly after the noise disturbance has ceased.

Therefore, based on the small geographic scope of the Study area, and that the area appears on the periphery of the SRKW's core range, no compromises to the viability of the population as a result of acoustic disturbance from Project-related increases in vessel traffic are expected. The residual adverse environmental effect of acoustic disturbance is therefore considered to be not significant. However, this prediction is made with moderate confidence as much remains to be understood regarding the effects of underwater noise on marine mammals, particularly in the longer term.

Since baleen whales are rare in the study area, and since vessels will be travelling at speeds lower than ten knots, the risk of lethal marine mammal-vessel strikes is assessed as low and the residual adverse environmental effect is therefore considered to be not significant.

No follow-up monitoring is proposed.

5.5 AIR QUALITY

5.5.1 Introduction

The air quality assessment investigates the potential changes in air contaminant emissions and associated effects on air quality as a result of the construction and operation of the proposed Project. This section summarises the report titled *Air Quality Assessment, Deltaport Terminal, Road and Rail Improvement Project* (2012a), prepared by SENES Consultants Ltd, which provides a detailed description of the methodology used to complete the air quality assessment and its results.

It is important to note that an air quality monitoring station (Station T39) was installed in Tsawwassen in June 2010 as part of Port Metro Vancouver's commitments for the Deltaport Third Berth Project. The station forms part of the Metro Vancouver monitoring network and Metro Vancouver provided a full year of monitoring data for the site from June 2010 to the end of May 2011 for this assessment. The availability of measured air quality data in the local area increases the confidence of this predictive air quality assessment (i.e., relationships can be made between known existing conditions (2010) operation emissions at Deltaport and the air quality conditions Station T39).

5.5.2 Methodology

5.5.2.1 Overview

The air quality assessment methodology consisted of the following steps:

1) An issue scoping exercise was conducted to determine air quality issues relevant to DTRRIP and to identify relevant regulatory air quality initiatives, (i.e., changes in emissions standards, air quality regulations, fuel quality, etc.) scheduled for implementation in the near future.
2) A review of ambient air quality observations was undertaken to define baseline air quality for common air contaminants (CACs) and these results were compared to applicable air quality objectives and standards.
3) Annual emission sources were identified, and their associated emission parameters were quantified, for four different time horizons (2010 (existing conditions), 2014, 2017, and 2020). Annual emission sources were quantified for the local and regional study areas.
4) The annual emission summaries were refined to determine short-term emission estimates (daily, one-hour and eight-hour (where appropriate) emission rates), so that the assessment of air quality effects could be compared to ambient air quality objectives. The daily and hourly effects were assessed on an average and maximum basis for all horizon years and contaminants (for the local and regional study areas).
5) The effect on ambient air quality resulting from the short-term emission estimates were evaluated based on anticipated concentrations at three main receptor areas:
    a. The T39 air quality monitoring station on English Bluff in Tsawwassen
    b. Within 200 metres of road corridor leading from Roberts Bank
    c. Within 200 metres of rail corridor leading from Roberts Bank.
6) The predicted air quality changes at the three receptor areas were compared to the applicable air quality objectives, standards, criteria or guidelines and comment was made on the significance of any changes due to the Project.

5.5.2.2 Spatial Scope of Assessment (Study Areas)

The DTRRIP air quality assessment presented considers both local emissions that occur in the immediate vicinity of the Deltaport container terminal (the LSA), and regional emissions that occur within a selected area of the western portion of the Lower Fraser Valley (LFV) and Georgia Strait (the RSA). The geographic scope within which emissions were estimated and the associated study areas are shown on **Figures 5.5-1** and **5.5-2** (attached).

Emissions were categorised as local if they resulted from activity in the immediate vicinity of Roberts Bank (i.e., at Roberts Bank terminal complex or along the Roberts Bank causeway). Regional emissions build on local emission estimates by adding emissions that were derived from transport to and from Roberts Bank, either by ship (i.e., in polygons 1-4 in **Figure 5.5-2**), rail or truck (i.e., within the Rail and Trucking Boundary depicted in **Figure 5.5-2**). Regional emission estimates include local emission estimates, in addition to emissions from ship movements in Georgia Strait and container truck and rail locomotives along specific travel corridors in Delta and Richmond.

5.5.2.3 Temporal Scope of Assessment (Time Horizons)

Deltaport is the largest container terminal in Canada with a capacity of 1.8 million twenty-foot equivalent units (TEUs). Project works proposed as part of DTRRIP could increase the container capacity at Deltaport by 600,000 TEUs to 2.4 million TEUs. The air quality assessment for the proposed Project was conducted assuming a Deltaport container terminal capacity of 2.4 million TEUs by year 2017[14]. Changes in air emissions were calculated for four time periods:

- 2010 (existing conditions)
- 2014 (the last year of construction, DTRRIP works complete and start of operations)
- 2017 (the year that Deltaport Terminal would reach full-capacity (2.4 million TEU))
- 2020 (the year at which additional regulatory improvements or proponent implemented changes would likely be fully realised).

The estimated emissions in each time period were based on detailed consideration of activity levels for each type of equipment associated with changes in container handling capacity. The emission estimates not only reflect changes in activity levels for marine vessels, cargo handling equipment, container trucks, and rail locomotives at the Deltaport container terminal, but also consider changes in fuel quality and the normal replacement of older equipment with newer equipment that meets new emission technology standards.

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[14] The SENES 2012a report evaluated three different project scenarios for differing throughputs and time horizons. The 2.4 million twenty-foot equivalent units (TEU) for Deltaport was determined to be the most practical and sustainable terminal operation scenario, therefore only this scenario is discussed within the CEAA Screening Report.

5.5.2.4 Air Contaminants Considered in the Assessment

The DTRRIP air quality assessment included estimates of air contaminant emissions for existing operations at the Deltaport container terminal in 2010, as well as estimates of future projections of emissions for the three horizon years to 2020. Air contaminant emissions were calculated for the following compounds:

- **Common Air Contaminants (CAC)**
  - Carbon Monoxide (CO)
  - Nitrogen Oxides (NO_X)
  - Sulphur Dioxide (SO_2)
  - Volatile Organic Compounds[15] (VOC)
  - Particulate Matter[16] (PM, PM_{10} and $PM_{2.5}$)
  - Ammonia[17] (NH_3)
- **Greenhouse Gases (GHG)**
  - Carbon Dioxide (CO_2)
  - Methane (CH_4), expressed as CO_2-equivalent[18] (CO_2e)
  - Nitrous Oxide (N_2O), expressed as CO_2-equivalent (CO_2e)

The following table (**Table 5.5-1**) identifies the key study contaminants along with major sources and the general overall observed and predicted trends for the Lower Fraser Valley (as presented in a recent Metro Vancouver report, 2010 Lower Fraser Valley Air Quality Summary (Metro Vancouver, 2011). The table also provides comment with respect to the Project's potential as sources of the key study contaminants.

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15 As hydrocarbons (HC)

16 Although emission calculations were completed for all three size fraction of particulate matter, most of the emission sources being evaluated are diesel-powered and 97% of the total PM emitted is composed of $PM_{2.5}$ emissions. Therefore, the focus of the air quality effect assessment is on the fine particulate fraction, $PM_{2.5}$.

17 Although ammonia emissions were considered in the inventory of emissions from all sources at Roberts Bank, the contribution of these sopurces to overall ammonia emissions in the Lower Fraser Valley is negligible. Therefore, the air quality assessment does not focus on air quality effects of ammonia emissions from activity at Roberts Bank.

18 For simplicity, and because carbon dioxide is the dominant source of GHGs, GHG emissions are expressed in CO_2e.

Table 5.5-1 Key Study Contaminants Summary

Contaminant	Major Sources for the Lower Fraser Valley (Metro Vancouver, 2011)	Observed and Predicted Trend for the Lower Fraser Valley (Metro Vancouver, 2011)	Comment with Respect to Potential DTRRIP Sources
CO	Light Duty Vehicles Space Heating Non-Road Vehicles	CO has steadily been declining. Ambient Air Quality Objectives (AAQO) achieved since 1990 and will continue to decline.	Cargo handling equipment (CHE) activity.
NO_X	Combustion sources including transportation sources, building heating, commercial and industrial operations.	NOx emissions have declined since 1990, and will stay steady or continue to decline.	Marine vessels and CHE operations.
SO_2	Industrial sources such as petroleum refining and cement plants.	SO_2 emissions have declined since 1990, and will continue to decline.	Marine vessels.
VOCs	Natural sources (vegetation), solvent evaporation and light-duty gasoline vehicles.	VOC emissions have declined since 1990, and will continue to decline.	CHE operations and some also from marine vessels.
NH_3	Agricultural activity.	Steadily increasing emissions.	Not applicable to DTRRIP.
PM, PM_{10} and $PM_{2.5}$	Action of the wind (fugitive dust), and anthropogenic sources, such as the combustion of fuels.	A gradual decline in annual PM_{10} and $PM_{2.5}$ for most locations has been observed.	Marine vessels and CHE operations.
CO_2e	Mobile Transportation Sources and Area Sources (e.g., agricultural activity, landfills residential and commercial space heating).	Light-duty gasoline-powered vehicle emissions are projected to decrease, while GHG emissions from area sources are projected to increase. Marine vessel emissions are also expected to increase.	CHE operations and some also from marine vessels.

Note: Revised from Metro Vancouver, 2011

5.5.2.5 Air Quality Assessment Criteria

The following table contains a summary of the air quality objectives and standards referred to as part of the DTRRIP Air Quality Assessment.

Table 5.5-2 Air Quality Objectives and Standards used in DTRRIP Air Quality

Contaminant	Ambient Air Quality Objectives (AAQOs)[19]	North American Air Quality Objectives (NAAQO Max. Desirable)	North American Air Quality Objectives (NAAQO Max. Acceptable)	Canada Wide Standards (CWS)
CO	30,000 µg/m^3 (1-hr) 10,000 µg/m^3 (8-hr)			
NOx	200 µg/m^3 (1-hr for NO_2) 40 µg/m^3 (annual for NO_2)			
SO_2	450 µg/m^3 (1-hr) 125 µg/m^3 (24-hr) 30 µg/m^3 (annual)			
VOCs	N.A.			
PM, PM_{10} and $PM_{2.5}$	50 µg/m^3 (24-hr for PM_{10}) 20 µg/m^3 (annual) for PM_{10}, 25 µg/m^3 (24-hr for $PM_{2.5}$) 12 µg/m^3 (annual) for $PM_{2.5}$			30 µg/m^3 (24-hr for $PM_{2.5}$)
CO_2e	N.A.	N.A.	N.A.	N.A.
O_3	127.6 µg/m^3 (8-hr)	100 µg/m^3 (1-hr) 100 µg/m^3 (8-hr)	160 µg/m^3 (1-hr) 127.6 µg/m^3 (8-hr)	127.6 µg/m^3 (8-hr)

5.5.2.6 Emissions Inventory Methodology

Emissions were calculated for four source groups or activities:

1. Marine Vessels
   - Activities consisting of underway, manoeuvring and alongside the terminal berth
   - Main engines, auxiliary engines, and boilers
   - Tug boat assist vessels
2. Cargo Handling Equipment (CHE)
   - Reach stackers
   - Rubber-tired gantry cranes
   - Top and/or side picks or reach stackers
   - Yard trucks and chassis (hostlers, goats, or terminal tractors)
3. On-road Vehicles
   - Container trucks, service vehicles, and employee-owned vehicles
4. Rail Locomotives

[19] Metro Vancouver and British Columbia Ambient Air Quality Objectives

The emission estimates were calculated using best practice methods adopted by Transport Canada, Environment Canada, and the United States (US) Environmental Protection Agency and were used to estimate marine and landside emissions for Port Metro Vancouver and other ports in California and Washington. Detailed emission estimate calculations are provided in SENES 2012a, Appendix A.

Emissions were assessed for the following time averaging periods:

- Average annual emissions (tonnes/yr)
- Daily maximum and average emissions (kg/day)
- Hourly maximum and average emissions (kg/hour)

By establishing source-receptor relationships (i.e., Deltaport container terminal emissions–Station T39 concentration relationships) and taking into account meteorological conditions, the predictive emission rates were able to be converted to $\mu g/m^3$ at the receptor site (Station T39). This conversion allows for comparisons of predictive air quality concentrations at the receptor site to be made to applicable air quality regulations.

5.5.2.7 Effect Assessment Methodology (Source Receptor Effects)

Effects on ambient air quality resulting from the short-term emission estimates were evaluated based on anticipated concentrations at three main receptor areas:

a. At the T39 air quality monitoring station on English Bluff in Tsawwassen
b. Within 200 metres of road corridors leading from Roberts Bank
c. Within 200 metres of rail corridor leading from Roberts Bank.

Station T39

For the purposes of this screening-level assessment, source-receptor relationships were established based on having measured air quality data for Station T39 in 2010 and knowing the emission rates at Roberts Bank for 2010 (based on the 2010 emissions inventory). As a result of this concurrent period of record, source-receptor relationships were determined for each air contaminant. No new dispersion modelling was conducted for this assessment to estimate changes in air quality at Station T39.

Once this source-receptor relationship was established for each contaminant, effects assessment predictions were made for Station T39 for the three DTRRIP time horizons. Predictions were made for various air quality concentrations as dictated in the relevant air quality regulations**:** one-hour average concentrations, as well as daily (24-hour) averaged concentrations (for NO_2, SO_2 and $PM_{2.5}$) and eight-hour averaged concentrations (for CO and ozone (O_3)), (**Table 5.5-2**). More detail on source receptor effects methodology is provided in **section 5.5.5** as well as in the technical report, SENES 2012a.

Road and Rail Corridors

The effect of road and rail traffic emissions associated with the marine terminals at Roberts Bank were evaluated in terms of incremental changes in ambient air quality within a distance of 200 metres from the road and rail corridors. Incremental effects refers to air quality effects due to emissions from Roberts Bank alone, excluding all other background emission sources that contribute to total air quality levels. This was conducted using a dispersion analysis previously conducted for the Deltaport Third Berth Project (SENES, 2006). In order to estimate maximum effects, it was assumed that all vehicular traffic would flow along one road. Therefore, the results presented are representative of maximum effects along Deltaport Way and the SFPR, but would overestimate potential effects along other roadways once traffic splits are considered beyond the junction of the SFPR and Highway 99. The analysis assumes that all of the traffic (i.e., container trucks and employee-owned vehicles) use one road between Roberts Bank and Highway 99, using Highway 17 in 2010 and the SFPR in subsequent horizon years. This oversimplification of traffic patterns provides a conservative estimate of potential air quality effects beside the roadway. This is not an issue for rail, as all train traffic is assumed to travel on one rail corridor.

5.5.2.8 Business as Usual Scenario

A separate comparison of the anticipated changes in air contaminant emissions and associated air quality associated with DTRRIP versus anticipated emissions and air quality if the Project were not to proceed (referred to 'Business as Usual' or 'BAU') and considers no future container terminal expansion at Deltaport was conducted by SENES (2012b). The BAU emissions presented were calculated using the same methodology used for the DTRRIP air quality assessment (see **Section 5.5.2.1** and SENES 2012a). However, in order to simplify the discussion and assessment for the BAU scenario, a reduced number of air quality metrics were considered including:

- Regional emissions, which include local emissions, but not local emissions separately.
- Three horizon years (2010, 2020, and 2030).
- Annual emissions only, versus including short-term daily and hourly emissions.
- Focusing on four key contaminants (SO_2, NO_x, $PM_{2.5}$, and CO_2e) as these are the main contaminants influenced by port operations (SENES, 2012a).

5.5.3 Existing Conditions

5.5.3.1 Air Quality in the Lower Fraser Valley

Metro Vancouver operates a network of air quality monitoring stations in the LFV. Information gathered from the LFV Air Quality Monitoring Network is used to support and guide Metro Vancouver's Air Quality Management Plan (AQMP) for the region. The network consists of 27 stations operated by Metro Vancouver and the Fraser Valley Regional District.

Estimated emissions of CACs in the LFV from 1990 to 2020 were derived by Metro Vancouver (2007). These include gaseous emissions (CO, NO_X, SO_X, VOC, and NH_3), as well as for particulate matter (PM_{10} and $PM_{2.5}$) and GHGs. The inventory includes emissions from all sources in Metro Vancouver, the Fraser Valley Regional District and Whatcom County, Washington.

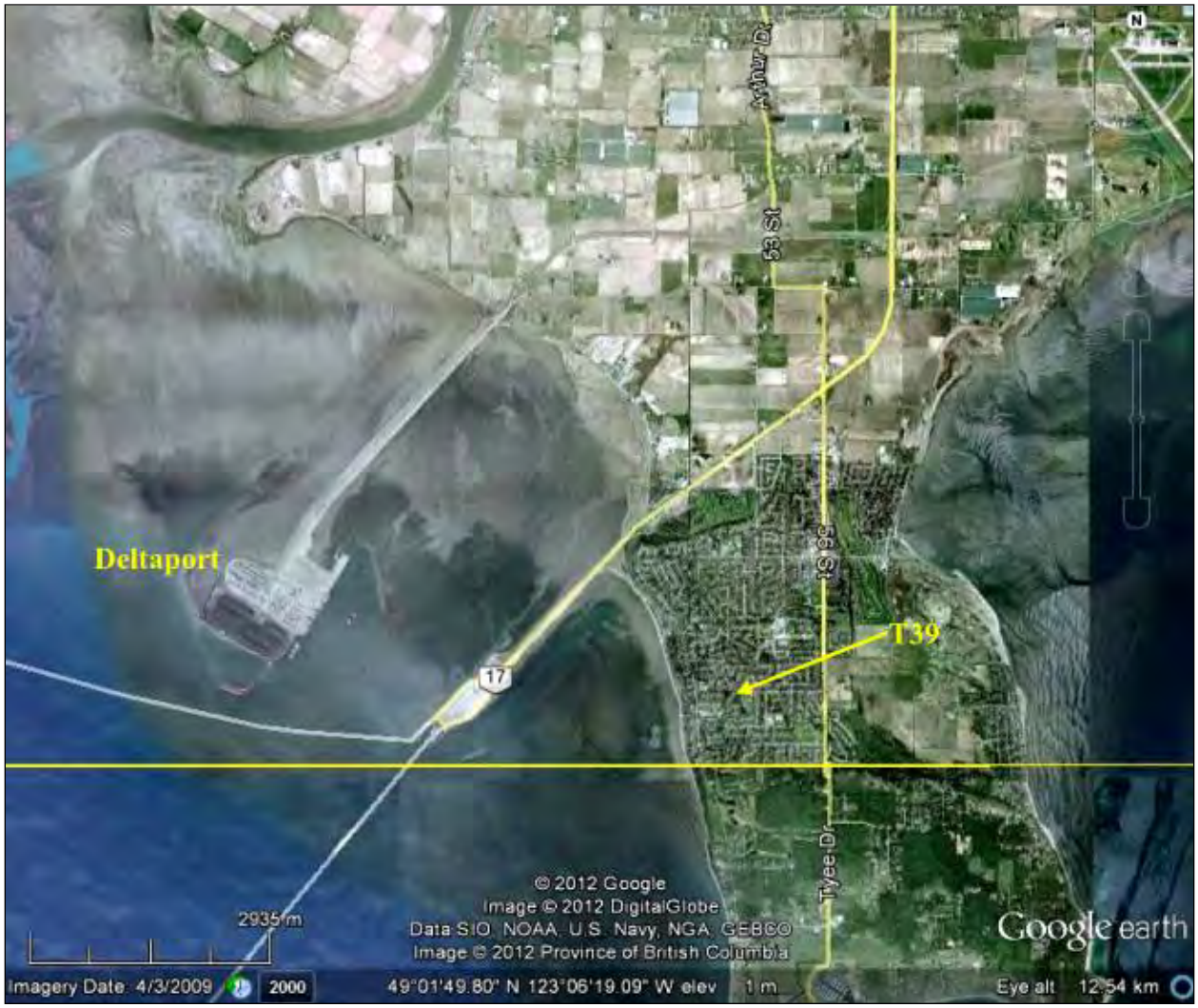
A summary of air quality sources and trends for the key study contaminants in the Lower Fraser Valley was presented earlier, in **Table 5.5-1**.

5.5.3.2 Air Quality in Tsawwassen

Metro Vancouver has completed several air quality monitoring studies specifically aimed at determining the air quality levels in the vicinity of the marine terminal operations at Roberts Bank. The results of the monitoring studies concluded that the measured air quality within the Delta study area was generally good as compared with other locations in Metro Vancouver and that the study contaminants are well below applicable AAQOs.

Metro Vancouver currently operates an air quality monitoring station in the English Bluff area of Tsawwassen, which is funded by Port Metro Vancouver. The station (T39) was established in the spring of 2010, and Metro Vancouver provided a full year of monitoring data for the site from June 2010 to the end of May 2011. The monitoring site is located in the northwest portion of Pebble Hill Park (**Graphic 5.5-1**). The T39 station provides monitoring data for CO, NO, NO_2, SO_2, O_3, and fine particulate matter ($PM_{2.5}$), as well as the meteorological parameters of wind speed, wind direction and temperature.

Graphic 5.5-1 Location of Station T39 in Tsawwassen

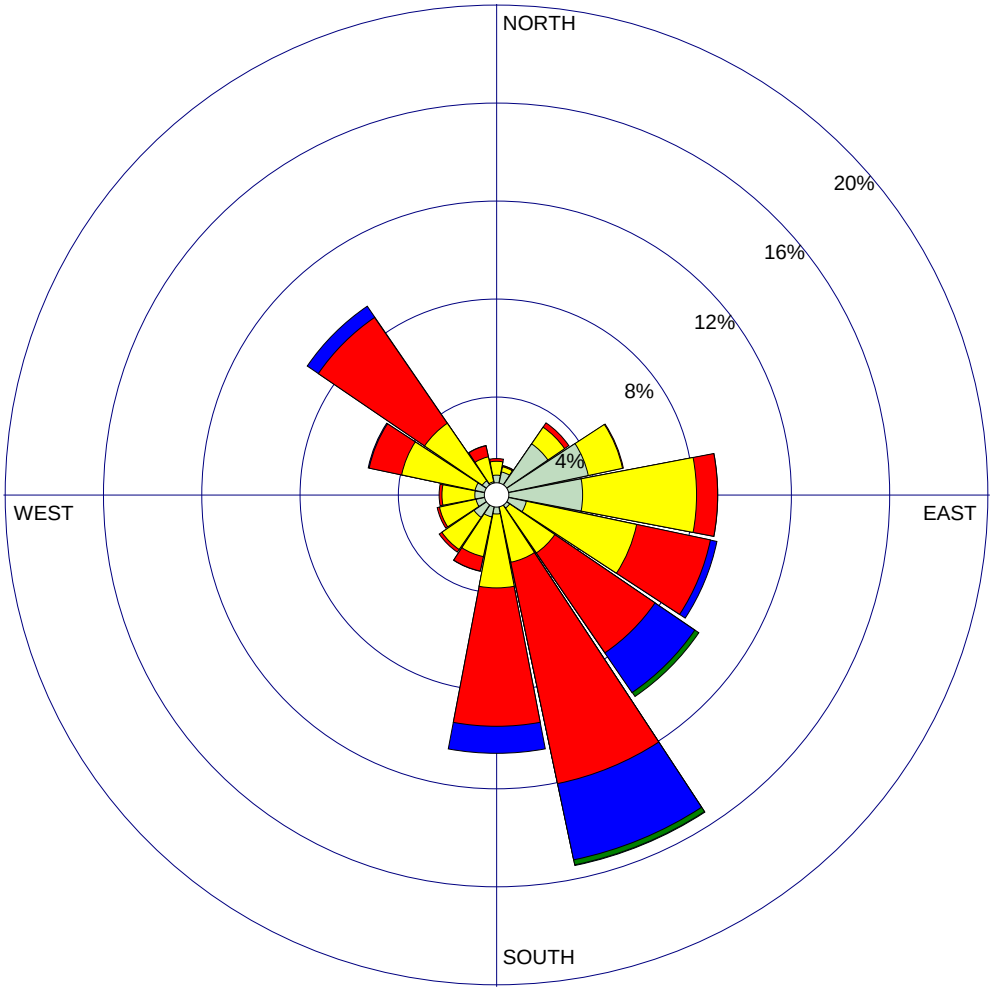


The data from T39 was used in the air quality effects assessment as an indication of the effect of existing operations at the Deltaport container terminal on air quality in an area most likely to be affected by any changes in emissions at Roberts Bank, and the observed air quality levels at this location were used as an indicator of possible changes in air quality due to DTRRIP. Separate calculations were conducted for anticipated incremental changes in air quality within 200 metres of a major roadway and along the rail corridor leading from the Deltaport container terminal.

Graphic 5.5-2 shows the frequency of winds by direction at T39 for the period of record from June 2010 to May 2011. The data indicate that air flow at English Bluff is largely channelled parallel to Georgia Strait, with prevailing winds from the south-southeast (SSE). Therefore, emissions from the marine terminals at Roberts Bank are most likely to be carried away from shore over Georgia Strait, with some of the emissions being transported toward English Bluff. Emissions from Roberts Bank are only infrequently transported directly eastward to the northern portion of Tsawwassen or towards Ladner.

Graphic 5.5-2 Station T39 Wind Rose

Pollution Rose Plot: **Station # 1102425 Tsawwassen, BC**		Display: **Wind Speed Direction (blowing From)**	



Date: 12/10/2011	Data Period: Start Date: 06/05/2010 End Date: 31/05/2011	Project Name:	Legend: Wind Speed (m/s)
Comments:	Average Wind Speed (m/s): 1.86 Calm Winds: 6.98%	Total Count: 9369 hours	>=8.0 6.0-8.0 4.0-6.0 2.0-4.0 1.0-2.0 0.5-1.0

For the purposes of evaluating the contribution of emissions from the marine terminals at Roberts Bank to the air quality concentrations measured at Station T39, the wind sector from 260° to 340° was considered to be the direction of possible influence as ships approach the Roberts Bank terminals up to and including all on-road vehicular and rail traffic along the Deltaport causeway. Any emissions from the Tsawwassen ferry terminal and traffic along the ferry terminal causeway would of necessity be included in this sector. Therefore, not all of the air contaminant concentrations recorded at Station T39 from this sector can be solely attributed to operations at Roberts Bank.

Table 5.5-3 provides a summary of the observed one-hour average CAC air quality levels at Station T39 from June 2010 to May 2011. The data are presented for two wind direction sectors: 1) from 260˚ to 340˚ representing the direction from which emissions at Roberts Bank and along the Roberts Bank causeway would be carried to Station T39; and 2) 340˚ to 260˚ representing the direction from which all other emissions sources would affect observations at the monitoring location.

Table 5.5-3 Observed One-hour Average Concentrations (µg/m3) for Station T39 (June 2010 – May 2011)

	CO	NO_2	SO_2	O_3	$PM_{2.5}$	
Metro Vancouver Ambient Air Quality Objective (AAQO)	30000	200	450			
NAAQO – Max. Desirable				100		
NAAQO – Max. Acceptable				160		
					All Data	**Filtered [a]**
260°-340° Sector	**Direction of Emissions From Roberts Bank**					
Maximum	800.4	62.5	53.5	108.2	41.6	20.3
Minimum	92.8	1.3	0.0	0.0	0.0	0
Mean	191.2	13.4	2.5	48.2	3.8	3.4
98th Percentile	348.0	43.8	11.5	85.8	14.4	9.8
340°-260° Sector	**Direction of Emissions from Other Source Regions**					
Maximum	696.0	120.1	34.6	127.6	45.7	41.2
Minimum	81.2	0.6	0.0	0.0	0.0	0
Mean	197.3	12.1	1.8	50.1	3.4	3.3
98th Percentile	394.4	46.4	7.2	91.6	11.4	10.5

Note: [a] Filtered data for $PM_{2.5}$ excludes days with elevated concentrations due to forest fires on August 4-6 and 15-17, 2010

All of the observed hourly averaged CAC concentrations are well below the regulatory objectives for CO, NO_2 and SO_2, while the O_3 levels meet the Maximum Acceptable NAAQO level but exceed the Maximum Desirable NAAQO level. There are no hourly objectives for $PM_{2.5}$. The maximum observed concentrations of CO and SO_2 are higher for winds from the direction of Roberts Bank, but the maximum observed concentrations of NO_2, O_3, and $PM_{2.5}$ are higher for winds from other source regions.

Ambient concentrations of NO_2, SO_2, and $PM_{2.5}$ are also regulated on the basis of daily averaged concentrations, while CO and O_3 are regulated on the basis of eight-hour averaged concentrations. **Table 5.5-4** provides a summary of the maximum observed concentrations of these contaminants in relation to the ambient air quality objectives adopted by Metro Vancouver, the Government of British Columbia[20] and the Federal Government. As wind direction can change over the course of several hours, it is not possible to clearly differentiate between concentrations due to wind flow from the direction of the Roberts Bank terminal complex and other wind directions in the same way that was done for hourly averaged concentrations.

Table 5.5-4 Observed Eight-hour and 24-hour Average Concentrations (µg/m3) for Station T39 (June 2010 – May 2011)

	CO	NO_2	SO_2	O_3	$PM_{2.5}$	
Averaging Period (hours)	8	24	24	8	24	
Canada-Wide Standard (CWS)				127.6[b]	30[a]	
Metro Vancouver AAQO	10,000	200	125	127.6	25	
					All Data	**Filtered [a]**
Maximum	503.2	48.1	7.1	109.2	25.8	9.5
Minimum	102.5	2.5	0.09	0.0	0.05	0.05
Mean	196.2	12.3	1.9	49.7	3.4	3.2
98th Percentile	361.1	37.8	6.0	87.7	9.0	8.2

Note:
[a] CWS attainment based on the 98th percentile averaged over three consecutive years
[b] CWS attainment based on the annual fourth-highest daily measurement, averaged over three consecutive years
[c] Filtered data excludes elevated $PM_{2.5}$ concentrations due to smoke from forest fires for two periods, August 4-6 and August 15-17, 2010

All of the maximum observed concentrations for the four gaseous contaminants (CO, NO_2, SO_2, and O_3) meet the ambient air quality criteria adopted by regulatory agencies. Only the AAQO adopted by Metro Vancouver for $PM_{2.5}$ was exceeded during the year of recorded observations, and that by less than one µg/m^3 on one day of the year (August 15, 2010). The exceedance of the objective coincided with similar exceedances and elevated concentrations that occurred throughout the LFV caused by smoke from forest fires (Metro Vancouver, 2011). However, excluding the days with smoke from forest fires, 99 percent of the time ambient $PM_{2.5}$ concentrations at T39 were at approximately 35 percent of the AAQO, while the 98th percentile was slightly more than one-quarter of the CWS value.

[20] Although the Federal government brought in the Canada Wide Standards for $PM_{2.5}$ and O_3, these standards were adopted jointly as a Federal/Provincial effort and it is the Provincial government that is responsible for their achievement within its jurisdiction.

5.5.3.3 Summary of Existing Conditions (2010)

The following points summarise the existing conditions (2010):

- The concentrations of CO and SO_2 are small fractions of the objectives, and the levels of SO_2 are likely to decline further in the future as a result of the regulated sulphur Emission Control Area (ECA) for shipping in North America (August 2012). However, contributions of SO_2 from oil refineries south of the border and a cement plant to the east of Tsawwassen will limit the degree of reduction in SO_2 levels at T39.
- Hourly averaged concentrations of NO_2 at T39 are higher at the highest percentile levels for winds from directions other than from the marine terminals, indicating that other sources of emission in the vicinity of the monitoring site contribute more to the highest NO_2 levels than do the marine terminals. The maximum contribution to hourly averaged NO_2 concentrations from the direction of the marine terminals is less than one-third of the Metro Vancouver AAQO, while the maximum 24-hour average NO_2 concentration from all directions was less than one-quarter of the AAQO.
- Ozone is a secondary contaminant formed in the atmosphere from the emission of NO_X and VOC. The available monitoring data at Station T39 indicate that the contaminant is always present in the area, but that the hourly averaged concentrations are slightly higher for wind directions other than those coming from the direction of the marine terminals at Roberts Bank.
- The Metro Vancouver AAQO for 24-hour average $PM_{2.5}$ was exceeded once during the year of recorded observations, and that by less than one $\mu g/m^3$ during a period of elevated pollution from forest fires in the region. Excluding the days with smoke from forest fires, 99 percent of the time ambient $PM_{2.5}$ concentrations at T39 were at approximately 35 percent of the AAQO, while the 98th percentile was slightly more than one-quarter of the CWS value.

Refer to the SENES (2012) report for additional details on air quality monitoring programs conducted in Tsawwassen and Delta.

5.5.4 Emissions Inventory

5.5.4.1 Annual Emissions Inventory – 2010

Estimates of both local and regional air contaminant emissions for existing operations at the Deltaport container terminal in 2010 were calculated for four source groups:

1. Marine vessels
2. Cargo handling equipment
3. On-road vehicles
4. Rail locomotives

Local Annual Emissions Inventory

Table 5.5-5 provides a summary of the local annual emissions of common air contaminants and CO_2e for 2010.

Table 5.5-5 Local Annual Emissions – 2010 (tonnes/yr)

Activity	CO	NO_x	SO_2	HC[21]	PM	$PM_{2.5}$	CO_2e
Ships	49.5	567.2	428.2	16.0	52.9	46.7	30,165
CHE	216.4	456.0	0.5	47.9	29.1	28.2	57,884
Vehicles	27.8	39.0	0.06	5.0	1.3	1.2	6,091
Rail	13.0	22.5	0.23	3.1	0.5	0.5	2,743
Total	306.7.0	1084.7	428.99	72	83.8	76.6	96,883

The following provides a brief summary for each contaminant[22]:

- CO emissions are primarily related to CHE activity.
- Both marine vessels and CHE operations are important contributors to NOx emissions at the Deltaport container terminal.
- Sulphur dioxide emissions are almost exclusively related to emissions from marine vessels.
- Local VOC (as HC) emissions are largely related to CHE operations, with additional important contributions from marine vessels.
- Local emissions of fine particulate matter are almost entirely related to marine vessels and CHE operations.
- GHG (as CO_2e) emissions are primarily related to CHE operations, with additional important contributions from marine vessels.

Table 5.5-6 provides a summary of the regional annual emissions of common air contaminants and CO_2e for 2010.

Table 5.5-6 Regional Annual Emissions – 2010 (tonnes/yr)

Activity	CO	NO_x	SO_2	HC	PM	$PM_{2.5}$	CO_2e
Ships	80.2	964.0	673.4	28.9	84.6	74.7	44,287
CHE	216.4	456.0	0.5	47.9	29.1	28.2	57,884
Vehicles	113.6	125.8	0.2	12.4	2.9	2.7	23,460
Rail	27.3	52.7	0.4	6.1	1.3	1.3	5,296
Total	**437.5**	**1598.5**	**674.5**	**95.3**	**117.9**	**106.9**	**130,927**

21 Hydrocarbons

22 Because PM_{10} emissions are only slightly higher than $PM_{2.5}$ emissions, the trend for $PM_{2.5}$ emissions provides an accurate indicator for PM_{10} emissions as well.

The following provides a brief summary for each contaminant[23]:

- For 2010, regional CO emissions are dominated by CHE operations, although marine vessels and on-road vehicles also contribute substantial amounts.
- Regional NOx emissions are dominated by emissions from marine vessels.
- Regional SO_2 emissions are virtually all related to marine vessel operations.
- Regional scale VOC (as HC) emissions are related to both marine vessel and CHE operations.
- Regional-scale $PM_{2.5}$ emissions are primarily related to marine vessel operations, followed by important contributions from CHE operations at the Deltaport container terminal. On-road vehicles and rail locomotives contribute a relatively small share of overall emissions.
- On a regional scale, GHG (as CO_2e) emissions are split between marine vessels, CHE operations, and on-road vehicles, with rail providing a much smaller share of total annual emissions.

Refer to the SENES 2012a report for additional 2010 emissions data (i.e., hourly local emission inventory, and daily local emissions inventory).

5.5.4.2 Projected Annual Emissions Inventory (DTRRIP Operation)

An estimate of both local and regional air contaminant emissions for each horizon year (**Section 5.5.3**) were calculated for the same four source groups or activities listed above in **Section 5.5.2.6**.

Annual DTRRIP Emissions Inventories

Table 5.5-7 provides a summary of the local annual emissions of common air contaminants and CO_2e projected during the operation of DTRRIP.

Table 5.5-7 DTRRIP Local Annual Emissions 2014, 2017, 2020 (tonnes/yr)

Activity	Year	CO	NO_x	SO_2	HC	PM	$PM_{2.5}$	CO_2e
Ships	2014	58.8	663.3	200.6	19.2	39.3	34.8	35,841
	2017	74.9	603.3	19.3	24.5	32.9	29.0	45,657
	2020	80.4	403.6	20.8	26.4	31.3	31.3	48,947
CHE	2014	235.1	470.9	0.6	52.4	33.3	32.3	65,360
	2017	295.5	599.4	0.8	66.9	42.3	41.0	89,196
	2020	228.6	409.5	0.7	54.9	36.0	34.9	86,058
Vehicles	2014	24.4	31.6	0.06	4.6	0.6	0.6	6,169
	2017	37.5	38.6	0.09	6.3	0.8	0.7	8,395
	2020	37.6	38.1	0.09	6.3	0.8	0.8	8,303

[23] Because PM_{10} emissions are only slightly higher than $PM_{2.5}$ emissions, the trend for $PM_{2.5}$ emissions provides an accurate indicator for PM_{10} emissions as well.

Activity	Year	CO	NO_x	SO_2	HC	PM	$PM_{2.5}$	CO_2e
Rail	2014	7.6	24.1	0.3	2.3	0.6	0.6	3,452
	2017	7.0	27.5	0.04	2.1	0.6	0.5	4,871
	2020	7.0	27.5	0.04	2.1	0.6	0.5	4,871
Total	**2014**	**325.9**	**1189.9**	**201.56**	**78.5**	**73.8**	**68.3**	**110,822**
	2017	**414.9**	**1268.8**	**20.23**	**99.8**	**76.6**	**71.2**	**148,119**
	2020	**353.6**	**878.7**	**21.63**	**89.7**	**68.7**	**67.5**	**14,8179**

The following provides a summary and discussion of the anticipated trends for each contaminant[24]:

Carbon Monoxide (CO)

CO emissions are primarily related to CHE operations. CO emissions are projected to increase to 2017 with increasing cargo throughput, after which emissions would decline due to gradual replacement of older CHE with newer, lower emitting equipment to levels in 2020 that are near emission levels in 2010. As is indicated in the monitoring data at Station T39 in Tsawwassen, ambient CO concentrations are far below any ambient air quality objectives. Therefore, the increase in CO emissions to 2017 would not be expected to result in any exceedance of the objectives, particularly as CO emissions from other sources in the vicinity (traffic along the ferry terminal causeway and local traffic in Tsawwassen) are important contributors to ambient CO levels in the community.

Nitrogen Oxides (NO_X)

NO_X emissions are expected to increase to 2017 as a result of increased shipping and cargo handling activity. However, by 2020, the gradual replacement of older ships with newer vessels to meet more stringent emission standards and the retirement of much of the older CHE fleet at the Deltaport container terminal would result in some large decreases in NOx emissions after 2020. Existing one-hour average NO_2 concentrations for winds blowing from the Deltaport container terminal to Station T39 are less than one-third of the ambient air quality objective.

Sulphur Dioxide (SO_2)

Sulphur dioxide emissions are almost exclusively related to emissions from marine vessels. The implementation of the sulphur ECA for North America will reduce these emissions for the 2014 horizon year, with additional reductions after 2015 for the other horizon years considered in this assessment. Local SO_2 emissions due to DTRRIP would decline to 2017 and remain fairly constant thereafter.

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24 Because PM_{10} emissions are only slightly higher than $PM_{2.5}$ emissions, the trend for $PM_{2.5}$ emissions provides an accurate indicator for PM_{10} emissions as well.

Volatile Organic Compounds (VOC)

Local VOC (as HC) emissions are largely related to CHE operations, with additional important contributions from marine vessels. VOC emissions would reach a peak in 2017 due to increased volumes of cargo shipments. However, as some of the older CHE is replaced with newer, lower emitting equipment by 2020, overall VOC emissions are expected to decline to levels near existing emissions in 2010.

Fine Particulate Matter ($PM_{2.5}$)

Local emissions of fine particulate matter are almost entirely related to marine vessels and CHE operations. Reductions in $PM_{2.5}$ emissions from marine vessels are related to the implementation of the ECA[25] and gradual fleet turnover to newer vessels meeting more stringent emission standards. Reductions in emissions from CHE operations are entirely related to the retirement of older equipment at the Deltaport container terminal, especially the replacement of older RTG cranes with newer cranes. As a result, the overall trend in local $PM_{2.5}$ emissions is not straightforward. $PM_{2.5}$ emissions are relatively consistent to 2020.

Greenhouse Gas Emissions (expressed as CO_2e)

GHG emissions are primarily related to CHE operations, with additional important contributions from marine vessels. Local scale GHG emissions would reach a peak emission rate in 2020, and level off thereafter.

Table 5.5-8 provides a summary of the regional annual emissions of common air contaminants and CO_2e during the operation of DTRRIP.

Table 5.5-8 DTRRIP Regional Annual Emissions 2014, 2017 and 2020 (tonnes/yr)

Activity	Year	CO	NO_x	SO_2	HC	PM	$PM_{2.5}$	CO_2e
Ships	2014	94.3	1080.8	305.9	34.1	61.3	54.2	52,152
	2017	119.0	947.1	32.1	43.1	50.5	44.6	65,901
	2020	126.8	605.7	34.3	46.0	54.0	47.7	70,271
CHE	2014	235.1	470.9	0.6	52.4	33.3	32.3	65,360
	2017	295.5	559.4	0.8	66.9	42.3	41.0	89,196
	2020	228.6	409.5	0.7	54.9	36.0	34.9	86,058
Vehicles	2014	93.1	57.7	0.2	9.8	1.1	1.1	22,022
	2017	153.8	55.2	0.3	13.4	1.2	1.1	29,994
	2020	154.3	52.5	0.3	13.5	1.2	1.2	29,573

[25] With the adoption of the Emissions Control Area (ECA) in North America beginning in 2012, the sulphur content of marine fuels will be reduced by about 96% by January 1, 2015.

Activity	Year	CO	NO_x	SO_2	HC	PM	$PM_{2.5}$	CO_2e
Rail	2014	21.8	60.9	0.1	5.3	1.5	1.4	6,856
	2017	19.5	73.5	0.1	4.6	1.4	1.4	9,976
	2020	19.5	73.5	0.1	4.6	1.4	1.4	9,976
Total	2014	444.6	1670.3	306.8	101.6	97.2	89.0	146,390
	2017	587.8	1635.2	33.3	128	95.4	88.1	195067
	2020	529.2	1141.2	35.4	119.0	92.6	85.2	195878

The following provides a summary and discussion of the anticipated trends for each contaminant[26].

Carbon Monoxide (CO)

In 2014, 2017, and 2020, regional DTRRIP CO emissions are projected to be dominated by CHE operations, although marine vessels and on-road vehicles also contribute substantial amounts. CO emissions peak in 2017, and decline thereafter due to gradual replacement of older CHE with newer, lower emitting equipment to levels slightly below those in 2010.

Nitrogen Oxides (NOx)

Regional DTRRIP NOx emissions are dominated by emissions from marine vessels. The gradual replacement of older vessels with newer vessels that meet more stringent emission standards, as required by the International Maritime Organization starting in 2011 and the more stringent North American Emission Control Area (ECA) NOx requirements in 2016, is the primary driver for changes in regional NOx emissions. NOx emissions are expected to remain similar to 2010 levels until 2020, and decline thereafter to levels below those in 2010.

Sulphur Dioxide (SO_2)

Regional DTRRIP SO_2 emissions are virtually all related to marine vessel operations. These emissions are expected to decline with the implementation of regulations for the North American ECA in August 2012 and further regulatory reductions in fuel sulphur levels in 2015.

Volatile Organic Compounds (VOC)

Regional scale VOC (as HC) emissions are related to both marine vessel and CHE operations. Emissions are projected to reach a peak in 2017, declining afterward but remaining at levels higher than in 2010. The decline in VOC emissions from CHE operations is related to the anticipated replacement of older CHE at Deltaport, particularly the RTGs, after 2020.

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[26] Because PM_{10} emissions are only slightly higher than $PM_{2.5}$ emissions, the trend for $PM_{2.5}$ emissions provides an accurate indicator for PM_{10} emissions as well.

Fine Particulate Matter ($PM_{2.5}$)

Regional-scale DTRRIP $PM_{2.5}$ emissions are primarily related to marine vessel operations, followed by important contributions from CHE at Deltaport. On-road vehicles and rail locomotives contribute a relatively small share of overall emissions. The trend in projected regional-scale $PM_{2.5}$ emissions shows a variable rate of emissions, with a slight decrease in emissions to 2014-2020. The fluctuating trends in $PM_{2.5}$ emissions over the horizon years are due to the variable effects of lower emissions resulting from reductions in fuel sulphur levels for ships and the gradual replacement of older, higher emitting ships, CHE, trucks and locomotives over time, counterbalanced by increased cargo handling throughput at the terminal.

Greenhouse Gas Emissions (expressed as CO_2e)

On a regional scale, GHG emissions from DTRRIP are split between marine vessels, CHE, and on-road vehicles, with rail providing a much smaller share of total annual emissions. Annual GHG emissions would increase to 2020 and then remain relatively steady.

5.5.4.3 Projected Short-Term Local Emissions Inventory (DTRRIP Operation)

Whereas the annual emission summaries provided in **Tables 5.5-5** and **5.5-6** in **Section 5.5.4.1** provide a useful measure of overall trends in emissions over time, the assessment of air quality effects in relation to ambient air quality objectives at the local scale requires consideration of emissions in terms of daily and hourly emissions. The daily and hourly effects were assessed on an average and maximum basis for all horizon years and contaminants. Short-term emissions are calculated based on a set of assumptions about the average and maximum number of ships, trucks and trains arriving, at berth or departing from the Deltaport container terminal in a given hour or within a 24-hour period. Assumptions used to calculate the short-term emission inventories used to estimate air quality effects are provided in Appendix A of the SENES 2012a report.

The particulate matter fractions (PM, PM_{10}, and $PM_{2.5}$) all show similar trends and the discussion focuses on $PM_{2.5}$ as an indicator of the particulate matter contaminants.

Hourly DTRRIP Local Emission Inventory

The maximum and average hourly emissions are shown in **Table 5.5-9** and **Table 5.5-10** for the study contaminants. $PM_{2.5}$, SO_2, and NOx are projected to decrease over the study period, while CO and VOC (as HC) emissions peak in the 2017-2020 time frame. Only GHG emissions (as CO_2e) would be expected to increase above existing levels in future.

Table 5.5-9 Maximum Hourly DTRRIP Emissions (kg/hour)

Activity	Year	CO	NO_x	SO_2	HC	PM	$PM_{2.5}$	CO_2e
Ships	2014	31.8	386.3	92.5	11.7	20.0	17.7	16,975
	2017	31.8	348.8	8.8	11.7	13.3	11.7	16,975
	2020	31.8	348.8	8.5	11.7	13.3	11.7	16,975
CHE	2014	26.8	53.8	0.1	6.0	3.8	3.7	7,461
	2017	33.7	63.9	0.1	7.6	4.8	4.7	10,182
	2020	26.1	46.7	0.1	6.3	4.1	4.0	9,824
Vehicles	2014	27.7	19.2	0.05	3.5	0.4	0.3	4,620
	2017	34.4	22.4	0.07	4.3	0.5	0.4	6,367
	2020	34.6	22.1	0.07	4.4	0.5	0.4	6,307
Rail	2014	2.3	6.5	0.01	0.6	0.2	0.2	635
	2017	1.5	5.6	0.01	0.4	0.1	0.1	635
	2020	1.5	5.6	0.01	0.4	0.1	0.1	635
Total	2014	88.6	465.8	92.66	21.8	24.4	21.9	29,691
	2017	101.4	440.7	8.98	24.0	18.7	16.9	34,159
	2020	94	423.2	8.68	22.8	18.0	16.2	33,741

Table 5.5-10 Average Hourly DTRRIP Emissions (kg/hour)

Activity	Year	CO	NO_x	SO_2	HC	PM	$PM_{2.5}$	CO_2e
Ships	2014	16.0	186.2	44.7	5.7	9.5	8.4	8,024
	2017	16.5	171.2	4.2	5.9	6.5	5.7	8,594
	2020	17.9	56.1	4.6	6.5	7.1	6.3	9,314
CHE	2014	26.8	53.8	0.1	6.0	3.8	3.7	7,461
	2017	33.7	63.9	0.1	7.6	4.8	4.7	10,182
	2020	26.1	46.7	0.1	6.3	4.1	4.0	9,824
Vehicles	2014	10.7	13.3	0.03	2.0	0.3	0.2	3,056
	2017	13.1	15.6	0.04	2.6	0.3	0.3	4,212
	2020	13.2	15.5	0.04	2.6	0.3	0.3	4,212
Rail	2014	0.9	2.8	0.00	0.3	0.1	0.1	394
	2017	0.8	3.1	0.00	0.2	0.1	0.1	556
	2020	0.8	3.1	0.00	0.2	0.1	0.1	556
Total	2014	54.4	256.1	44.83	14	13.7	12.4	18,935
	2017	64.1	253.8	4.34	16.3	11.7	10.8	23544
	2020	58	121.4	4.74	15.6	11.6	10.7	23906

Carbon Monoxide (CO)

Hourly CO emissions for the DTRRIP local scale are primarily the result of ship, CHE, and vehicle activities. Under the maximum hourly emissions scenario, emissions are expected to peak in 2017 and decrease in 2020 to near existing levels. Ambient CO levels are well below any applicable air quality criteria, and the increase in maximum hourly CO emissions in 2017 would not result in those criteria being exceeded in Tsawwassen. In general, the average hourly emissions of CO are less than half of the maximum hourly emissions..

Nitrogen Oxides (NOx)

Local average hourly DTRRIP NOx emissions are dominated by ship operations until 2020 when the average hourly ship emissions contributions decrease by more than a factor of three. In general, the average hourly NOx emissions are approximately half that of the maximum hourly NOx emissions in the period up to 2020.

Sulphur Dioxide (SO_2)

As with the case for annual emissions, local hourly SO_2 emissions are almost entirely related to marine vessel operations. Total hourly emissions are projected to decrease after 2010 due to the implementation of the provisions for lower sulphur fuels under the North American ECA agreement. The maximum hourly SO_2 emissions are approximately double the average hourly SO_2 emissions.

Volatile Organic Compounds (VOC)

Local hourly emissions of VOCs (as HC) are primarily related to ship operations, with additional contributions from CHE operations. The relative magnitude of CHE emissions is projected to peak in 2017 and decrease by 2020 due to replacement of older equipment with newer equipment that meets more stringent emission standards. As a result, the importance of VOC emissions from marine vessels relative to the other three source groups is projected to increase over time. Overall, maximum hourly VOC emissions are projected to be within approximately 20 percent of existing 2010 levels throughout the study period with some increase to 2020. Average VOC emissions are marginally lower than maximum VOC emissions.

Fine Particulate Matter ($PM_{2.5}$)

Maximum hourly DTRRIP $PM_{2.5}$ emissions at the local scale are primarily related to marine vessel operations and are also a function of fuel sulphur content of the marine fuels used by those ships. On-road vehicles and rail locomotives contribute a relatively small share of overall emissions. The trend in projected local average $PM_{2.5}$ emissions shows a gradual decrease in emissions to approximately 60 percent of the existing 2010 emissions by 2020 due to lower fuel sulphur levels in fuels for ships and the gradual replacement of older, higher emitting ships with newer ships that meet more stringent

emission standards. Maximum hourly emissions are approximately double the average hourly emissions in 2010, but in later years the difference is less notable, with maximum hourly emissions being only about 20 percent higher than average hourly emissions.

Greenhouse Gas Emissions (expressed as CO_2e)

On a local scale, maximum GHG emissions from DTRRIP are split between ship and CHE. Emissions are expected to reach peak emission rates in 2020 due to the increase in total cargo handling throughput. For the maximum hourly emission scenario, GHG emissions in 2020 would be expected to increase by up to 45 percent above 2010 levels. The average hourly emissions are about 20 percent lower than the maximum hourly emissions.

Daily DTRRIP Local Emission Inventory

The maximum daily and average daily emissions are shown in **Table 5.5-11** and **5.5-12** for the study contaminants.

Table 5.5-11 Maximum Daily DTRRIP Emissions (kg/hour)

Activity	Year	CO	NO_x	SO_2	HC	PM	$PM_{2.5}$	CO_2e
Ships	2014	457.3	5468.2	1415.3	158.2	300.8	266.0	266,908
	2017	457.3	5243.4	120.9	158.2	200.9	177.4	266,908
	2020	469.1	5322.2	121.6	160.3	203.0	179.3	272,411
CHE	2014	644.0	1290.1	1.6	143.6	91.3	88.6	179,068
	2017	809.5	1532.5	2.1	183.2	115.9	112.4	244,372
	2020	626.2	1121.9	1.9	150.3	98.7	95.7	235,774
Vehicles	2014	102.7	153.2	0.34	21.7	3.0	2.8	34,777
	2017	124.5	181.4	0.47	28.5	3.7	3.5	47,269
	2020	125.5	178.0	0.47	28.7	3.8	3.5	47,959
Rail	2014	20.9	66.2	0.08	6.2	1.6	1.5	9,458
	2017	19.2	75.4	0.11	5.7	1.5	1.5	13,345
	2020	19.2	75.4	0.11	5.7	1.5	1.5	13,345
Total	2014	1224.9	6977.7	1417.32	339.7	396.7	358.9	490211
	2017	1410.5	7032.7	123.58	375.6	322	294.8	571894
	2020	1240	6697.5	124.08	345	307	280	569489

Table 5.5-12 Average Daily DTRRIP Emissions (kg/day)

Activity	Year	CO	NO_x	SO_2	HC	PM	$PM_{2.5}$	CO_2e
Ships	2014	91.4	1018.2	289.7	29.4	57.3	50.7	53,481
	2017	93.8	1008.2	22.9	30.3	38.7	34.2	54,876
	2020	105.3	351.3	25.3	33.9	43.0	38.0	61,098
CHE	2014	644.0	1290.1	1.6	143.6	91.3	88.6	179,068
	2017	809.5	1532.5	2.1	183.2	115.9	112.4	244,372
	2020	626.2	1121.9	1.9	150.3	98.7	95.7	235,774
Vehicles	2014	90.5	111.3	0.26	16.7	2.2	2.0	25,539
	2017	110.6	131.6	0.36	21.5	2.7	2.5	35,441
	2020	111.4	129.1	0.36	21.7	2.7	2.5	35,159
Rail	2014	20.9	66.2	0.08	6.2	1.6	1.5	9,458
	2017	19.2	75.4	0.11	5.7	1.5	1.5	3,345
	2020	19.2	75.4	0.11	5.7	1.5	1.5	13,345
Total	2014	846.8	2885.8	561.28	205.9	152.4	142.8	267546
	2017	1033.1	2747.7	25.47	240.7	158.8	150.6	338034
	2020	862.1	1677.7	27.67	211.6	145.9	137.7	345376

Carbon Monoxide (CO)

Maximum daily CO emissions for the DTRRIP local scale are primarily associated with ship and CHE operations in 2010, and these two source categories remain as the primary sources of CO emissions to 2017. Thereafter, emissions from ships become more important for the maximum daily emissions, while CHE emissions dominate for the average daily emissions. Overall, maximum CO emissions are projected to increase over existing emissions in 2010 until the 2017-2020 period.

Nitrogen Oxides (NOx)

Local DTTRIP NOx emissions are dominated by ship operations until 2017, after which time emissions are associated with both ship and CHE. By 2020, average daily NOx emissions are expected to be less than half of those in 2010. Local average daily DTRRIP NOx emissions are the result of a combination of ship and CHE operations until 2020 when the average hourly ship emissions contributions decrease by up to a factor of three and CHE activities become the dominant source of NOx emissions.

Sulphur Dioxide (SO_2)

SO_2 emissions are almost entirely related to marine vessel operations. Total average and maximum daily emissions are projected to decrease after 2010 due to the implementation of the provisions for lower sulphur fuels under the North American ECA. The maximum predicted daily SO_2 emissions in 2020 are estimated to be approximately four times higher than the average daily SO_2 emissions.

Volatile Organic Compounds (VOC)

Maximum daily DTTRIP emissions of VOCs (as HC) at the local scale are currently split between marine vessel and CHE operations while local average daily emissions of VOCs are primarily related to CHE operations. Overall maximum VOC emissions are projected to increase above existing levels in 2010 to 2020. Average emissions increase to 2017 and then decrease to near 2010 levels in 2020. Average daily VOC emissions are estimated to be approximately 40 percent lower than maximum daily VOC emissions.

Fine Particulate Matter ($PM_{2.5}$)

Maximum daily DTRRIP $PM_{2.5}$ emissions at the local scale are primarily related to marine vessel operations, while average daily $PM_{2.5}$ emissions are primarily related to CHE operations. Both maximum and average daily emissions are also a function of fuel sulphur content. On-road vehicles and rail locomotives contribute a relatively small share of overall emissions. The trend in projected local average and maximum daily $PM_{2.5}$ emissions shows a decrease in emissions to less than half of the existing 2010 emissions by the year 2020. Maximum daily emissions are approximately double the average daily emissions for most of the study years.

Greenhouse Gas Emissions (expressed as CO_2e)

On a local scale, maximum daily GHG emissions from DTRRIP are split between ship and CHE, while average GHG emissions from are dominated by CHE operations. Maximum daily GHG emissions are projected to increase by approximately ten percent above 2010 levels by 2020 due to the increase in cargo handling throughput.

5.5.4.4 Business as Usual Scenario (No DTRRIP)

Total Annual Regional Emissions

The 2014 horizon year scenario was considered an adequate representation of BAU scenario as the Deltaport Container Terminal has an effective cap of 1.8 million TEU cargo handling capacity, and the 2014 horizon year for DTRRIP considered 1.74 million TEU as its capacity. Cargo throughput was held at 2014 levels for BAU for the balance of the horizon years (2020 and 2030). Refer to SENES 2012b, for additional details on the BAU assessment.

Nitrogen Oxides (NO_x)

NO_x emissions are expected to decrease to below half of the 2010 emissions by 2030 under both scenarios (DTRRIP and BAU). The dominant contributors to NO_x emissions are ships and CHE in both BAU and DTRRIP. Total annual DTRRIP NO_x emissions are expected to be 26% higher than BAU NO_x emissions in 2020 and 2030.

Sulphur Dioxide (SO_2)

SO_2 emissions are dominated by ships and are highest in 2010. By 2020, when low sulphur fuel regulations have been fully implemented, SO_2 emissions for both BAU and DTRRIP are expected to be reduced by 95% or more from levels in 2010.

Fine Particulate Matter ($PM_{2.5}$)

$PM_{2.5}$ emissions are dominated by ships, but with a large contribution from CHE as well. $PM_{2.5}$ emissions are highest in 2010, but by 2030 would be reduced to 48% of 2010 levels for the BAU scenario and to 60% of 2010 levels for DTRRIP. As with SO_2, $PM_{2.5}$ emissions are impacted favourably by lower sulphur fuel regulations and start to decrease by 2020. Annual emissions of $PM_{2.5}$ will be approximately 23% higher with DTRRIP than with BAU in 2030.

Greenhouse Gas Emissions (expressed as CO_2e)

CO_2e emissions are dominated by CHE and ships and are highest in 2020. Total annual emissions in 2020 and 2030 are higher for both BAU and DTRRIP than in 2010. Emissions for DTRRIP are about 30% higher than for the BAU scenario in both 2020 and 2030. Emissions decrease for CHE by about 20% between 2020 and 2030 as the RTG cranes are assumed to be replaced with electric cranes for both scenarios.

Summary

Short term concentrations of contaminants at monitoring locations in Tsawwassen would not necessarily be different between the BAU and DTRIRP scenarios as concentrations at these locations are more influenced on the number of ships at the terminal berths at one time or the amount of cargo loaded and unloaded per hour or within a 24-hour period, and not on the total annual activity of ships, CHE, vehicles and trains. However, quite small differences in ambient air quality effects from the DTRRIP scenario could be observed at roadside and trackside locations due to the higher number of container trucks and container trains that would be needed to transport the additional cargo under DTRRIP versus the BAU scenario (SENES, 2012b).

As the air quality effects for the BAU scenario would be similar to or lower than the effects projected for the DTRRIP emission scenario, BAU is not considered in the effects assessment below in **Section 5.5.5**.

5.5.5 Potential Effects and Proposed Mitigations

This section identifies and analyses potential effects associated with the Project. The analysis of potential effects compares the existing conditions, described above, potential changes in air contaminant emissions and associated effects on air quality as a result of the construction and operation of DTRRIP.

5.5.5.1 Construction

The effects of DTRRIP construction activities cannot be quantified until a detailed construction plan is developed. As such, explicit effects on air quality during construction were not included in the air quality assessment (SENES, 2012a). However, it should be noted that air quality effects associated with construction activities would be temporary and low in magnitude, similar to those that were determined for the Deltaport Third Berth Project. As a result, air emissions from construction have not been included in the assessment of regional trends, and regional-level effects from DTRRIP.

The effects of construction on air quality include sources such as worker travel to construction sites, emissions associated with trucks transporting pre-load material, equipment emissions and dust created during site clearing, pre-loading and overpass construction. In general, these sources have low effect because they have a small contribution to total emissions or can be effectively mitigated by standard best management practices (dust generation during construction).

Standard mitigation measures during construction may include:

- Maintaining construction equipment in good working order.
- Watering of exposed soils and haul roads to reduce fugitive dust emissions.
- Chemical stabilisation by applying environmentally compatible soil stabilisers and dust suppressants to maintain soil moisture levels in exposed soils.
- Traffic and speed restrictions on vehicles at the construction site to reduce the amount of dust generated through travel on exposed soils.
- Minimising the areas of disturbed soils.
- Compaction of disturbed soils when not being worked.
- Wind breaks to reduce wind erosion.
- Covering steep slopes with netting or mulch to reduce wind erosion.
- Track-out controls to prevent dirt or mud from being spread by trucks leaving the construction site. These may include:
    - Asphalt paving or gravel at driveway access points.
    - Removal of dirt or mud deposited on paved roads.
    - Limiting load size and covering the loaded trucks when hauling material off-site;

    - Watering or chemical stabilisation of loads.
    - Washing or treating loaded haul trucks to remove materials from the exterior of the vehicles prior to leaving the site.
    - Speed restrictions.
- Maintain construction equipment in good working order and operate equipment at optimum rated loads.
- All heavy-duty diesel on-road vehicles (i.e., licensed vehicles, such as dump trucks) are in good working order while operating on the project site.
- Operate equipment and vehicles so as to minimize exhaust emissions by restricting idling of machinery when not in use.

With the implementation of the above mitigation measures, no residual adverse effects are anticipated.

5.5.5.2 Operations

Potential effects associated with the DTTRIP operation phase may include changes to the local and regional air quality.

The effect on ambient air quality resulting from the short-term (i.e., hourly, daily) emission estimates were evaluated based on anticipated changes in ambient concentrations at the location of the T39 air quality monitoring station on English Bluff in Tsawwassen and beside the road and rail corridors leading from Roberts Bank. For the purposes of this screening-level assessment, the determination of ambient air quality concentrations due to emissions at Roberts Bank were based on the observed air quality concentrations at the station as being representative of average emission rates at Roberts Bank in 2010, and relative increases in average and maximum, hourly, and daily emission rates. No new dispersion modelling was conducted for this assessment to estimate changes in air quality at Station T39. For changes in air quality beside the road and rail corridors, a previous dispersion modelling analysis conducted for the Deltaport Third Berth Project (SENES, 2006) was used to determine the incremental change in concentrations within 200 metres of the road or rail corridor.

Source-Receptor Effects at Station T39 due to DTRRIP Operation

The daily and hourly effects on air quality were assessed on an average and maximum emission scenario basis for all horizon years and contaminants. **Table 5.5-13 and Table 5.5-14** list the estimated hourly and daily (respectively) ambient air concentrations at Station T39 for the changes in emissions at Roberts Bank that would be attributable entirely to changes in emissions at Deltaport. The estimates include Project inputs only (i.e., they do not include changes in hourly emissions that would be attributable to other emission sources such as operations at Westshore Terminals, the Tsawwassen Ferry Terminal, on-road vehicular traffic at the ferry terminal, and along roads on English Bluff).

Because the emission of SO_2 at Roberts Bank is almost entirely related to emissions from marine vessels, the relationship between emission rates at Roberts Bank and observed ambient air concentrations at English Bluff provides a suitable indicator compound for estimating the relationship between emissions and observed concentrations over the approximate five-kilometre distance. For the purposes of this analysis, only the SO_2 emissions from ship manoeuvring and while at berth were considered to be solely responsible for the observed SO_2 concentrations at T39 for winds from the sector 260° -340°. The contribution of SO_2 emissions from ships while underway to or from Roberts Bank does not need to be accounted for explicitly because these emissions would occur over a wider area and their contribution to ambient concentrations at a given point such as T39 would not coincide with emissions from ships closer to Roberts Bank while manoeuvring and at berth. Although some SO_2 emissions would also be attributable to the operation of ferries at the Tsawwassen terminal, the B.C. Ferry Corporation uses low sulphur fuel compared with ocean-going vessels that call at Roberts Bank. Consequently, all of the observed effect at Station T39 was conservatively assumed to be attributable to marine vessels at the Deltaport and Westshore terminals.

The highest observed hourly and daily SO_2 concentration at Station T39 occurred on June 22, 2010 with a maximum hourly averaged SO_2 concentration of 53.5 µg/m3 and a 24-hour averaged concentration of 7.1 µg/m3. For the purposes of this assessment, it has been conservatively assumed that the maximum observed SO_2 concentrations at Station T39 on this date were representative of average SO_2 emissions at Roberts Bank in 2010.

The average hourly SO_2 emission rate at Roberts Bank (Deltaport and Westshore Terminals) was estimated at 132.6 kg/h, while the average daily SO_2 emission rate was estimated at 1069.1 kg/day for ship manoeuvring and berthing activity (refer to Section 6.0 of SENES, 2012). Using these emission rates and the observed SO_2 concentrations listed in **Table 5.5-3** and **Table 5.5-4**, the source-receptor relationships for average hourly and daily SO_2 emissions are listed in **Table 5.5-13**.

Table 5.5-13 Source-Receptor Relationship for SO_2 Emissions at Roberts Bank

Emission Scenario	Source-Receptor Relationship ($\mu g/m^3$ at T39 per 1 kg SO_2 emission at Roberts Bank)		
	100th Percentile	99th Percentile	98th Percentile
Maximum Hourly	0.4036	0.1109	0.0868
Maximum Daily	0.0066	0.0060	0.0056

Taking a conservative approach, the same relationship was assumed to apply for CO and $PM_{2.5}$ as well, since these contaminants are non-reactive contaminants over the distance between Roberts Bank and the T39 monitoring station. Further rationale for this approach is provided in SENES 2012a.

The source-receptor relationship for NO_2 is somewhat more complicated to estimate than for CO, SO_2 and $PM_{2.5}$ because 90-95 percent of the NO_x emitted at Roberts Bank is emitted as NO, and only a portion of this is likely to be transformed to NO_2 in transport from Roberts Bank to T39. The approach adopted in this assessment attempts to provide a realistic estimate of NO_2 concentrations based on the Janssen method (1998), and additional detail on this approach is provided in SENES 2012a.

Table 5.5-14 Estimated DTRRIP Hourly Averaged Concentrations at Station T39[27]

Horizon Year	AAQO (µg/m³)	1-Hour Average Concentrations (µg/m³) at Percentile Level					
		Average Hourly Activity			Peak Hourly Activity		
		100th	99th	98th	100th	99th	98th
CO							
2010	30,000	797.1	370.3	347.3	810.7	374.0	350.2
2014		398.0	370.5	347.5	812.2	374.5	350.5
2017		802.0	371.6	348.3	817.5	375.9	351.7
2020		799.5	370.9	347.8	814.4	375.1	351.0
NO_2							
2010	200	55.3	47.3	42.3	91.7	57.3	50.1
2014		56.3	47.6	42.3	90.9	57.1	49.9
2017		56.0	47.5	42.4	86.8	56.0	49.0
2020		34.1	41.5	37.7	83.9	55.2	48.4
SO_2							
2010	450	46.4	12.7	10.0	101.4	24.9	21.8
2014		18.6	5.1	4.0	38.5	10.6	8.3
2017		1.8	0.5	0.4	3.6	1.0	0.8
2020		1.9	0.5	0.4	3.6	1.0	0.8

Note: Representative of contaminant dispersion from the 260°-340° wind sector

Table 5.5-15 Estimated DTRRIP Daily Averaged Concentrations at Station T39

Horizon Year	AAQO (µg/m³)	24-Hour Average Concentrations (µg/m³) at Percentile Level					
		Average Daily Activity			Peak Daily Activity		
		100th	99th	98th	100th	99th	98th
NO_2							
2010	200	46.0	38.0	36.0	57.0	47.9	45.4
2014		46.1	38.1	36.1	56.9	47.9	45.4
2017		46.8	38.7	36.7	57.1	50.7	45.5
2020		44.2	36.4	34.4	56.3	47.3	44.8

[27] GHG emissions do not have an effect on local or regional air quality and are only a concern as contributions to total GHG emissions in the LFV, BC or Canada as a whole in relation to global warming potential. Therefore GHG emissions were not included in the effect assessment.

Horizon Year	AAQO (µg/m^3)	24-Hour Average Concentrations (µg/m^3) at Percentile Level					
		Average Daily Activity			Peak Daily Activity		
		100th	99th	98th	100th	99th	98th
SO_2							
2010	125	4.3	3.9	3.6	22.3	20.1	18.8
2014		1.8	1.6	1.5	8.6	7.7	7.3
2017		0.2	0.1	0.1	0.7	0.7	0.6
2020		0.2	0.2	0.1	0.8	0.7	0.6
$PM_{2.5}$							
2010	25	9.1	8.4	7.9	11.2	10.3	9.7
2014		9.0	8.3	7.8	10.3	9.5	8.9
2017		9.1	8.3	7.8	9.9	9.1	8.6
2020		9.0	8.3	7.8	9.9	9.0	8.5

Note: Representative of contaminant dispersion from the 260° -340° wind sector.

CO Concentrations

There would be fairly minor variation in one-hour average CO concentrations in Tsawwassen for the five horizon years for the average hourly emission scenario as compared with existing observed CO concentrations at T39 in 2010. For the peak hourly emission scenario, CO concentrations would be five-to-eight µg/m^3 higher than for the average emission scenario at the 100th percentile level, but all concentrations would remain well below the Metro Vancouver AAQO level of 30,000 µg/m^3.

NO_2 Concentrations

The observed one-hour average NO_2 concentrations in Tsawwassen could increase by about five µg/m^3 between 2010 and 2017 for the average emission scenario, but would then be reduced by more than 20 µg/m^3 at the 100th percentile level by 2020 due to fleet turnover of ships and CHE. Although the peak one-hour average NO_2 concentrations may be more than 40 µg/m3 higher with the peak emission scenario than for the average emission scenario, all NO_2 concentrations would remain well below the Metro Vancouver AAQO of 200 µg/m^3.

There would be minor variations in 24-hour average NO_2 concentrations during the horizon years 2014 and 2017 compared with existing levels in 2010 for the average emission scenario, but NO_2 concentrations could be reduced by two µg/m^3 in 2020 at the 100th percentile level. The NO_2 concentrations could be approximately 13-14 µg/m^3 higher for the peak emission scenario until 2017 than has been observed to date. However, by 2020, NO_2 concentrations for the peak emission scenario would be comparable to existing levels for the average emission scenario. All concentrations would remain well below the Metro Vancouver AAQO of 200 µg/m^3.

SO_2 Concentrations

Hourly averaged SO_2 concentrations in Tsawwassen are currently at their peak for emissions from the direction of Roberts Bank and will decline by 2014 and again, most precipitously, after 2017. The reduction in fuel sulphur content as part of the ECA will reduce observed SO_2 concentrations to a fraction of existing levels for winds from Roberts Bank from 2017 to 2020. All one-hour average SO_2 concentrations would remain well below the Metro Vancouver AAQO of 450 µg/m^3 for all emission scenarios and all horizon years.

All projected 24-hour average SO_2 concentrations for the average emission scenario represent a small fraction of the Metro Vancouver AAQO of 125 µg/m^3 for all horizon years. With the reduction in fuel sulphur levels, 24-hour average SO_2 concentrations from the direction of Roberts Bank would be reduced to below existing observations after 2014 even for the peak emission scenario.

$PM_{2.5}$ Concentrations

For the combustion sources at Roberts Bank, all projected changes in 24-hour average $PM_{2.5}$ concentrations in Tsawwassen would vary by less than 0.5 µg/m^3 over the future horizon years at the 100th percentile level for the average emission scenario. Concentrations could potentially be about 1.5-2 µg/m^3 higher for the peak traffic day emission scenario than for the average traffic day emission scenario, but would remain at 40 percent or less of the Metro Vancouver AAQO of 25 µg/m^3 in future horizon years.

Source – Receptor Effects along Road and Rail Corridors due to DTRRIP Operation

The road and rail traffic emissions associated with the marine terminals at Roberts Bank were evaluated in terms of incremental changes in ambient air quality within a distance of 200 metres from the road and rail corridors. In order to estimate maximum effects, it was assumed that all vehicular traffic would flow along one road. Therefore, the results presented are representative of maximum effects along Deltaport Way and the SFPR (see **Section 5.5.2.7**).

While air quality concentrations due to both peak and average traffic levels were presented in the SENES 2012a technical report, the peak concentrations are discussed below because, for all contaminants, the concentrations are well below applicable criteria or are indistinguishable from background levels when using the peak traffic scenarios. Accordingly, the average concentrations would also be below the applicable criteria.

The air quality effects of emissions from traffic related to road and rail corridors is presented as incremental effects for these traffic emissions alone. Background air quality levels for emissions from other sources are based on the 98th percentile concentrations observed at Station T39, consistent with the methodology recommended in the *Guidelines for Air Quality Dispersion Modelling in British Columbia* issued by the Ministry of Environment. The use of the 98th percentile value of observed concentrations is an inherently conservative approach to defining background air quality.

Refer to the technical report prepared by SENES (2012) for additional assumptions and methods used in the assessment.

DTRRIP Roadside Air Quality Effects

Roadside emissions were calculated based on assumptions about the maximum number of container trucks and employee owned vehicles that are likely to be using a particular stretch of roadway in a given hour. All traffic was assumed to be on the same roadway, so the emissions may be most representative of emissions along the SFPR between Highway 99 and Roberts Bank (refer to Table 6.10 in the technical report by SENES (2012) for the estimated emission rates (in kg/hr-km) for the average hour and peak hour traffic levels assumed to occur along a kilometre of SFPR roadway).

Table 5.5-16 lists the estimated incremental one-hour peak ambient air quality effects beside the roadway for the peak hour traffic levels along the roadway. Predicted concentrations are highest within ten metres of the roadway, and decrease with increasing distance from the roadway.

Table 5.5-16 Estimated DTRRIP Average Concentrations – Road

Distance (metres)	AAQO (µg/m^3)	1-Hour Average Concentrations (µg/m^3)			
		Peak Hour Traffic Activity			
		2010	2014	2017	2020
CO					
50	30,000	156	185	230	231
190		69	82	102	102
NO_2					
50	200	22.3	9.6	6.1	5.4
190		8.9	3.8	2.4	2.2
SO_2					
50	450	0.5	0.6	0.8	0.8
190		0.2	0.3	0.4	0.4
$PM_{2.5}$					
50	n/a	2.0	0.8	0.7	0.7
190		0.9	0.4	0.3	0.3

CO Concentrations

For CO emissions, the highest effects are projected to occur in 2020 for the peak hour traffic activity scenarios. At 50 metres, from the roadway, ambient concentrations are estimated at 231 µg/m^3, declining with distance from the roadway to 102 µg/m^3 at 190 metres from the roadway. Even if the 98th percentile observed CO concentration of 394 µg/m^3 (see **Table 5.5-2**) were added as background CO concentration to the incremental effects, the total ambient air concentration of 625 µg/m^3 would represent approximately two percent of the Metro Vancouver ambient air quality objective of 30,000 µg/m^3.

NO_2 Concentrations

Due to more stringent emission standards for heavy-duty diesel-powered vehicles and fleet turnover, ambient air quality NO_2 effects from container trucks on the roadway are estimated to be highest in 2010, declining in all subsequent years, even with the projected additional traffic levels in 2020 (**Table 5.5-16**). At 50 metres from the roadway, the maximum estimated incremental ambient air quality effect for peak traffic levels in 2010 is 27.6 µg/m^3. Even with the addition of the observed 98th percentile NO_2 concentration of 46 µg/m^3 at T39 as a measure of background NO_2 levels, the total air quality level of 73.6 µg/m^3 is still well below the Metro Vancouver ambient air quality objective of 200 µg/m^3. With declining emissions in all subsequent years, the AAQO would be achieved at all distances from the roadway.

SO_2 Concentrations

Table 5.5-16 indicates that all estimated peak hour ambient air concentrations of SO_2 are very low, ranging from 2.1 µg/m^3 for peak traffic levels in 2010 (10 metres from roadway) to just 3.4 µg/m^3 for peak traffic levels in 2020. Even if the 98th percentile SO_2 concentration of 7.2 µg/m^3 were added to the incremental effects from DTRRIP roadway emissions, the total concentration of SO_2 would be less than three percent of the Metro Vancouver ambient air quality objective of 450 µg/m^3. At greater distances from the roadway, the small incremental effects of less than one-to-two µg/m^3 would be indistinguishable from background SO_2 concentrations.

$PM_{2.5}$ Concentrations

Similar to the NO_2 concentrations, the estimated $PM_{2.5}$ concentrations are highest in 2010 and decline in subsequent years, even with increased traffic activity in 2020. There are no applicable ambient air quality objectives for one-hour peak $PM_{2.5}$ concentrations. However, since measured concentrations of $PM_{2.5}$ less than three µg/m^3 are likely to fall within the 'noise' range of monitoring equipment[28], all estimated concentrations beyond 50 metres from the roadway in the horizon years 2014 and beyond are likely to be indistinguishable from background concentrations.

DTRRIP Rail Air Quality Effects

The DTRRIP rail corridor emissions assume one container train per hour for the average hour traffic scenario and two trains per hour for the peak hour traffic scenario. Table 6.11 of the SENES (2012) technical report lists estimated emission rates along a one kilometre stretch of the rail corridor.

Table 5.5-17 lists the estimated one-hour average concentrations in the immediate vicinity of the rail corridor for the peak hour train activity related to DTRRIP.

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[28] For example, studies of collocated continuous PM_{10} sampling instruments have a reported precision of $\pm$2.8 µg/m^3 for hourly averaged PM_{10} concentrations. Due to the smaller mass of $PM_{2.5}$ particles, the precision of $PM_{2.5}$ sampling equipment could be even lower.

Table 5.5-17 Estimated DTRRIP Average Hour Concentrations – Rail

Distance (metres)	AAQO (µg/m^3)	1-Hour Average Concentrations (µg/m^3)			
		Average Hour Traffic Activity			
		2010	2014	2017	2020
CO					
50	30,000	20.9	15.6	9.2	9.2
190		9.2	6.9	4.1	4.1
NO_2					
50	200	11.1	10.1	8.4	8.4
190		4.4	4.0	3.4	3.4
SO_2					
50	450	0.75	0.08	0.08	0.08
190		0.34	0.03	0.03	0.03
$PM_{2.5}$					
50	n/a	1.4	1.2	0.8	0.8
190		0.7	0.6	0.3	0.3

CO Concentrations

At 50 metres from the rail line CO concentrations in 2010 are 22.9 µg/m^3, declining slightly by 2014 and then remaining steady. Even if the 98th percentile CO concentration measured at T39 (**Table 5.5-3**) were to be added to the predicted incremental effects from rail emissions, the total concentration of 370 µg/m^3 in 2010 would comprise less than one percent of the Metro Vancouver ambient air quality objective of 30,000 µg/m^3. Concentrations would be even lower at greater distances from the rail line.

NO_2 Concentrations

At 50 metres from the rail line NO_2 concentrations in 2010 are 20.0 µg/m^3, declining in 2014 and then remaining steady. Even if the 98th percentile NO_2 concentration measured at T39 (**Table 5.5-3**) were to be added to the predicted incremental effects from rail emissions, the total concentrations of 63.8 µg/m^3 in 2010 at 50 metres from the rail line is still well below the Metro Vancouver ambient air quality objective of 200 µg/m^3, and would be much lower at greater distances from the rail line.

SO_2 Concentrations

At 50 metres from the rail line SO_2 concentrations in 2010 are 1.5 µg/m^3, declining in 2014 to 0.2 µg/m^3 or less at greater distances from the rail line by 2020. At such low levels, the incremental effects of SO_2 emissions from the rail corridor would be indistinguishable from background SO_2 levels.

$PM_{2.5}$ Concentrations

At 50 metres from the rail line NO_2 concentrations in 2010 are 2.4 µg/m^3, declining in 2014 and then remaining steady. Incremental $PM_{2.5}$ concentrations would be less than 1.0 µg/m^3 at 190 metres from the rail line from 2014 onwards, making the incremental effects indistinguishable from background $PM_{2.5}$ levels.

5.5.5.3 Summary of Predicted Effects

In general, for most contaminants, ships and CHE are the dominant sources from DTTRIP with minor contributions from the rail and vehicle activities. The following annual trends are observed for both local and regional emissions:

- CO and VOCs increase to 2017 and 2020 due to increased cargo handling throughput, but remain well below applicable air quality objectives and standards.
- NO_x emissions increase to 2014 and 2017, and then decrease to well below 2010 levels, primarily due to fleet turnover to equipment that meets more stringent emissions standards.
- SO_2 emissions are dominated by shipping activities and are highest in 2010 and then decrease to well below 2010 levels by 2014 as a result of lower sulphur fuel requirements established by the North America ECA (see additional text below).
- Particulate emissions, including PM_{10} and $PM_{2.5}$, fluctuate around 2010 levels due to decreased emissions associated with lower fuel sulphur levels and the gradual replacement of older ships, CHE, and on-road vehicles but also increased operations due to higher cargo handling throughput.
- CO_2e emissions increase above 2010 levels to 2020 due to higher cargo handling throughput and then stabilise near the 2020 levels after 2020.

At present, the average fuel sulphur content of marine fuel used by commercial vessels in Vancouver is about 2.7 percent. With the regulatory adoption of the sulphur portion of the North American ECA that comes into effect on August 1 2012, the sulphur content of marine fuels will be reduced significantly. All vessels within the North American ECA zone will be required to use fuel with no more than one percent fuel sulphur content. By January 1, 2015, ships will not be allowed to use fuel with sulphur content greater than 0.1 percent. This requirement will result in a reduction in SO_2 emissions of approximately 96 percent from marine vessels compared to existing levels. Because the emission of $PM_{2.5}$ is partially related to SO_2 emissions, the reduction in fuel sulphur content will also result in lower $PM_{2.5}$ emissions as well. In addition, the ECA will require that newer ships have reduced levels of NOx emission, representing an 80 percent reduction in emissions from existing standards.

5.5.5.4 Proposed Mitigation

Based on the air quality effects assessment, the emissions due to Project Operation meet the applicable objectives and standards. However, Port Metro Vancouver and TSI, the terminal operator, will work together to pursue further initiatives to reduce air quality emissions related to operation of the existing Deltaport container terminal and the Project. This could include, but is not limited to, the use of electric rather than diesel-powered equipment. Emission reductions from CHE are anticipated to occur as a result of normal equipment fleet turnover to newer, lower emitting equipment as each piece of equipment reaches the end of its useful working life. The largest emission reductions could occur as a result of the replacement of the RTG cranes at the Deltaport container terminal by newer diesel-powered RTGs that meet more stringent emission standards.

Port Metro Vancouver is currently undertaking a number of initiatives to reduce air emissions for the entire Port jurisdiction, including the existing Deltaport container terminal. Port Metro Vancouver's Air Action Program focuses on development of a data baseline, reducing emissions and tracking progress towards Port Metro Vancouver's goal of continuous improvement in terms of reducing emissions that contribute to air quality and climate change.

Port Metro Vancouver is collaborating with other ports, the marine industry and with government agencies to develop a data baseline, promote efficiency, implement technologies, and support regulatory changes to reduce air emissions. Some key components of the Air Action Program include:

- EcoAction Program – promotes attainable emissions reduction goals for ocean-going vessels that enter Port Metro Vancouver, and rewards those who excel in environmental stewardship. In 2010, Port Metro Vancouver launched the Blue Circle Award for the EcoAction Program for Shipping, a user-friendly financial incentive for shipping lines that reduce emissions of their ocean-going vessels.
- Northwest Ports Clean Air Strategy – Port Metro Vancouver is working with the Ports of Seattle and Tacoma to address port-related contributions to air quality and climate change in the Georgia Basin Puget Sound air shed through the Northwest Port's Clean Air Strategy. Port Metro Vancouver also collaborates with national and international stakeholders to ensure the programs in place have a lasting effect.
- Land Side Air Emissions Inventory – Port Metro Vancouver undertook, with scientific input and oversight from Environment Canada and Metro Vancouver, a port landside emissions inventory for all common air contaminants and greenhouse gases. The first inventory was completed in 2008 for the 2005 inventory year and subsequently updated for the 2010 inventory year in 2012 and expanded to include energy use
- Truck Licensing System (TLS) Program – Starting in 2008 Port Metro Vancouver introduced increasingly stringent environmental requirements into the Container TLS Program. Requirements focused on the replacement of older truck engine platforms, mandatory opacity testing, idling limits when on Port property and a driver awareness program. Consistent with the Northwest Ports Clean Air Strategy, the TLS requirements will bring the Port container truck fleet up to the equivalent of a 2007 truck engine performance for particulate matter emissions by 2015.

All maximum incremental concentrations predicted for Project operation, in conjunction with 98th percentile background values measured in Tsawwassen, are less than applicable Canada-wide Standards and the Metro Vancouver AAQO's. The contribution of Project operation emissions and the effect on ambient air quality in the local and regional area is considered low for all operational emission scenarios. Notwithstanding that this assessment indicates only small and temporary increases in some contaminants that could affect air quality, these changes were regarded to be residual effects and carried forward into the cumulative effects assessment (see **Section 8.0**).

5.5.6 Residual Effects and Determination of Significance

Changes to air quality are considered low in magnitude and occurring over the local and regional area. The effect is considered temporary in duration as most of the minor increases that are predicted for future years (i.e., 2014 and 2017) are predicted to decrease to near or below 2010 concentrations in the years beyond 2017 (when additional regulatory improvements or proponent implemented changes would likely be fully realised). The residual adverse effect is considered to be not significant. Based on the air quality assessment methodology and available information from the various studies conducted to date in Delta and Tsawwassen, as well as data collected from Station T39, this prediction is made with a high degree of confidence.

6.0 SOCIO-COMMUNITY EFFECTS ASSESSMENT

6.1 NOISE AND VIBRATION

6.1.1 Introduction

The noise and vibration effect assessment identifies potential noise effects on adjacent areas as a result of the construction and operation of DTRRIP, and mitigation measures where appropriate. This section is based on the noise and vibration effects assessment undertaken by BKL Consultants Ltd. (BKL) titled *Deltaport Terminal Road and Rail Improvements Project Environmental Noise and Vibration Assessment* (2012), which provides further details on methodology, and results.

This section considers the potential noise and vibration effects on noise-sensitive residential[29] land uses adjacent to the Project and includes:

- An evaluation of existing noise and vibration conditions adjacent to the Project.
- An assessment of how noise and vibration conditions along the Project corridor could change as a result of the construction and operation of DTRRIP.
- A description of potential mitigation measures to avoid or mitigate Project related noise and vibration effects.
- An assessment of the significance of any residual noise and vibration effects.

6.1.2 Study Area

The LSA considered in assessing noise and vibration effects includes:

- The Roberts Bank terminal complex and causeway.
- Areas adjacent to the existing rail right-of-way extending east as far as Glover Road in Langley.
- Areas in close proximity to the shoreline extending from the Roberts Bank causeway southward to the Tsawwassen Beach residential area (see **Figure 6.1-1**).

The shoreline north of Roberts Bank causeway was not included since land use in this area is primarily agricultural rather than residential and therefore it is much less sensitive to noise. The rationale for including residential communities to the east is that they overlook the rail line which serves Roberts Bank almost exclusively. Residential areas further east are exposed to a mix of rail traffic serving both Roberts Bank and other areas.

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[29] The noise and vibration assessment identified only residential type receptors for inclusion in the effects assessment. Other noise sensitive land uses can include institutional, commercial, marine, or wildlife type receptor, however these were not included in the assessment.

6.1.3 Acoustic Terminology

A glossary of acoustic terminology used in this chapter is contained in **Table 6.1-1**.

Table 6.1-1 Acoustic Terminology

Term	Definition
Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.
dB	The basic unit of measurement in acoustics which represents a logarithmic ratio of the pressure variation in air relative to a reference pressure.
dBA	"A-weighting" networks commonly employed in sound level meters to simulate the frequency response of human hearing. A-weighted sound levels are designated dBA rather than dB.
Frequency (Hz)	Audible sound occurs over a wide frequency range from approximately 20 Hertz (Hz) to 20,000 Hz but the human ear is less sensitive to low and very high frequency sounds than to sounds in the mid frequency range (500-4000 Hz).
L_{eq}	The Equivalent Sound Level (L_{eq}) is commonly used to indicate the average sound level over a period of time. Leq represents the steady level of sound which would contain the same amount of sound energy as does the actual time-varying sound level. Although it is an average, it is strongly influenced by the loudest events occurring during the time period because these loudest events contain most of the sound energy.
L_d	Ld is L_{eq} measured throughout day time hours (7:00am to 10:00pm).
L_n	L_n is L_{eq} measured throughout night time hours (10:00pm to 7:00am)
L_{dn}	The Day Night Equivalent Level (L_{dn}) is the L_{eq}(24) calculated after increasing the night time noise levels by 10dB to account for greater sensitivities to noise during the hours from 10:00pm to 7:00am. This metric is commonly used to represent community noise levels.
Annoyance	A mental state characterised by irritation often leading to emotional responses such as frustration and anger.
Peak particle velocity	The peak signal value of an oscillating vibration velocity waveform.
Root mean square velocity level	The square root of the mean-square value of an oscillating vibration velocity time signal, where the mean-square value is obtained by squaring the value of amplitudes at each instant of time and then averaging these values over the sample time.

6.1.4 Methodology

6.1.4.1 Noise and Vibration Assessment Criteria

Construction Noise Effect Assessment Criteria

The construction noise assessment follows the guidelines contained in the US Federal Transit Administration (FTA) document *Transit Noise and Vibration Impact Assessment* (Harris Miller Miller Hanson Inc. 2006), as there is no published Canadian standard that guides noise effects assessment. The noise effects assessment methodology utilised in this report makes reference to the FTA document's "General Assessment" procedure which recommends estimating the combined noise level in one hour from the two noisiest pieces of equipment and identifying locations in which the predicted noise levels exceed the criteria in **Table 6.1-2**.

Table 6.1-2 FTA General Assessment Guideline Values for Construction Noise

Land Use	One-hour L_{eq} (dBA)	
	Day	Night
Residential	90	80
Commercial	100	100
Industrial	100	100

Source: Harris Miller Miller Hanson, 2006

Predicted construction noise levels provided in this study combine noise levels from several pieces of construction equipment. Rather than using only the two noisiest pieces of equipment, the additional pieces of construction equipment were included in the analysis to provide a more conservative estimate of construction noise levels within the community.

Construction Vibration Effect Assessment Criteria

Building damage induced by ground-borne vibration from construction activities is quite rare. However, construction activities can cause ground-borne vibration levels that can be felt by those in the immediate area. Since there is no published Canadian standard that adequately addresses construction vibration effects assessment, this assessment makes use of the FTA *Transit Noise and Vibration Impact Assessment* "Annoyance Assessment" for vibrations caused by construction. The "Annoyance Assessment" provides a distance propagation model to estimate vibration levels at sensitive receptors. Estimated vibration levels are then compared to the effect criteria presented in **Table 6.1-3**.

While information on equipment peak-particle velocity (PPV) is most readily available for construction vibration assessments, public perception is more closely related to changes in the average, or RMS, velocity level. Therefore, the slow time constant maximum RMS velocity level has been used for the construction vibration assessment, as per the FTA guideline. The guideline prescribes maximum recommended ground-borne vibration levels. The metric used is the maximum level using the "slow" time constant summed over the frequency range from four Hz to 80 Hz. The effect criteria are summarised in **Table 6.1-3**.

Table 6.1-3 FTA Guideline Limits for Ground-Borne Vibration

Land Use Description	Maximum RMS Vibration (mm/s)	
	Frequent Events[1]	Infrequent Events[2]
Buildings where vibration would interfere with interior operations	0.05	0.05
Dwellings where people sleep	0.10	0.30
Institutional, quiet offices	0.14	0.40

Notes: [1] 'Frequent Events' defined as more than 70 vibration events of the same source per day.
[2] 'Infrequent Events' defined as fewer than 30 vibration events of the same source per day.

Source: Harris Miller Miller Hanson 2006.

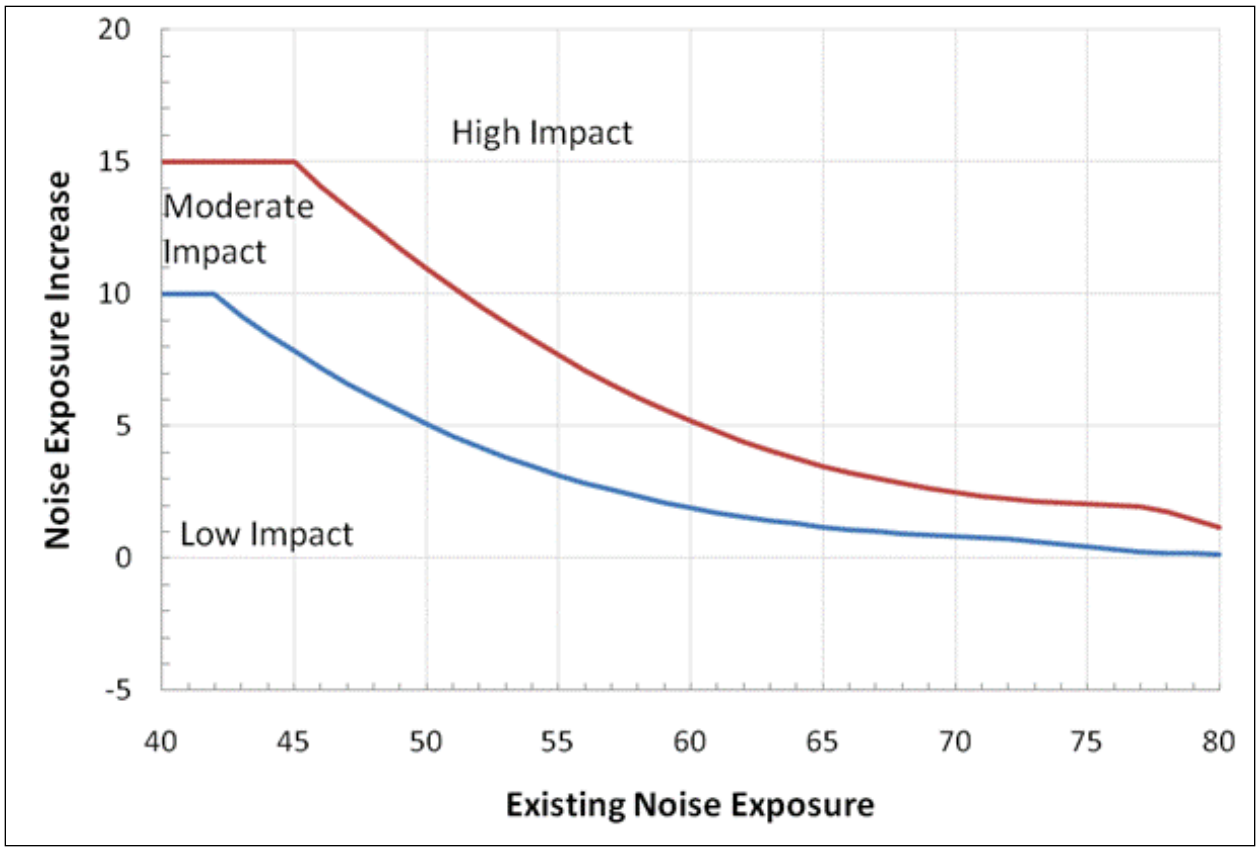
Operation Noise Effects Assessment Criteria

This assessment makes use of the FTA document *Transit Noise and Vibration Impact Assessment* (Harris Miller Miller Hanson Inc., 2006) to assess the effects of operation noise increases. The FTA guideline can be applied to rail operations including fixed facilities such as storage and maintenance yards.

The basis for the development of the noise effect criteria has been the relationship between the percentage of "highly annoyed" people and the noise levels of their residential environment and, at higher levels of noise, on activity interference due to intrusive noise. Consequently, the criteria are centred around residential land using L_{dn} as the noise descriptor.

The noise effects criteria for operational phase noise effects assessment are shown in **Graphic 6.1-1.** The horizontal axis describes the existing noise exposure with the vertical axis describing the increase in cumulative noise due to the Project.

Graphic 6.1-1 FTA Noise Criteria for Residential Land Uses



Note: Adapted from Harris Miller Miller Hanson Inc. 2006

As part of this noise effects assessment, a noise study was performed between July - October 2011 at several potentially affected locations to establish existing noise conditions. Predicted future noise increases were then calculated for the operations phase for the year 2020. However, it is noted here that the maximum projected capacity for Deltaport would occur in the year 2017. The noise effects assessment then compared predicted post-Project noise exposure increases with the allowable increase in cumulative noise level indicated in **Graphic 6.1-1** at each monitoring location**.**

Operation Vibration Effect Assessment Criteria

The FTA guideline has also been used for the operation phase vibration effect assessment. Vibration monitoring was performed at two residences within the Study Area in order to establish typical existing ground-borne vibration levels from rail pass-bys.

6.1.4.2 Noise and Vibration Prediction Methodology

Construction Noise Prediction Method

The detailed construction schedules and specific equipment requirements will not be available until after the final design is complete; therefore construction noise effects were predicted by reviewing the likely major activities (and associated equipment) to be undertaken during construction, their noise characteristics and levels. DTRRIP is assumed to involve the construction activities and equipment shown in **Table 2-2 in Section 2.6**.

Construction activities are anticipated to take place Monday – Saturday from 7 AM – 5 PM. Night works would occur from 7 PM - 5 AM during overpass construction for a period of approximately 85 days starting in September 2013 or on an as-needed basis at other locations.

Exterior noise levels at 15 metres from diesel-powered equipment currently in use are consistent, typically ranging from about 75 to 85 dBA. Usage factors[30] for dozers, loaders, derrick cranes, and many other types of earth moving equipment are typically in the 65 to 85 percent range. The usage factor for dump trucks is typically lower (about 25 percent) and for generators and compressors, the usage factor is generally 100 percent.

To provide an initial and conservative prediction of construction noise along the Project corridor, it was assumed that ten pieces of construction equipment would operate simultaneously in order to simulate a one-hour "worst-case" scenario. It was further assumed that the noise level of each piece of construction equipment would be 85 dBA at a reference distance of 15 metres with a 100 percent usage factor. The combined noise level resulting from these sources would yield a 95 dBA total noise level at a distance of 15 metres.

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[30] Documented noise levels for various types of equipment, measured at a reference distance of 15m are adjusted according to their “usage factors” to account for the fact that most equipment does not operate continuously at full power.

Construction Vibration Prediction Method

Ground-borne vibration levels resulting from a vibratory roller were used to investigate the potential for construction related vibration effects. The roller in **Table 2-2** is considered to be the strongest vibratory source listed among the preliminary construction equipment. The FTA *Transit Noise and Vibration Impact Assessment* document provides a typical vibration source level for a vibratory roller. The slow time constant maximum RMS velocity level provided in the FTA document for a vibratory roller is 1.26 mm/s at a distance of 7.6 metres. The vibration propagation model provided in the FTA manual was used to predict the level of vibration received at a distance of 100 metres from the modelled vibratory roller. The 100 metres distance was selected for assessment since there are no residential dwellings located within 100 metres of the Project rail corridor.

Operation Noise Prediction Method

Increasing the container capacity at the Deltaport container terminal will result in increased ship, road and rail traffic noise levels within the community. Noise from on site cargo handling equipment is also expected to increase.

The following relationship has been used to estimate increased Project noise levels:

Noise level increase in dB = 10log(increased volume/original volume)

For example, a 25 percent increase in rail traffic volume would raise noise levels by once decibel and a 100 percent increase (i.e. doubling) would raise noise levels by three decibels.

The predicted increases in Project noise and vibration levels are based on container capacity (TEUs), ship, road, and rail volume increases for the year 2020. Increases in noise associated with cargo handling equipment have been assumed to increase in proportion to Deltaport container terminal capacity (TEUs) relative to year 2010. Projected ship, road, and rail traffic volumes are presented in **Section 2.7.2**.

A logarithmic relationship between 2010 and projected traffic volume increases was used to provide an estimate of future 2020 Project noise increases. As an example, to predict the increase in Project road traffic noise, it was assumed that the total noise energy will increase by 10log(1240/790) = 2 dB. It is noted here that road noise on Deltaport Way is dominated by heavy truck traffic servicing Deltaport Terminal. As such, any increase in road noise on Deltaport Way will be attributed to an increase in truck volumes. **Table 6.1-4**, shown below, provides the estimated Project noise increases for cargo handling equipment, ship, road and rail volumes servicing the Deltaport container terminal.

Table 6.1-4 Summary of Predicted Project Noise Increases for Ship, Road and Rail Traffic

Year	Noise Level Increase for Cargo Handling Equipment (dB)	Noise Level Increase for Ship Movements (dB)	Noise Level Increase for Road Traffic (dB)	Noise Level Increase for Deltaport Rail Traffic (dB)
2020	2	1	2	3 - 4

As part of DTRRIP, additional tracks will be added in Gulf and Fisher Yards to accommodate Deltaport Terminal's increased container capacity. Increased shunting noise could potentially occur in the Gulf Yard. It has been assumed that this noise will increase in proportion to increases in train pass-by noise. The alignment of these tracks towards fronting residences also has the potential to further increase noise levels. It was determined that there are two residences along the Project corridor which could be potentially affected by the rail track additions. These include 4032 28B Avenue, Delta and 3044 41B Street, Delta which are both located in close proximity to the Gulf Yard. Rail noise increases of one decibel have been predicted for receivers at 4032 28B Avenue and 3044 41B Street due to a decreased setback distance from the nearest track to the residences.

Operation Vibration Prediction Method

Ground-borne vibration levels were determined directly from the vibration measurements performed at sites S3 and S4 for typical rail pass-bys. These levels were then compared to the criteria presented in **Table 6.1-2**.

6.1.4.3 Effects Assessment Criteria

To assess the effect of construction noise, construction vibration, operation noise, and operation vibration, guidelines from the US FTA document *Transit Noise and Vibration Impact Assessment* (Harris, Miller, Miller, Hanson, Inc., 2006) have been used.

6.1.5 Existing Conditions – Noise and Vibration

The LSA is currently subject to noise emissions from existing port operations, road traffic, rail traffic from the BC Rail line and from the BC Ferries causeway and terminal.

According to comments received on the DTRRIP Project Description, as well as comments received during the December 2011 consultation activities (see **Section 3.0**), existing noise in the LSA is a concern. The primary source of existing noise within the LSA is from trains (locomotives engines, wheel/rail noise, coupling). Residents in the area have reported perceived vibrations from rail activity and have indicated rail noise as a disturbance. In addition, residents also indicated that noise from terminal equipment alarms, ship loading conveyors at Westshore Terminal and from traffic on the BC Ferries causeway have been sources of noise disturbance.

Noise monitoring was performed between July and October 2011 at six sites (S1 - S6) chosen to represent the existing environment of noise sensitive receptors within the Study Area (see **Table 6.1-5** and **Figure 6.1-1**) that could potentially experience changes in noise levels as a result of the Project.

Table 6.1-5 Description of Existing (2011) Monitoring Locations S1 – S6

Site No.	Address	Representative Environment	Dominant Noise and Vibration Sources	Description
S1	476 Tsawwassen Beach Rd, Tsawwassen	Residences south of Roberts Bank Rail Corridor along Tsawwassen Beach Rd (Photo 6.1-1)	Local residential activity, BC Ferries, wildlife and Roberts Bank	Noise monitor located 4.7 kilometres from Deltaport Terminal
S2	Tsawwassen First Nations Longhouse 2148 Tsawwassen Dr N, Tsawwassen	First Nation Community south of Roberts Bank Rail Corridor	Wildlife, BC Ferries and Roberts Bank	Noise monitor located 1.8 kilometres from Roberts Bank Rail Corridor and 4.8 kilometres from Deltaport Terminal
S3	3044A 41B St, Delta	Rural residences fronting Roberts Bank Rail Corridor (Gulf Yard)	DTRRIP Overpass construction, rail, local activities, traffic on Deltaport Way and Wildlife	Noise and vibration monitors located 250 metres from Roberts Bank Rail Corridor
S4	6900 36 Ave, Delta	Rural residence fronting Roberts Bank Rail Corridor (Fisher Yard)	Rail traffic, DTRRIP Overpass construction, local farming activity	Noise and vibration monitors located 230 metres from Roberts Bank Rail Corridor
S5	12726 Southridge Dr, Surrey	South facing Panorama Ridge residences in Surrey exposed to rail activities serving Roberts Bank as well as other destinations	Rail traffic, aircraft, highway traffic and local wildlife	Noise monitor located 460 metres from Roberts Bank Rail Corridor
S6	6270 Glover Rd, Langley	Rural Langley residences on Glover Road exposed to rail activities serving Roberts Bank as well as other destinations	Rail traffic, local road traffic and aircraft	Noise monitor located 68 metres from Roberts Bank Rail Corridor

Noise monitoring was performed for an approximate two-week period at sites S1 - S3. The two-week monitoring period permitted an investigation of the day-to-day variability in the Port-related and overall noise exposure. Noise monitoring was performed for two-day periods at sites S4 - S6.

Measurements were conducted using Bruel & Kjaer Type 2250 sound level meters and a Soundbook Acoustic & Vibration Measurement System, all of which meet the Type 1 specifications in ANSI S1.4:1983 (ANSI, 1983). The microphones were field calibrated before each monitoring period using a Bruel & Kjaer Type 4230 Calibrator.

Graphic 6.1-2 Monitoring Location S1 – East of Deltaport Container Terminal

Graphic 6.1-3 Monitoring Location S1 – Looking West towards Deltaport Container Terminal

Details regarding the placement of the measurement transducers and site conditions are provided in Appendix A of the technical report.

A Davis Instruments VantagePro2 weather station was used to collect meteorological data during the noise monitoring periods at S1 - S3. The station was mounted at a height of 3.5 metres above ground at S1 and at a height of 4.8 metres above the ground at S2 (**Graphic 6.1-4**). Meteorological data was collected only at S3 (not at S2) during the two week measurement period starting on August 17, 2011. This was done since meteorological conditions at S2 and S3 are considered to be similar given the close proximity of the two sites and the flat terrain.

Graphic 6.1-4 Microphone and Weather Station at S2 Looking North towards Existing Railway

Table 6.1-7 summarises the results of the 2011 noise monitoring study at S1 - S6 in terms of the day-night average noise level, L_{dn}. Average L_{dn} levels ranged from 50 - 62 dBA at sites S1 - S6. Day-to-day variation in the L_{dn} (expressed as the standard deviation in **Table 6.1-6**) was on average +/- 2 dB across all sites.

Table 6.1-6 Summary of Existing (2011) Noise Measurement Results and Estimates of Port-Related Noise

Site No.	Measurement Start Date (dd-mm-yyyy)	Measurement Duration (Days)	Total Measured Noise Level		Estimated Port-Related Noise Level	
			Mean L_{dn}	Std Dev	L_{dn}	Std Dev
S1	28-07-2011	15	53	2	40	8
S2	17-08-2011	14	50	1	44	2
S3	17-08-2011	14	59	2	55	3
S4	18-10-2011	2	61	2	58	2
S5	18-10-2011	2	62	< 1	56	< 1
S6	07-10-2011	2	68	< 1	62	< 1

The total noise exposure at sites S1 - S6 results from a combination of noise sources from existing Port related activities (Deltaport container terminal operations including ship, road, and rail activities) and other local noise sources (local road traffic, BC Ferry Terminal, wildlife, farming activities, etc.). The total overall noise exposure at sites S1 - S2 is largely dominated by noise sources other than existing Port-related noise sources. This is due to the large distance (two to five kilometres) between Port-related noise sources and receiver locations at S1 and S2. In contrast, noise levels at S3 - S5 are largely dominated by Project related rail activities along the Roberts Bank Rail Corridor. Noise levels at S6 are dominated by both road and rail traffic. Trains utilising the corridor near S6 include those servicing Roberts Bank as well as other destinations. The estimation of Port noise from rail activity at S6 was calculated assuming equal traffic volumes in Port-related and non-Port related rail activity.

The estimated Port-related noise levels presented in **Table 6.1-6** were calculated after reviewing specific Port-related noise events recorded during the monitoring period. For sites S3 - S5, the estimated Port related noise levels provided in **Table 6.1-6** are the result of rail activities exclusively. The identification of Port-related noise events at sites S1 and S2 was complicated by the low noise levels recorded and the presence of other, potentially more predominant noise sources, such as those from the BC Ferry Terminal. As a result, there is a high degree of uncertainty in the estimated Port-related noise levels at sites S1 and S2 as shown in **Table 6.1-6** under the standard deviation column.

A review of historical noise measurements performed at sites S1, S2, S3, and S5 indicated that noise Measured Noise Level L_{dn} (dBA) have remained fairly constant over the years (**Table 6.1-7**). No previous measurement data was available for sites S4 and S6.

Table 6.1-7 Summary of Historical Measurement Data at S1, S2, S3, & S5

Site No.	Year	Measurement Duration (Days)	Measured Noise Level L_{dn} (dBA)
S1	2004	2	51
	2011	15	53
S2	1993	1	49
	2000	1	54
	2001	1	54
	2011	14	50
S3	1995	7	55
	2004	2	62
	2011	14	59
S5	2004	2	61
	2011	2	61

Vibration levels were also measured at sites S3 and S4. Vibration from train pass-bys was measurable but below the generally accepted threshold of perception (< 0.04 mm/s).

6.1.6 Potential Effects and Proposed Mitigations

This section identifies and analyses potential effects associated with the Project. The analysis of potential effects compares the existing conditions, described above, to the type and scale of Project activities and potential for changes in noise and vibration levels in relation to the construction and operation of the Project.

6.1.6.1 Construction

Noise

DTRRIP construction activities will generate noise from the use of heavy equipment and vehicles. Activities associated with the construction of the Project will increase ambient noise levels, which in turn can constitute a disturbance to adjacent communities, and wildlife (see **Section 5.1**).

Predicted construction noise levels at each of the monitoring locations compared to the existing noise levels at these locations are shown in **Table 6.1-8**.

Table 6.1-8 Noise Levels from Construction

Site No.	Predicted "Worst Case" One -Hour Leq (dBA)	FTA Guideline Limits		Exceeds Criteria?	
		Day (dBA)	Night (dBA)	Day	Night
S1	45	90	80	No	No
S2	53			No	No
S3	71			No	No
S4	71			No	No

Note: * S5 and S6 are beyond the Project construction limits

Setback distances at which the "worst-case"[31] construction noise levels meet the daytime and nighttime criteria listed in **Table 6.1-1** for residential land use were identified in accordance with the FTA's noise criteria. The setback distance at which the "worst-case" construction noise levels meet the daytime noise criteria of 90 dBA is at 27 metres from the noise sources. The setback distance at which noise levels meet the nighttime noise criteria of 80 dBA is at 84 metres from the noise sources.

Based on a review of aerial photography of the Project area, it would appear that there are no residential receptors located within 100 metres of the Deltaport Terminal or the Gulf and Fisher Yards where Project works will occur. As a result, the initial construction noise effects assessment indicates that exceedance of the FTA's "General Assessment" noise criteria for construction is unlikely to occur. The closest receptor is S3, a rural residence approximately 200 metres from the Project corridor (**Figure 6.1-1**). S6 is located within 68 metres of the existing Roberts Bank Rail Corridor, but is approximately 30 kilometres directly east of the Project area (**Figure 6.1-1**) and will not be affected by DTRRIP construction activities.

[31] Refer to section 6.1.4.2 - it was assumed that 10 pieces of construction equipment would operate simultaneously in order to simulate a one-hour "worst-case" scenario.

Construction workers operating noisy equipment could potentially be at risk of noise induced hearing loss (NIHL). In accordance with Worksafe BC, hearing protection will be supplied to and made mandatory for workers exposed to noise in excess of 85 dBA to reduce their noise exposure.

Construction related traffic is unlikely to exceed the daytime or nighttime criteria adopted in this assessment due to the already existing traffic in the study area as the number of trucks required to deliver material to the site would be low relative to the existing truck traffic serving the existing terminal.

Mitigation measures are proposed to reduce construction noise effects. Port Metro Vancouver will aim to minimise effects through the development of a noise management plan that will be incorporated into the construction EMP and will include the following:

- Construction Equipment Noise Control – A maximum allowable noise emission from each type of equipment will be set prior to construction to ensure that contractors do not utilise any excessively noisy equipment (i.e., equipment that is significantly noisier than the typical equipment assumed in the noise prediction calculations).
- Awareness and Training – Provision of training to ensure that construction workers are aware of the noise created during construction (e.g., idling, back up alarms) and are appropriately trained to minimise noise where possible.
- Noise Complaints – Port Metro Vancouver will continue operating its 24-hour Community Complaint Line to deal with noise and nuisance complaints that may arise from construction activities. Each complaint would be investigated and appropriate noise amelioration measures established to mitigate future occurrences.

The contribution to noise levels is only expected temporarily during construction – approximately 2.5 years. The noise may be of moderate to high magnitude for short periods of time, but noise from construction sites are typically low for the majority of the time. Upon completion of construction, noise levels are anticipated to return to the levels experienced prior to construction. With the implementation of the proposed mitigation measures, and considering the temporary nature of construction efforts, no residual adverse effects are anticipated.

6.1.6.2 Construction – Vibration

The slow time constant maximum RMS velocity level provided in the FTA document for a vibratory roller is 1.26 mm/s at a distance of 7.6 metres. This would result in a vibration level 0.03 mm/s at a setback distance of 100 metres using the vibration propagation model provided in the FTA manual.

The vibration effect criteria for annoyance in **Table 6.1-2** for dwellings in which people sleep is 0.30 mm/s. The predicted level from a vibratory roller is 0.03 mm/s at a distance of 100 metres. Given that all dwellings are at a distance of 100 metres or more from the Project, it is unlikely that the vibration criteria for annoyance in a residential dwelling will be exceeded. As a result, annoyance effects from vibration during the construction phase are considered to be low and vibration mitigation is not warranted, and no residual adverse effects are anticipated.

The potential for building damage is often a major concern regarding construction vibration. The FTA provides construction damage criteria for various building categories in terms of the PPV (peak particle velocity). For typical buildings in close proximity to the Project corridor, a PPV limit of 5.0 mm/s would be appropriate. The potential for building damage from construction vibration is rare and only occurs when a high level vibratory source operates in close proximity to a building. For example, a typical PPV value for the vibratory roller is 5.0 mm/s at distance of 7.6 metres.

To avoid exceeding the criteria, it would advisable to maintain a distance of at least 7.6 metres between the roller and any nearby structure. The possibility for building damage from a vibratory roller would be low provided it is operated at a distance further than 7.6 metres from any adjacent structure. With the above mitigation measure, no residual adverse effects are anticipated.

6.1.6.3 Operation

Noise

The following noise sources were considered in the prediction of operational noise levels for the Project:

- Additional cargo handling equipment
- Trains
- Road traffic
- Marine vessels

Noise increases at S1 and S2 were estimated from increased cargo handling equipment on site at Deltaport Terminal. Noise increases at sites S3 - S6 were estimated from increased rail activities which dominate the overall noise exposure at these locations.

Table 6.1-10 summarises the predicted Project noise levels for the year 2020 after applying the predicted Project noise increases shown in **Table 6.1-5** to the existing conditions. **Table 6.1-10** also shows the predicted total noise levels resulting from Project related increases. The analysis has shown the potential for a one-to-three-decibel increase in operational noise for the year 2020, depending on proximity to the Roberts Bank Rail Corridor.

Table 6.1-9 Predicted Project and Total Day Night Average Noise Levels for the Year 2020

Site No.	Predicted Project Noise Level L_{dn} (dBA)		Total Noise Level L_{dn} (dBA)		Total Noise Increase	Effect
	Existing	2020	Existing	2020	2020	
S1	40	42	53	53	0	Low
S2	44	46	50	51	1	Low
S3	55	60	59	62	**3**	Moderate
S4	58	62	61	63	2	Low
S5	56	60	62	63	1	Low
S6	59*	63	68	69	1	Low

Note: * Predicted Project noise level calculated assuming equal rail volumes in Port-related and non Port-related rail activity

The FTA guideline stresses the need for mitigation measures when post-Project noise levels fall within the "High Effect" range for noise effects. Noise effects within this range would have the greatest adverse effects on the community. For noise effects falling within the FTA's "Moderate Effect" category, the guideline suggests that mitigation measures be considered where reasonable. Some of these considerations include:

- The number of affected noise-sensitive sites
- The extent by which Project noise increases exceed the effect thresholds
- The effectiveness of mitigation
- Community views
- Cost considerations

There are three main types of noise mitigation that can be applied to address operational sources of noise, including:

- Source measures – include equipment maintenance/repair, the use of electricity instead of diesel or diesel-electric moving equipment, the purchase of low noise options when selecting new equipment (e.g. better than standard exhaust silencers) and reducing the speed of putting down a container (i.e., to minimise noise generated during stacking of containers).
- Propagation measures – include the use of containers as noise barriers, pointing directional sound sources away from residences, the use of non-residential buildings as barriers along road or railways, or the use of single purpose noise barriers (e.g. concrete noise walls or earth berms).
- Receiver measures – typically include increasing the sound insulation of existing houses (e.g. replacing windows).

Port Metro Vancouver recognises the importance of minimising noise effects from port operations. Some of the initiatives Port Metro Vancouver has recently undertaken include:

- **Establishing a community complaint line** – In October 2009, Port Metro Vancouver set up a community complaint line to assist in understanding and tracking of noise and nuisance complaints, and to focus resources effectively when working with Port users, tenants and the community to manage, investigate and address complaints.
- **Developing a Noise and Nuisance Management Plan** – In 2010, Port Metro Vancouver developed a Port-wide Noise and Nuisance Management Plan. The key objectives of the plan are to:
    1. Achieve a consistent and efficient response to all noise and nuisance complaints.
    2. Improve understanding of noise and nuisance issues (e.g., on-going ambient noise monitoring at fixed stations, including Roberts Bank; noise mapping in selected areas; agreement on ‘acceptable’ noise thresholds).
    3. Reduce noise and nuisance issues from Port, tenant and port user activities.

Port Metro Vancouver is planning to implement a land side noise monitoring program with permanent noise monitoring stations on the South Shore of Burrard Inlet in 2012. Pending the results of the initial "pilot" program, Port Metro Vancouver will evaluate expanding the program to other communities including Delta in 2013 and 2014.

With the successful implementation of the noise mitigation measures described above, as well as Port Metro Vancouver's ongoing initiatives to managing port related noise, the effects would be reduced to a low effect rating (refer to **Graphic 6.1-1**). However, potential residual effects will remain because mitigation cannot eliminate all possible noise increases.

Vibration

The frequency of rail pass-bys is anticipated to increase in the year 2020 to accommodate Deltaport Terminal's increased capacity. However, the maximum vibration level received at residential receptors along the Roberts Bank Rail Corridor is unlikely to change by a noticeable amount. The results of the 2011 vibration monitoring performed at sites S3 and S4 have shown that typical vibration levels from rail events along the Roberts Bank Rail Corridor are well below the effect criteria. As such, the potential for vibration-related effects within the community are unlikely and no mitigation measures are proposed. No residual adverse effects are anticipated.

6.1.7 Residual Effects and Determination of Significance

With the implementation of the proposed mitigation, no residual adverse effects of noise and vibration associated with construction are anticipated. There are no residual adverse effects of vibration associated with DTRRIP operations.

Potential residual adverse effects during operations are predicted to be low in magnitude, throughout the local study area, for a long duration. Residual adverse effects of noise during operations of the Project will be low to moderate[32] at residential receiver locations. The overall significance of potential residual adverse effects during operations of the DTRRIP are not significant.

[32] As per effect criteria ratings described in Section 6.1.4.1.

6.2 VISUAL

6.2.1 Introduction

The visual effect assessment investigates the potential effect of the two new ship-to-shore cranes and the new DTRRIP Overpass installed as a result of the Project. This section draws from the report titled *Visual Effects Assessment of the Deltaport Terminal, Road and Rail Improvement Project* authored by Hemmera (2012a) which provides more details on methodology and results.

6.2.2 Study Area

The visual effects assessment study area encompasses the following:

- Roberts Bank terminal complex
- Roberts Bank causeway
- Tsawwassen First Nation Village
- Highway 17 (BC Ferries causeway)
- BC Ferries Terminal
- The dyke that extends from the shoreline of the TFN reserve.

The study area includes the visual sensitivity units (VSUs) detailed in **section 6.2.4.1** and shown below in **Graphic 6.2-1**.

Graphic 6.2-1 Adjacent Visual Sensitivity Units

Source: Visual Effects Assessment of the Project (Hemmera, 2012a)

6.2.3 Methodology

The visual effects assessment took into consideration several attributes related to visual resources in the study area. The main objectives of the visual effects assessment included:

- Identification and description of VSUs in the study area.
- Selection and description of three representative viewpoints for assessment.
- Computer models from the representative viewpoints using modeling software.
- Comparison of viewpoints with the existing view and the proposed changes (additional cranes and DTRRIP Overpass).
- Quantification of the viewing condition at each viewpoint.

To determine the ability of the surrounding viewscape and existing infrastructure of the Roberts Bank terminal complex to absorb the visual effect of the proposed changes baseline information on the viewpoints were examined, including:

- Viewing distance
- Viewing frequency
- Viewing duration
- Number of viewers
- Viewing angle
- Viewer expectations

Each factor above was rated individually according to the definitions in **Table 6.2-1**.

Table 6.2-1 Viewing Condition and Viewer Rating Criteria[33]

Criteria	Definition
Viewing Distance	
Long distance (background)	> 3 kilometres
Moderate distance (midground)	1.0 – 3 kilometres
Short distance (foreground)	< 1.0 kilometres
Viewing Frequency	
High	Five or more viewpoints
Moderate	Three or four viewpoints
Low	One or two viewpoints, glimpses or no specific viewing opportunities

[33] Resources Inventory Committee. May 1997. Visual Landscape Inventory Procedures and Standards Manual (in combination with previously accepted measurements from 2004).

Criteria	Definition
Viewing Duration (land or water)	
High (long)	> 1 hour
Moderate	5 minutes to 1 hour
Low (short)	< 5 minutes
Number of Viewers	
High	> 1000 people average per day or large number of viewers relative to type of activity being pursued
Moderate	200-1000 people average per day or a moderate number of viewers relative to the activity being pursued
Low	< 200 people average per day
Viewing Angle	
High	Focal
Moderate	Oblique or tangent
Low	Peripheral
Viewer Expectations	
High	Scenic quality is of primary importance to the activity or experience being pursued (i.e. cruise ships)
Moderate	Scenic quality is of secondary importance to the activity or experience being pursued (i.e. fishing)
Low	Scenic quality is of little importance to the activity or experience being pursued (i.e. fish farming, mining)

Viewer expectations were determined by the number of viewers relative to the area and duration of the view, as per **Table 6.2-2** below. If the angle of view is tangential or peripheral, the viewer expectation rating is dropped down one level. For example, if there are a moderate number of viewers, with a moderate duration of view, and the angle is focal, the viewer expectation rating is moderate, as per the table below, if however, the angle is tangential or peripheral, then the rating is dropped to low.

Table 6.2-2 Viewer Expectations

	Number of Viewers		
Duration of View	**Low**	**Moderate**	**High**
Low (short)	L	L	L
Moderate	L	M	M
High (Long)	M	H	H

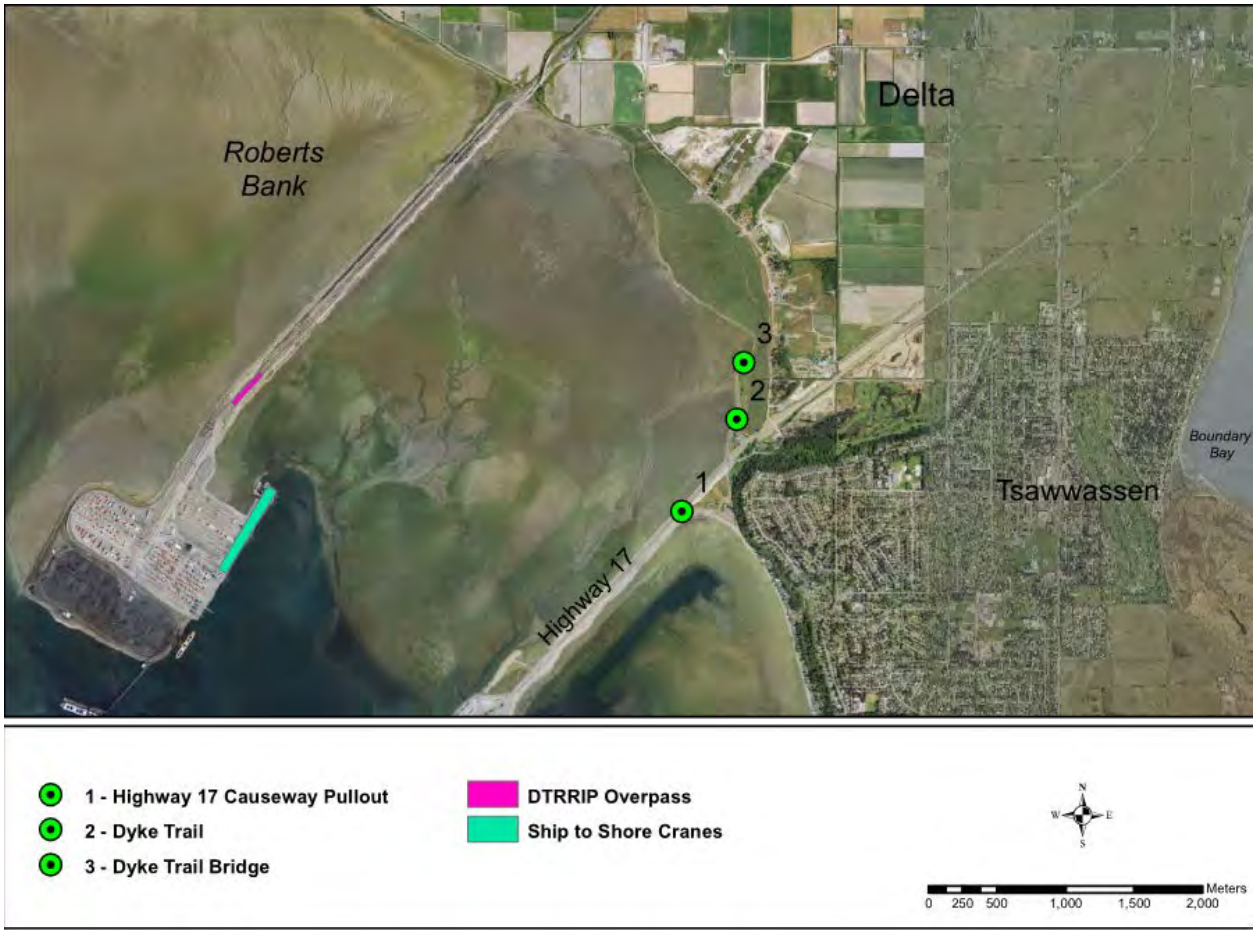
Once viewer expectations were established, the overall visual effect rating (low, moderate, high) was determined by viewer expectations and the visual effect rating and taking into consideration of all of the above criteria.

Further details on the methodology of the visual effects assessment can be found in *Visual Effects Assessment of the Deltaport Terminal, Road and Rail Improvement Project* (Hemmera, 2012a).

6.2.3.1 Viewpoints

In order to assess the potential aesthetic effects of the Project, three viewpoint locations were identified: the Highway 17 causeway pullout, and two locations on the dyke trail near to the TFN Band Office (**Graphic 6.2-2**).

Graphic 6.2-2 Viewpoint Locations



The three viewpoints selected provided a sampling of the various viewing conditions in the study area. A summary of the viewpoint details can be found in **Table 6.2-3**.

Table 6.2-3 Viewpoint Details

Location ID	Coordinates	Location description	Viewer Status	Elevation (metres)	Distance to Deltaport (kilometres)
Viewpoint 1	N- 5430631 E- 492585	Highway 17 pullout (near BC Ferries terminal). This viewpoint is the closest location from which the proposed Project is seen by the public.	Mobile/ Stationary	3	3.2
Viewpoint 2	N- 5430950 E- 492629	Outer dyke trail, adjacent to the TFN Band Office representing views from the northeast.	Mobile/ Stationary	4	3.7
Viewpoint 3	N- 5431155 E- 492687	Outer dyke trail near the footbridge, adjacent to the TFN office representing views from the northeast.	Mobile/ Stationary	5	3.9

6.2.3.2 Computer Models

The viewpoint selection and Project description information were utilised to create images from the viewpoint perspective showing the DTRRIP Overpass and new gantry crane locations. Utilising specialised software, the scaled renderings show the extent of the Project components seen from each viewpoint. Photos were taken from the selected viewpoints to document the existing visual condition and models were completed to show the views that would be expected from the viewpoints after construction.

6.2.4 Existing Conditions

6.2.4.1 Visual Sensitivity Units

VSUs are distinct topographical units viewed from one or more viewpoints and are defined or delineated based on the homogeneity of the landform and biophysical elements (Resources Inventory Committee, 1997). **Graphic 6.2-1** indicates the different VSUs that are present in the study area.

A biophysical description of each VSU is as follows:

1. Roberts Bank terminal complex – The Roberts Bank terminal complex is a large industrial facility that includes the Deltaport container terminal and Westshore Terminals. It is a dominant visual feature from a number of locations both on land and from the water. The four most prominent visible features of the Roberts Bank terminal complex are:
    a. The ten gantry cranes
    b. The multi-coloured shipping containers stacked in the yard
    c. The large container ships that occupy the berths at the terminal
    d. The coal piles at the bulk handling coal facility
2. Roberts Bank causeway – The Roberts Bank causeway serves rail and truck traffic to the Deltaport container terminal and Westshore Terminals. Public use is limited on the causeway but not restricted. The causeway is visible from a number of locations on the water and on land but most prominent from immediate adjacent locations such as the Tsawwassen First Nation Village and Tsawwassen Road.

3. Tsawwassen First Nation Village – The TFN community lives on the 290 ha (716 acres) Pre-Treaty Reserve. The community is aligned with the sea, fronting North Tsawwassen Drive. The lands to the east are undeveloped, fallow pasture lands. The focal point of the community is the Band Administration office, TFN Youth Centre, the Recreation Centre, Elders Centre, and Early Childhood Education Centre. A cemetery is located near the entrance to the community at Highway 17, while the Long House is located north of the existing administration center (TFN, 2009).
4. Highway 17 (BC Ferries Causeway) – Highway 17 leading to the BC Ferry Terminal accommodates high levels of traffic to and from the BC Ferries terminal. The Roberts Bank terminal complex is a dominant feature to the north. There are two pullouts along the BC Ferries causeway and neither pullout is marked with signage and is typically used for brief stops or other specific purposes. They are not formal viewing locations.
5. BC Ferries Terminal – The BC Ferry terminal is a high use public transportation area. Views from the terminal area are extensive and provide infinite views of the Roberts Bank terminal complex.
6. Dyke – The outer dyke extends along the shoreline from the TFN reserve. There is a gravel service road along the top. Public use of the dyke is low to moderate relative to the area (TFN, 2009). Deltaport is visible from the dyke, as is the BC Ferries terminal.

6.2.4.2 Existing Visual Conditions at Selected Viewpoints

Baseline information at each viewpoint was determined including existing visual condition, type and number of viewers, distance of view, and typical duration of view (**Table 6.2-4**). Photos were taken from each viewpoint to document the existing visual condition (**Graphics 6.2-3 – 6.2-4**).

Table 6.2-4 Existing Visual Conditions at Selected Viewpoints

Existing Visual Conditions		
Viewpoint	Highway 17 - BC Ferries causeway (viewpoint 1)	Dyke locations (viewpoint 2 and 3)
Viewing Condition	Traffic to and from the BC Ferries terminal on a major Highway. This pullout is not marked with any signage and should not be considered a formal viewpoint. It is too small to accommodate commercial vehicles but there are private vehicles there on occasion. Views from the Highway range from focal to periphery and until one gets to the terminal, the viewing duration is low.	Service road along top of dyke supports small amount of public use (walking and cycling). View of facility changes gradually as one moves along the dyke. The dyke is easily accessible by the public and is gated near the BC Hydro substation for restricted vehicular access.
Existing Visual Condition	Agriculture, marine, urban development and Roberts Bank terminal complex views	Agriculture, marine, urban development and Deltaport views
Type of Viewers	General Public	General public
Relative Number of Viewers	High (> 1000 people average per day or large number of viewers relative to type of activity being pursued)	Low (< 200 people average per day)
Viewing Distance	Long distance (i.e. > 3 kilometres)	Long distance (i.e. > 3 kilometres)
Viewing Duration	Moderate (5 minutes to 1 hour)	High (> 1 hour)
Viewing Angle	Focal/Tangential/Peripheral	Tangential and focal

Graphic 6.2-3 Existing Visual Condition from Highway 17 (Viewpoint 1)

Graphic 6.2-4 Existing Visual Conditions from the Outer Dyke Trail (Viewpoint 2)

Graphic 6.2-5 Existing Visual Condition from the Outer Dyke Trail near the Footbridge (Viewpoint 3)

6.2.5 Potential Effects and Proposed Mitigations

6.2.5.1 Analysis of Visual Effects

The visual effects of the proposed Project were reviewed from the three representative viewpoints. For each representative location viewer expectations, overall visual effect and models of the potential changes to the viewscape were determined.

Visual Effects on Highway 17 (Viewpoint 1)

The proposed Project would have a moderate overall visual effect on the views of motorists using Highway 17 (BC Ferries causeway) (**Table 6.2-5**).

Table 6.2-5 Highway 17 Pullout – Viewpoint 1

Viewing Condition	Traffic to and from the BC Ferries terminal on a major Highway. This pullout is not marked with any signage and should not be considered a formal viewpoint. It is too small to accommodate commercial vehicles but there are private vehicles there on occasion. Views from the Highway range from focal to periphery and until one gets to the terminal, the viewing duration is low.
Existing Visual Condition	Agriculture, marine, urban development and Roberts Bank terminal complex views
Type of Viewers	General Public
Relative Number of Viewers	High
Viewing Distance	Long distance
Viewing Duration	Moderate
Viewing Angle	Focal/Tangential/Peripheral
Viewer Expectations	Moderate
Overall Visual Effect	Moderate

The Highway 17 viewpoint is a static location and will have a very low number of viewers compared to the moving vehicles to and from the BC Ferry Terminal. The general public that would view the proposed Project (whether from this pullout or in their vehicle), will do so for a moderate duration of time (five minutes to one hour). The 'new' views would include the visibility of two additional cranes and the DTRRIP Overpass. However, the DTTRIP Overpass will have a low horizontal effect in the perspective view. The long line of rolling stock (intermodal containers) will most likely draw the attention before the DTRRIP Overpass. The placement of the identical cranes is immediately to the north of the existing northernmost cranes. The aesthetic effect of these structures is expected to be moderate since they are directly across from this static location and the highway enroute to the BC Ferry Terminal. Twelve cranes would be visible instead of the existing ten cranes.

Graphic 6.2-6 Model of Proposed Additional Gantry Cranes and DTRRIP Overpass from Highway 17 (Viewpoint 1)

Graphic 6.2-7 Model of Proposed DTRRIP Overpass from Highway 17 (Viewpoint 1) – Zoomed

Visual Effects on Dyke Trail (Viewpoints 2 and 3)

The proposed DTRRIP would have a low overall visual effect on views of the general public from the dyke trail (**Table 6.2-6**).

Table 6.2-6 Visual Effect on Dyke Locations (Viewpoints 2 and 3)[34]

Viewing Condition	Service road along top of dyke supports small amount of public use (walking and cycling). View of facility changes gradually as one moves along the dyke. The dyke is easily accessible by the public and is gated near the BC Hydro substation for restricted vehicular access.
Existing Visual Condition	Agriculture, marine, urban development and Deltaport views
Type of Viewers	General public
Relative Number of Viewers	Low
Viewing Distance	Long distance

[34] Excerpts from the 'Visual and Lighting Impact Assessment of the Roberts Bank Container Expansion Deltaport Third Berth Project'. (C. Berris Associates and Associated Engineering. 2004, November. Prepared for Vancouver Port Authority).

Viewing Duration	High
Angle of View	Tangential and focal
Viewer Expectations	Low
Overall Visual Effect	Low

The general public would view the proposed DTRRIP, over a long distance and for a moderate duration of time (five minutes to one hour). The 'new' views would include the visibility of two additional cranes and the DTRRIP Overpass. However, the DTTRIP Overpass will have a low horizontal effect in the perspective view. The long line of rolling stock (intermodal containers) will most likely draw the attention before the DTRRIP Overpass. The placement of the identical cranes is immediately to the north of the existing northernmost cranes. The aesthetic effect of these structures is expected to be low. Twelve cranes would be visible instead of the existing ten cranes and the additional cranes would also appear slightly larger than the existing cranes.

Graphic 6.2-8 Model of Proposed Additional Gantry Cranes and DTTRIP Overpass from Outer Dyke Trail (Viewpoint 2) – Zoomed

Graphic 6.2-9 Model of Proposed Additional Gantry Cranes and DTRRIP Overpass from Outer Dyke Trail near Footbridge (Viewpoint 3)

Graphic 6.2-10 Model of Proposed DTRRIP Overpass from Outer Dyke Trail near Footbridge (Viewpoint 3) – Zoomed

Table 6.2-7 provides a summary of the visual effect assessment and overall ratings for each viewpoint.

Table 6.2-7 Summary of Overall Visual Effect Assessment Ratings

Viewpoint	Viewer Expectations	Overall Visual Effect
1. BC Ferries Causeway	Moderate	Moderate
2. Dyke Trail	Low	Low
3. Dyke Trail	Low	Low

6.2.5.2 Construction

Visual effects during construction of the proposed Project would be a result of the following activities and associated materials and equipment:

- Construction work in the terminal area to erect the additional cranes.
- Equipment and materials necessary to construct the DTRRIP Overpass on the causeway.

For Highway 17 (BC Ferries causeway) the effect was assessed as moderate and the dyke trail viewpoints effect was assessed as low.

No mitigation is proposed.

6.2.5.3 Operation

Once construction is complete, the additional gantry cranes and DTTRIP Overpass will be permanent and the visual effects of the additions will stand out to varying degrees based on the effects assessment. For Highway 17 (BC Ferries causeway) the effect was assessed as moderate and the dyke trail viewpoints effect was assessed as low.

No mitigation is proposed.

6.2.6 Residual Effects and Determination of Significance

No residual adverse effects are anticipated.

6.3 LIGHTING

6.3.1 Introduction

The lighting effects assessment investigates the potential lighting effects on local residents as a result of construction and operation of the proposed Project, and identifies mitigation options where appropriate. This section draws from the *DTRRIP Lighting Report* authored by DMD & Associates Ltd. (DMD, 2012). Potential effects of lighting on terrestrial wildlife are discussed in **Section 5.1**.

6.3.2 Study Area

The study area, for the purpose of the lighting effects assessment, is shown on **Figure 6.3-1** and encompasses the existing Roberts Bank causeway and the Project area to the east of 64th Street. The study area was selected based on the location of the lighting requirements for the proposed Project, i.e., DTRRIP Overpass and switching points in the Gulf Yard. New lighting is not required in the Fisher Yard, at the P Yard or within the container terminal.

6.3.3 Methodology

The methodology for assessing the lighting effects involved defining the lighting requirements for the Project and design criteria based on industry standards, and undertaking lighting designs using computer lighting design modeling software. Definitions for lighting terminology are provided in **Section 6.3.3.1**. This preliminary design information was then used to assess potential effects on local residents during the construction and operation phases of the Project, and present mitigation measures to avoid, minimise or reduce those effects.

6.3.4 Lighting Terminology

A glossary of lighting terminology used in this section is contained in **Table 6.3-1**.

Table 6.3-1 Lighting Terminology

Term	Definition
Glare	Condition of vision in which there is discomfort or a reduction in the ability to see significant objects, or both, due to an unsuitable distribution or range of luminance or to extreme contrasts in space or time.
Spill	The scattered light falling outside the area intended to be illuminated
Candela	Candela (cd) (formerly candle) – The unit of luminous intensity of a source (energy of a defined visible light frequency per steradian)
Lux	The International System (SI) unit of illumination. It is the illumination on a surface one square metre in area on which there is a uniformly distributed flux of one lumen, or the illumination produced at a surface all points of which are at a distance of one metre from a uniform point source of one candela.
High pressure sodium	A high-intensity discharge (HID) lamp in which light is produced by radiation from sodium vapor. Includes clear and diffuse lamps.
Metal halide	Discharge lamp in which the major portion of the light is produced by the radiation from a mixture of a metallic vapor (for example, mercury) and the products of the dissociation of halides (for example, halides of thallium, indium or sodium).
Cut-off[a]	A luminaire light distribution where the candlepower per 1,000 lamp lumens does not numerically exceed 25 (2.5 percent) at or above an angle of 90 degrees above nadar, and 100 (10 percent) at or above a vertical angle of 80 degrees above nadir. This applies to all lateral angles around the luminaire.
Light trespass[b]	Effects of light that strays from the intended purpose and becomes an annoyance, a nuisance, or a determent to visual performance. As such, light trespass should always be considered negative, unlike spill light which can have positive or negative attributes. Light trespass is the encroachment of light causing annoyance, loss of privacy, or other nuisance.

Source: Transportation Association of Canada Guide for the Design of Roadway Lighting, 2006.

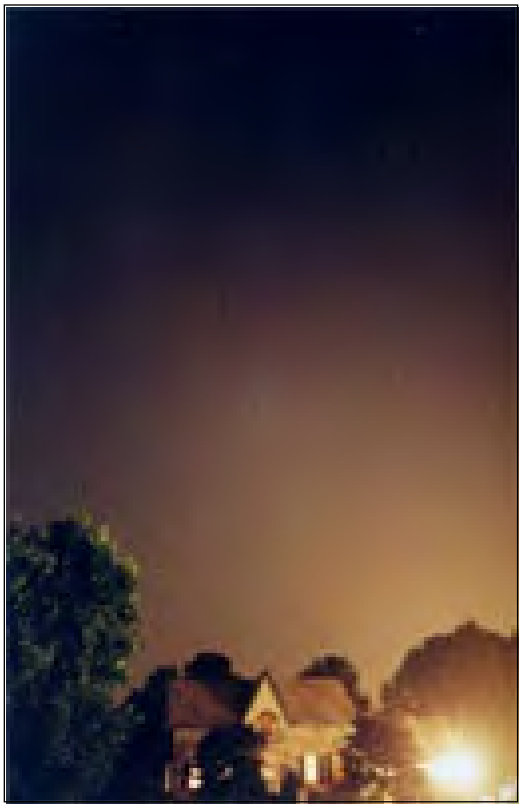
[a] IESNA RP-8 -05 American National Standard Practice for Roadway Lighting, 2000.

[b] Illuminating Engineering Society (IES) TM-10-00 Addressing Obtrusive Lighting in Conjunction with Roadway Lighting, 2011.

6.3.4.1 Criteria for Obtrusive Lighting

Light trespass is defined where light that strays from the intended purpose and becomes an annoyance, a nuisance, or a determent to visual performance. As such, light trespass is considered an adverse effect, unlike spill light which can have positive or negative attributes. Light trespass is the encroachment of light causing annoyance, loss of privacy, or other nuisance. A visual representation of light trespass is presented in **Graphic 6.3-1**.

Graphic 6.3-1 Light Trespass



Lighting standards have been developed both to ensure sufficient lighting for safety purposes for the work at hand, and to minimize the annoyance of light trespass, or “obtrusive” light, however quantitative definitions for light trespass are more challenging due to their subjective nature.

Lighting standards to ensure worker safety include:

- Work Safe BC – Occupational Heath Safety – Part 4 General Conditions – Illumination (WorkSafeBC, 2012)
- AREMA – Manual For Railway Engineering – Section 10.1 Illumination

The *Illuminating Engineering Society of North America* (IESNA) TM 11 and *International Commission of Illumination (CIE) 150:2003* provide guidance on thresholds for light trespass. Generally, the following principles are applicable for assessing light trespass:

- The degree to which light trespass is objectionable increases with increasing source luminance.
- Increased source area, for a given luminance, increases the level of objection.
- The environment (rural, suburban, urban) and ambient light level affect the reaction to light trespass.
- The degree of objection decreases as distance to the source increases.

The recognised technical authority for lighting in North America is the IESNA. The IESNA does not have a document that specifically addresses lighting standards for container storage port facilities; however they do have documents that address off-site effects from lighting sources. In *IESNA TM-11 Lighting Trespass: Research, Results and Recommendations* and *RP-33 Outdoor Lighting*, specific requirements and limitations for off-site illumination (spill light) are defined. These are, however, based on vertical illumination levels from the light source(s) measured at the residence, which are not applicable due to large the distance from the Project to the residences.

The other measure of lighting effect is an analysis of the brightness of the light source as viewed by local residents off-site. This is further defined in IESNA TM-11 as follows: *"Source brightness had been generally identified as being the principal characteristic to which persons object. Spill light was seen as a less significant effect. It was decided, therefore, to design experimentation to identify quantitatively the relationship between source brightness and the degree to which the light source was found objectionable."* Recommendations for assessing area lighting when viewed from long distance (> 500 metres), such as what exists at the Deltaport container terminal are not available.

The *International Commission of Illumination (CIE) 150:2003 Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations* defines limitations for source brightness (intensity) for outdoor lighting applications (Table **6.3-2** and **Table 6.3-3** below).

Table 6.3-2 Obtrusive Light Limitations for Outdoor Lighting

Light Technical Parameter	Application Conditions	Environmental Zones			
		E1	E2	E3	E4
Luminous intensity emitted by luminaires	Pre-curfew	2,500 cd	7,500 cd	10,000 cd	25,000 cd
	Post curfew hours	0 cd*	500 cd	1,000 cd	2,500 cd

Note: * If the luminaire is for public (road) lighting then this value may be up to 500 cd.

Table 6.3-3 Environmental Lighting Zones

Zone	Surrounding	Lighting Environment	Examples
E1	Natural	Intrinsically dark	National parks or protected sites
E2	Rural	Low district brightness	Industrial or residential rural areas
E3	Suburban	Medium district brightness	Industrial or residential suburbs
E4	Urban	High district brightness	Town centres and commercial areas

Based on E2 Zone Definition above a limit of 500 candelas (**Figure 6.3-1**) would be applicable. Based on the pole mounting heights 11m to 13m high, luminaire optics, wattages and the two-to-three kilometres distance from the Project area, the source brightness levels at local residences would be non-existent (DMD, 2012).

Based on the lighting, proposed spill light will be virtually non-existent due to distance of the lighting from local residences. The source brightness visible will be below the 500 candela requirements listed above.

6.3.5 Existing Conditions

6.3.5.1 Container and Intermodal Yard Lighting

The Deltaport container terminal is currently illuminated to an average maintained level of 50 Lux, with high pressure sodium lamps mounted on 35 metres poles. Typically there are 12 to 16 luminaires on each pole, with aiming angles at a maximum of approximately 68°. The lighting on the terminal is set to meet the Labour Canada requirements.

The existing ship-to-shore gantry cranes also have lighting mounted on their booms which illuminate the immediate work area around the crane. The booms are occasionally raised and lowered during operation, which changes the visibility of lighting. Cranes are also mounted with red aviation lights and white flashing warning lights for use during the daylight hours.

Since the construction of the Deltaport Third Berth Project, the following changes to the terminal lighting system have been made in response to comments made by the Deltaport Third Berth Project Community Liaison Committee:

- Creation of a ‘Security setting’: when the terminal is not operating, only four of the 12 lights facing the coast will be illuminated.
- Installation of a lighting control system on the booms of the ship-to-shore gantry cranes to automatically shut off the lighting after 15 minutes when the arm is raised.
- Port Metro Vancouver's 24-hour Community Complaint line and email address established and monitored.

6.3.5.2 Causeway and Rail Yard Lighting

The Roberts Bank causeway and existing rail yards are largely un-illuminated. The exceptions are at intersections where localised lighting and traffic signals are installed and at overpass structures, which take road traffic above the railroad. There are overpass structures where railroad tracks intersect Deltaport Way, 41B Street, 46A Street, 53rd Street, Highway 17, 36th Ave, and 72nd Street.

The marshalling yards for the railroad are also illuminated using low-level pole-mounted low-pressure-sodium lamps to provide lighting for safety of rail yard workers and security. At the south-west end of the causeway from the intersection of Deltaport Way and Westshore Way to the port facility, the causeway is continuously illuminated by high pressure sodium lamps. This lighting does not add significantly to the overall lighting levels, as area floodlighting overpowers the low-level roadway and marshalling yard lighting.

The SFPR, scheduled for completion in 2013, will add lighting where the SFPR is laid parallel to the existing rail right-of-way.

6.3.6 Potential Effects and Proposed Mitigation

6.3.6.1 Introduction

Potential lighting effects of the Project on residential receptors have been minimized where possible through the lighting design for the Project. Mitigation measures proposed below further avoid or minimize the potential effects.

An iterative modelling exercise was carried out to assess the potential effects of the lighting during operation for various design configurations. The extent of the areas within which the 1 lux and 500 candela thresholds for light trespass are exceeded based on the recommended lighting design are shown on **Figure 6.3-1**.

Incorporated lighting design measures include:

- Full cut-off or cut-off optics to reduce light trespass.
- Low mounting heights.
- Lighting focused only on work areas (i.e., overpass, existing rail yard).

Residential receptors are considered to be the designated residential areas in planning documents. Existing and proposed future residential areas, identified in the Delta OCP (Corporation of Delta 2012, Map 2) are located in the Tsawwassen and Ladner areas, both 2 km to 3 km to the south and north of the Project respectively. Additional residential areas are located in the Tsawwassen First Nations lands, however the Project is separated from residential areas by lands designated industrial. The area adjacent to the Project is designated agricultural in the OCP.

6.3.6.2 Construction

Nighttime lighting effects would be created by lighting associated with the construction activities for terminal improvements, the DTRRIP overpass, and Gulf and Fisher rail yards. Effects will vary depending on the time of day and season, as well as the construction schedule milestones.

Terminal Improvements

Lighting improvements for terminal improvement works will be minimal as works will take place within the existing terminal and intermodal yard, both of which are currently lit to an average illumination of 50 Lux. If additional task lighting is required, lighting will be via portable lighting sources which will be aimed down and directly towards the area where the work is taking place. Other sources of lighting during construction activities would result from vehicle lights and equipment lighting. These lights would likely have minimal effect on the surrounding environment, due to their relatively low intensity and height.

DTRRIP Overpass

Construction of the DTRRIP Overpass is proposed to start in spring 2013 with completion in September 2014. Lighting for the construction works would be typically low level, portable lighting sources which will be aimed down and directly towards the area where the work is taking place. Other sources of lighting during construction activities would result from vehicle lights and equipment lighting. Preliminary construction scheduling indicates that construction of the DTRRIP Overpass will require some overnight work (7 pm to 5 am) from approximately March 2013 to September 2014 and only when required to meet operational conflict avoidance. Lighting requirements during causeway construction are anticipated to have minimal effect on the surrounding environment, due to their relatively low intensity and height.

Rail Yards (Gulf and Fisher Yards)

Construction within the rail yards, including the preloading activities, will normally be accomplished during normal daylight working hours starting in the spring of 2013 and completion in the fall of 2014. While night work will be minimal, when work occurs at night, the work will be performed with task lighting, as much of the existing rail yards are largely un-illuminated. Task lighting will be via portable (service vehicle mounted) lighting sources which will be aimed down and directly towards the area where the work is taking place. Other sources of lighting during construction activities would result from vehicle lights and equipment lighting. These lights are expected to have minimal effect on the surrounding environment, and not to exceed the criteria presented in **Section 6.3.3.2**, due to their relatively low intensity and height.

Lighting during construction is anticipated to have minimal effects on local residents. The following mitigation measures will, however be implemented to minimise lighting effects during construction:

- Ensure lighting equipment is pointed north and west as much as possible (to reduce effects to residents who are typically located east and south of the Roberts Bank port facility).
- Implement shielding on construction lighting.
- Maintain 24-hour Community Complaint line and email address.
- Posting and/or distribution of Project updates (e.g., construction schedule and timing of nighttime construction activities).

With the implementation of the above mitigation measures, the magnitude of the light trespass is anticipated to be low, and the extent of trespass outside of construction areas is minimal and not anticipated to affect residential areas or residents. As such, no residual adverse effects are anticipated for residential receptors.

6.3.6.3 Operation

The main function of lighting is to provide a safe operating environment for workers who have to perform their duties when natural light is not present or sufficient. Lighting is also required for security of both the public and of property.

Container Terminal and Intermodal Yard

The working area of the intermodal yard will be unchanged and lighting will not require any adjustment, assuming that lighting levels remain unchanged.

Lighting is required on the new gantry cranes to meet worker safety and operational requirements. Lighting would be similar to what exists at Deltaport. The ship-to-shore gantry cranes have their own lighting systems mounted on the gantry booms. Lighting on the gantry crane superstructure (main support column) is used to raise the illumination level around the perimeter of the crane to meet lighting requirements for worker safety. This lighting is of a floodlight nature, which spills light around the crane and also reflects off the white paint of the equipment which may be visible to local residents (DMD, 2012).

TSI, the Detlaport terminal operator, has installed a lighting control system on the booms of the existing ship-to-shore gantry cranes to automatically shut the lighting off after 15 minutes when the arm is raised. The same control systems would apply to the new gantry cranes.

Road and Rail

Based on preliminary design, two areas of DTRRIP will require new lighting, and the lighting design requirements vary for each based on the different activities that will occur in each area. These include:

- DTRRIP Overpass – 20 Lux
- Gulf Yard (switching points only) – 20 Lux

The following sections describe the lighting requirements by area in more detail.

DTRRIP Overpass

Based on preliminary lighting design, the DTRRIP Overpass will consist of 13 street light poles, 11 metres tall, each with 250W high pressure sodium luminaires (orange light source). This will achieve an average illumination level of 20 Lux, which meets the lighting design requirements defined by the BC MoTI. The luminaires will have full cut-off optics designed to direct the light down on the area where illumination is required to reduce effects on local residents (**Graphic 6.3-2**). These light poles are much lower than the existing 35 metres high mast light poles which exist at the Deltaport container terminal. The lighting would be turned on at dusk and off at dawn via automatic photocell control (DMD, 2012).

Graphic 6.3-2 Proposed Pole and Luminaire for DTRRIP Overpass

Gulf Yard

New lighting within the Gulf Yard is required at switching points only. Based on preliminary design, lighting will be to a level of 20 Lux at each switching point as required by railway standards. Twenty-two street light poles, 11-metres-tall, each with 400W metal halide luminaires (white light source) will be installed in both yards. The luminaires will have full cut-off optics to reduce effects on local residents. Lighting will be on during hours of darkness.

The spill lighting and brightness zones for all the areas to be illuminated as part of the Project are illustrated on **Figure 6.3-1**. The area in which the thresholds for spill lighting and source brightness are exceeded are in very close proximity to the lighted sites and are approximately 2 to 3 km distance from residential areas.

Based on the modeling and the limited areal extent in which lighting exceeds criteria, lighting during operations is not expected to exceed the criteria presented in **Section 6.3.3.2**, and therefore anticipated to have minimal effects on local residents. Residences and residential areas are not within the areas adjacent to the Project in which thresholds (**Section 6.3.3.2**) are exceeded. In addition to the design mitigation measures described above, the following mitigation measures will also be implemented to minimize lighting effects during operations:

- Use of lighting control systems to reduce the intensity of lighting in selected areas during periods of low activity.
- Ensure task lighting equipment (when needed) is pointed north and west as much as possible (to reduce effects to residents who are typically located east and south of the Roberts Bank port facility).
- Continue to maintain Port Metro Vancouver's 24-hour Community Complaint line and email address.

With the implementation of the above mitigation measures, potential residual effects are anticipated to be nil to low in magnitude (less than thresholds), limited in extent (within the areas shown on **Figure 6.3-1**), long term and reversible. As such, no residual adverse lighting effects to residential areas during operation are anticipated.

6.3.7 Residual Effects and Determination of Significance

Modelling for the potential residual effects of lighting during operation did not identify light trespass to residential receptors. Following implementation of the design measures incorporated into the modelling and the proposed mitigation measures, potential residual effects for both construction and operation are anticipated to be nil to low in magnitude, limited in extent (within the areas shown on **Figure 6.3-1** for operation, and less for construction), short to medium term for construction (less than 1 year), long term for operation and reversible. No residual adverse effects of the lighting systems on the residential areas are expected.

6.4 SOCIO-ECONOMIC

6.4.1 Introduction

This section of the EA report sets out the existing socio-economic conditions and identifies potential effects of the Project on identified VSCs. The assessment draws on a variety of inputs, identifies VSCs that could potentially be affected by the Project and provides an assessment of potential adverse and beneficial effects resulting from the Project's construction and operation.

As this is a screening-level EA under the CEAA, socio- economic effects need only be considered if they result from any identified environmental effect. This would primarily be related to effects on land and natural resource use and indirect effects on the local economy and quality of life. However, Port Metro Vancouver strives to ensure that all new developments meet applicable standards and minimise environmental and community effects. As such, a broader corporate social responsibility approach has been applied to the socio-economic assessment to take into consideration other topics of interest such as employment creation; land use; traffic and transportation; community demographics; and services and infrastructure.

6.4.2 Existing Conditions

The existing socio-economic conditions have been compiled utilising desk-based research and analysis of publicly available information and resources, supplemented with information gathered from Port Metro Vancouver's public and stakeholder consultation process. Information sources included:

- A review of Statistics Canada and BC Stats data.
- A review of regional and local economic development and community planning documents and bylaws.
- Information gathered through the public, stakeholder and First Nations engagement process for DTRRIP.

The LSA is considered to be the Project footprint as shown in **Figure 2-1.** The RSA is considered to be the Corporation of Delta and the Tsawwassen First Nation, and includes Musqueam Indian Band Reserve No. 4, as the primary receptors for potential effects due to proximity to the Project and associated activities. The majority of information presented in the existing conditions in the RSA is related to demographics and community services. Information presented for the LSA is limited to land and resource use as it is limited to existing rail lands and agricultural lands.

6.4.2.1 Population and Demographics

The Corporation of Delta (Delta), population 96,723 (Statistics Canada, 2007), is a suburban municipality in the southwest corner of the Lower Mainland. The majority of the population is largely concentrated within three residential areas (Ladner, North Delta, & Tsawwassen), with the remainder spread through the rural farm land areas. Between 2001 and 2006, the population of Delta declined by 0.2 percent, compared to population growth of 6.5 percent in Metro Vancouver (Statistics Canada, 2007).

Ladner (population 21,112) is the closest residential neighbourhood to the Project — three kilometres to the northeast (Corp. of Delta, 2007). Tsawwassen (population 20,993), a residential community with a commercial core, is east of Deltaport (Corp. of Delta, 2007). North Delta (population 51,623) is the largest residential area in the municipality and is approximately 15 kilometres north east of Deltaport (Corp. of Delta, 2007).

The TFN is located on approximately 290 ha of land (former reserve lands) situated in Delta along the shore of Roberts Bank, between the Tsawwassen BC Ferry Terminal and the Roberts Bank terminal complex. According to the 2009/2010 TFN Annual Report, there are a total of 405 TFN members, of which about half live on Tsawwassen Lands and the rest reside in BC's Lower Mainland, Whatcom County (Washington), the interior of BC and elsewhere in Canada. Approximately 40 percent of TFN members are under 18 years old.

Musqueam Indian Band Reserve No.4 is located approximately 1 km northwest of the Project. As of the 2011 Census, there were approximately five people residing at Musqueam Reserve No.4, with a total of two un-serviced private dwellings.

6.4.2.2 Land Use and Land Use Planning

Delta is bounded by the Strait of Georgia to the west, the Fraser River to the north, the municipality of Surrey to the east and the US Border to the south. Delta covers a land area of approximately 36,433 ha.

Corporation of Delta Official Community Plan

Land use and new development within the Corporation of Delta is managed by the policies and directions set out by the Delta Official Community Plan (OCP). The OCP was first adopted in 1986, with subsequent revisions in 2005, 2009 and 2011. Four main objectives described in the OCP are to: improve the physical environment, increase diversity of community activities, improve access/movement within the community and encourage economic growth.

Agriculture is a major land use and contributor to the Delta economy. Approximately one quarter of Delta's farms are small, mixed use operations that engage in crop, and in some cases livestock production. There are also large operators that specialise in field crops and vegetable production. The average farm size in Delta is among the highest in the Lower Mainland. The growth of greenhouse operations has been significant over the last ten-to-15 years and Delta now has about 25 percent of the total greenhouse floor area in the province.

Parks and open space account for 2,546 ha (15 percent) of Delta's land. This includes both municipal and regional parks. A significant portion of the open space in Delta is at the 2,000 ha Burns Bog Ecological Conservancy Area.

The Project respects many of Delta's OCP policies and objectives, such as maximising the capacity of existing transportation corridors before building new ones, promoting rail and barge as alternatives to truck traffic for the movement of goods and supporting industrial activities that generate economic benefits to the community. The OCP also seeks to reduce traffic congestion and mitigate its negative effects. The proposed Project is intended to facilitate traffic movement and remove some of the barriers to traffic flow into and out of Roberts Bank.

Tsawwassen First Nation Land Use and Land Use Planning

The TFN is located on approximately 290 ha of land (former reserve lands) situated in Delta along the shore of Roberts Bank, between the Tsawwassen BC Ferry Terminal and the Roberts Bank port. Their land is eight kilometres south of Ladner and two kilometres north of the US border. Total land holdings of the TFN, in addition to former reserve lands, include 372 ha of former provincial Crown land, and

subsurface rights, and 62 ha of land comprised of Boundary Bay and Fraser River parcels that TFN owns in fee simple[35], but remain under the jurisdiction of the Corporation of Delta (TFN, 2009). Approximately 98 ha is designated environmentally sensitive foreshore, 72 ha developed for housing (16 ha of which is market, non-member housing), community facilities and businesses, and 120 ha are undeveloped.

The Tsawwassen First Nation Final Agreement came in effect on April 3, 2009 and is BC's first modern urban treaty and the first treaty completed under the BC Treaty Commission process. In addition to the transfer of lands described above, the Treaty provides for:

- The resolution of TFN's title claim over its 10,000 square kilometre traditional territory and the retention of hunting, fishing, and gathering rights in the territory.
- An agreed-upon percentage of the total annual allowable sockeye catch on the Fraser River and commercial fishing opportunities for both crab and various species of salmon.
- Self-government provisions, including jurisdiction over land management, and aspects of health care, education, post-secondary education, social assistance, and child and family services.

TFN's Land Use Plan, approved in July 2008, sets out how they will use, develop, and protect their lands through land use designations for community lands, residential, industrial, or commercial development. It also sets aside significant portions for recreation, agriculture, and conservation.

The *TFN Land use Planning and Development Act* sets out the principles for land use planning and zoning that must be used on TFN lands. A land use plan was approved by the community in 2008 and the act gives it the force of law. Land use designations have been assigned to large blocks of land, each of which is subject to a variety of zoning regulations. TFN lands adjacent to the Project (near to repair tracks) are currently designated A1 (Agriculture and Forestry) and I1 (Industrial) (TFN, 2009).

Musqueam Indian Band Reserve No. 4

Musqueam Reserve No. 4 is 57.2 ha in size and is surrounded by the Corporation of Delta and is within the provincial Agricultural Land Reserve. It includes two un-serviced homes for Musqueam members, while the farm land is leased out to a private farmer. The soils are known to be very rich and can support a variety of healthy crops. The potential for industrial development or to support port activities at Roberts Bank is also identified in the Musqueam Community Profile (2007).

Vancouver Fraser Port Authority Land Use Plan

Port Metro Vancouver is responsible for the administration, management and control of land and water within its jurisdiction. Port Metro Vancouver is a non-shareholder, financially self-sufficient corporation, established by the Government of Canada in January 2008, pursuant to the *Canada Marine Act*, and is

[35] A form of freehold ownership.

accountable to the federal Minister of Transport. Port Metro Vancouver has the authority to make planning decisions about its own land use without requesting permission from local authorities, though it does engage with and inform stakeholders about changes that may influence them. Port Metro Vancouver works with environmental agencies and various levels of government to identify potential risks to the environment that are associated with Port Metro Vancouver's operations. Where environmental risks are identified, Port Metro Vancouver will take action and work to eliminate or mitigate those effects. New developments should also support the Port's land use objectives as described in the Vancouver Fraser Port Authority (VFPA) Land Use Plan (VFPA, consolidated in 2008).

Plans and objectives for Roberts Bank are currently included in Attachment A – Burrard Inlet and Roberts Bank of the consolidated land use plan. A general land use policy direction relevant to the proposed Project is to utilise Port lands to support the continued ability of Port Metro Vancouver to remain competitive and financially self-sufficient and to optimise the utilisation of the Port's limited land base by:

- Retaining Port Metro Vancouver's existing industrial land base.
- Encouraging land use efficiency and operational productivity.
- Ensuring that sufficient and appropriate land is available for future Port Metro Vancouver growth opportunities by acquiring, creating or exchanging lands as needed.

6.4.2.3 Housing

As of 2006, there were approximately 35,125 total private dwellings in Delta, of which approximately 64 percent are single-detached houses and 27 percent are apartments. Approximately 80 percent of dwellings are owned and the remaining 20 percent are rented. The average value of owned dwellings was around $477,000.

The housing stock is projected to increase by approximately 5,200 dwellings units by 2021, to match forecast growth in population. The majority of growth is expected in North Delta (CoD, 2009).

6.4.2.4 Community Services

Health and Emergency Services

Delta Hospital is located approximately five kilometres from Deltaport and provides day surgery, endoscopy, hospice care, rehabilitation and recuperation, 24-hour emergency, and residential long term care services. Major trauma cases are transferred to Royal Columbia Hospital (New Westminster), Vancouver General Hospital or Lions Gate Hospital (North Vancouver). Deltaport operators utilise the emergency ward of Delta Hospital approximately 15–20 times a year. Of those incidents, approximately eight to ten required ambulance services.

Security and Policing

The Delta Police Department serves the communities of Ladner, Tsawwassen and North Delta. The main station is located in Ladner, with community policing operations in Tsawwassen, Ladner and North Delta. As of 2009, there were 165 police officers and 68 civilian personnel with an average of 626 residents per officer. Delta Police respond to routine police calls at Deltaport and Westshore. The RCMP are the police organization responsible to respond to issues of National threat, including a Marine Security (MARSEC) level[36] 2 or 3 security situation. TSI and Westshore each retain independent security companies to provide day to day security services for the Deltaport Container Terminal and Roberts Bank coal terminal respectively.

Port Metro Vancouver is responsible for implementing innovative security solutions that safeguard and enhance the movement of cargo and passengers through Canada's largest port including:

- fully operational 24/7 land and marine security surveillance
- card-only and gate access in place at all Port terminals and port roadways
- continuous video surveillance of Port roadways and terminals
- full security coverage of Port lands
- advanced gamma ray container screening equipment
- radiation portal program at container terminals
- 100 percent passenger and baggage screening at cruise terminals
- lighting, perimeter security, intrusion detection, and signage on Port properties
- incident reporting program to track suspicious activity

Fire and Emergency Response

Delta Fire and Emergency Services provide response for fires, motor vehicle accidents, medical emergency services, rescue and safety, public service calls, emergency measures and planning, fire prevention and public education, fire investigation, and community support to Delta. Deltaport is served by Fire Hall No. 1, the largest and best equipped of all Delta's halls with a minimum of eight staff on duty.

Ambulance services are provided by the BC Ambulance Services. This is a regionally dispatched service with no service boundaries. The Ladner ambulance station has four ambulances; back up is available from Richmond, Delta or White Rock. BC Ambulance Services also has two helicopters, two turboprops, and one jet at the Vancouver International Airport, South Terminal.

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[36] MARSEC Level 2: a heightened risk of a security threat or a security incident. MARSEC Level 3: a security threat or security incident is probable or imminent.

6.4.2.5 Economy and Employment

Economy

Based on the 2006 Census data, the business services sector is the top employer to Delta residents (23.6 percent) followed by other services (19.3 percent), with construction and retail trade each accounting for 9.6 percent. A list of prominent employers was recently published in the South Delta Leader (August 26, 2011) and included a variety of organisations from public service providers such as the school district and hospital, large scale manufacturers such as wheel manufacturer Captin Toyota, the Port, and a helicopter repair centre, which all show the diverse range of employment opportunities available in Delta.

Delta's industrial land market is limited by supply of suitable quality product and zoned land (Avison Young, Spring 2011 Delta Industrial Report) and increased infrastructure spending will create further demand pressure. Delta currently has the highest industrial vacancy rate - 7.7 percent - in Metro Vancouver. Lack of new construction is attributable to lack of available quality land which is restricted by other land-use designations such as the ALR and the Burns Bog Ecological Conservancy Area, along with the Tsawwassen First Nation focusing on retail development (Avison Young, 2011).

Employment

Sales and services jobs represent the greatest share of occupations held by Delta residents at almost 25 percent of the labour force (Statistics Canada, 2007). Between 2001 and 2006, the size of the total experienced labour force declined in Delta by 0.01 percent, compared to growth of 0.1 percent in Metro Vancouver, though the number of people employed in the trades, transport, and equipment operator sector has increased in Delta over the same time period.

As of 2006, approximately 24 percent of people lived and worked within Delta, while 53 percent of employed people worked outside the municipality (Statistics Canada, 2007).

Income

Personal income levels in Delta have consistently been high in comparison to Richmond, the Greater Vancouver Regional District, and British Columbia as a whole.

Delta continues to have a higher share of personal income derived from employment than Richmond, Metro Vancouver or BC (CoD, 2007). Pension income increased sharply regionally and provincially between 1990 and 2000. A more dramatic increase occurred in Delta over this period, which saw a proportionate increase in pension income of 50 percent. A jump in pension income without a corresponding increase in the 65 plus age group in the community suggests that a significant number of residents in Delta may be choosing to retire prior to 65. Income from investment sources has declined for all areas and the goods producing labour force in Delta has also been in slow decline.

Delta has maintained a higher percentage of workers in the management and trades occupations than generally observed in Metro Vancouver. These occupations typically have higher income than other occupations and have historically captured higher percentage wage increases during economic expansion.

6.4.2.6 Transportation and Traffic

This section describes the existing traffic conditions for road, rail and vessels. The follow sub-sections are based data contained within the CCIP Road Traffic Distribution Report (Rev E, 2012) prepared by Collings Johnston *et. al*., and *Projections of Vessel Calls at Deltaport and Westshore Terminals* (2011) prepared by Seaport Consultants.

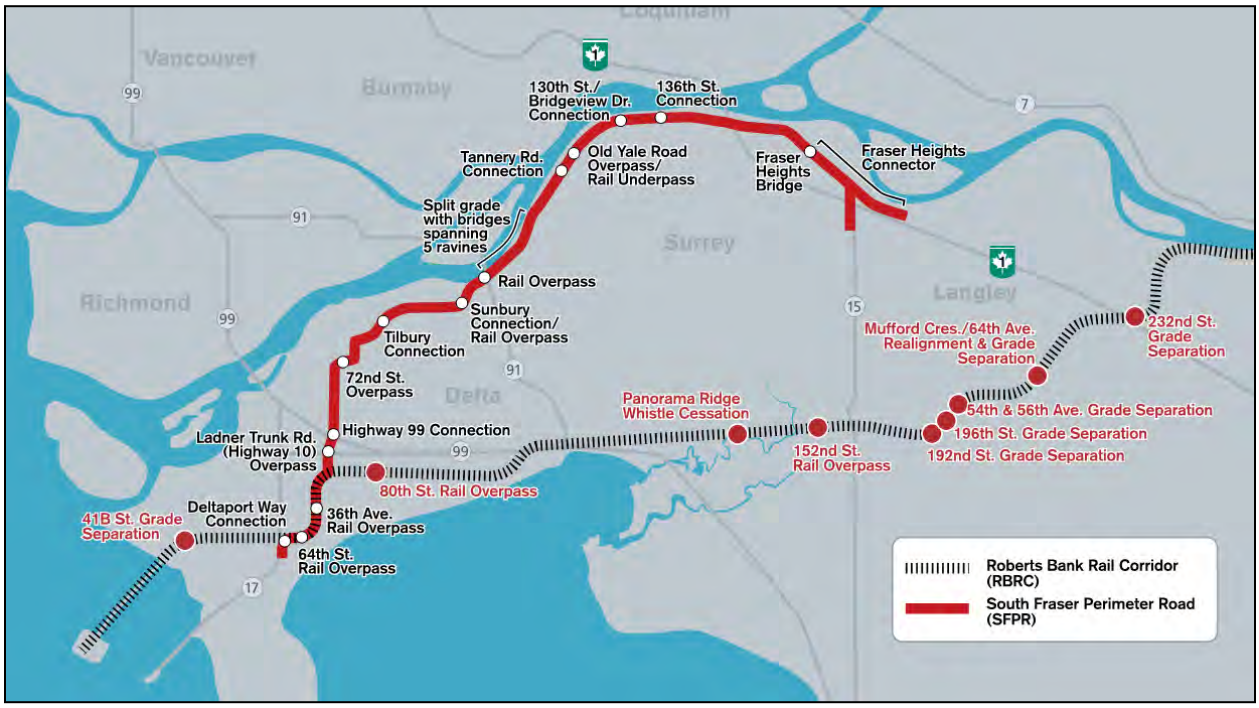
The scope of the DTRRIP transportation plan focused on the local road network, Deltaport Way and Roberts Bank Way, and the local rail network, the Deltaport intermodal yard, South Yard (S Yard), the Coal Loop, North Yard (N Yard), Gulf Yard, and the Fisher Yard. Considerations have been made for the overall implications to the Greater Vancouver road and rail networks.

Roberts Bank Rail Access

The RBRC supports the Roberts Bank terminal complex and extends approximately 50 kilometres in length from Roberts Bank in Tsawwassen to CN Hydro on the CN mainline close to 240th Street in Langley. The line is owned by BC Rail Port Sub Ltd. as far east as Pratt and intersects with the BNSF Railway line, which runs north-south along the western boundary of North Delta.

The RBRC (**Graphic 6.4-1**) includes the Gulf Yard, Fisher Yard, Mud Bay Siding, Pratt Siding, and Rawlison Siding and is currently undergoing improvements to increase capacity and functionality by reducing the number of at-grade crossings and by accommodating track extensions in the yards and sidings.

Graphic 6.4-1 Map Illustrating the South Fraser Perimeter Road and Roberts Bank Rail Corridor Program Improvements



BC Rail has a central dispatch centre for the Port Subdivision. The integrated and computerised system provides real-time monitoring of track status, switching and train movement. The dispatch centre monitors trains from BC Rail, CN, CP Rail, BNSF, and Southern Rail and provides immediate operational and emergency communication.

In 2010, approximately 60 percent of all import and export containers to and from Deltaport were handled by rail. This represents an average of four-to-six container trains passing over the corridor per day (two-to-three trains in and two-to-three trains out) that currently arrive at and depart Deltaport. In addition, eight-to-twelve coal trains arrive and depart daily (four-to-six trains in and four-to-six trains out) from the Westshore Terminals coal facility.

Roberts Bank Road Access

Delta contains four of the Lower Mainland's major roadways: Highways 17, 91 and 99, and Nordel Way. Traffic congestion is known to occur on these roads, in particular on Highway 99 through the Massey Tunnel, River Road and Highway 17 between Ladner and the Highway 99 Junction.

The road facilities supporting the Roberts Bank terminal complex provide access to the terminals for general traffic, container trucks, and employees, as well as to the traditional fishing grounds of the TFN.

General road traffic and container trucks access the coal and container terminals along Deltaport Way from Highway 17. Deltaport Way has been built to two-lane, two-way, rural arterial standards. At the shoreline of the causeway there is an existing overpass structure that crosses the two lead terminal rail tracks. The main entrance gates of the Deltaport container terminal are located about four kilometres down Roberts Bank Way (South) and receive all of Deltaport's general purpose and employee traffic, and the entry of all, as well as the exit of some container trucks.

The access road to Westshore terminal intersects with Deltaport Way about three kilometres down the causeway. The access road then follows an alignment between the North Yard and South Yard to an overpass structure spanning the coal tracks and then enters the Westshore terminal facility. This road provides access to Westshore employees and is also used by Deltaport for the exit of some container trucks.

In 2010, approximately 45 percent of all import and export containers were handled by truck. For an average day, the average hour container truck volume is 288 trucks per hour, or approximately 2,404 average truck trips per day (1,202 in and 1,202 out). There are no trucks associated with Westshore's operation.

Other Sources of Road Traffic

Employee traffic to both terminals at Roberts Bank also contributes to traffic volumes on the local and regional roads.

- Deltaport Container Terminal – Based on the existing layout, with all three berths in service, it is estimated that up to 380 employees would be on site at one time on a peak day, including administrative and office staff. The peak hours for employee traffic occurs at 7 am, one hour before the peak truck traffic.
- Westshore Terminals – Based on discussions with the terminal operator, it is estimated that 86 employees would be on-site for the day shift. Shifts are arranged from 8:00 AM to 4:00 PM, 4:00 PM to 12:00 Midnight (30 employees) and Midnight to 8:00 AM (15 employees).

It is assumed that on a typical day, 40 inbound and 40 outbound vehicle trips would be generated by non-employee functions on the terminals. These could include visitors, service vehicles such as waste removal and traffic related to the tug basin.

Traffic Distribution

The majority of trucks servicing containers at Deltaport originate from or are destined to a transload facility in the Lower Mainland. As transload facility operators can vary their production or change their location with very little notice, the origins and destinations of these containers are fluid and frequently changing. Most import containers handle consumer goods. Notable import transload facilities are HBC Logistics and Maersk Distribution, which together handle over a quarter of import transloads in the Lower Mainland.

The existing locations of the transload facilities indicate that most of the trucks carrying containers to and from Deltaport are likely to use the SFPR, currently under construction, to access locations south of the Fraser River, and either Highway 99 (Massey Tunnel) or Highway 91 (Alex Fraser Bridge) for locations north of the river.

The assumed distribution of external Port container truck traffic is based on a review of information from the 2008 Port Truck Driver Origin Destination Survey, along with previous truck assignment assumption derived from the regional EMME/2[37] travel model (**Table 6.4-1**).

[37] EMME is a travel demand forecasting system.

Table 6.4-1 Assumed Distribution of Container Truck Trips Related to Deltaport

Container Truck Trips To/From	Percent
Massey Tunnel	35%
Highway 99 South	10%
Highway 10 East	5%
80th Street / Tilbury Industrial	25%
Alex Fraser Bridge	10%
SFPR East of Highway 91	15%
Total	**100%**

Source: DTRRIP Transportation Plan, in draft

The assumed distribution of port employee and service vehicle traffic was based on assignments in the EMME/2 model, as well as the general distribution of population throughout the Lower Mainland (**Table 6.4-2**).

Table 6.4-2 Employee and Service Vehicle Traffic Distribution

Employee /Service Vehicle Trips To/From	Percent
Massey Tunnel	40%
Highway 99 South	5%
Highway 10 East	15%
80th Street / Tilbury Industrial	0%
Alex Fraser Bridge	25%
SFPR East of Highway 91	15%
Total	**100**

Source: DTRRIP Transportation Plan, in draft

Roberts Bank Vessel Movements

Ship traffic to the Roberts Bank Port Terminal Complex includes ship traffic to both Deltaport (container vessels) and Westshore terminals (bulk coal vessels). In 2010, 245 ships (594 ship movements[38]) were served by Deltaport. In the same year, the coal terminal operated by Westshore Terminals served 246 ships (492 movements). For vessels calling at Deltaport the average ship capacity increased from about 2,700 TEU in 1999 to about 6,400 TEU in 2010 (**Table 6.4-3**). But overall the number of container ship calls at Deltaport has remained constant over the same period (Seaport, 2011).

[38] As described in Section 2.7.2.3, in 2010, Deltaport had a split service that called twice at the terminal. The split service adds 104 ship movements for 2010.

Table 6.4-3 Container Services at Deltaport 1999-2010

Deltaport Container Terminal				
Item	**1999**	**2003**	**2008**	**2010**
Average Ship TEU Capacity	2,728	4,086	4,720	6,392
Number of Ship Calls	260	364	208	260[a]
TEU / Ship Call	2,005	2,492	4,965	6,116

Source: Modified from Seaport, 2011
Notes: [a] Port Metro Vancouver records show 245 ships calls in 2010.

Table 6.4-4 illustrates the number of ships and percent distributions for 2010. A reasonably large number of ship calls at Deltaport were between 8,000 and 9,000 TEU and a few ships were in excess of 10,000 TEU. Deltaport has few ships under 4,000 TEU.

Table 6.4-4 Size Distributions of Container Ships Calling at Deltaport in 2010

Vessel Capacity TEU)	Number of Ship Calls – Deltaport	Percent Distribution – Deltaport
<= 2,000	0	0
2,000 - 3,000	8	3
3,000 - 4,000	0	0
4,000 - 5,000	29	12
5,000 - 6,000	74	30
6,000 - 7,000	38	16
7,000 - 8,000	23	9
8,000 - 9,000	66	27
9,000 - 10,000	0	0
> 10,000	7	3
Total	**245**	**100**

Air

Boundary Bay Airport (CZBB) in Delta serves light aircrafts and is used as a flight-training centre. The Vancouver International Airport (YVR) is located 20 kilometres northwest of Deltaport. YVR is a large air transportation and cargo terminal serviced by major international carriers.

6.4.3 Potential Effects

This section identifies and analyses potential adverse and beneficial social effects associated with the Project. The analysis of potential effects compares the existing conditions, described above, to the type and scale of Project activities and potential for changes in population and in demand on services and infrastructure in relation to the construction and operation of the Project.

The assessment of socio-economic effects can often result in the identification of potential positive effects for the local population and communities in terms of increased employment and business opportunities. However, adverse effects can arise due to the Project attracting a labour force that increases the population beyond what would be manageable with existing services and infrastructure. The assessment is carried out for two temporal frames – the construction phase (2.5 yrs starting in 2012) and the operations phase, assumed to be indefinite following completion of construction.

The VSCs and key considerations of the assessment are:

- Employment and economic opportunities – what are the employment and economic opportunities associated with the construction phase investment in the economy and the ongoing operations of Deltaport once the Project is complete?
- Population and demographics – will the Project result in a change in population and/or demographics that may have follow-on effects on community services and infrastructure?
- Land use and land use planning – does the Project result in changes to land use that is in opposition to existing land use plans or designations?
- Housing – will the Project result in a population increase that will place increased demand on the housing market?
- Community services – will the Project result in a population increase that will disrupt or limit access to community services such health, policing and fire and emergency response?
- Traffic and Transportation – will the Project result in a change in traffic volumes or type?

6.4.3.1 Construction Phase

Employment and Economics

The Project is expected to provide long-term economic benefits to Canada and Canadians as a result of both its construction and operation. The initial but temporary benefits relating to the Project itself include construction activities, equipment supply and installation. It is estimated that approximately 1,200 person-years of construction work will be generated over the construction of DTRRIP, which over the 30-month construction period could generate up to 400 people working on site per year (Port Metro Vancouver, 2011a). However, it is likely that some positions will be required less frequently and sporadically throughout the length of construction, while other jobs will be more frequent and for longer periods of time.

Population and Demographics

The Project could result in changes in population and demographics by way of employment opportunities associated with its construction attracting people to live and work in Delta. As discussed above, during construction it is estimated that up to 400 jobs could be created per year of construction. Based on the labour force statistics presented above for people that both live and work in Delta, it is assumed that

about 24 percent of the jobs (approximately 115 positions) would be held by people already living in Delta and the remainder would be held by people living outside of Delta. The number of local hires could be positively influenced by the contractor selected to build the Project and Port Metro Vancouver's hiring and procurement objectives.

Overall, the construction phase is not anticipated to affect the population or demographic make-up of Delta as most people are unlikely to relocate for temporary/short-term construction phase employment.

Land Use and Land Use Planning

Components of the Project that result in a modification to existing land-use or land use designation are described below:

- A new DTRRIP Overpass, which will lie entirely within the existing footprint of the causeway.
- Road improvements including removal of the existing 46A Street farm overpass with part of the footprint area returned to the ALR and part incorporated into the Gulf Yard (subject to the ALC approval, as being part of the plan to develop the Option Lands into a rail yard.
- Railway improvements in the Gulf Yard which will require approximately 8.33 ha of agricultural land taken from Option Lands (refer to **Section 2.4.3** of the Project Description for more information).

Segments of the Project footprint extend into lands that are currently part of the ALR and an application has been made to the ALC (see **Section 6.5**). The remainder of Project works are planned for within the existing terminal, road and rail footprint.

Housing

The construction phase of the Project is not anticipated to result in increased demand for housing due to the temporary and short-term nature of employment opportunities.

Community Services

Health and Emergency Services

For heavy construction projects of this scale in BC, the injury rate is estimated at approximately 4.78 loss time injury (LTIs) per 100 employed construction workers (Infrastructure Health and Safety Association, 2008). Based on an annual average of up to 480 positions on the site during the construction period it is estimated that there could be up to 58 LTIs over the course of construction, or 23 LTIs per year.

While all of these injuries involve a loss of time from work, many will not require emergency services or hospital care. For example, 23 percent of injuries are caused by overexertion and 12 percent by repetitive motion or other bodily motion (WorkSafeBC, 2011). Based on these numbers it is assumed that roughly a dozen calls on local hospital and medical services per year may be required throughout the course of construction.

Security and Policing

Port Metro Vancouver is required to meet the International Ship and Port Facility Security (ISPS) Code (July 1, 2004) for all its container terminals. Existing fencing and security gates will be utilised wherever possible and where new sections of fence are required they will be designed to meet the latest security standards.

No additional demand for police call-outs are expected as a result of the construction phase workforce. However, there may be some requirement for an increase in patrolling of the active construction site as such sites are often the target of vandalism and mischief, with more equipment and materials being stored on site.

Fire and Emergency Response

There is the potential for fire department callouts in relation to the construction phase of the Project. The Project will involve welding, heavy equipment operations and other mechanical equipment operations that increase the risk of fire or other on-site emergencies. Currently, there are adequate emergency response capabilities within the Corporation of Delta.

Traffic and Transportation

There will be both short-term and long-term effects on transportation as a result of the Project. The short-term effects are related to the increase in construction vehicles and workers travelling to the site. The maximum work force to be on-site during the peak of construction is estimated at approximately 200 workers in 2013.

Delivery of equipment and construction materials is expected to be highest during the preload for the rail sites commencing in summer 2012 with approximately 2,640 deliveries per month (120 deliveries per day) for an eight month period. Deliveries are anticipated to be made with trucks during daytime work shift (7am until 4pm). These trucks will use Deltaport Way as the primary access route and use the 41B overpass, Arthur Drive overpass, and 57B at grade crossing to deliver the preload (see **Section 2.6.8**).

After the preload placement phase, equipment and material deliveries are anticipated to decrease to a very small number of supply and personal vehicles as most of the rail will be delivered via train with the possibility that rail ballast may be delivered to the site at the rate of about 20 trucks a day.

The traffic associated with construction of DTRRIP is anticipated to be low compared to regular traffic associated with terminal operations.

Rail

No changes to the rail traffic volumes are expected during construction.

As part of the rail works, the existing farmers overpass at 46A street will be demolished. The potential effects and the mitigation associated with the removal of the private farmers overpass at 46A Street are discussed in **Section 6.5**.

Marine

Both the Deltaport container terminal and Westshore Terminals will remain open during construction. There will be no change in marine activities during the construction of the Project.

6.4.3.2 Operation

Employment and Economics

DTRRIP is expected to result in increased efficiency in container traffic movements that will support Port Metro Vancouver's ability to meet the forecast growth in containerised trade. In addition to rail tracks and related infrastructure, additional equipment and vehicles necessary for operating a container intermodal yard would be added, such as three new rail mounted gantries, to load and unload container rail cars and two additional ship-to-shore gantry cranes.

The more long term recurring employment benefits, indirectly related to DTRRIP, will arise from the increased container trade generated by Deltaport's increased capacity of 600,000 TEUs per year. This increase represents a change in port throughput of approximately 24 percent above 2010 throughput levels as a result of DTRRIP. By applying the same percentage increase to the employment generated by container throughput, it is estimated that up to 2,600 person-years of direct employment could be created in the Metro Vancouver port economy with the additional capacity provided by DTRRIP.

Indirect and induced employment are those jobs created in supplier industries that support the operations of Port Metro Vancouver and employment generated from expenditures by individuals employed directly or indirectly by Port Metro Vancouver. Indirect and induced employment related to the operation of the Project is estimated at between 2,500 and 2,700 person-years across Metro Vancouver, of which a portion will be jobs in Delta (InterVISTAS, 2011).

Population and Demographics

While it is likely that a number of jobs will be created at Deltaport to manage the increased capacity brought about by the Project, the overall numbers are unlikely to influence population and demographics within Delta.

Land Use Planning Context

During operation, the Project will have no further implications for land use or land use planning. The changes made during construction will remain, and any land no longer used for construction purposes will be returned to their original status.

Housing

The housing stock in Delta is forecast to increase by approximately 5,200 units by 2021 to meet the forecast increase in population Capacity growth at Deltaport has been considered since the Deltaport Third Berth Project was completed and as such, the population forecasts for Delta likely considered the potential employment growth at the Port and the associated potential for any increase in population. Throughput at the Deltaport container terminal will not increase overnight, but there will be a gradual ramping up as the terminal adjusts its quantities to meet the new capacity. As a result, housing and housing development will be able to adjust to meet market demands and there is unlikely to be a noticeable shortage or increase in demand for housing directly related to the operations phase of the Project.

Community Services

Similar to housing, the supply of community services will adjust to meet market demand. The Project is expected to result in a gradual increase in Port and Port-related activities and consequently any associated change in population will be gradual, which will allow community services to adjust as appropriate to meet any new demand.

Traffic and Transportation

Road

Effects on the community during the operational phase of the Project will primarily be from increased truck traffic on the major routes, and increased worker and supply traffic travelling to and from the Deltaport container terminal.

The road improvements proposed as part of DTRRIP, as described in **Section 2.4.4**, will support improved efficiency and safety at the Deltaport container terminal. The improvements will reduce traffic congestion on the causeway, and at the existing at-grade crossings, as vehicles no longer have to wait for trains to pass by to continue their journey.

As part of the road and rail modifications for DTRRIP, the Project team assessed the regional road and rail systems through modelling and simulation to match existing and future infrastructure capacities with projected cargo growth. The results of the analysis indicate that the road network, as designed, will operate satisfactorily at build-out capacity of DTRRIP with one lane in each direction for terminal traffic on the causeway and on Deltaport Way. The completion of SFPR is a critical element of the road network.

Rail

Increased rail traffic associated with the operation of the Project will have minor effects on the community, as the increase in container capacity at the Deltaport container terminal has been anticipated, aligned with, and accounted for in road and rail improvements that are currently underway, including the RBRC Program.

Marine

DTRRIP will allow containers to be loaded and unloaded more efficiently which will allow for ships to move in and out of Deltaport in a more efficient manner. This will minimise the length of time ships are actually berthed at the terminal.

Ship traffic associated with the Project is predicted to increase by 67 ships per year (134 movements per year – see **Table 2-6**) by the year 2017; this takes into consideration that the size of individual container ships will increase. The effect on safe navigation due to the additional ship traffic is negligible.

6.4.4 Mitigation and/or Enhancement Measures

Mitigation or enhancement measures are proposed below that will serve to minimise/avoid potential adverse effects or improve any potential beneficial effects of the proposed Project.

6.4.4.1 Employment and Economics

Port Metro Vancouver is committed to maximising local and First Nations employment and procurement opportunities during construction and will work with the contractor(s) selected to build the Project to ensure local and First Nations employment is a priority.

6.4.4.2 Population and Demographics

No mitigation proposed.

6.4.4.3 Land Use and Land Use Planning

Port Metro Vancouver is committed to consultation and communications with local land owners and users, particularly the TFN and farmers, to identify any unforeseen effects to land use due to direct effects of the Project.

6.4.4.4 Community Services

Health and Emergency Services

During construction, the selected contractor(s) will develop appropriate health and safety management plans and emergency response plans to minimise the risks to employee health and safety and the demands of existing health and emergency services.

During operation, the health and safety management plans of the Port and its operators will be in effect.

Security and Policing

The construction site will have 24-hour security to minimise the need for additional patrols from the Delta Police Department.

The terminal operator is responsible for maintaining security within the terminal footprint. The terminal operator will be responsible to reassess the need to modify security presence during the construction and operation of DTRRIP.

Fire and Emergency Response

Port Metro Vancouver will advise local fire and emergency response crews about the construction of the Project and keep them informed of any potentially hazardous activities.

6.4.4.5 Traffic and Transportation

Road and Rail

Project Specific Mitigations

A traffic management plan will be prepared in conjunction with the BC MoTI and the Corporation of Delta, to manage construction traffic during Project construction. The traffic management plan will include a communications plan to ensure information on traffic detours or interruptions will be communicated in a timely manner.

On-going Mitigation Initiatives

The increase in container capacity at the Deltaport container terminal has been anticipated, aligned with, and accounted for in road and rail improvements that are currently underway, including the SFPR and the RBRC Program.

SFPR, scheduled for completion in 2013, will reroute container trucks departing from the Deltaport container terminal onto the new highway, removing them from Highway 17 north of Deltaport Way, and from Highway 10 west of Highway 91 (**Graphic 6.4-1**).

The RBRC Program includes one road network improvement project and eight overpasses in Delta, Surrey, the City of Langley and the Township of Langley (**Graphic 6.4-1**). These projects are being funded by a collaboration of 12 funding partners, including local, regional, provincial and federal governments, as well as private industry. Port Metro Vancouver and its tenants and stakeholders are contributing $50 million.

The overpasses will separate road and rail traffic, thereby improving safety, easing community connections and minimising train whistling. The overpasses will also improve efficiency of rail operations and, in turn, the overall efficiency of the port. All nine projects are underway, and will be complete by 2014 – in advance of additional container movements to and from Deltaport. Port Metro Vancouver has been working to identify additional measures that might reduce truck congestion such as its Truck Licensing System (TLS) that serves to regulate truck movements, driver behaviour, and manage a reduction in truck emissions. The policy requires that all trucks accessing marine terminals under the jurisdiction of Port Metro Vancouver, such as Deltaport, have a valid TLS licence.

The TLS requires trucks to reduce idling within Port Metro Vancouver terminals to no more than three minutes in any hour, and restricts the age and emissions standards of vehicles that are allowed to enter Port Metro Vancouver terminals. The TLS, and how it relates to emissions and air quality is discussed further in **Section 5.5**.

Port Metro Vancouver recognises the importance of reducing container truck traffic in local communities and on local roads. Other opportunities to be investigated to reduce truck congestion include:

1. Diversifying truck trip schedules – Truck trips in peak periods could be reduced by spreading truck trips across more hours of the day. Port Metro Vancouver is exploring incentives that may encourage truck drivers and companies to shift their pickup and delivery to off-peak delivery times, reducing congestion and related air emissions.
2. Minimising empty truck trips – Working with trucking associations and companies, Port Metro Vancouver could explore implementing a dispatch system to reduce the number of empty trips (trips to or from the terminal with no container). This would reduce the overall number and duration of truck trips, leading to reduced congestion and truck emissions.
3. Truck notification and tracking system – Port Metro Vancouver could work with trucking associations and companies to utilise GPS or other tracking technology to identify, locate and contact vehicles on a real-time basis. Using this technology, fleet operators would be able to anticipate travelling conditions for individual vehicles, creating better arrival and departure strategies that could reduce truck congestion, which would lead to a reduction in idling and truck emissions.
4. Providing designated truck waiting areas – Port Metro Vancouver could explore sites in the vicinity of Deltaport that would provide a designated waiting area for container trucks, leading to reduced congestion and idling.

Marine

Effects and mitigation measures for the forecasted increase in marine operations are discussed in each of the respective areas of study (i.e., marine environment and air quality).

6.4.5 Residual Effects and Determination of Significance

This section describes any potential residual adverse effects remaining after proposed mitigation measures have been applied.

6.4.5.1 Assessment Criteria

The effects assessment used the criteria in **Table 6.4-9** to assess the significance of effects. This section has been developed to address Port Metro Vancouver's corporate social responsibility objectives and goes beyond considering socio-economic effects that are a direct result of identified bio-physical environmental effects.

Table 6.4-5 Significance Criteria

Attribute	Descriptor	Definition
Extent	Site	Effect restricted to the DTRRIP footprint
	Local	Effect restricted to the Corporation of Delta and/or Tsawwassen First Nation
	Regional	Effect extends beyond the boundaries of Delta and/or Tsawwassen
Direction	Positive	Net beneficial effect
	Neutral	No net change
	Negative	Adverse effect
Magnitude	Low	Effect above baseline, but well below average rate of change/conditions experienced over the last five years.
	Moderate	Effect above baseline and approaching average rate of growth/conditions experienced over the last five years
	High	Effect will exceed average rate of growth/conditions experienced over the last five years.
Duration	Short-term	Effects occur to end of construction
	Medium-term	Effects occur for first five years of operation
	Long-term	Effects occur for duration of operations
Frequency	Once	Occurs only once
	Sporadic	Occurs on occasion and at irregular intervals
	Continuous	Occurs on a regular basis at regular intervals
Confidence	Low	Direct supporting or related information is lacking, best professional judgment cannot be make without evidence
	Moderate	Direct supporting information is lacking but conclusions can be made on related evidence and professional judgment
	High	Based on reliable site-specific or regional data, well-documented cause-effect relationship
Reversibility	Yes or No	Can effects be reversed upon completion of construction or at the end of the project's life cycle?
Significance	Not Significant or Significant	Based on the analysis and best professional judgment, is the effect on the socio-economic component significant?

Employment and Economics

The employment and economic opportunities associated with the construction phase of the Project are considered to be positive both during construction and operation. The magnitude of effect during the construction phase could be enhanced with the implementation of local employment and procurement strategies to help maximise local take-up. The effect is considered positive, local in extent, low to moderate in magnitude, short-term though continuous during the length of the construction phase and reversible once construction is complete. Overall, the construction phase employment and economic effect is considered insignificant due to its temporary nature.

The operation phase of DTRRIP is expected to deliver long-term employment opportunities, including a number of permanent positions in Delta. An increase in job opportunities and associated indirect and induced jobs and economic spending is considered a significant positive effect of the Project, that is regional in extent, high in magnitude, long term in duration, and continuous in frequency.

Population and Demographics

Any potential change in population and/or demographics associated with the construction phase of DTTRIP is estimated to be neutral as it is considered unlikely that a noticeable proportion of the construction phase workforce would choose to relocate for temporary employment opportunities.

There will likely be some increase in population in Delta associated with the more long term job opportunities that arise due to increased capacity at Deltaport as result of the Project in operation. However, population growth is generally considered a positive outcome and is sought by most municipalities. It is only a concern if it happens too quickly and services and infrastructure are unable to cope with an increase in demand. The potential effect on population and demographics is estimated to be low in magnitude and positive in that municipalities prefer to see population growth over decline. The effect will be long term in duration but sporadic in that jobs will be filled on as needed basis. Employment opportunities are reversible and follow market cycles. Due to the scale of the Project and ensuing potential employment opportunities, the effect on population in considered not significant.

Land Use and Land Use Planning

The direct loss of agricultural land within the Project footprint is 8.33 ha of ALR lands, 6.46 ha of which are cultivated (see **Table 6.5-1, Section 6.5**). The implementation of the proposed mitigation measures discussed in **Section 6.5** would partially off-set the permanent loss of arable ALR land, therefore compensation programs will be required by the ALC in order to meet the ALC policy of a “net benefit to agriculture” when considering development projects involving ALR lands.

No residual adverse effects are expected following implementation of the proposed mitigation and compensation measures.

Community Services and Infrastructure

Health and Emergency Services

There will be some increase in demand for health and emergency services but with the implementation of appropriate health and safety plans any increase in use of local hospital and emergency services will be minimal.

This is a temporary effect that will last throughout the construction phase and will be more likely to occur during peak construction. The contractor will be required to have first aid services available on-site and this will help to reduce the use of local hospital and emergency services. The effect is considered negative as it will result in an increased use of services, though the magnitude is low. It will be short-term in duration, sporadic in frequency, and reversible once construction is complete.

There is no anticipated residual effect due to operations.

Policing and Security

There is some potential for a temporary effect on local police services, as construction sites often attract vandalism and thefts, but with 24-hour on-site security the effect is considered negligible.

There is no anticipated residual effect due to operations.

Fire and Emergency Services

There is some potential for a temporary effect on local fire services during the construction period due to the types of activities taking place on-site (e.g., welding, heavy equipment operations, etc.). However, the contractor will be required to maintain a level of fire protection on-site and the effect is considered negligible.

There is no anticipated residual effect due to operations.

Traffic and Transportation

Construction effects on transportation are considered negative though low in magnitude. The effect will be local in extent, short-term in duration, and continuous though reversible once construction is complete. Construction phase effects on transportation are estimated to be not significant.

The operations phase of the Project will result in an increase in the number of truck trips to and from Deltaport by about 50 percent by the year 2017. However, ongoing and planned measures to reduce congestion in Delta, as described **Section 6.4.4.5** will help to alleviate potential effects on the local population. Although there will likely be a negative effect in terms of increased traffic volume, this will be partially offset by improved traffic flows. The potential effect is considered moderate in magnitude, regional in extent, continuous, and long-term in duration. Traffic is of concern to the local community and Port Metro Vancouver is committed to ongoing consultation to identify additional opportunities for improvements.

Anticipated socio-community effects related to the predicted increase in marine vessel traffic and train movements are related to air quality and noise, which are discussed in **Section 5.5** and **Section 6.1** and respectively.

6.5 AGRICULTURE

6.5.1 Introduction

This section is based on the Agriculture Impact Assessment (AIA) described in, *Agriculture Impact Assessment, Deltaport Terminal, Road and Rail Improvement Project* (2012), which provides further details on methodology, and results.

As discussed in **Section 2.6.5**, rail improvements to the east of Arthur Drive will take place in the existing railway right-of-way. Rail improvements in the Gulf Yard, west of Arthur Drive, will take place within the existing railway right-of-way and on a portion of the Option Lands, located within the Agricultural Land Reserve (**Figure 2-1**).

The Option Lands refer to properties along the Deltaport Way corridor that were previously expropriated by the Province of BC (in mid-1960s), and then sold back (in 1999) to local farmers subject to Options to Purchase in favour of BCR. The options were negotiated in anticipation of future expansion of railway operations, and extended to a 60 metres (200 ft) strip immediately south and adjacent to the existing right-of-way between 27B Street and Arthur Drive (**Figure 2-1**).

In 2008, the Agricultural Land Commission, an independent Provincial agency responsible for administering the Province's ALR in favour of agriculture, conditionally approved an application from BCR to acquire the Option Lands to create an expanded rail right-of-way for rail operations in support of the activities at Deltaport (ALC File: 0-37610, Resolution # 169/2008). The ALC approval was subject to two conditions: 1) arranging leases for the Option Lands for farming purposes until the rail construction has been approved and the land is need for construction, and 2) submission of final design and agricultural mitigation/compensation plans.

Subsequently, the Option Lands were purchased by BCR and leased back to the farmers who had historically cultivated the lands. The arable areas of the Option Lands will be actively cultivated until the DTTRIP has been approved and the lands are needed for Project construction.

Port Metro Vancouver recognises the agricultural values associated with the ALR lands proposed to be used for rail expansion purposes and is committed to working with the ALC to address potential Project-related effects to these values.

The purpose of the AIA, was to determine the agricultural attributes and values of the Option Lands, and to address the agricultural issues associated with developing these lands for railway use at a level that will meet the requirements of the ALC preliminary approval.

6.5.2 Study Area

The agriculture effects assessment study area encompasses the following:

- The Option Lands, comprising a 60 metres strip along the south side of the existing rail tracks between 27B Avenue and Arthur Drive. The parcels within the Option Lands total 20.37 ha where the primary land use is vegetable crops and forage production.
- The proposed new right of way within the Option Lands that is required to support Project works. This new right of way varies from approximately 30 metres to 55 metres wide, and totals 8.33 ha, or 41 percent of the Option Lands.
- Lands adjacent to the Option Lands, including access routes, drainage ditches, agricultural fields, and other areas.

6.5.3 Methodology

The agriculture effects assessment relied on existing information sources, including published soils and agricultural capability mapping, interpretation of recent orthophotos, and review of land ownership records, combined with field reconnaissance and farm operator interviews.

Potential Project-related effects were determined on a property (legal parcel) basis, including the areal extent of arable lands lost within the proposed right-of-way, as well as the identification of practical mitigation measures to either offset or reduce potentially negative effects. Potential mitigation measures address effects to crop production and farm infrastructure. The main objectives of the AIA were:

1. Determination of the extent of crop and pasture lands within the proposed right-of-way.
2. Identification of agricultural infrastructure such as out buildings, storage areas, driveways, fences, corrals, and drainage/irrigation works that may be affected by Project construction.
3. Development of mitigation strategies and measures that could be implemented where effects are unavoidable, such as the provision of alternative site access routes, construction of new fencing, and drainage/irrigation works.
4. Development of a Topsoil Conservation Program strategy to conserve topsoil within the footprint of the Project development areas.
5. Identification of regional compensation opportunities to address the overall loss of agricultural land to the Project.

6.5.4 Existing Conditions

6.5.4.1 Option Lands Ownership, Extent and Use

The Option Lands extend along the south side of the Deltaport causeway and the BCR line between 27B Avenue and Arthur Drive (**Figure 6.5-3**). All Option Lands lie within the ALR.

The Option Lands transect seven legal parcels, totalling 20.37 ha, of which the Project will be using 8.33 ha (**Table 6.5-1**). The BCR Property numbers relate to the BCR historic property designations. All seven parcels are owned by BCR.

Table 6.5-1 Agriculture Assessment Summary

BCR Prop #	Owner	PID	Parcel Size		Non-Cultivated within Proposed Right of Way		Cultivated Area within Proposed Right of Way		Remaining Portion outside Proposed Right of Way	
			Ha	Ac	Ha	Ac	Ha	Ac	Ha	Ac
1	BCR	011-653-337	0.57	1.41	0.57	1.41	0.00	0.00	0.00	0.00
2	BCR	027-725-839	1.13	2.79	0.48	1.19	0.65	1.61	0.00	0.00
3	BCR	027-725-758	1.44	3.56	0.07	0.17	0.00	0.00	1.37	3.39
4	BCR	027-726-240	2.70	6.67	0.46	1.14	2.24	5.54	0.00	0.00
5	BCR	027-882-209	0.53	1.31	0.16	0.40	0.37	0.91	0.00	0.00
6	BCR	027-831-043	8.12	20.06	0.13	0.32	3.2	7.91	4.79	11.84
7	BCR	027-913-791	5.88	14.53	0.00	0.00	0.00	0.00	5.88	14.53
		Subtotals	20.37	50.33	**1.87**	4.62	**6.46**	15.96	12.04	29.75

6.5.4.2 Climate Capability for Agriculture

The unimproved (non-irrigated) Climate Capability for Agriculture rating for the Study Area is Class 3A with soil moisture deficiency during the growing season. The improved (irrigated) rating is Class 1 for soils with sandy loam or finer textures (MoE, 1981 and Ministry of Agriculture and Food, 1983). This climate is capable of supporting a wide range of crops, with supplemental irrigation required during dry periods for optimal production levels.

6.5.4.3 Soils

The soils of the Study Area are composed of very deep, fine (silty) to medium (sandy loam) textured deltaic materials deposited by the Fraser River following de-glaciation. Delta, Spetifore, Ladner and Crescent soils are mapped as occurring within the Study Area (Luttmerding, 1981).

6.5.4.4 Land Capability for Agriculture

The BC Land Capability for Agriculture system rates lands within Classes 1 to 7, with Class 1 being the highest rating with few soil limitations to crop production and Class 7 being the lowest rating with essentially no capability for crop production due to severe soil limitations (Kenk and Cotic, 1983).

Generally, Class 1 to Class 4 soils are considered to be arable, capable of supporting a decreasing range of crops progressing from Class 1 to 4. Class 5 soils are capable of supporting only a narrow range of crops such as forage, and in some cases specialty crops such as blueberries or cranberries. Class 6 lands cannot be cultivated and are capable of supporting only pasture or grazing.

For the Study Area, both unimproved (no major agricultural improvements) and improved (irrigated and/or drained) ratings are shown on the published Land Capability for Agriculture mapping. Drainage and irrigation improvements are common throughout Delta and within the Study Area and the most relevant rating is the improved rating.

6.5.4.5 Drainage

The South Delta Watershed encompasses 13,500 ha land of which 6,300 ha are active agricultural land. The drainage and irrigation system of the area operates in drainage mode from fall to spring, when water is collected by an extensive network of drainage ditches and discharged through 21 outfalls into the Fraser River, the Strait of Georgia, or Boundary Bay. Water levels in the system are generally kept low during the drainage season.

The Project is located in the center of the 4,200 ha southwest part of the Delta Watershed, on the boundary of three major drainage basins. The mean ground elevation in the watershed is +1.1 metres, with ground elevations between 0.0 and +1.5 metres (Geodetic Datum) in ALR lands and close to +2.0 metres or higher in urban areas of Ladner at the north and Tsawwassen at the south boundary, and along major transportation corridors through the watershed. The maximum water surface elevation in the Lower Fraser River and the Strait of Georgia adjacent to the watershed is +2.9 metres (200-year return period tidal surge event), 1.8 metres higher than the mean ground elevation. To prevent inundation, the area is protected by a levee (dyke) system with +3.2 to +4.0 metres crest elevation, creating a low lying inland water system in Delta.

Drainage for the Southwest Delta Watershed is provided by a 360 kilometres network of ditches, 73 kilometres of closed conduit storm drains in urban areas and three major and five secondary outfalls. The Corporation of Delta maintains 127 kilometres of the ditch network, the storm drains, and the outfalls. Farmers, the operators of transportation corridors and other private entities maintain the rest of the ditch system.

The major outfalls (Chillukthan Slough, Mason Canal and Brandrith) are a combination of flood boxes and pump stations, providing gravity outflow when the tide is low, and pumped discharge when the tide elevation is higher than the water level in the inland system. Of the five secondary outfalls, three are flood boxes, providing gravity outflow only, one is a small pump station, and one, is a combination of a flood box and a small pump station. The flood boxes are equipped with flap gates on circular pipes or swing gates on rectangular box structures to allow one-directional outward flow only through the structures.

Due to the tidal influence at the outfalls, only about 25 percent of the total storm water runoff is discharged by gravity through the flood boxes and the remainder is discharged by pump stations. The three major outfalls represent over 94 percent of the total discharge capacity. The combined discharge capacity of the five secondary outfalls is less than 6 percent. The Deltaport Pump Station is the outfall closest to the Project and represents only 0.4 percent of the total discharge capacity.

Figure 6.5-1 provides an overview of the drainage system of the Southwest Delta Watershed. The size of the outfall symbols on the exhibit indicates the relative discharge capacity of the outfall.

In addition to the drainage features shown on **Figure 6.5-1**, there are minor, on-farm drainage ditches that connect to the major ditch system.

6.5.4.6 Irrigation

From spring to fall, the system operates in irrigation mode, when screw gates at some of the outfalls are opened (Chillukthan, Mason and Montgomery), irrigation pump stations are put into operation (64th Street and 28th Avenue), and various irrigation control structures are activated. The existing irrigation system is a passive system where water is supplied by gravity by opening screw gates at some of the flood boxes. In the existing configuration 70 percent of the irrigation water is provided through the Chillukthan, 20 percent at Mason and 10 percent at the Montgomery intakes to the Southwest delta Watershed area. The Chillukthan intake also supplies irrigation water to East Delta via the 64th Street irrigation pump station. Suitable (low salinity) irrigation water through these intakes is typically available in the spring and early summer when Fraser River flows are high. Later in the summer, when Fraser River flows are low, the salinity level of the Fraser River water is high and often not suitable for irrigation. During these periods irrigation water supply is dependent on the water stored in the ditches throughout the system.

The Delta Irrigation Enhancement Project (DIEP), which is currently under construction, will result in significant changes in the operation of the Delta Irrigation System by providing greater flow capacity and access to suitable water throughout the irrigation season. It introduces a new irrigation intake pump station at 80th Street, about nine kilometres upstream of the Chillukthan intake in the Fraser River where the salinity level of the water is typically low, with an exception of infrequent and short period high salinity events, throughout the entire irrigation season. The DIEP also introduces nine kilometres of new irrigation channels, two irrigation lift stations, four automated and several manually operated control gates and enhances about 18 kilometres of existing irrigation ditches. The initial intake capacity of the system matches the projected peak irrigation demand about five years after implementation in 2012, with provisions for increasing the capacity to match the projected peak irrigation demand in 15 to 20 years after implementation.

Figure 6.5-2 provides an overview of the Southwest Delta Irrigation System.

6.5.4.7 Crop Production

In 2010, the Delta ALR was about 9,403 ha, of which about 7,515 ha were cultivated (ZAEC and QPC, 2011). Major Delta crops include field crops (potatoes and vegetables), forage (grass/legume hay), improved pasture, silage corn, blueberries (and other berries), greenhouses, cranberries, unimproved pasture, grain, turf grass and golf courses, and nurseries. Delta land owners and farm operators regularly lease or trade cultivated lands between themselves and cropping patterns change year to year for field and forage crops. Common cropping practises include:

- Annual, or bi-annual cultivation of field crop and vegetable fields
- Renovation (cultivation) of forage fields every three-to-five years
- Rotations of grass legume hay with silage corn
- Rotations of field vegetables (beans, peas, turnip, etc.) with potatoes
- Planting of a winter cover crop, usually wheat or barley, following cultivation in the fall

The following description of crop production within the Option Lands is based on interviews with the existing lessees of the Option Lands, conducted during the period September to December, 2011.

The Option Lands are dominantly in crop production under lease arrangements between BCR and local farm operators (refer to **Table 6.5-1**). Of the 8.33 ha within the proposed right-of-way, 6.46 ha are cultivated, dominantly to field crops (potatoes and vegetables) and/or forage (corn/grass and legume hay).

The cultivated lands of BCR Parcel 6, leased to Felix Farms, are cropped contiguously with their adjoining private lands to the south. The cultivated fields are rotated between vegetables (potatoes, beans, peas, sweet corn, pumpkins, turnip) and forage or cereal crops.

The fields within BCR Parcel 7, are also cropped contiguously by the existing lessees with the adjoining private lands to the south, which are owned by BCR, and are currently leased. These fields are used for Chinese vegetable production, including bok choy, yau choy, gai lan, Shanghai pak choi, and others.

The small field area within BCR Parcel 2, leased to Fraserland Farms Partnership and Bow Chong Farm Ltd., is no longer being cultivated, as the adjacent land to the southeast is now owned by the TFN and is not currently being farmed.

6.5.4.8 Infrastructure

General Access

General east – west access through the Study Area is via Deltaport Way or 28th Avenue/27B Avenue. North – south access is via 41B Street, Arthur Drive and 57B Street. The 46A/48th Street alignment provides farm access across Deltaport Way and the BCR tracks via a private farm (Felix Farms) overpass. The BC Ministry of Transportation and Infrastructure has recently constructed an overpass at 41B Street across Deltaport Way and the only other existing public overpass of Deltaport Way is at Arthur Drive.

Property Access

The Felix Farms headquarters is located on the west side of 46A Street, on the north side of Deltaport Way, at 34B Avenue. Felix Farms cultivate owned and leased lands (including BCR Parcel 6) on both the north and south sides of Deltaport Way, with about 80 ha under cultivation most years on the south side. The full complement of farm vehicles and equipment accesses the south side lands either via their private farm overpass at 46A Street, and then using their internal farm roads, or on occasion, by turning on to Deltaport Way from the north side and using 41B to access either their private farm roads, the BCR gravel road along the south side of the existing tracks, or 27B Avenue.

The existing lessees of BCR Parcel 7 access their cultivated lands from Arthur Drive at the southeast corner of the field, and then use internal field trails.

Fencing

The BCR right-of-way has page wire fencing on both sides for the length of the Option Lands. Most other field boundaries have private farm fencing.

Buildings

The only existing buildings within the Option Lands are the BCR office and equipment structures within BCR PID 011-653-337.

Utilities

The only electrical, potable water and sewage facilities within the Option Lands are associated with the BCR office and equipment building within BCR PID 011-653-337.

6.5.5 Effects Assessment

6.5.5.1 Direct Effects

Direct effects occur within the Project footprint (defined for this study as the proposed right-of-way within the Option Lands) and are due to the construction of Project infrastructure works which result in the permanent removal of agricultural lands and loss of improvements within those lands. Within the proposed right-of-ways, direct effects on agricultural resources that potentially could occur fall into two categories:

1. The permanent loss of agriculturally capable and/or currently cropped lands.
2. Removal of agricultural infrastructure improvements within the lands, including: irrigation ditches, irrigation systems, farmyards, utilities, fencing and access roads.

Permanent Loss of Agricultural Lands

Table 6.5-1 summarises the legal information, parcel sizes, and Project land takings, including the cultivated area within the right-of-way. Construction within the right-of-way shown would result in the alienation of 8.33 ha of ALR lands, of which 6.46 ha are cultivated. All of these lands have high improved (irrigated and/or drained) capability for agriculture (Classes 2 and 3).

Drainage and Irrigation Effects

The drainage and irrigation features within the immediate vicinity of the Project may be directly affected. Additionally, there may also be indirect effects on drainage and irrigation features that are a result of the affected features.

Information on the size, elevation and condition of the potentially effected existing drainage and irrigation features is limited. Survey and condition assessments will be necessary for the evaluation of the geometry and physical condition of the features, and to provide the information necessary for the assessment of their hydraulic performance.

Due to the nature of the very flat inland water system, the hydraulic performance of the various drainage and irrigation features could only be evaluated in the context of the entire system, in this case, the whole drainage and irrigation system of the Southwest Delta Watershed. Analysing this highly complex hydraulic system requires an appropriate tool to evaluate their performance and developing measures for mitigating the potential effects of the Project. The Gateway Program in association with the SFPR and the DIEP has developed the Delta Watershed Model (DWSM) using the XPSWMM software platform. The Gateway Program has agreed to the use of this model by the Project.

During on-going Project design studies, DWSM will be updated with more existing and more accurate information on the drainage and irrigation features in the vicinity of the Project. It will be used for establishing base line hydraulic performance parameters, evaluating the potential effects of the Project, developing measures for mitigating potential effects and supporting the design of the various features selected for implementation.

In summary, the potential direct effects on drainage and irrigation farm infrastructure include:

- Loss of major irrigation/drainage ditch on NW boundary of BCR property #6 (Felix Farms).
- Loss of minor drainage ditch on NE boundary of BCR property #6.
- Disruption of three major irrigation/drainage ditch crossings of Deltaport Way along the north boundary of BCR property #6 (Felix Farms).

Farmyard, Building, Utilities, Fencing Effects

There are no farmyards or farm buildings within the Option Lands.

The page wire fencing between BCR right-of-way and BCR properties #2, 4, and 6 will be removed. The field fences that run perpendicular to the BCR right-of-way are tied in to the page wire fencing along the BCR right-of-way.

Farm Access Effects

As a result of the removal of the 46A Street overpass, Felix Farms will no longer have direct access between fields that they operate on both the south and north sides of Deltaport Way. Felix Farms will be provided with an alternative farm road that allows passage of farm vehicles utilizing the 41B Street overpass.

6.5.5.2 Indirect Effects

Indirect effects that could potentially occur within the adjacent lands surrounding the Project footprint (right-of-way) during construction and/or operational Project phases include:

- Aesthetic effects
- Noise effects

6.5.6 Potential Mitigation and Compensation

6.5.6.1 Direct Effects Mitigation

Less than 5 percent (4.7 million ha) of BC is in the ALR and of this, only 2.4 million ha (53 percent of the ALR) are rated as Class 1, 2, 3, or 4. In the Lower Mainland Region, including Delta, the ALR encompasses about 175,000 ha, of which about 74,000 ha are rated as Class 1, 2, 3, or 4 (**Section 6.5.4.4**). The loss of prime agricultural land from the ALR could only be completely off-set by either:

- Including non-ALR land of similar agricultural capability and of equal extent into the ALR, or
- Reclamation and inclusion if required, of less capable lands (an example would be the reclamation of mines and gravel pits).

Finding opportunities for ALR land replacement-in-kind in BC is difficult in all regions, but in the Lower Mainland the opportunity for replacement land is extremely remote given the scarcity of vacant lands. The only potential mitigation measure to off-set the permanent loss of agricultural lands due to DTRRIP is the reclamation of very small field areas following removal of the 46A Street private farm overpass. For this reason, the mitigation and compensation measures described below do not include an evaluation of replacement opportunities and all measures, other than the reclamation areas associated with the 46A Street overpass, are described as partially off-setting.

Proposed mitigation measures to address direct effects to farm infrastructure include:

- Development and implementation of a Topsoil Conservation Program entailing the salvage of topsoil from cultivated lands within the Project footprint and placement on adjacent cultivated areas to improve field configuration and drainage.
- Demolition of private farm[39] overpass access across Deltaport Way at 46A Street and reclamation of footprint areas not required for on-going access, on north and south sides to condition suitable for agricultural use.
- Construction of a gravel access road along the south side of the new BCR tracks within the BCR right-of-way and constructing a connection to the new overpass at 41B Street.
- Construction of a gravel access road along the south side of the Felix Farms fields north of Deltaport Way and constructing a connection to the new 41B Street overpass.
- Reconstruction of the major irrigation/drainage ditch on NW boundary of BCR property #6 (Felix Farms).
- Reconstruction of minor drainage ditch on NE boundary of BCR property #6.
- Replacement of page wire fencing between BCR right-of-way and BCR properties #2, 4, and 6 and tie-in of farm cross fences.

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[39] Farm overpass between Felix Farms – BCR property #6

The following subsections describe some of the proposed mitigation measures listed above in more detail.

Topsoil Conservation Program

Mineral topsoil removed from the right-of-way required for the Project-related works will be salvaged and spread over adjacent farm fields where the property owner is amenable and improvements are deemed feasible. The Topsoil Conservation Program, including topsoil stripping, storage, and re-use, will be supervised and monitored by the DTRRIP Professional Agrologist, who will maintain regular liaison with ALC and Corporation of Delta staff during the construction of the Project.

Demolition and Reclamation of Private Farm Overpass

As discussed in **Section 2.4.3.5**, the private farm overpass at 46A Street is proposed to be removed during the early stage of Project construction. The entire concrete structure would be removed followed by removal of the compacted earth approach slopes. The area of the approach slopes adjacent to either farm fields or the farm access road along the 46A Street alignment would be reclaimed for farm use, either as part of the access road or cultivated fields. Regular liaison will be maintained with Felix Farms during the detailed planning and decommissioning process.

Details of the demolition and reclamation activities are described in **Section 2.6.5.2**.

Construction of Farm Access Routes and Use of New 41B Street Overpass

Once the 46A Street overpass is removed, the north-south movement of farm equipment over Deltaport Way will use the new 41B Street overpass.

In order to minimise the effect of the increased time required to cross Deltaport Way, construction of additional infrastructure that complements the existing 41B overpass is proposed to expedite the movement of farm vehicles over Deltaport Way. This would include:

- Construction of an east-west gravel access road (approx 1 kilometres) on the southern boundary of the property on the north side of Deltaport Way that ties into the northern approach to 41B overpass.
- Construction of an access between the southern end of the 41B overpass and the east-west gravel road (which will be relocated as a part of the Project), on the south side of Deltaport Way within the existing rail right-of-way.
- Reinstatement of an access point between the east-west gravel road with the existing rail right-of-way (south side of Deltaport Way) and Arthur Drive.

Re-construction of Drainage/Irrigation Features

The mitigation objectives for the drainage and irrigation system propose to maintain, or improve the level of service, measured as the hydraulic performance, provided by the existing system. The hydraulic performance objectives for the drainage and irrigation system are:

- For the drainage system, the objectives are to reduce maximum water surface elevations, and the duration of high water levels in the system during critical storm events. These objectives typically may be achieved by drainage improvements across the Project and between the Project and the primary drainage ditches leading to the major outfalls of the system.
- For the irrigation system, the objective is to deliver irrigation water from the main supply channels to the location of the irrigation demand with minimum losses across the Project and at a water level that is suitable for satisfying the irrigation demand. This objective may be achieved by providing ditches and structures crossing the Project at an elevation that will present minimal constraints through the structure and that will not interfere with the operation of various irrigation controls.

During the detailed design phase, the DTTRIP team will work closely with the local farmers to ensure that the existing ditch system is reconfigured in a manner that will improve the overall level of service of the drainage and irrigation systems.

Fencing

At the start of Project construction, the page wire fencing installed along the south side of the existing right-of-way will be replaced along the south side of the new right-of-way with similar fencing, in accordance with BCR fencing standards. Existing field fences will be replaced with appropriate fencing, tied in to the BCR fencing, as determined in consultations with the adjacent property owners prior to Project construction.

6.5.6.2 Indirect Effects Mitigation

Potential mitigation measures to off-set indirect effects that may occur during construction and/or operational Project phases within the adjacent lands surrounding the Project footprint include the following:

- Construction of fences to reduce risks to livestock.
- Regular liaison with farm operators during Project construction to address issues that might arise related to access, noise and aesthetics to ensure they are addressed in a timely manner.

There are no anticipated indirect effects due to severance or isolation of farm fields.

6.5.6.3 Compensation

The ALC promotes a policy of achieving a “net benefit to agriculture” when considering development projects involving ALR lands. As part of their approval for several recent Provincial projects, the ALC has endorsed agricultural enhancement initiatives as compensation designed to off-set the permanent loss of ALR lands. It is assumed that potential agricultural enhancement initiatives will be discussed with the ALC, Corporation of Delta, and Delta Farmers Institute, to ensure that proposed compensation initiatives are supported by the ALC and key stakeholders.

In addition to the mitigation measures outlined above (Topsoil Conservation Program, drainage/irrigation improvements on adjacent lands and provision of farm access to the new 41B Street overpass) the Project is proposing to provide additional funding for the construction, monitoring and maintenance of the DIEP.

Potential compensation measures will be discussed with farmers potentially affected by the Project, the ALC, the DFI and the Corporation of Delta throughout Project detailed design stage and as part of ongoing consultations regarding ALC approval for the Project.

6.5.7 Residual Effects and Determination of Significance

The direct losses of agricultural land within the Project footprint is 8.33 ha of ALR lands, 6.46 ha of which are cultivated (**Table 6.5-1**). The implementation of the proposed mitigation measures above would partially off-set the permanent loss of arable ALR land, therefore compensation programs would likely be required by the ALC in order to meet their policy of a “net benefit to agriculture” when considering development projects involving ALR lands. It is important to note that every project considered by the ALC is done so independently and the ultimate compensation amount to be provided by DTRRIP would be negotiated with ALC.

No residual adverse effects to agriculture are expected following implementation of the proposed mitigation and compensation measures.

6.6 ARCHAEOLOGY RESOURCES

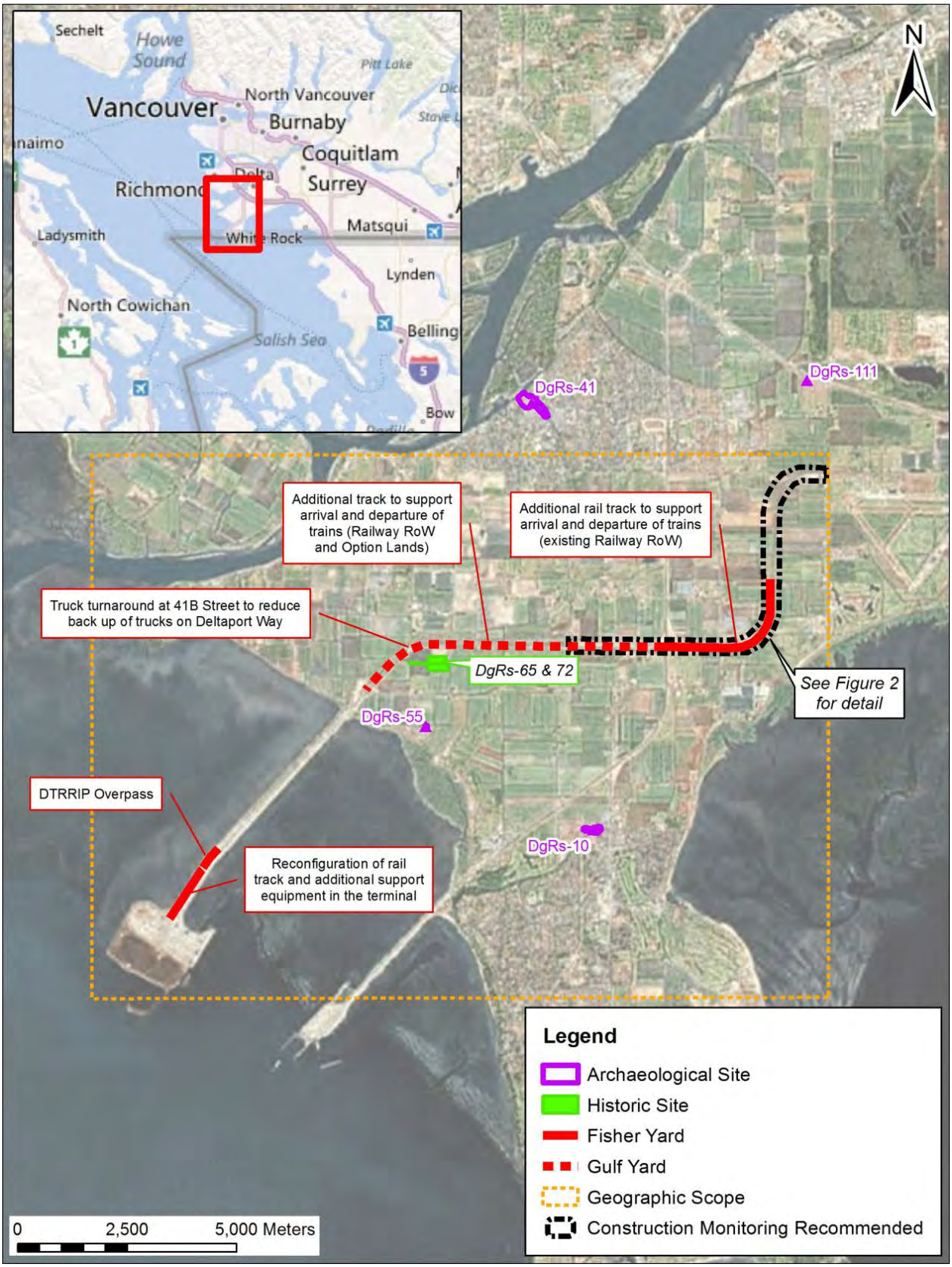
6.6.1 Introduction

The archaeological assessment of the proposed Project was completed in October 2011, and included an Archaeological Overview Assessment (AOA) conducted by Millennia Research Ltd. The following section is based on the report by Millennia Research Ltd. titled *An Archaeological Overview Assessment for the Proposed Deltaport Terminal, Road and Rail Improvement Project (DTRRIP*), 2012.

6.6.2 Existing Conditions

The archaeological study area (**Graphic 6.6-1**) is located within land located inland from Roberts Bank, and includes subtidal and mudflat areas, as well as upland areas that have been subject to the development of transportation corridors and farming. The assessment area is within the treaty territory of the Tsawwassen First Nation, as well as the asserted traditional territories of the Musqueam First Nation, Katzie Indian Band and Sto:lo Nation. To date, a number of archaeological studies have been conducted in the vicinity of the Project in response to infrastructure developments that have occurred within the last 50 years. Within the DTRRIP footprint, recent archaeological studies have included AOAs and Archaeological Impact Assessments (AIAs) relating to the Deltaport container terminal. Most recently, AIAs were conducted for the Deltaport Way Expansion (Arcas, 1995), Deltaport Third Berth Expansion Project (Eldridge and Anaya-Hernandez, 2004), the South Fraser Perimeter Road (Mason *et al.,* 2006), and the 41B Street Overpass (Myles, 2009) all within study areas that encompassed a part of the DTRRIP location as it is currently designed.

Graphic 6.6-1 Archaeological Overview Study Area



In conducting the AOA, findings from previous studies that were located within the DTRRIP footprint were researched and used to assess the need for additional field research. A number of areas of high archaeological potential within the Project footprint were identified through a review of these studies, determined based on the presence of ancient channels and sloughs, as well as from an understanding of the ethnographic history of the area. However, Millennia Research Ltd. has revised the potential rating based on the amount of development that has affected the physical environment of the Fraser River Delta since contact with early Euro-Canadian settlers and the negative findings along similar possible watercourses during prior archaeological work. Millennia Research Ltd. has now rated the archaeological potential of these areas as moderate.

Currently there are 20 archaeological sites identified within the archaeological study area, including four known sites within a four-kilometre area of the DTRRIP footprint. The nearest known site is located more than a kilometre away.

There are two historic sites recorded in the Provincial Heritage Registry and may be protected under section 977 (1) of the *Local Government Act by the* Community Heritage Register of the Corporation of Delta. These are located outside of the Project footprint.

6.6.3 Potential Effects and Proposed Mitigation

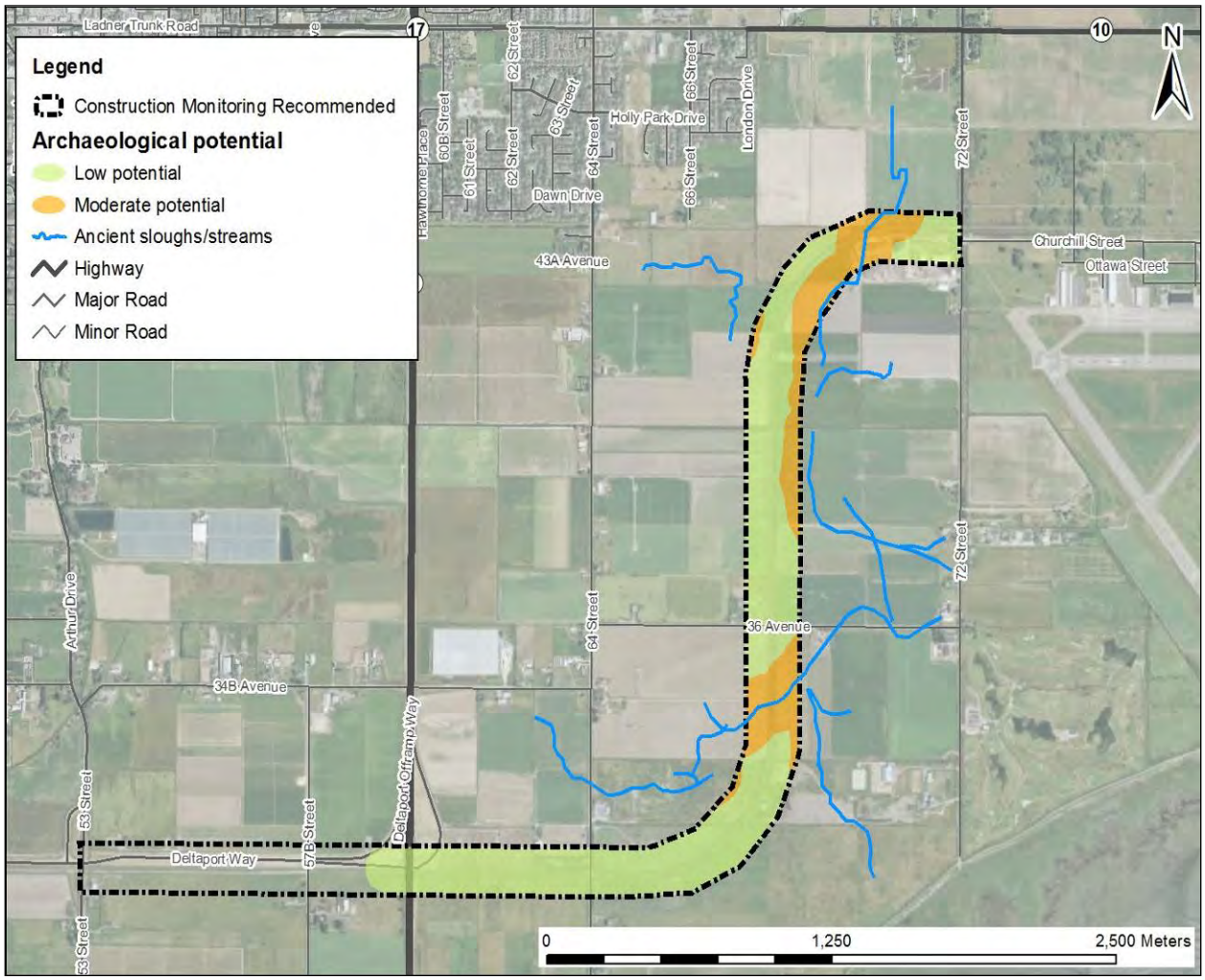
Although no known archaeological sites are located within the proposed footprint of the DTRRIP, Millennia Research Ltd. identified areas of moderate archaeological potential along the segment of the Project from Arthur Drive to 72nd Avenue. Potential effects may occur to undiscovered archaeological sites as a result of ground disturbance created during the construction phase. However, giving consideration to the degree of previous ground disturbances in the area, the number of past archaeological investigations that have occurred in the area, and that based on existing design, all Project works will be confined to the existing railway right-of-way, Millennia Research Ltd. is recommending construction monitoring and Archaeological Awareness training and does not recommend additional archaeological testing within the footprint.

6.6.3.1 Construction

Measures proposed to mitigate against the chance of disturbing subsurface archaeological materials will include construction monitoring, to be conducted by experienced First Nations technicians in areas identified in the AOA that contain moderate archaeological potential. Additionally, Archaeological Awareness training, in the form of the development of a chance find procedure for construction crews, will further ensure the protection of any subsurface archaeological materials that may be encountered during DTRRIP construction.

Construction monitoring by qualified First Nations technicians, combined with Archaeological Awareness training for Project construction workers will address the need for the protection of subsurface archaeological materials that may be located along the proposed route. As per the findings of the AOA, these activities will be concentrated in areas that are within and along the banks of former slough channels, in order to prevent disturbance to potential wet sites, lithic scatters and shell middens that may be located there. It is recommended that these mitigation measures be focused on that section of the Project located between Arthur Drive and 72nd Avenue (**Graphic 6.6-2**).

Graphic 6.6-2 Recommended Construction Monitoring and Archaeological Potential



Note: Redrawn and modified after Mason *et. al*., 2006 based on Golder's SFPR report.

If archaeological resources are identified during the construction of DTRRIP, construction activities in the immediate area will be halted until an archaeologist undertakes an assessment of the archaeological significance and potential effects. Following this, the archaeologist will make further recommendations regarding the necessary avoidance or mitigation measures for the identified archaeological materials.

6.6.3.2 Operation

Following mitigation measures proposed during the construction phase, no additional mitigation is recommended for the operation phase.

6.6.4 Residual Effects and Determination of Significance

No residual adverse effects on archaeology resources are expected following implementation of the proposed mitigation measures. Given that no ground disturbances will occur outside of the Project footprint, monitoring for the presence of archaeological resources by trained First Nations technicians will not be required following the construction of DTRRIP. Construction monitoring that will occur during the construction phase of the Project will have already addressed potential effects of the Project to archaeological resources.

7.0 ACCIDENTS AND MALFUNCTIONS

7.1 INTRODUCTION

Pursuant to the CEAA, an assessment of the environmental effects of any potential Project accidents or malfunctions that may occur in connection with its construction and operation is required. This section presents the Project components where accidents and malfunctions could occur, assesses the risk to the environment and identifies the need for environmental management, spill response, or emergency response plans.

A summary of the potential environmental effects that could arise due to possible accidents or malfunctions is presented in **Table 7-1** along with the proposed mitigation or emergency response measures. **Table 7-1** is located at the end of this section.

7.2 CONSTRUCTION

During the construction phase, the potential for malfunctions and accidents related to the proposed Project components is similar to any other large construction site. They can occur as a result of the use of construction materials, machinery and equipment, waste management, and in particular, the storage of fuels and lubricants, and refuelling procedures.

Potential accident and malfunction incidents that might occur during construction that could affect the environment include:

- Construction equipment mobilisation to and from the Project site (traffic accidents and transportation of dangerous goods).
- Construction of DTRRIP Overpass (fuelling, spills and leaks, waste management).
- Rail construction (fuelling, spills and leaks, waste management).
- Overall health and safety (major accident or death).

7.2.1 Vehicle Accidents

Vehicle accidents during construction can result in personal injury, as well as potential spills of toxic/hazardous materials. The construction Environmental Management Plan (EMP), to be developed prior to construction, will outline mitigation measures to avoid and minimise the potential for traffic hazards during construction, including compliance with the transport and storage of dangerous goods (i.e., fuels), as per the *Transportation of Dangerous Goods Act,* and worker safety as per the BC Workers Compensation Board.

A traffic management plan will be developed for construction to reduce the potential for traffic incidents.

7.2.2 Spills and Leaks

The primary concern to the environment that could arise from an accident or malfunction is during refuelling of construction equipment on site. Spills have the potential to effect soil, groundwater, and surface water quality as well as fish and wildlife. There is concern regarding the potential for accidental spills and leaks in the proposed repair yard to affect areas of biofilm, a critical food source for Western sandpipers and other shorebirds. The rail repair yard is located approximately 600 metres from shore, and on the other side of the causeway from the identified area of biofilm. It is therefore anticipated that there will be no adverse effects to biofilm due to the distance of land between the two areas, and the physical barrier provided by the causeway. The contractor for the Project will be required to meet stringent requirements to conduct all fuelling of equipment, including storage of petroleum products (e.g., fuel, oil, lubricants), appropriately, in accordance with all applicable guidelines, legislation, and best management practices to eliminate the risk of spills.

The contractor will also be required to have an appropriate and specific spill prevention, containment and cleanup contingency plan for hydrocarbon products (e.g., fuel, oil, hydraulic fluid, lubricants), and all other deleterious substances (i.e., concrete) that may be used in association with the Project. This plan will be put in place prior to work commencing at the Project site. The contractor will also be required to have all appropriate containment and clean up materials on site throughout the course of work on the Project including the demonstrated expertise in deployment. The contractor's spill prevention, containment and cleanup contingency plan will become a sub-plan of the construction EMP, and shall be submitted to the regulatory agencies for review prior to the start of construction.

Accidental spills and leaks are discussed further in **Section 7.3 Operation**.

7.2.2.1 Concrete Spills

Based on existing design, the majority of the DTRRIP Overpass superstructure will be prefabricated and assembled on site. Some concrete pouring will be required for finishing of the bridge deck.

Concrete (un-cured and dry concrete) accidentally released during construction can increase pH to potentially toxic levels, affecting some aquatic life, and should be prevented from entering the water environment.

Contractors will be required to have materials and equipment as a contingency measure for minimising the effects of concrete accidentally released in or adjacent to watercourses, including storm drains. Un-cured concrete will be covered during rain events and rinse water from cement truck cleaning will be contained and disposed of appropriately. Concrete management measures will be outlined in a Construction EMP that will be developed prior to construction.

7.2.3 Waste Management

Uncontained and improperly disposed of waste can effect the terrestrial environment. Waste and deleterious materials can also act to degrade water quality when released into water bodies or drainages leading to water bodies, potentially resulting in contamination of the marine environment and having effects on fish, marine mammals, seabirds and waterfowl.

All waste and deleterious materials generated by construction of the Project will be appropriately contained by the contractor in the immediate work area, collected, and appropriately disposed of in accordance with all applicable legislation, guidelines, and best management practices. Waste management procedures will be outlined in a Construction EMP that will be developed prior to construction.

7.2.4 Health and Safety / Emergency Response

All contractors will be required to develop a health and safety plan for their component of work prior to the start of construction. The health and safety plan would typically include:

- Site location and prime contacts
- Local emergency and Project contact numbers
- Description and map of emergency routes
- Safety equipment required
- List of site hazards and mitigation
- Potential waste generation and disposal methods

The health and safety plan should also outline emergency response procedures during construction. Primary responsibility for on-site emergency planning and response during construction rests with the contractor. Local government's emergency services (fire, police, and ambulance) are responsible for operational support to the extent that expertise and resources are available and to the extent that the response functions are within their mandate.

7.3 OPERATION

Potential accidents and malfunctions during operation of the Project that may effect the environment, include:

- Spills and leaks including those from fuelling operations, liquid ship emissions (ballast water and bilge water), terminal and rail operations and storm water.
- Vehicle/ ship collisions/grounding.
- Transportation of dangerous goods.

- Waste management.
- Health and safety.
- Emergency response.

An existing TSI Operational Management Plan included in the November 2009 “Pre-Operations EAC Compliance Report” for the Delta Port Third Berth Expansion Project along with its associated Table of Commitments and Assurances is available on the Port website in the DP3 section.

7.3.1 Spills and Leaks

The fuelling of terminal and rail equipment, and off-site vehicles represents a potential effect to the environment in the event of a spill. Specific policies and procedures have been established to reduce the probability of spills occurring, which are outlined below. Port Metro Vancouver prohibits fuelling or bunkering of all marine vessels at Roberts Bank by any means.

7.3.1.1 Fuel Management of Terminal Equipment – Deltaport Container Terminal

TSI has established a Fuel Management and Dispensing Operating Procedure as part of the existing Deltaport Terminal Environmental Management Plan. The purpose of the Fuel Management and Dispensing Operating Procedure is to minimise the effect of hydrocarbons on the environment during fuelling of terminal equipment. The Fuel Management and Dispensing Operating Procedure includes requirements for maintenance of the fuelling areas, procedures for vehicle fuelling and a spill response/emergency response procedure.

The Project does not require the construction of additional fuel storage or fuelling facilities at the Deltaport terminal, as the present facilities are adequate. If needed, TSI’s existing Fuel Management and Dispensing Operating Procedure will be updated.

7.3.1.2 Fuel Management of Off-site Trucks and Cars

All fuelling for road container trucks or employee vehicles is conducted off-site, at designated and approved fuelling facilities. There will be no fuelling of container trucks or employee vehicles as part of the operations of the Project.

7.3.1.3 Fuel Management of Rail

The Roberts Bank terminal complex is located at the end of the BCR Port Subdivision (Port Sub), which connects Deltaport by rail to the inland networks of the CN Railway, CPR, and BNSF. All three railways ship bulk coal via the Roberts Bank rail corridor.

As described in Section 2.4.5.5, about eight to ten trains per day (intermodal and bulk coal), arrive and depart at Roberts Bank. Only one of the CPR trains per day is normally fuelled at Roberts Bank, with all other road locomotives being fuelled elsewhere on the CN, CPR and BNSF rail lines. All fuelling is carried out as DTL (Direct to Locomotive) fuelling by DTL fuelling contractors, operating TDG regulated fuel trucks under contract to CN and CPR. The fuel truck contractors must comply with CN and CPR DTL Fuelling Policy and Procedures. Any spill response would be provided under CN or CPR Spill Response Plans, under the co-ordination of BCR's Emergency Response Plan.

DTRRIP will provide a single designated fuelling track location with positive spill containment infrastructure in the Gulf Yard. All DTL fuelling procedures and protocols will remain as-is, but will be done at the designated location with spill containment, except in instances where it is operational circumstances make it unfeasible.

BCR has instituted emergency protocols on BCR's Port Subdivision and CPR's Page Subdivision. BCR has a central dispatch centre that monitors the trains and tracks that run from Roberts Bank through Delta, Surrey, and Langley. The fully integrated computerised system provides real-time monitoring of track status and train movement on the line. The dispatch centre monitors trains from CN, CPR, BNSF, and SRY and is in constant radio contact with the train operators providing immediate operational and emergency communication. Included in the monitoring system is information on the distances between rail crossings, which are used to provide accurate movement forecasting between track and road based operations.

The centre provides a 24-hour emergency contact for the rail companies and the Royal Canadian Mounted Police (RCMP) and manages the communication plan to deal with incidents that involve the rail line. If an accident that involves a train stoppage should occur trackside, BCR will contact the RCMP who in turn will notify the Fire and Ambulance Departments in order to minimise the effect on emergency response operations. If a non-train related incident occurs and the RCMP decide that passing trains will affect the on-scene incident management, the RCMP will contact BCR who can alter train operations accordingly.

7.3.1.4 Marine Ballast Water Exchange

Ballast water refers to water (with its suspended matter) that is taken on board a ship to control trim, list, draught, stability or stresses of a ship. Port Metro Vancouver implemented a mandatory ballast water management program in January 1998 to limit the possibility of transferring non-indigenous species into Canadian waters while protecting the safety of ships.

With the introduction of Transport Canada's national ballast water control requirements in 2007 (set out in "*A Guide to Canada's Ballast Water Control and Management Regulations TP13617 E")* , Port Metro Vancouver no longer needed to manage ballast discharges for non-indigenous species and the program was discontinued. Port Metro Vancouver authorization is still required for de-ballasting operations in Port jurisdiction.

As per the Transport Canada requirements, vessels arriving in Canadian Ports will exchange ballast not less than 200 nautical miles from shore as dictated by the *Ballast Water Control and Management Regulations* made pursuant to the *Canada Shipping Act.*

7.3.1.5 Bilge Water

It is an offence to discharge into the Port of Vancouver harbour, including Roberts Bank, any oil or other liquids containing oil (bilge water). Bilge water is any water that collects in the sides or bottom of the ship's hull (bilge) including effluent from the engine compartment. To help protect vessels and the environment from the accidental discharge of oil or oily water, the Harbour Master's Patrol Staff seal the engine room bilge overside discharge valve(s).

In accordance with Transport Canada's Oil Pollution Prevention Regulations, no oil or oily mixture shall be discharged from a vessel in waters under Canadian jurisdiction.

All accidental overside discharges are to be reported immediately to the Harbour Master's Office. If the discharges contain oil or other deleterious substances, the vessel must immediately notify Marine Communications and Traffic Services (MCTS) Vancouver and the vessel must activate its Oil Pollution Emergency Plan. This plan is a requirement of the *Canada Shipping Act*.

The Oil Pollution Emergency Plan must identify the person authorised to implement the plan and also confirm the vessel has an arrangement with a Canadian Coast Guard certified response organisation. In the event of a spill the vessel must immediately notify the MCTS Vancouver, which in turn notifies the Canadian Coast Guard and the Harbour Master's office. The Harbour Master is the On Scene Commander for the incident for marine based oil spills.

7.3.1.6 Ships, Collisions and Grounding

The Project will result in an increase from 245 vessel calls (container ships) in 2010 to 318 vessel calls (container ships) in 2017 (an increase of approximately 29 percent). As in any marine waterway, especially where there is crossing traffic, there is always a potential for an accident. There are a number of special operating procedures already in place, mainly tied in with the International Regulations for the Prevention of Collision at Sea (ColRegs) requirements for navigating in traffic separation zones. These will continue to remain in force for the foreseeable future. In the event of a collision or grounding there is potential for release of fuels and oils as well as physical destruction or compaction of the habitat on the seabed.

Risks for an accident are minimised though the (ColRegs). Comprehensive marine VHF radio coverage and the high level of communications that takes place between virtually all ships minimise the risks of collision. All deep-sea foreign flag ships over 350 gross registered tonnes are required to have a licensed Canadian pilot on board while in compulsory pilotage waters. Ferries, tugs, and fishing vessels are

required by law to have licensed personnel on board. As of September 15, 2009 all recreational boaters in Canada are required to carry a Pleasure Craft Operator Card or they risk expensive fines. The Operator Card, accredited by Transport Canada, is proof of competency that a recreational boater has the basic knowledge to operate a motorized vessel safely and is aware of the above-mentioned Collision Regulations.

7.3.2 Storm Water Management

Collection and disposal of storm water at the Deltaport container terminal will be as it is today; there will be no change in the impervious area.

The roads on the Roberts Bank causeway and modifications near or adjacent to Deltaport Way will be graded for storm water to drain and infiltrate into the gravel shoulder. Storm water runoff from the new DTRRIP Overpass will be collected and discharged directly to the ground via a standpipe, and allowed to infiltrate into the gravel.

Works associated with railway improvement include the installation of a new storm sewer and potential ditch re-alignment. Culverts will be designed to sizes and as per standards required to carry flows and will meet the requirements of the BC *Railway Safety Act* and other applicable regulations and standards. The realignment of the existing ditches to accommodate the Project will require detailed hydraulic assessments and close coordination with the local farmers and the Corporation of Delta (i.e. the Delta Irrigation Enhancement Project). A *Water Act* Approval or Notification will need to be in place prior to any modification or relocation of agricultural ditches or drainage channels.

7.3.3 Transportation of Dangerous Goods

The *Transportation of Dangerous Goods* (TDG) *Act* imposes the legal obligation on individuals having custody of products that meet the definition of dangerous goods to ensure that goods are safely and securely packaged and transported, and that they are identifiable through approved labelling. Together with the *Canada Shipping Act*, it imposes special regulations and provisions on intermodal carriers to train and certify staff involved in the transport of dangerous goods.

7.3.4 Waste Management

Waste and deleterious materials generated throughout the operation of the Project will be appropriately contained by the contractor in the immediate work area, collected, and appropriately disposed of in accordance with all applicable legislation, guidelines, and best management practices.

7.3.4.1 Terminal

Improper waste management and disposal methods from the terminal could result in potential effects on marine and terrestrial environments.

TSI has established an EMP to ensure environmentally responsible purchase and use of products including proper storage and disposal. TSI has established environmental procedures for items used at the terminal including empty drums, pails and other containers, solid non-hazardous waste, used absorbent materials, batteries, ozone depleting substances including Freon and Halon, used oil filters, waste antifreeze, waste oil and petroleum products, and waste solvents.

7.3.4.2 Rail

Wastes generated from associated BCR operations is anticipated to be limited to domestic waste and recycling picked up from the Yard Office. No locomotive maintenance activities will be conducted on the Port Sub that would generate deleterious wastes. Track maintenance or upgrading work parts will be collected and re-cycled as re-usable or scrap materials.

7.3.4.3 Ships

Improper waste management and disposal methods from ships could result in effects to marine mammals, fish, fish habitat, waterfowl, coastal seabirds, and shorebirds, either through the ingestion of waste, exposure to the waste or entanglement in associated debris.

The International Convention for the Prevention of Pollution from Ships (MARPOL) governs the release of oil, hazardous substances, and garbage into the marine environment. MARPOL (revised) Annex V deals with wastes (which include plastics, metal, glass, galley wastes, and other materials).

This international legislation deals with different types of ship board waste and specifies the distances from land and the manner in which they may be disposed of. The most important feature of the Annex is the complete ban imposed on the dumping into the sea of all forms of plastic. Ships wanting to dispose of wastes in the Port of Vancouver can apply to do so. Ship-board waste is considered international waste under the *Canada Shipping Act* and requires special collection procedures and incineration rather than landfilling. The Roberts Bank terminal complex does not accept ship-board waste, as there are no collection facilities.

7.3.5 Health and Safety

Unsafe work conditions can result in effects on workers and/or neighbouring communities.

TSI has established a Health and Safety Plan for the existing Deltaport container terminal. This plan will be updated to include new Project components and equipment as appropriate prior to operation.

Delta Hospital is located approximately 5 kilometres from the Project and provides 24-hour emergency services, along with other medical services. Major trauma cases are transferred to Royal Columbia Hospital (New Westminster), Vancouver General Hospital, or Lions Gate Hospital (North Vancouver).

7.3.6 Emergency Response

7.3.6.1 Hazardous Materials

The *TDG Act* requires that before a person offers for transport or imports certain dangerous goods, the person must have an approved Emergency Response Assistance Plan (ERAP). TSI, as the terminal operator, and CP and CN Rail have established Emergency Response Assistance Plans. Spills of TDG Class 3 – *flammable liquids* > 100 litres (L) must be reported to the Provincial Emergency Program .

Primary responsibility for on-site emergency planning and response rests with the Responsible Party (perpetrator/ polluter/ spiller) of the hazardous material released. Local governments with their emergency services (fire, police, and ambulance) are responsible for operational support to the extent that expertise and resources are available and to the extent that the response functions are within their mandate. If needed or requested, the Province will provide technical assistance to industry, local government, and/or both in accordance to this plan. Response escalation generally builds from the bottom up: from field operations, to the site's Incident Command Post, to supporting emergency operations centres. Under the Incident Command System (ICS), unified (shared) command with local government and other government jurisdictions as well as the Responsible Party is the primary mechanism to ensure governance and corporate issues and priorities are addressed at the site.

For incidents on the BC rail line the On Scene Commander is BC Rail Port Sub Ltd. For dangerous goods incidents on provincial roadways the On Scene Commander responsibility is shared between the Responsible Party and the local fire department.

TSI is the On Scene Commander for any incidents within the Deltaport container terminal. Key initial environmental procedures extracted from TSI's Emergency Response Plan for spill management are:

- Report the spill to supervisor, co-ordinate spill team and evacuate non-spill team person(s)
- Assess area
- Identify the spill
- Respond
- Clean-up/disposal
- Reporting

7.3.6.2 Fire and Emergency Services

Delta Fire and Emergency Services provide response for fires, motor vehicle accidents, medical emergency services, rescue and safety, public service calls, emergency measures and planning, fire prevention and public education, fire investigation, and community support to Delta.

The Delta Fire Department responds to those hazardous material (HAZMAT) incidences that can be handled by standard issued protected turnout clothing and breathing apparatus. For incidents requiring a more comprehensive response, Delta has a Mutual Aid Agreement with the Surrey and Vancouver Fire Departments, which have full HAZMAT response capability.

Key initial procedures extracted from TSI's Emergency Response Plan for fires are:

- Activate the fire alarm, alert others, and move people away from the area of the fire
- Close doors behind you
- Follow the Emergency Response Plan
- Call 911, report the location of the fire
- Know muster station locations

7.3.6.3 Police and Security

The Delta Police Department serves the communities of Ladner, Tsawwassen, and North Delta. The main station is located in Ladner, with community policing operations in Tsawwassen, Ladner, and North Delta. The Delta Police Department is responsible for regular policing at the Roberts Bank terminal complex, whereas the RCMP is responsible for responding to issues of national threat (i.e., MARSEC increase).

Security services for Roberts Bank are a shared responsibility between Port Metro Vancouver and the terminal operators. If Port Metro Vancouver determines a need for increased security, Delta police may be contracted to provide extra officers for the period of heightened security. The International Ship and Port Facility Code, implemented in July 2004, is the security standard for the Port. New Marine Transportation Security Regulations designed to strengthen security requirements for vessels, marine facilities and ports, and to be compliant with the International Maritime Organisation Code, also came into effect in 2004.

7.3.7 Conclusion

The environmental effects of any potential Project malfunctions or accidents that may occur in connection with construction and operation of the Project can be addressed with appropriate construction and operational environmental management spill response, health and safety and emergency response plans. Provided such plans are in place and are updated for the Project no significant effects to the environment or human health and safety are likely to occur.

Table 7-1 Summary of Potential Environmental Effects due to Accidents and Malfunctions

Accident or Malfunction	Potential Environmental Effect	Mitigation / Response Plan
Construction		
Vehicle Accidents	• Personal injury • Spills of toxic/hazardous materials	The construction Environmental Management Plan (EMP), to be developed prior to construction, will outline mitigation measures to avoid and minimise the potential for traffic hazards during construction, including compliance with the transport and storage of dangerous goods (i.e., fuels), in accordance with the *Transportation of Dangerous Goods Act*, and worker safety as per the WorkSafeBC. A traffic management plan will be developed for construction to reduce the potential for traffic incidents.
Spills and Leaks	• Contamination of soil, groundwater and surface water quality • Effects on terrestrial and aquatic environments (including fish, terrestrial and marine wildlife)	The contractor will be required to meet stringent requirements to conduct all fuelling of equipment, including storage of petroleum products (e.g. fuel, oil, lubricants), in compliance with all applicable guidelines, legislation, and best management practices. The contractor will also be required to have an appropriate spill prevention, containment and cleanup contingency plan for hydrocarbon products (e.g., fuel, oil, hydraulic fluid, lubricants), and all other deleterious substances, including concrete, that may be used in association with the Project. This plan will be put in place prior to work commencing at the Project site and will become a sub-plan of the construction EMP. Contractors will be required to have materials and equipment as a contingency measure for minimising the effects of concrete accidentally released in or adjacent to watercourses, including storm drains. Un-cured concrete will be covered during rain events and rinse water from cement truck cleaning will be contained and disposed of appropriately. Concrete management measures will be outlined in a Construction EMP that will be developed prior to construction. The contractor will be required to have all appropriate containment and clean up materials on site throughout the course of work on the Project including the demonstrated expertise in deployment. The contractor's spill prevention, containment and cleanup contingency plans will be submitted to the regulatory agencies for review prior to the start of construction.
Waste Management	• Degradation of water quality • Effects on terrestrial and aquatic environments(including fish, terrestrial and marine wildlife)	The contractor will be required to have appropriate waste management procedures outlined in a construction EMP prior to construction. All waste and deleterious materials generated by construction of the Project will be appropriately contained by the contractor in the immediate work area, collected, and appropriately disposed of in accordance with applicable legislation, guidelines, and best management practices.

Accident or Malfunction	Potential Environmental Effect	Mitigation / Response Plan
Transport of Dangerous Goods	• Toxicity/mortality to fish and wildlife • Effects on the terrestrial environment • Effects to human health	The transport and storage of dangerous goods will be carried out in compliance with the federal *Transportation of Dangerous Goods Act* (TDG).
Health and Safety / Emergency Response	• Effects on workers • Effects on neighbouring communities	All contractors will be required to develop a health and safety plan for their component of work prior to the start of construction. The health and safety plan would typically include: • Site location and prime contacts • Local emergency and Project contact numbers • Description and map of emergency routes • Safety equipment required • List of site hazards and mitigation • Potential waste generation and disposal methods The health and safety plan will also outline emergency response procedures during construction. Primary responsibility for on-site emergency planning and response during construction rests with the contractor. Local government's emergency services (fire, police, and ambulance) are responsible for operational support to the extent that expertise and resources are available and to the extent that the response functions are within their mandate. A traffic management plan will be developed for construction to reduce the potential for traffic incidents.
Operations – Fuel and Liquid Management from Ships, Terminal Operations and Road and Rail		
Fuel Management of Terminal Equipment – Deltaport Container Terminal	• Potential for spills that result in effects on the marine environment including; degradation of water quality, contamination of marine sediments, toxicity/mortality to fish and marine mammals, toxicity/mortality to waterfowl and coastal seabirds.	TSI has established a Fuel Management and Dispensing Operating Procedure as part of the existing Deltaport Terminal Environmental Management Plan. The purpose of the Fuel Management and Dispensing Operating Procedure is to minimise the effect of hydrocarbons on the environment during fuelling of terminal equipment.

Accident or Malfunction	Potential Environmental Effect	Mitigation / Response Plan
Fuel Management of Off-site Trucks and Cars	• Potential for spills that result in effects on the terrestrial environment but could also link to the marine environment and could result in the degradation of water quality, contamination of soils or marine sediments toxicity/mortality of terrestrial species, toxicity/mortality to fish and marine mammals, and toxicity/mortality to waterfowl and coastal seabirds.	All fuelling for road container trucks or employee vehicles will be conducted off-site, away from the existing Deltaport container terminal, at approved fuelling facilities.
Fuel Management of Intermodal and Rail Improvements	• Potential for spills that result in effects on the terrestrial environment and the marine environment and could result in the degradation of water quality, contamination of soils or marine sediments.	When fuelling operations take place, the individual railways appropriate fuel management measures will be employed and BC Rail Emergency Response Protocols for spill response will be followed. All TDG regulated fuel trucks (vehicles) transporting fuel will have the existing spill response plan and procedures on hand, along with a spill response kit capable of containing and absorbing fuel spills. BC Rail also has a central dispatch centre that is in constant radio contact with the train operators, monitoring and providing immediate operational and emergency communication for the tracks that run from Roberts Bank through Delta, Surrey, Langley and Abbotsford.
Bunkering of Marine Vessels	• Potential for spills that result in effects on the terrestrial environment and the marine environment and could result in the degradation of water quality, contamination of soils or marine sediments.	Port Metro Vancouver prohibits fuelling or bunkering of all marine vessels at Roberts Bank by any means.
Marine Ballast Water	• The potential for non-indigenous species to be transported in ballast water and be deposited to establish in the local environment either as a pest species effecting the native species.	Vessels arriving at the terminal will exchange ballast not less than 200 nautical miles from shore as dictated by the *Ballast Water Control and Management Regulations* of the *Canada Shipping Act*.
Bilge Water	• The discharge of bilge water can contain oil or oily water degrading water quality, contaminating marine sediments, potential toxicity/mortality to fish and marine mammals and potential toxicity/mortality to waterfowl and coastal seabirds.	As per the Port Authority Operations Regulations there is no discharge of bilge water within PMV's jurisdiction. Further, in accordance with Transport Canada's Oil Pollution Prevention Regulations, no oil or oily mixture shall be discharged from a vessel in waters under Canadian jurisdiction. All accidental overside discharges will be reported immediately to the Harbour Master's Office. In the event of a spill, or if the discharges contain oil or other deleterious substances, the vessel must immediately notify Marine Communications and Traffic Services Centre (MCTS) Vancouver and the vessel must activate its Oil Pollution Emergency Plan, as required by the *Canada Shipping Act*.

Accident or Malfunction	Potential Environmental Effect	Mitigation / Response Plan
Ship Collisions and Grounding	• In the event of a collision or grounding there is potential for release of fuels and oils as well as physical destruction or compaction of the habitat on the seabed.	Risks for an accident are minimised though the *International Regulations for the Prevention of Collision at Sea* (ColRegs). Comprehensive marine VHF radio coverage and the high level of communications that takes place between virtually all ships minimise the risks of collision. All deep-sea foreign flag ships over 350 gross registered tonnes are required to have a licensed Canadian pilot on board while in compulsory pilotage waters. Ferries, tugs and fishing vessels are required by law to have licensed personnel on board. All recreational boaters in Canada are required to carry a Pleasure Craft Operator Card or they risk expensive fines.
Storm Water Management	• Culvert extension, storm drain installation and potential ditch realignment	The realignment of the existing ditches to accommodate the Project will require detailed hydraulic assessments and close coordination with the local farmers and the Corporation of Delta. Culverts will be designed to sizes and in accordance with standards required to carry flows and will meet the requirements of the BC *Railway Safety Act* and other applicable regulations and standards.
Transport of Dangerous Goods on Ships	• Spills from dangerous (hazardous) goods as a result of an accident have the potential to effect the marine environment.	The Transportation of Dangerous Goods (TDG) *Act* imposes the legal obligation on individuals having custody of products that meet the definition of dangerous goods to ensure that these goods are safely and securely packaged and transported, and that they are identifiable through approved labelling. Together with the *Canada Shipping Act*, the TDG imposes special regulations and provisions on intermodal carriers to train and certify staff involved in the transport of dangerous goods.
Operation – Waste Management		
Waste Management General Operations	• Improper waste management and disposal methods can effect aquatic and terrestrial environments, and associated fish and wildlife.	Waste and deleterious materials generated throughout the operation of the Project will be appropriately contained by the Operator in the immediate work area, collected, and appropriately disposed of in accordance with all applicable legislation, guidelines, and best management practices.
Waste Management and Disposal from Terminal	• Improper waste management and disposal methods from the terminal could result in possible effects on the marine and terrestrial environment and possible air quality effects.	TSI, the Deltaport Terminal Operator, has established an EMP to ensure environmentally responsible purchase and use of various items used at the terminal, including proper storage and disposal.

Accident or Malfunction	Potential Environmental Effect	Mitigation / Response Plan
Waste Management and Disposal from Railways	• Improper waste management and disposal methods from rail operations could result in soil and groundwater contamination, possible effects on the terrestrial environment.	Waste generated from associated BCR operations is anticipated to be limited to domestic waste and recycling picked up from the Yard Office. No locomotive maintenance activities will be conducted on the Port Sub that would generate deleterious wastes. Track maintenance or upgrading work parts will be collected and re-cycled as re-usable or scrap materials.
Waste Management and Disposal from Ships	• Improper waste management and disposal methods from the ships could result in possible effects on the marine and terrestrial (foreshore) environment and associated fish and wildlife.	The International Convention for the Prevention of Pollution from Ships (MARPOL) governs the release of oil, hazardous substances, and garbage into the marine environment. MARPOL (revised) Annex V deals with wastes (which include plastics, metal, glass, galley wastes and other materials). Ship-board waste in not accepted at the Roberts Bank terminal complex.
Operation – Health and Safety / Emergency Response		
Health and Safety	• Effects on workers • Effects on neighbouring communities	TSI has established a Health and Safety Plan for the existing Deltaport container terminal. This plan will be updated to include new Project components and equipment as appropriate prior to operation.
Emergency Response – Hazardous Materials, Fire and Emergency Service, Police and Security	• Effects on workers • Effects on neighbouring communities	TSI, as the terminal operator, and CP and CN Rail have established Emergency Response Assistance Plans for hazardous spills. TSI is the On Scene Commander for any incidents within the Deltaport container terminal. The Delta Fire Department responds to those hazardous material (HAZMAT) incidences that can be handled by standard issued protected turnout clothing and breathing apparatus. For incidents requiring a more comprehensive response, Delta has a Mutual Aid Agreement with the Surrey and Vancouver Fire Departments, which have full HAZMAT response capability. The Delta Police Department is responsible for regular policing at the Roberts Bank terminal complex, whereas the RCMP is responsible for responding to issues of national threat (i.e., MARSEC increase). Security services for Roberts Bank are a shared responsibility between Port Metro Vancouver and the terminal operators. If Port Metro Vancouver determines a need for increased security, Delta police may be contracted to provide extra officers for the period of heightened security. The International Ship and Port Facility Code, implemented in July 2004, is the security standard for Metro Vancouver Ports.

8.0 CUMULATIVE EFFECTS ASSESSMENT

8.1 INTRODUCTION

Cumulative environmental effects are changes to the environment that are caused by an action in combination with other past, present and future human actions. A cumulative environmental effects assessment (CEA) is a requirement under Section 16(1) (a) of CEAA. This CEA has been completed using the CEAA practitioners guide (Hegmann *et al*., 1999) and the CEAA Operational Policy Statement (CEAA, 2007) as a framework. As defined in Hegmann *et. al.*, a CEA is:

> "An assessment of the incremental effects of an action on the environment when the effects are combined with those from other past, existing and future actions."

This cumulative environmental effects assessment of DTRRIP has been undertaken to determine the combined effects of the Project with other projects and activities in the study area. It determines the incremental contribution of residual effects of DTRRIP, with the impacts caused by relevant past, present, and where possible, reasonably foreseeable, future human activities.

8.2 METHODOLOGY

The CEA for DTRRIP considers residual effects that were identified in the previous sections of this environmental impact assessment. This approach includes scoping, analysis of effects, development of mitigation measures, assessment of cumulative residual effects and an evaluation of their significance.

The scope of the cumulative effects assessment was established by comparing the Project residual effects with residual effects of other projects and activities. If there was a potential interaction between a Project residual effect and a project or activity, the interaction was considered in the cumulative effects assessment.

The residual effects of the proposed Project that are considered in the CEA were drawn from Section 5 and 6 of the Report. Where a residual effect of the Project was identified as non-significant, it has been carried forward for consideration in the cumulative effects assessment. Social and economic effects were considered where there was a residual adverse socio-economic effect of the proposed Project resulting from a biophysical effect.

Where cumulative effects are identified, mitigation measures and monitoring have been recommended. Where the mitigation and/or monitoring is beyond the mandate of the Proponent, or of this environmental assessment, the mitigation and/or monitoring is addressed through other approval processes, or operational management and monitoring requirements, as appropriate. An example where this would apply is regulations for marine vessels not owned or operated by the port.

Cumulative effects are described using a similar approach to the way in which Project related effects are described and uses effects characteristics (e.g., magnitude, extent, duration and frequency, ecological context, reversibility) as described in **Section 4.6** to determine the significance of residual cumulative effects. The level of cumulative effect is assessed as either non-significant or significant.

8.3 SCOPING OF THE DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT CEA

The scope of the CEA has been determined by a review of potential interactions between the Project related residual effects and the effects of other projects and activities with sufficient publicly available information. Where an interaction is considered possible, an assessment of cumulative effects is carried out.

8.3.1 Project Related Residual Effects

The cumulative effects assessment considers those Project related residual effects that were assessed in **Sections 5** and **6** as non-significant, as there may be a reasonable likelihood of an interaction with residual effects associated with other projects and activities that could result in a significant effect to the relevant VC. No significant Project related residual effects were identified, and effects with no residual effect are not considered. A summary of the Project residual effects used in the CEA is presented in **Table 8-1**.

None of the biophysical resource assessments (**Section 5**) identified direct Project residual effects that would result in adverse effects to socio-economic VECs. In recognition of public and stakeholder concerns, the cumulative effects assessment also considers the potential cumulative effects of noise, vibration and light, assessed in the socio-community section (**Section 6**) (**Table 8-1**).

Table 8-1 Project Related Residual Effects

Resource	Project Phase	VEC	Potential Residual Effect	VEC Included in CEA	Section Reference
Biophysical Resources					
Vegetation and Wildlife	Construction Operations	All	No residual adverse effects identified		Section 5.1.8
Water Resources	Construction Operations	All	No residual adverse effects identified		Section 5.2.6
Fish and Fish Habitat	Construction	All	No residual adverse effects identified		Section 5.3.7
Marine Environment	Operations	Marine and anadromous fish	Disturbance or displacement from habitat as a result of underwater noise from increases in vessel calls during the operations phase	√	Section 5.4.6.3
		Coastal seabirds	Disturbance or displacement from habitat as a result of in-air acoustic emissions from increases in vessel calls during the operations phase	√	Section 5.4.6.4
		Marine mammals	Physiological and behavioural changes as a result of acoustic disturbance and physical injury/direct mortality as a result of vessel strikes from increases in vessel calls during operations phase	√	Section 5.4.6.5
Air Quality	Construction	Air Quality	No residual adverse effects identified		Section 5.5.6
	Operations		Increase in air contaminant levels during operations phase	√	Section 5.5.7
Socio-community Considerations					
Noise	Construction	Noise	No residual adverse effects identified		Section 6.1.7
	Operations	Noise	Increase in noise level using L_{dn} as the noise descriptor during operations phase.	√	Section 6.1.7
Vibration	Construction, Operations	Vibration	No residual adverse effects identified		Section 6.1.7
Light	Construction, Operations	Light	No residual adverse effects identified		Section 6.3.6

Therefore, based on the potential for there to be a residual effect as a result of the Project, the VECs that are considered in this CEA are:

- Marine environment (operations only): marine and anadromous fish, coastal seabirds, marine mammals.
- Air Quality (operations only): air quality.
- Noise (operations only): noise.

8.3.2 Spatial and Temporal Boundaries

8.3.2.1 Spatial Boundaries

The spatial boundary for the CEA encompasses the area in which there is a potential for Project related effects to overlap with residual effects of other projects and activities. Beyond this boundary, it is assumed that the effects of the Project have substantially diminished (i.e., very low probability of occurrence or acceptably small magnitude). The spatial boundary is tailored to, and varies with, each VEC. The following CEA spatial boundaries are defined:

- Marine Environment – The CEA study area for marine and anadromous fish and coastal seabirds includes a 5 km radius around existing Port facilities. (**Figure 5.4.1**). The CEA study area for marine mammals is broader and includes the Strait of Georgia, north to a line approximately between Nanaimo (Vancouver Island) and Horseshoe Bay (West Vancouver), and south to those Boundary Pass, Haro Straight and Straight of Juan de Fuca waters that lie on the north side of the Canada-US border. This increased spatial scope addresses the risk that the increased ship traffic due to operations has the potential for cumulative marine mammal effects in more distant waters.
- Air Quality – The cumulative effects study area includes the communities of Tsawwassen, the TFN, Ladner, Delta, and the City of Richmond (**Figure 5.5-1**) The emission inventory is presented as both local emissions that occur in the immediate vicinity of the Deltaport terminal, and regional emissions that occur within a selected area of the western portion of the Lower Fraser Valley (LFV) and Georgia Strait. Emissions are categorized as local if they resulted from activity in the immediate vicinity of Roberts Bank, and regional if the emissions are derived from transport to and from Roberts Bank, either by ship, rail or truck. Local emission estimates are included in the regional emission estimates. Marine vessel emissions are categorized as regional emissions if they occur within Georgia Strait from the southern tip of Saturna Island up to and including English Bay because any emissions within this area are likely to contribute to overall air quality within the LFV.
- Noise – The geographic area considered in assessing noise impacts include the Roberts Bank port facilities and causeway, residential communities adjacent to the BC Rail line extending east as far as Glover Road in Langley and residential areas in close proximity to the shoreline extending from the Roberts Bank causeway southward to the Tsawwassen Beach residential area (**Figure 6.1-1**).

Marine vessel traffic information is required to inform the CEA marine and air quality impact assessments. Marine vessel traffic information from the southern Strait of Georgia area, from a line approximately between Nanaimo (Vancouver Island) and Horseshoe Bay (West Vancouver) south to the waters that lie on the north side of the Canada-US border, will be used.

Both road and rail traffic information is required to inform the CEA air quality and noise impact assessments. The CEA road traffic information area is bounded by the Fraser River to the north from the George Massey tunnel upstream to the Pattullo Bridge, to the east by the King George Highway in Surrey and by the Nicomekl River and Boundary Bay to the south. Road traffic volumes in 2010 will be compared

with 2014 (the year DTRRIP is expected to be operational), 2020 (the year Terminal 2 could potentially become operational) and 2025 (the year the Terminal 2 Project is projected to operate at its maximum additional cargo capacity of 2.40 million twenty-foot equivalent unit containers). The CEA rail traffic study area follows the rail corridor from Deltaport east to Highway 1. Rail traffic is compared using the same years as the road traffic volumes.

8.3.2.2 Temporal Boundary

The CEA uses the date of existing conditions studies (2011) as the temporal boundary, or baseline conditions for the assessment. Establishing this as the temporal boundary, ensures that the cumulative effects of historic and existing projects and activities are reflected in existing conditions which are reported in the EA.

The following historic and existing projects and activities that may have influenced the baseline ecosystem conditions for the Roberts Bank habitats in the study areas are:

- The existing Roberts Bank port causeway and terminal facilities in Delta (the Deltaport container terminal, including the Deltaport Third Berth, Westshore coal loading facility, and associated operations).
- BC Ferries Corporation ferry causeway, terminal and ferry operations, including the two new super C-class ferries that joined the fleet in 2008 and the Tsawwassen Berth 4 upgrades.
- Fraser River port operations including recent upgrades at the Fraser Surrey Docks, Fraser Wharves and the Seaspan Coastal Intermodal facility.
- Marine vessel movements including domestic movements of commercial fishing and recreational boats, tug-and-barge traffic, ferries, foreign vessels, whale-watching vessels and cruise ships.
- Dykes constructed to protect adjacent agricultural, residential and commercial land in the lower Fraser River floodplain and dyke maintenance and shoreline stabilization works.
- Dredging of the Fraser River to maintain shipping channels.
- The 44 km long mainline railway from Fort Langley to the Gulf Yard at Roberts Bank and the train tracks on the causeway.
- Deltaport Way, Highway 17, servicing Tsawwassen and the BC Ferries terminal and other local roads serving rural settlements and the communities of the Tsawwassen First Nation and Ladner.
- Residential developments including the Tsawwassen First Nation, Ladner, Tsawwassen and North Delta.
- Adjacent land uses including agriculture.
- Overhead utilities including power transmission lines and telephone utility lines.

8.3.2.3 Temporal Boundary

A CEA must consider all future projects that are “certain” to proceed or are “reasonably foreseeable” and may interact with the Project’s effects. This DTRRIP CEA uses a minimum of 5 years out as the future temporal boundary for most VECs, but has looked beyond 2017 in the event there is a known project that is approved but not expected to be constructed or operational until after 2017.

Although the scope, scale and location of the potential Roberts Bank Terminal 2 Project container terminal in Delta has not been defined, Port Metro Vancouver is undertaking preliminary technical analysis to determine its feasibility and suitability. Should Terminal 2 prove to be technically and environmentally feasible, construction could occur in phases beginning as early as 2018. As such, the Terminal 2 project is considered in the DTRRIP CEA and the future temporal boundary extended to 2025, the year the Terminal 2 project is assumed to operate at its maximum additional cargo capacity of 2.40 million TEUs (twenty-foot equivalent unit containers).

8.3.3 Other Projects and Activities

The DTRRIP CEA future scenario consists of other projects and activities that may affect the same VECs as the Project, and are “reasonably foreseeable” or “certain to proceed” between now and 2017. They include projects such as those that have been publicly announced or are currently involved in a regulatory process that require approvals to proceed. Online research and consultation with agencies and environmental assessment practitioners was undertaken in an effort to identify activities and projects that potentially overlap spatially and temporally with DTRRIP residual effects. Sources of information that were searched include: the EAO’s online e-PIC resource, the CEA Agency’s registry, the Fraser River Estuary Management Program (FREMP) Environmental Review Committee (ERC) site and the National Energy Board major applications and projects site. The Government of Canada’s Asia-Pacific Gateway and Corridor Initiative website, and the corresponding Interactive Map, and the Province of British Columbia’s Gateway Program website were also consulted.

Future projects and activities that potentially interact with DTRRIP’s effects are listed in **Table 8-2**. The locations of these future projects and activities are shown on **Figure 8-1**.

The following facilities, projects and activities were considered for inclusion in the development of the CEA future scenario but were not selected for the reasons explained below:

- BC Ferries terminal at Tsawwassen — The BC Ferries website was reviewed for information on planned projects or planned asset investments. BC Ferries invested in major berth replacement and refurbishment at the Tsawwassen terminal in the twelve months ending March 31, 2011. According to the 2010/2011 Annual Report, the next vessel renewal program will focus on minor and intermediate sized vessels that are contemplated for replacement within the next two performance terms (British Columbia Ferry Services Inc. and B.C. Ferry Authority, 2011). Therefore, there are no foreseeable projects or additional asset investments planned for the Tsawwassen ferry terminal.

- Five Short-sea Shipping Projects in the Lower Mainland — The Government of Canada has identified $20.9 million in Asia-Pacific Gateway and Corridor Initiative funding for these short-sea shipping service projects, four of which are located along the Fraser River (Government of Canada, 2011). In 2011 Port Metro Vancouver studied the feasibility of short-sea shipping and explored whether using these terminals for future increased container capacity is a feasible option. While Port Metro Vancouver is supportive of short-sea shipping, none of the projects have passed the feasibility stage and Deltaport is not equipped to participate in short-sea shipping. In order to make Deltaport short-sea operational it would require the installation of a new barge ramp, which would be a separate project and subject to its own CEAA screening.
- Delta Irrigation Enhancement Project (DIEP) — The Ministry of Transportation and Infrastructure is undertaking enhancements to the existing drainage and irrigation network that supports agricultural activities in southwest Delta to mitigate impacts to agricultural land as a result of the construction of the South Fraser Perimeter Road (SFPR) project. While the project has the potential to spatially overlap with DTRRIP in the area west from 72nd Street to Deltaport Way at 46A Street during construction and operations, the CEAA Screening conducted for the project concluded that DIEP is not expected to result in any residual effects (DFO, 2010). As such, there is no opportunity for synergistic effects between residual effects of DIEP and residual effects of other projects in the study area.
- Iona Island Liquid Waste Management Plant and Treatment Plant Improvements — The existing plant is located in Richmond, north of the Vancouver International Airport. Proposed improvements to the facility include upgrading to secondary level treatment. However, a review of the Integrated Liquid Waste and Resource Management plan (Metro Vancouver, 2010) indicates that there is no firm schedule for the proposed upgrade other than it must be completed no later than 2030. As such, this project was eliminated from further consideration because the potential effects do not temporally overlap with DTRRIP effects.
- Corporation of Delta Projects and Initiatives — The Corporation of Delta's website was reviewed for information on planned projects, initiatives or Official Community Plan updates (CoD, 2011). Of the community and planning or facilities and infrastructure projects and initiatives, the Delsom Estates (Sunstone Community) and Tsawwassen Springs developments and a proposed residential/commercial development at 56th street and 18th Avenue were eliminated from consideration in the CEA because the effects from these projects do not spatially overlap with DTRRIP effects.

8.3.3.1 CEA Project Information and Potential Interactions with DTRRIP

A brief description of each of the proposed projects and activities that are reasonably certain to proceed is provided in **Table 8-2**. Four categories of project are considered:

- Deep Sea Terminals and Marine Traffic
- Coastal/Riparian Modifications
- Railways, Roads and Airports
- Residential/Retail and Industrial Developments

Potential interactions between the other proposed projects and DTRRIP are summarized in **Table 8-3.** Where a potential interaction is identified, the potential interaction is discussed in more detail and cumulative effects are assessed in the following sections.

Table 8-2 Descriptions of Other Projects and Activities Assessment of DTRRIP

Project Name	Proponent	Location	Timeframe	Project Description
Deep Sea Terminals and Marine Traffic				
Roberts Bank Terminal 2 Project (T2)	Port Metro Vancouver	Roberts Bank	Subject to environmental approvals, construction could occur in phases beginning July 2018 and be operational beginning 2020 reaching container capacity by 2025.	The Roberts Bank Terminal 2 Project is a multi-berth marine terminal that, if built, would increase container capacity per year to meet forecast demand until 2030. The project consists of construction of a offshore marine terminal equipped with ship-to-shore cranes capable of handling the latest generation of container ships, berth space for three container vessels, expansion of the existing Deltaport tug basin to accommodate the additional tugs and linehandling boats, widening the Roberts Bank causeway to the northwest to accommodate new rail and road infrastructure, and rail and road improvements within existing right-of way and within the Option Lands.
Future additional investments at Deltaport to accommodate 3 million TEU's	Port Metro Vancouver	Roberts Bank	Future scenario based on potential for terminal upgrades and efficiencies.	The DTRRIP effects assessment is based on a "Maximum Practical Sustainable Capacity" of 2.4 million TEU's, which is the amount of cargo the terminal and its components can be expected to handle in an efficient and economic manner year after year. The overall capacity of the terminal is based upon the component with the least capacity; therefore upgrades to certain operational components and/or operational efficiencies could potentially provide for increased container movements at Delta Port. However, in order to realize such increases, significant investments would be required such as: reconfiguration of facilities or addition of new infrastructure to increase efficiency of movements. Although there are currently no plans for such investments, the CEA assumes a future scenario of 3 million TEUs, or an increase of 600,000 TEUs from the initial assessment of 2.4 million.
General terminal upgrades and operational changes	Westshore Terminal Investment Corp, Fraser Wharves Ltd., Neptune Bulk Terminals Ltd., Kinder Morgan Canada	Various locations including Roberts Bank, south arm of the Fraser River, and Burrard Inlet	2012-2013 for specific projects, but the resulting increase in marine traffic is long-term.	Port terminals continue to upgrade their facilities to increase throughput capacity. Works or projects at the following locations represent the upgrades and operational changes: Westshore Terminal, Fraser Wharves Ltd. Vehicle Storage Facility Expansion Project, Neptune Bulk Terminals (Canada) Ltd. and Westridge Marine Terminal. The resulting increased marine traffic in combination with general marine traffic trends has the potential to act cumulatively with DTRRIP, and it is this operational activity, not the project construction, that is the subject of the cumulative effects assessment. • On March 15, 2011 Westshore announced an upgrade to its Roberts bank site, to be completed by the end of 2012, which will increase potential throughput capacity from current levels of 28-29 million tonnes to approximately 33 million tonnes. See: http://www.westshore.com/pdf/news/2011/mar15.pdf • The Notice of Commencement of an Environmental Assessment was updated on May 25, 2011 on the CEAA website for the Fraser Wharves Ltd. Vehicle Storage Facility Expansion Project along the south arm of the Fraser River. The scope of the Project includes dredging, placement of fill, construction of retaining walls, installation of four dolphin structures, and construction of a bridge crossing the slough. If permitted, construction could be complete by 2013. See: http://www.ceaa.gc.ca/050/details-eng.cfm?evaluation=46697 • Neptune Bulk Terminals (Canada) Ltd. is a joint venture of bulk commodity handlers. According to their May 18, 2011 news release, they are investing $63.5 million in new equipment to improve the terminal coal handling capacity, optimize energize efficiency, and enhance environmental performance at the facility on the north sore of Burrard Inlet. The upgrades will be complete by fall 2012. See: http://www.neptuneterminals.com/news-post/neptune-terminals-investing-63-5-million-in-north-vancouver/ • On December 1, 2011 the National Energy Board released its decision to grant the application for Firm Service, a form of long-term buying contract, to the Westridge Marine Terminal (Westridge dock). This 52% increase in capacity at the Westridge dock will result in an increase in the number of crude tanker arrivals. The Board was of the view that marine traffic will not increase beyond levels that can presently occur under previous approvals of the Board. See: http://www.neb.gc.ca/clf-nsi/rthnb/nwsrls/2011/nwsrls35-eng.html
Coastal/Riparian Modifications				
Fraser River Dredging, etc.	Port Metro Vancouver, Private operators	Fraser River South Arm	Ongoing	Dredging is undertaken to maintain the existing Fraser River shipping, navigation channels and marina accesses. Port Metro Vancouver is responsible for maintaining the navigable depth of the Fraser River navigation channels. Other dredging works include those proposed by Fraser River Pile and Dredge and Delta Tug and Barge Ltd. Private proponents undertake riverbank stabilization and dike and pier repairs. Applications to dredge the Fraser River, undertake riverbank stabilization and dike and pier repairs will be ongoing in the future. See: http://www.portmetrovancouver.com/en/users/marineoperations/dredging.aspx and http://www.bieapfremp.org/referral_logs.html
Marina Development for Boat Moorage	Janda Industries	4200 Block River Road West, Delta, BC	Construction February 2010 onwards.	Janda Industries Inc. is proposing to develop a marina in the Fraser River at 4227, 4231, 4249, 4259, 4267, 4273 River Road West, Delta, BC. The marina development will primarily entail pile driving for floats and ramps, placement of floats, placement of outfalls for the sewage treatment system and dredging. The dredging will involve a volume of 4,000 cubic metres or less with the dredged material disposed of at sea. Port Metro Vancouver coordinated the Project review. See: http://www.bieapfremp.org/referral_logs/referral_log_details.cfm?ID=8927&source=F

Project Name	Proponent	Location	Timeframe	Project Description
Railways, Roads and Airports				
Roberts Bank Rail Corridor Program	Funded by twelve partners representing local, regional, provincial, and federal governments as well as private industry and delivered by various agencies	A 70-kilometre rail corridor from Roberts Bank Deltaport to 232nd Street in Langley Township	Construction ongoing to 2014, Operations 2014 onwards.	The Roberts Bank Rail Corridor Program is a package of nine road and rail improvements in Delta, Surrey, and the City and Township of Langley that includes eight overpass projects and one railway siding project. It is part of Canada's Asia-Pacific Gateway and Corridor Initiative and its purpose is to improve the safety and add efficiencies to the road and rail networks in four municipalities. The projects are: 41B Street Rail Overpass at Deltaport Way Project, 80th Street Rail Overpass Project (Delta), Panorama Ridge Whistle-Cessation Projects (Surrey), 152nd Street Rail Overpass Project (Surrey), 192nd Street Rail Overpass Project (Surrey, City of Langley), 54th Avenue Rail Overpass Project (Surrey, City of Langley), 196th Street Rail Overpass Project (Surrey, City of Langley), Mufford/64th Avenue at Hwy 10 Project, and 232nd Street Overpass Project (Township of Langley). See: http://www.robertsbankrailcorridor.ca/
South Fraser Perimeter Road (SFPR)	Ministry of Transportation and Infrastructure	South side of the Fraser River extending from Deltaport Way in southwest Delta on an east/west route to 176th Street (Hwy 15) in Surrey	Construction 2008 to 2013, Operations 2013 onwards.	SFPR is an approximately 40km long, four-lane, 80km/hr divided highway that is currently under construction. The new route includes connections to Highways 1, 15, 17, 91, 99, and the Golden Ears Bridge. SFPR will provide an efficient transportation corridor serving goods movers and regional traffic, while reducing truck and other traffic on municipal road networks in Delta and Surrey. It will provide a continuous and efficient route to serve the port facilities, rail yards and industrial sites along the corridor and will facilitate access to borders, the Tsawwassen ferry terminal and the BC Interior. See: http://www.th.gov.bc.ca/gateway/SFPR/sfpr.htm and http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_project_home_196.html
Vancouver Airport Fuel Delivery Project, specifically the shipping component	Vancouver Airport Fuel Facilities Corporation	Marine terminal on the north shore of the South Arm of the Fraser River	Construction phase taking 24 months and perhaps beginning 2012, project operations starting 2014.	The Vancouver Airport Fuel Facilities Corporation (VAFFC) proposes a marine terminal on the south arm of the Fraser River, an adjacent fuel storage facility, and a 15 kilometre pipeline to YVR to meet future demand for fuel at the airport. The proposed marine facility will eliminate the need for tanker trucks to transport aviation fuel, reduce the vessel transit distance by rerouting marine traffic from Westridge Marine Terminal to the new marine terminal on the south arm of the Fraser River, and result in a single marine-based fuel delivery system. See: http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_project_home_346.html
Residential/Retail and Industrial Developments				
Tsawwassen First Nation Land Use Plan	Tsawwassen First Nation	Along the shores of Roberts Bank, mostly between Highway 17 and Deltaport Way	Construction 2012 onwards.	Under the Tsawwassen First Nation Final Agreement the TFN land base now totals724 hectares and the TFN have powers to plan and regulate these lands. Their Land Use Plan includes designations for TFN community member use and commercial enterprise/residential, single family and multiple family housing, industrial, mixed use, agriculture and managed forest, bluff, tidal marsh/water lot and development permit areas. The TFN has entered into an Memorandum of Understanding with Ivanhoe Cambridge and Property Development Group to develop an up to 70 hectare mixed-use project along the north side of Highway 17. Site preparations for the destination retail neighbourhood, including a 12 million square foot indoor mall and 600,000 square feet of outdoor accessed retail could begin in 2012. The band also has plans to build 1,600 new homes and to develop 135 hectares adjacent to Deltaport Way as an industrial park. Site preparations for phase 1 of the industrial lands development is slated to occur in 2012. See: http://www.tsawwassenfirstnation.com/land_use_plan.php and http://www.tsawwassenfirstnation.com/TEDC_Open_for_Business_Brochure.pdf

Table 8-3 Potential Interactions between Project Related Residual Effects and Residual Effects of Other Projects and Activities

Project Related Residual Effect	Other Projects and Activities – Categories			
	Deep Sea Terminals and Marine Traffic	Coastal/ Riparian Modifications	Railways, Roads and Airports	Residential/ Retail and Industrial Developments
Marine and Anadromous Fish – Disturbance or displacement from habitat as a result of underwater noise from increases in vessel calls during the operations phase	Yes	Yes	Yes	Yes
Coastal Seabirds – Disturbance or displacement from habitat as a result of in-air acoustic emissions from increases in vessel calls during the operations phase	Yes	Yes	Yes	Yes
Marine Mammals – Physiological and behavioural changes as a result of acoustic disturbance and physical injury/direct mortality as a result of vessel strikes from increases in vessel calls during operations phase	Yes	No	Yes	No
Air Quality – Increase in air contaminant levels during operations phase	Yes	No	Yes	Yes
Noise – Increase in noise level using L_{dn} as the noise descriptor during operations phase	Yes	No	Yes	Yes

8.4 MARINE ENVIRONMENT

8.4.1 Introduction

This section investigates the potential changes to marine and anadromous fish, coastal seabirds, and marine mammals as a result of the operation of DTRRIP in combination with other planned or reasonably foreseeable projects and activities described in **Table 8-2**.

While the assessment addresses the effects to the marine environment, the cumulative effects to marine VECs have the potential to, in turn, result in effects to social values. Marine mammals, including the SRKW, play a central role in the mythology, history and art of the First Nations along the Pacific Coast. Killer whales are represented in both the tangible and intangible culture of the First Nations and society at large and the survival of the SRKW is therefore of importance to the First Nations and the general public.

8.4.2 Project Interactions with Other Projects and Activities

The types of projects and activities whose effects could spatially and temporally overlap with the effects of DTRRIP on the marine environment ecosystem VECs are identified in **Table 8-3**.

The effects of DTRRIP on the marine environment ecosystem VECs have the potential to spatially and temporally overlap with the effects of other Deep Sea Terminal projects. Specifically, the effects of increased vessel traffic from DTRRIP will overlap with the effects of increased vessel traffic from the Roberts Bank Terminal 2 Project and from general terminal upgrades and operational changes, including those at Westshore Terminal, Fraser Wharves, Neptune Bulk Terminals (Canada) Ltd. and Westridge Marine Terminal. Additional information on marine traffic is presented in **Section 8.4.3** below.

Of the Coastal/Riparian Modification projects, it is possible that the effects of dredging to maintain the existing Fraser River shipping, navigation channels and marina access, riverbank stabilization and dike and pier repairs could interact with the effects of DTRRIP. Additionally, the effects of DTRRIP could spatially and temporally overlap with the effects of the proposed marina development in 4200 Block River Road West, Delta.

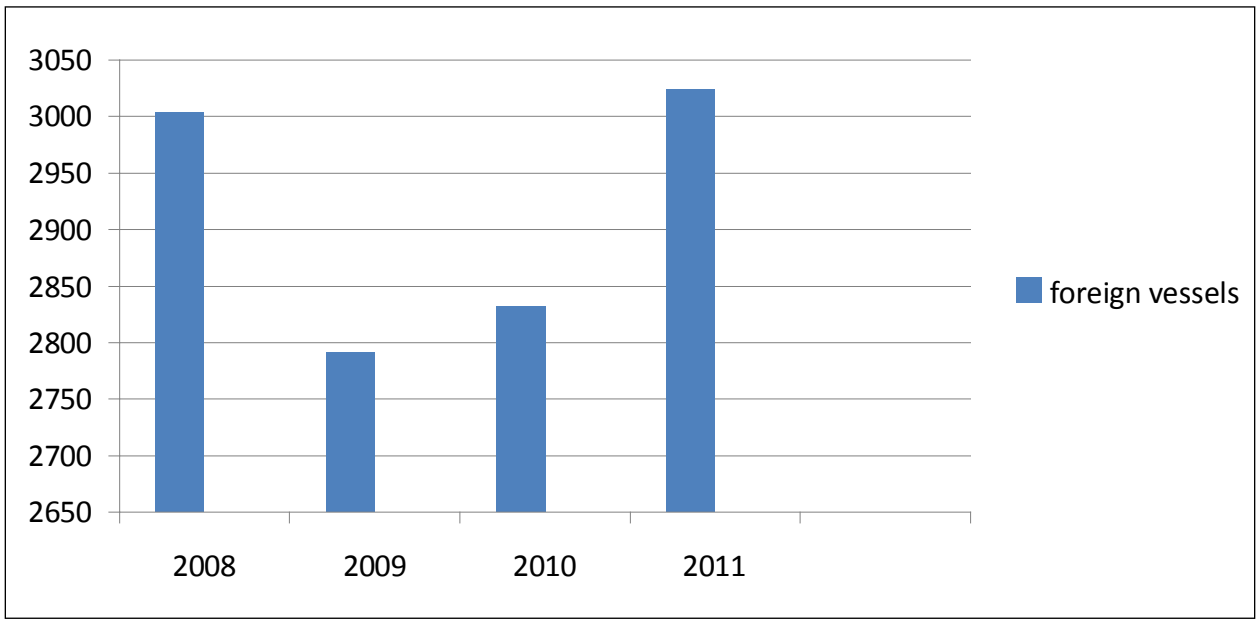
Of the future Railways, Roads and Airports projects, only the effects of the shipping component of the Vancouver Airport Fuel Delivery Project have the potential to overlap in time and space with the effects of DTRRIP.

The effects of Residential/Retail and Industrial Developments do not generally have the potential to affect the marine environment ecosystem receptors. The only exception might be the effects on coastal seabirds of the Tsawwassen First Nation Land Use Plan and the associated residential, retail and industrial development.

8.4.3 Marine Traffic Information

The Southern Strait of Georgia has a substantial amount of marine traffic including movements of fishing and recreational boats, tug-and-barge traffic, ferries, foreign vessels, whale-watching vessels and cruise ships. Port Metro Vancouver issues overview annual statistics for foreign vessel traffic at the terminal facilities within their jurisdiction. **Graphic 8-1** summarizes Port Metro Vancouver vessel traffic data for the years 2008 through 2011 to illustrate current marine traffic conditions. During this time, foreign vessel traffic arrivals, at terminal facilities within Port Metro Vancouver jurisdiction ranged between 2,791 (2009) and 3,004 (2011) (Port Metro Vancouver 2011c; Port Metro Vancouver 2011c). This includes bulk carrier, tanker and cruise ship arrivals.

Graphic 8-1 Annual Statistics for Foreign Vessel Traffic Arrivals



Looking forward, annual ship calls are expected to increase at terminal facilities. However, predictions for increases in ship calls are only available for the following projects: DTRRIP, Roberts Bank Terminal 2 Project, additional coal throughput at the Westshore Terminal and the proposed Vancouver Airport Fuel Delivery Project. **Table 8-4** provides a summary of actual (2010) and predicted (2014, 2017, 2020 and 2025) annual ship calls as a result of these major projects and activities. Port Metro Vancouver provided predicted ship call data associated with Deltaport, Terminal 2 Project, and Westshore. The data for the Vancouver Airport Fuel Delivery Project is sourced from the *Vancouver Airport Fuel Delivery Project Environmental Assessment Certificate Application* (Vancouver Airport Fuel Facilities Corporation, 2011). The annual ship calls at Deltaport drop to 260 in 2025 from 312 in 2017 based on the assumption that the cargo volumes will remain constant at 2.40 TEUs per year but that there will be an increase in vessel size and therefore fewer vessel calls.

Table 8-4 Actual (2010) and Projected (2014 Onwards) Annual Ship Calls

	Deltaport (including DTRRIP starting in 2014)	Roberts Bank Terminal 2	Westshore	Vancouver Airport Fuel Delivery Project
2010	245	na	246	na
2014	260	na	250	36-60
2017	312	na	280	36-60
2020	312	156	310	36-60
2025	260	260	350	36-60

Based on the project information presented above, it is assumed that the increased throughput capacity associated with various projects and activities will result in an increasing trend in annual ship calls in the future, which, in turn, will contribute more underwater noise to the current baseline condition. These projects and activities combine with each other and with the general trends in marine traffic, foreign vessel calls and cruise ship calls to create the marine traffic CEA future scenario.

8.4.4 Analysis of Effects

The primary interactions between DTRRIP and the marine environment are through vessel operation, specifically in-water noise emission, and to a lesser degree, in-air noise emission and marine mammal vessel strikes. No in-water construction is planned for DTRRIP. As a result, no in-water construction related effects are would be expected to occur.

8.4.4.1 Marine and Anadromous Fish

Potential residual effects from DTRRIP vessel operation on marine and anadromous fish relate to underwater noise and its potential to disrupt/displace fish from their habitat. Project-related operational noise has the potential to act cumulatively with that produced by other existing and proposed projects (e.g., Terminal 2, marina development, Fraser River dredging etc.), which will similarly contribute to peak and background noise levels in the study area. As mentioned in **Section 5.4.5.3**, noise may induce behavioural and/or physiological stress responses in fish, though these are difficult to quantify and have not been extensively studied.

As indicated in **Table 8-4**, 245 vessels per year currently call on Deltaport, and with DTRRIP, this is projected to increase to 300 calls per year by 2020. From a cumulative perspective, there are currently 491 vessel calls per year at the existing marine facilities (DP3 and Westshore). By 2020, assuming Terminal 2 and the Vancouver Airport Fuel Delivery developments proceed, the number of vessel calls will increase to 778, representing a 59 percent increase. However, the portion contributed by DTRRIP is small – an increase of 55 vessel calls, accounting for 2 percent of the total predicted noise increase over this 10 year time period.

While uncertainty remains surrounding potential population level consequences of the effects of noise on fish, Roberts Bank supports high volumes of marine traffic with co-existing fisheries, suggesting that existing routine vessel traffic does not measurably affect the abundance or distribution of marine or anadromous fish species. It is therefore unlikely that the incremental effects from DTRRIP (outlined above) will act in combination with effects from other projects to cause the characteristics or long-term viability of marine fish populations to adversely change in a measurable or meaningful way.

8.4.4.2 Coastal Seabirds

Potential effects from DTRRIP vessel operation on coastal seabirds relate to sensory disturbance and habitat avoidance from in-air acoustic emissions. This has the potential to interact cumulatively with noise from other existing and proposed projects (e.g., Terminal 2, Vancouver Airport Fuel Delivery Project, industrial developments on Tsawwassen First Nation land, etc.,). As mentioned in **Section 5.4.5.4**, ambient noise may be detrimental to birds through direct stress, masking of predator arrival or associated alarm calls, and by interference of acoustic signals in general, which may result in direct negative fitness consequences (Slabbekoorn and Ripmeester, 2008). Noise from increased vessel traffic, particularly loud, random, infrequent or intermittent noise will result in behavioural impacts, but birds are expected to resume normal activity when the source of disturbance ceases.

Coastal seabirds have been closely monitored as part of the DP3 Adaptive Management Strategy (AMS) since 2007 (Hemmera, 2008, 2009b, 2010). In 2010 the Science Advisory Committee of the AMS recommended discontinuing monthly coastal seabird and waterfowl point based on results for the first three years of monitoring, which indicated that overall abundance and habitat use within the inter-causeway area by birds were similar to pre-construction surveys conducted from 2003-2004 (Hemmera, 2010).

Additionally, observations during the 2010 survey period indicate that birds used alternative habitat available within the inter-causeway area, suggesting that birds can adapt to increasing noise levels (Hemmera, 2010). As outlined above, DTRRIP's contribution to cumulative increases in vessel calls (and therefore noise production) is slight – 2 percent of a 59 percent increase. Further, migratory birds (such as western sandpipers and Pacific dunlin) are present in the study area for only a small portion of the

year, and therefore are not exposed to such disturbances continuously. Based on these observations, it is reasonable to assume that incremental effects from increased vessel traffic resulting from DTRRIP will not act synergistically with effects from other projects to cause an adverse change of consequence in the characteristics or long-term viability of coastal bird populations.

8.4.4.3 Marine Mammals

As some marine mammal species occurring in the Strait of Georgia are of conservation concern (e.g., Southern Resident Killer Whales (SRKWs), transient killer whales, humpback whales), there is a potential that cumulative effects from DTRRIP and other projects/activities may result in an adverse environmental effect to their populations. Such effects are described in **Section 5.4.5.5** and relate to:

- The influence of underwater sound on behaviour, communication and life function. The National Recovery Team identified such effects as threats to Southern Resident Killer Whale population recovery (DFO, 2011b).
- Marine mammal vessel strikes leading to physical injuries or fatalities. This is more of a concern for baleen whales than for other marine mammals. While populations of humpback and grey whales appear to be increasing, they are not yet considered secure, and COSEWIC (2011) identified vessel strikes as a major threat.

Underwater Sound

SRKWs are listed as endangered in Schedule 1 of the SARA and the critical habitat for SRKWs in Canadian waters (DFO, 2011b) lies within the CEA marine mammal study area. As such, this underwater sound assessment focuses on SRKWs as the marine mammal species of highest priority.

Underwater sound from various sources in the Strait of Georgia (e.g., BC Ferries, whale watching, cruise ship industry etc.), as well as from future projects and activities (e.g., Terminal 2, Vancouver Airport Fuel Delivery Project, etc.,) has the potential to act synergistically with that from DTRRIP-associated vessel increases. As mentioned above, the contribution of DTRRIP, on its own, is likely too small to produce a significant environmental effect on the SRKW population. However, in combination with other activities that produce underwater sound, there is a potential for adverse cumulative effects to the SRKW population.

There is overlap between the frequency of sound generated by commercial ships and the frequency of discrete calls used by killer whales to communicate and forage (Holt, 2008). However, at such low frequencies (10-500 Hz), underwater sound generated by container ships is generally below the peak frequency range of killer whale vocalizations (18-42 kHz; Hunt, 2007). The degree to which this overlap in sound frequency may influence SRKWs is not well understood.

Acute auditory damage to SRKWs, as a result of marine traffic, is unlikely and hence is not discussed further in this cumulative effects assessment. However, depending on the life function of the whale, and the value of their habitat, many years of chronic sound from vessel operation may have bio-energetic costs that incrementally change the whale's health (e.g., reduced feeding success). It is similarly possible that anthropogenic sound may positively affect SRKW feeding success and therefore health. SRKW's actively produce acoustic calls to locate and capture prey. It is theoretically possible that SRKWs 'scavenge' acoustic signals made from vessels to locate prey (Dr. *Lance* Barrett-Lennard, pers. comm. 2012).

That SRKW continue to use "busy" marine waterways does not imply a lack of effect. For example, they may be tolerating higher than normal underwater sound levels to access critical feeding habitat. Killer whales rarely show overt signs of disturbance; rather, recent studies indicate that killer whales may subtly change their behaviour (e.g., stop feeding) in relation to underwater sound, which in turn, may affect survivorship.

Hence, there is potential for chronic underwater sound from vessel operation to induce biologically meaningful effects to this population. Consequences of such long-term effects have not been measured or quantified. With presently available information it is therefore not possible to confidently assess the nature of this cumulative effect on SRKWs.

Vessel Strike

Evidence suggests that lethal vessel strikes to whales are infrequent at speeds of less than 14 knots and are rare at speeds of less than 10 knots (Laist *et al.,* 2001); however, there is some new evidence that calls this into question. Toothed whales (e.g., SRKW) and pinnipeds (e.g., sea lions) are rarely struck by vessels as they are fast swimming and agile, enabling them to avoid approaching vessels (Laist *et al.,* 2001; Jensen and Silber, 2004). However, there is potential that DTRRIP related vessels may strike large, slow-moving, baleen whales. Populations of several of these whale species (e.g., humpbacks) are starting to show signs of growth, and a series of fatal strikes may be detrimental to their continued recovery. The humpback whale is listed as threatened in Schedule 1 of the SARA. Although no longer considered threatened by COSEWIC, the humpback whale is not considered secure yet.

Similar to the issue of underwater sound, vessel-whale strikes are becoming the focus of increased attention and study. The risk of a strike to baleen whale relates directly to vessel size and speed and whale habitat use (Laist *et al.,* 2001). Although all types and sizes of vessels may hit whales, Laist and others (2001) suggest most of the lethal and serious whale injuries are caused by relatively large vessels (e.g., 80 m or longer). Ships currently calling at Port Metro Vancouver range in size from less than 500 TEU (feeder) to over 5000 TEU (corresponding to lengths over 300 m). Average ship size in the world fleet is projected to increase from 6,519 TEU in 2010 to about 9,600 TEU in 2030. As ship size steadily increases, the potential risk of fatality/serious physical injury to whales upon collision rises as well.

As container ships typically travel at reduced speeds within inland waterways (e.g., Boundary Pass, Strait of Georgia), the risk and effect of a strike is considered relatively low. Further, apart from gray whales (the population of which is large and growing), large baleen whale presence in these areas is considered relatively scarce (they typically prefer habitats further offshore, such as continental shelf waters off southwest Vancouver Island) and hence the likelihood of interaction with a container ship is similarly low.

Container ship speeds are likely to be higher in Haro Strait than in the inland water ways (above): the National Research Council (2003) listed average tanker speeds as between 14 -18.5 knots. Also, baleen whale presence in Haro and Juan de Fuca Straits is also higher than in the inland waterways. Therefore, the risk of a container ship – baleen whale strike in these areas is considered higher. Further, the study area does not include the continental shelves, where Laist *et al.,* (2001) reported that the majority of ship strikes seem to occur. Based on available information, it is currently not possible to quantify the probability or risk of such strikes. However, based on existing information, it is reasonable to assume that it is unlikely that the small incremental increase in vessel traffic contributed by DTRRIP will act cumulatively with that from other Projects to compromise the viability of marine mammal populations because (i) there are few risks to fast swimming odontocetes (ii) baleen whale populations are growing and recovering (iii) vessel speeds are slower within inland waterways; and (iv) the study area is outside the continental shelves, where marine mammals may be more likely to be fatally struck.

8.4.5 Proposed Mitigation

No specific mitigation measures are required for the cumulative effects to marine and anadromous fish and coastal seabirds, as the potential effects are considered to be non-significant.

Information from the literature suggests several mitigation measures which could potentially lower the effects of ship-based underwater sound on SRKWs. These include (but may not be limited to):

- Regular maintenance of propellers (the majority of underwater sound from vessels comes from propeller induced cavitation; regular maintenance may lower cavitation and underwater sound)
- Vessel speed reduction (underwater sound production is positively correlated with vessel speed; hence lowered vessel speeds are likely to lower the amount of vessel-base underwater sound)
- Vessel re-routing to avoid sensitive SRKW habitat and sensitive periods (e.g., feeding)
- Marine architectural engineering specifically to reduce underwater sound (e.g., propeller design)

Insufficient information exists to understand how implementation of such mitigation measures may lower underwater sound levels in the Strait of Georgia. It is also unclear if implementation of such mitigation measures will be sufficient to positively affect SRKW population viability. The Port Metro Vancouver will therefore monitor the efficacy of these and other mitigation measures in concert with planning and studies described below.

As mentioned earlier, there are several sources of underwater sound that may act cumulatively on SRKWs (container ships, ferries, bulk cargo ships, tug boats, whale watching vessels, , recreational boaters, commercial fishing vessels, etc.). While Port Metro Vancouver does not have the mandate or jurisdiction to directly influence this broader range of marine transportation activities, Port Metro Vancouver is supportive of a collaborative approach to both better understand this issue and identify potential solutions for managing underwater noise levels and their effects on marine mammals including SRKWs. Elements of such a collaborative process would include: leadership by the key regulatory agency (i.e., DFO) and the involvement of key stakeholders within the marine transportation sector including ports and marine transportation providers.

To this end, as part of its ongoing commitment to corporate social responsibility and minimize environmental effects associated with ongoing port operations, Port Metro Vancouver is working on a number of initiatives intended to assess and address potential impacts of marine underwater noise on marine mammals, including SRKW, such as:

- Working with DFO and key stakeholders in order to explore strategies for addressing underwater noise that may be impacting SRKW populations in the southern Strait of Georgia.
- Working with the British Columbia pilots to develop an education and awareness program about marine mammals and have pilots of vessels transiting Roberts Bank steer away from observed pods when vessel safety is not compromised.
- Working with scientific experts, regulators and interested stakeholders in the design and implementation of studies to address data gaps in the collective understanding of impacts of underwater noise on SRKWs.

Such initiatives have been planned or are underway for in advance of DTRRIP and will be implemented as stand-alone programs rather than project-specific mitigation.

8.4.6 Cumulative Residual Adverse Effects

A summary of the characteristics of the marine cumulative residual adverse effects and the level of scientific certainty or confidence associated with the prediction is provided in **Table 8-5.** A discussion of the significance of the residual effects is presented in **Section 8.7.1**.

Table 8-5 Characterization of Marine Environment Cumulative Residual Adverse Effects

Ecosystem Component (VEC)	Potential Cumulative Residual Effect	Criteria						Level of Scientific Certainty
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological Context	
Marine and anadromous fish	Disturbance or displacement from habitat as a result of underwater sound from increases in vessel calls during the operations phase.	l	l	l	com	r	hd	h
Coastal seabirds	Disturbance or displacement from habitat as a result of in-air acoustic emissions from increases in vessel calls during the operations phase.	l	l	l	com	r	hd	h
Marine mammals	Physiological and behavioural changes as a result of acoustic disturbance from increases in vessel calls during operations phase.	h	r	l	com	r	hd	l
	Physical injury/direct mortality as a result of vessel strikes from increases in vessel calls during operations phase.	h	r	l	r	p	m	m

Notes: Magnitude expressed as negligible (n), low (l), moderate (m), high (h).
Geographic extent expressed as negligible (n), local (assessment area) (l), regional (assessment area) (r), provincial (p).
Duration expressed as short- (s), medium-(m), long-term (l).
Frequency expressed as rare (r), uncommon (isolated) (u), common (regular basis) (com), continuous (con).
Reversibility expressed as reversible (r) or permanent (p).
Ecological context expressed as intact (i), modified (m) and highly disturbed (hd).
Level of scientific certainty expressed as low (l), moderate (m), high (h) confidence.

Cumulative effects to marine and anadromous fish and coastal seabirds from acoustic disturbance stemming from DTRRIP and other projects/activities are expected to be low in magnitude, local in geographic extent, long-term in duration, relatively common in frequency and reversible, and would occur within an already highly disturbed ecological context. Extensive studies conducted for the DP3 Environmental Assessment and AMS Monitoring Programs found little to no change in abundance, distribution or habitat use during construction or operations (Hemmera, 2010). Hence it is unlikely that such cumulative effects hold the potential to adversely affect the viability of populations. This prediction is made with a high degree of confidence.

Cumulative effects to the SRKW population will include long-term and regular anthropogenic sound in the marine environment, which may act cumulatively with underwater sound from existing and future vessel traffic and raise the ambient sound levels within the RSA to potentially mask communication signals and induce behavioural changes. Effects are further characterized as high in magnitude, regional in geographic extent and likely reversible if the source of disturbance ceases.

There are currently no studies quantifying the energetic costs of chronic sound disturbance on SRKW and it is therefore not known whether the cumulative environmental effect on SRKW (from all marine activities) will affect the long-term viability or recovery of this population. Uncertainties include, but are not limited to, the following:

- The threshold at which killer whales change their behaviour due to underwater sound.
- How potential increases in duration, spatial extent, spectrum and intensity of underwater sound (from container ships) affect killer whale communication, prey detection and social behaviour.
- Where, when, and how many killer whales may be exposed to underwater sound (also taking into account seasonality in container ship volume).
- The distances that sounds from ships capable of influencing SRKWs extend.
- How underwater sound from DTRRIP related ships interact with that from other vessels, and locations pinpointing where these interactions are most likely to occur.
- Identifying and quantifying the energetic costs to killer whales associated with effects from underwater sound.

Additional studies, proposed by Port Metro Vancouver in **Section 8.4.5**, will assist in addressing some of these uncertainties and improve the collective capacity to better manage marine underwater sound impacts.

Potential cumulative effect of physical injury to marine mammals resulting from vessel strikes is not likely to affect the long-term viability or recovery of populations of species whose range includes the Regional Study Area. Effects are characterized as high in magnitude (from an individual, not population, perspective), regional in geographic extent but rare in frequency. This assessment is made with moderate confidence for the following reasons:

- Understanding of baleen whale species' distribution and density for all seasons in the RSA is limited and modelling of risk of strike or frequency of strike has not yet been completed.
- Collisions are frequently unnoticed and consequently unreported, making monitoring difficult.
- Quantifying population-level effects is extremely difficult, especially with regard to non-lethal injuries.

8.5 AIR QUALITY

8.5.1 Introduction

This air quality cumulative effects assessment investigates the potential changes in air contaminant emissions and associated effects on air quality as a result of the operation of DTRRIP in combination with other planned or reasonably foreseeable projects and activities described in **Table 8-2**. This section summarizes the cumulative effects section of the report titled *Air Quality Assessment, Deltaport Terminal,*

Road and Rail Improvement Project (2012), prepared by SENES Consultants Ltd. For a full description of the detailed analysis, including an overview of air quality in the Lower Fraser Valley, regulatory initiatives in future emission scenarios, the DTRRIP emission inventory assessment, and the full cumulative effects assessment, readers are advised to read the SENES report available on Port Metro Vancouver's website (www.portmetrovancouver.com/en/projects/Container_Capacity_Improvement_Program/CCIP.aspx).

8.5.2 Project Interactions with Other Projects and Activities

The other projects and activities whose effects could spatially and temporally overlap with the residual effects of DTRRIP on air quality are Deep Sea Terminals, Railways/Roads/Airport and Residential/Retail/Industrial Developments (**Table 8-3**). A more detailed description of these projects and activities is described in **Table 8-2**.

The residential, retail and industrial developments described in the Tsawwassen First Nation Land Use Plan are not explicitly assessed, but these types of developments are considered mobile and are therefore accounted for to some extent in regional growth projections, the regional air emissions inventory and projected trends.

8.5.3 Methodology

This section presents the approach undertaken to assess cumulative local and regional annual emissions from the Deltaport and Terminal 2 container terminals and the Westshore terminal, increases in fugitive dust emissions from future coal shipments at the Westshore terminal and emissions associated with the proposed VAFFC development.

The CEA emission inventory assesses both local emissions that occur in the immediate vicinity of the Deltaport terminal and regional emissions that occur within a selected area of the western portion of the Lower Fraser Valley (LFV) and Georgia Strait. The geographic scope within which emissions were estimated is shown in **Figure 5.5-1**. Emissions were categorized as local if they resulted from activity in the immediate vicinity of Roberts Bank, and regional if the emissions were derived from transport to and from Roberts Bank, either by ship, rail or truck (see **Section 8.3.2.1** for spatial boundary rationale).

The emissions inventory for the CEA considers anticipated changes in future cargo handling capacity at the Deltaport container terminal as a result of DTRRIP, in combination with increasing coal volumes at the existing Westshore (WS) coal terminal at Roberts Bank and operation of the Terminal 2 Project. **Table 8-6** lists the projected cargo throughput per horizon year of the assessment. Emissions are calculated based on the Deltaport container terminal reaching a capacity of 3 million TEUs per year by 2020 due to Deltaport improvements. For Westshore Terminals, emissions are calculated for a potential increase in coal shipments from a 2010 level of 24.7 million tonnes per year to a maximum 35 million tonnes per year reached by 2025. For Terminal 2, the projected operating scenario begins at 1.10 million TEU in 2020 and reaches a maximum 2.4 million TEU per year by 2025.

Table 8-6 Cargo Volume Comparison

Horizon Year	CEA Operational Scenario		
	Deltaport – DTRRIP (million TEU)	Westshore Terminal (Mt. Coal)	Terminal 2 (million TEU)
2010	1.54	24.7	0.00
2014	1.74	25.0	0.00
2017	2.40	28.0	0.00
2020	2.40	31.0	1.10
2025	2.40	35.0	2.40
2030	2.40	35.0	2.40

As with the air quality assessment for DTRRIP, the CEA air contaminant emissions were calculated for the following compounds:

- **Common Air Contaminants (CAC)**
  - Carbon Monoxide (CO)
  - Nitrogen Oxides (NO_X)
  - Sulphur Dioxide (SO_2)
  - Volatile Organic Compounds (VOC), specifically Hydrocarbons (HC)
  - Ammonia (NH_3)
  - Particulate Matter (PM, PM_{10} and $PM_{2.5}$)
- **Greenhouse Gases (GHG)**
  - Carbon Dioxide (CO_2)
  - Methane (CH_4), expressed as CO_2-equivalent (CO_2e)
  - Nitrous Oxide (N_2O), expressed as CO_2-equivalent (CO_2e)

Emissions were calculated for four source groups at Deltaport:

- Marine Vessels
  - Activity consisting of underway, manoeuvring and while at berth
  - Main engines, auxiliary engines and boilers
  - Tug boat assist vessels
- Cargo Handling Equipment (CHE)
  - Reach stackers
  - Rubber-tired gantry (RTG) cranes
  - Top and/or side picks chassis or reach stackers
  - Yard trucks (hostler, goats and terminal tractors)

- On-road Vehicles
  - Container trucks and employee-owned vehicles
- Rail Locomotives

Emissions were assessed for the following time averaging periods:

- Average annual emissions;
- Daily maximum and average emissions; and
- Hourly maximum and average emissions.

As discussed in **Section 5.5.3**, baseline air quality measurements are taken from Metro Vancouver Station T39 in Tsawwassen, considered representative of the existing environment Study Area (see **Figure 5.5-2**).

8.5.4 Analysis of Effects – Ambient Air Quality Impacts Assessment

This analysis focuses on predicted changes in air quality condition as a result of emissions from identified projects and activities. The Metro Vancouver Ambient Air Quality Objective (AAQO) is the measure against which the air contaminant concentration predictions are compared to determine if the cumulative effects could potentially exceed acceptable limits. Where the AAQO does not provide a quantifiable objective for comparison, a qualitative opinion on the gravity and consequence of the predicted change is provided. The cumulative air quality impacts at Station T39 and along the road and rail corridors are presented. The predicted effect of the changes in cumulative emissions on ambient air quality is estimated at three levels, namely:

1. Anticipated changes in maximum 1-hour and 24-hour average concentrations of the common air contaminants at the Tsawwassen monitoring station (1-hour average concentrations of CO,NO_2, and SO_2 and 24-hour average concentrations of NO_2, SO_2 and $PM_{2.5}$).
2. Anticipated changes in maximum 1-hour and 24-hour average concentrations of the common air contaminants CO, NO_2, SO_2 and $PM_{2.5}$ within a distance of 200 metres of Highway 17 for 2010 and the SFPR for future horizon years for container truck traffic and employee-owned vehicles, as well as within 200 metres of the rail corridor for rail traffic from Roberts Bank through Delta.
3. Fugitive coal dust emissions from the Westshore coal terminal and along the rail corridor from in-transit coal trains.

Details of the analyses of the predicted changes in air quality are presented in the report *Air Quality Assessment, Deltaport Terminal, Road and Rail Improvement Project* (SENES, 2012). A summary of the potential cumulative residual effects for relevant parameters (CO, NO_2, SO_2, VOCs, $PM_{2.5}$ and CO_2e) is presented in **Section 8.5.5** below.

8.5.5 Potential Cumulative Effects Summary

A summary of the cumulative residual adverse effects to air quality anticipated at station T39 is provided in **Table 8-7**. The table provides the ambient air quality objective where applicable, the 2010-2011 maximum observed average concentrations at T39 (i.e., the baseline), the maximum predicted concentration and the year this occurs, a summary of the dominant source of the emissions and a comment on the predicted trends. As indicated, the maximum predicted CO, NO_2, SO_2 and $PM_{2.5}$ concentrations are all well below the applicable Metro Vancouver AAQO.

Changes in VOC emissions at Roberts Bank are of more relevance to the extended regional scale impacts for the Lower Fraser Valley as a whole with respect to ground-level ozone formation or the formation of secondary organic aerosols than to any changes in local air quality.

The estimated percentage increase in VOC emissions due to increases in CEA emissions at Roberts Bank relative to the projected VOC emission inventory in the Lower Fraser Valley prepared by Metro Vancouver (2005) are: 0.08 percent increase in 2020, 0.09 percent increase in 2025 and 0.09 percent increase in 2030.. As such, the increased VOC emissions due to the CEA operational scenario would account for less than 0.1 percent of total emissions in the LFV. On that basis, any increases in VOC emissions at Roberts Bank would have negligible impacts on regional formation of ozone and secondary organic aerosols.

GHG emissions have no impact on local or regional air quality, and therefore can only be discussed in terms of the emission inventories and trends. The estimated percentage increase in GHG emissions (as CO_2e) due to increases in CEA emissions at Roberts Bank relative to the projected GHG emission inventory in the Lower Fraser Valley prepared by Metro Vancouver (2005) are: 0.70 percent increase in 2020, 0.97 percent increase in 2025, and 0.96 percent increase in 2030. As such, the increased GHG emissions due to the CEA operational scenario would account for approximately 0.7 percent of total emissions in the LFV in 2020 and less than 1 percent in 2030.

The maximum predicted cumulative CO, NO_2, and SO_2 concentrations, based on peak hourly traffic levels, are all well below the applicable Metro Vancouver AAQO for all distances from the road in the current and forecast years (**Table 8-8**). The 1-hour average $PM_{2.5}$ concentrations based on the peak hour traffic scenario are lower in 2025 than in 2010 for all distances from the road.

The maximum predicted cumulative CO, NO_2, and SO_2 concentrations at trackside, based on peak hourly rail traffic levels, are all well below the applicable Metro Vancouver AAQO for all distances from the track in the current and forecast years (**Table 8-9**). The 1-hour average $PM_{2.5}$ concentrations based on the peak hour rail traffic scenario are lower in 2020 than in 2010 for all distances from the road.

Table 8-7 Anticipated Changes in Air Quality at Station T39 (including Fugitive Coal Dust)

Contaminant	AAQO ($\mu g/m^3$)	Max. Observed Concentration 2010-2011		Maximum Predicted Concentration and Year[b]	Dominant Source of Emissions at Roberts Bank	Comment
		All Wind Directions	Wind Sector 260˚ - 340˚			
CO	30,000 (1-hr)	800.4	800.4	832.7 (2025)	CHE, with large contributions from ships and on-road vehicles	Slight decline after 2025 due to reduction in CHE emissions; concentrations remain well below AAQO
NO_2	200 (1-hr)	120.1	62.5	117.7 (2020)	Ships	55 percent decline in peak hourly concentrations after 2024 due to reductions in ship emissions; concentrations remain well below AAQO
	200 (24-hr)	48.1	N.A.	73.6 (2020)	Ships	20 percent decline in daily concentrations after 2024 due to reductions in ship emissions; concentrations remain well below AAQO
SO_2	450 (1-hr) 125 (24-hr)	53.5 7.1	53.5 N.A.	43.9 (2014) 10.7 (2014)	Ships Ships	85 percent decline in concentrations after 2014 due to ECA requirement for low sulphur fuels for ships
VOCs	N.A.	---	---	---	Ships	Increase after 2020 due to ship emissions
$PM_{2.5}$	25 (24-hr)	25.8 9.5[a]	N.A. N.A.	11.3 (2020)	Ships	Slight decline after 2024 due to reduction in CHE emissions; concentrations remain well below AAQO
CO_2e	N.A.	---	---	---	Ships, with large contributions from CHE	Increase after 2020 due to ship emissions

Notes: AAQO:Ambient Air Quality Objective. CHE: Cargo Handling Equipment
N.A.:Not applicable
[a] Filtered to exclude influence of smoke from forest fires
[b] Peak hourly/daily emissions for wind sector 260˚ to 340˚ only (i.e., from Roberts Bank and Deltaport causeway)

Table 8-8 Anticipated Changes in Incremental Peak Hour Air Quality at Roadside

	CO		NO_2		SO_2		$PM_{2.5}$	
AAQO (µg/m³)	30,000		200		125		N.A.	
Year	2010	2030	2010	2025	2010	2025	2010	2025
Distance from Road (m)	**Maximum Predicted Peak Hourly Concentration (µg/m³)**							
10	761	1936	86.4	35.3	2.0	6.0	8.0	6.1
30	270	686	31.8	13.0	0.8	2.4	2.8	2.2
50	187	476	22.7	9.3	0.6	1.7	2.0	1.5
70	148	376	18.2	7.4	0.5	1.4	1.6	1.2
90	122	310	13.6	5.6	0.4	1.2	1.4	1.0
110	104	265	13.6	5.6	0.3	1.0	1.2	0.9
130	96	243	13.6	5.6	0.3	0.9	1.0	0.8
150	91	232	13.9	5.7	0.3	0.8	1.0	0.8
170	87	221	9.1	3.7	0.3	0.8	0.9	0.7
190	83	210	9.1	3.7	0.3	0.8	0.9	0.7

Table 8-9 Anticipated Changes in Incremental Peak Hour Air Quality at Trackside

	CO		NO_2		SO_2		$PM_{2.5}$	
AAQO (µg/m³)	30,000		200		125		N.A.	
Year	2010	2020	2010	2020	2010	2020	2010	2020
Distance from Track (m)	**Maximum Predicted Peak Hourly Concentration (µg/m³)**							
10	334.5	146.5	164.9	125.5	10.0	1.0	22.4	11.8[a]
30	118.5	51.9	60.8	46.3	4.0	0.4	7.9	4.2
50	82.2	36.0	43.4	33.0	2.9	0.3	5.6	3.0
70	65.0	28.5	34.7	26.4	2.4	0.2	4.5	2.4
90	53.5	23.4	26.0	19.8	2.0	0.2	3.8	2.0
110	45.9	20.1	26.0	19.8	1.7	0.2	3.3	1.7
130	42.0	18.4	26.5	19.8	1.5	0.2	2.9	1.5
150	40.1	17.6	17.4	20.2	1.4	0.1	2.8	1.5
170	38.2	16.7	17.4	13.2	1.4	0.1	2.6	1.4
190	36.3	15.9	11.7	13.2	1.3	0.1	2.6	1.3

Notes: [a] Fugitive coal dust from six moderate-to-heavy dusting in-transit coal trains could potentially add up to 0.4 to 0.6 µg/m³ to ambient $PM_{2.5}$ concentrations at 10 m from the track over a seven hour period.

Based on the air quality cumulative effects assessment, there are no predicted exceedances of the AAQO contaminant concentrations.

8.5.6 Proposed Mitigation

Based on the air quality cumulative effects assessment, there are no predicted exceedances of the AAQO contaminant concentrations as a result of the proposed project. . Since the predicted cumulative effects are below the objectives and there is no risk to health and the environment no mitigation measures additional to the measures described in **Section 5.5.6.4** are proposed to mitigate cumulative effects.

8.5.7 Cumulative Residual Adverse Effects

A summary of the characteristics of the air quality cumulative residual adverse effects and the level of scientific certainty or confidence associated with the prediction is provided in **Table 8-10**. A discussion of the significance of the residual effects is presented in **Section 8.7.2**.

Changes to air quality are considered negligible to low in magnitude and occur over the local and regional area. The duration of the effect is considered medium-term and continuous in frequency. The effect is considered reversible given the slight to major declines in daily concentrations predicted for future years. The ecological context is presently modified. Based on the air quality assessment methodology and available information from the various studies conducted to date in Delta and Tsawwassen, as well as data collected from Station T39, this prediction is made with a high degree of confidence.

Table 8-10 Characterization of Air Quality Cumulative Residual Adverse Effects

Ecosystem Component	Potential Cumulative Residual Effect	Criteria						Level of Scientific Certainty
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological Context	
Air Quality	Increase in air contaminant levels	n/l	l/r	m	con	r	m	h

Notes: Magnitude expressed as negligible (n), low (l), moderate (m), high (h).
Geographic extent expressed as negligible (n), local (assessment area) (l), regional (assessment area) (r), provincial (p).
Duration expressed as short- (s), medium-(m), long-term (l).
Frequency expressed as rare (r), uncommon (isolated) (u), common (regular basis) (com), continuous (con).
Reversibility expressed as reversible (r) or permanent (p).
Ecological context expressed as intact (i), modified (m) and highly disturbed (hd).
Level of scientific certainty expressed as low (l), moderate (m), high (h) confidence.

8.6 NOISE

8.6.1 Introduction

This noise cumulative effects assessment investigates the potential changes in noise (and associated effects on human receptors) as a result of the operation of DTRRIP in combination with other planned or reasonably foreseeable projects and activities described in **Table 8-2**. Health impacts to human receptors are likely to increase with increases in noise. Health Canada (Health Canada, 2011) recognizes the following health impacts associated with noise:

- Noise-induced hearing loss
- Sleep disturbance
- Interference with speech communication
- Complaints
- High annoyance.

With the exception of noise-induced hearing loss, the potential for all the above health impacts currently exists for all residential receptors discussed in the assessment of Project related effects. Impulsive or intermittent noises (shunting, train whistles), or low frequency noise associated with heavy rail activity and container handling can potentially interrupt sleep for residences fronting Roberts Bank and the Roberts Bank Rail Corridor depending on factors such as building construction and individual sensitivity.

Noise impact criteria for this assessment are based on the potential effects to human receptors (see **Section 6.1.4**). According to the US Federal Transit Administration noise criteria, a moderate impact is "determined by the threshold at which the percentage of people highly annoyed by the project noise starts to become measurable." A high impact corresponds to a "higher, more significant percentage of people highly annoyed by project noise". Where the L_{dn} is above 75 dBA, Health Canada suggests that sleep disturbance is highly likely even with a high degree of sound insulation.

8.6.2 Project Interactions with Other Projects and Activities

As there are no construction phase residual adverse effects of the project, the scope of this noise cumulative effects assessment is therefore focused on how the noise effects of the operations phase of DTRRIP might combine and interact with other projects and activities described in **Table 8-2.** Other projects and activities whose effects could spatially and temporally overlap with the effects of DTRRIP on the noise ecosystem receptors during the operations period are Deep Sea Terminals, Coast/Riparian Modifications, Railways/Roads/Airport and Residential/Retail/Industrial Developments (**Table 8-3**).

The noise effects of DTRRIP operations have the potential to spatially and temporally overlap with the effects of other Deep Sea Terminal projects. Specifically, increases in DTRRIP noise levels due to the increase in ship movements, cargo handling and trains will overlap with the increased noise emissions due to growth in coal delivery and handling at Westshore. Additionally, the noise effects of DTRRIP operations have the potential to spatially and temporally overlap with the effects of container handling at the Roberts Bank Terminal 2. Noise effects of future Coastal/Riparian modifications are not expected to spatially overlap with the effects of DTRRIP.

Of the future Railways, Roads and Airport projects, both the increases in noise levels from the Roberts Bank Rail Corridor (RBRC) project and the South Fraser Perimeter Road (SFPR) operations could spatially and temporally overlap with increases in noise levels during DTRRIP operations.

Residential, Retail and Industrial Developments have the potential to increase noise, but also the potential to change noise exposures due to land use changes. Specifically, the Tsawwassen First Nations Land Use Plan will be considered cumulatively with the noise effects of DTRRIP operations.

8.6.3 Analysis of Effects

Cumulative effects were assessed through a comparison of the existing noise conditions adjacent to sensitive receptors within the Study Area to predicted noise conditions with other projects and activities.

As discussed in **Section 6.1.5**, noise measurements were performed at six sites (S1 - S6) chosen to represent the existing environment of noise sensitive receptors within the Study Area (see **Figure 6.1-1**). For a discussion of acoustic terminology and noise impact assessment criteria please refer to sections 6.1.3 and 6.1.4 respectively. DTRRIP noise monitoring locations summarized in **Table 6.1-6** are repeated in this section in **Table 8-11** for ease of reference.

Table 8-11 Description of Existing (2011) Monitoring Locations S1 – S6

Site No.	Address	Representative Environment	Dominant Noise and Vibration Sources	Description
S1	476 Tsawwassen Beach Rd, Tsawwassen	Residences south of Roberts Bank Rail Corridor along Tsawwassen Beach Rd (Photo 6.1-1)	Local residential activity, BC Ferries, wildlife and Roberts Bank	Noise monitor located 4.7 km from Deltaport Terminal
S2	Tsawwassen First Nations Longhouse 2148 Tsawwassen Dr N, Tsawwassen	First Nation Community south of Roberts Bank Rail Corridor	Wildlife, BC Ferries and Roberts Bank	Noise monitor located 1.8 km from Roberts Bank Rail Corridor and 4.8 km from Deltaport Terminal
S3	3044A 41B St, Delta	Rural residences fronting Roberts Bank Rail Corridor (Gulf Yard)	Overpass construction, rail, local activities, traffic on Deltaport Way and Wildlife	Noise and vibration monitors located 250 m from Roberts Bank Rail Corridor

Site No.	Address	Representative Environment	Dominant Noise and Vibration Sources	Description
S4	6900 36 Ave, Delta	Rural residence fronting Roberts Bank Rail Corridor (Fisher Yard)	Rail traffic, overpass construction, local farming activity	Noise and vibration monitors located 230 m from Roberts Bank Rail Corridor
S5	12726 Southridge Dr, Surrey	South facing Panorama Ridge residences in Surrey exposed to rail activities serving Roberts Bank as well as other destinations	Rail traffic, aircraft, highway traffic and wildlife	Noise monitor located 460 m from Roberts Bank Rail Corridor
S6	6270 Glover Rd, Langley	Rural Langley residences on Glover Road exposed to rail activities serving Roberts Bank as well as other destinations	Rail traffic, local road traffic and aircraft	Noise monitor located 68 m from Roberts Bank Rail Corridor

Section 6.1.6.3 indicates the potential for a range of 1 - 3 dB increases in noise levels at receiver locations attributable to DTRRIP for the year 2020, depending on proximity to the Roberts Bank Rail Corridor. This analysis is made without factoring the benefits of noise mitigation and acknowledges that effects would be reduced with the implementation of noise mitigation.

8.6.3.1 Increases in Westshore Coal Ship and Train Volumes

As indicated in **Table 8-12,** throughput of coal at Westshore is expected to increase from the current level of 24.7 million tonnes coal to 35 million tonnes coal by 2025. As a result of DTRRIP, container capacity at Deltaport will increase from 1.54 million TEU currently to 2.4 million TEU by 2020. For the purpose of this CEA it is assumed, as discussed in Table 8.2, that further upgrades/investments to existing facilities at Deltaport could provide for an additional 600,000 TEUs of capacity and a total capacity of 3 million TEU's.

Table 8-12 Summary of Westshore and Deltaport Cargo Volumes and Ship, Road and Rail Traffic Volumes

Year	Container Capacity Deltaport (1,000,000 TEUs)		Total Average Ship Movements (Ships/day)		Total Two Way Trains (Trains/day)	
	Deltaport	Westshore (Mt. Coal)	Deltaport	Westshore	Deltaport	Westshore
2010	1.54	24.7	1.6	1.3	6	10
2020	3	31	2.3	1.7	12-16	10 – 14
2025	3	35	2.3	1.9	12-16	10 – 14

Noise emissions due to the increase in Westshore ship movements, cargo handling and trains are expected to increase in the future. However, based on these volumes, the estimated additional noise exposure due to ship movements and coal trains passing over the corridor each day is negligible and less than 1 dB. Noise emission due to increases in Westshore cargo-handling equipment could potentially increase by 1 - 2 dBA.

8.6.3.2 Roberts Bank Terminal 2 (T2) Project

Port Metro Vancouver is in the planning stages of development for an additional container terminal at Roberts Bank. The container capacity associated with the Roberts Bank Terminal 2 Project, is projected to equal the container capacity at the Deltaport Terminal by the year 2030.

The ratio between the 2010 container capacity at Deltaport and the combined 2020 and 2030 container capacities of both the improved Deltaport Terminal and Terminal 2 was used to calculate an initial evaluation of future noise increases. **Table 8-13** summarizes the projected container capacities of both terminals for years 2010, 2020 and 2030.

Table 8-13 Projected Deltaport Terminal and Terminal 2 Container Capacities

Year	Container Capacity (1,000,000 TEUs)		
	Deltaport	Terminal 2	Combined Capacity of Deltaport and Terminal 2
2010	1.54	-	1.54
2020	3	0.50	3.50
2030	3	3	6

Based on the container capacities noted in Table 8-13, the projected cumulative noise increase in the year 2020 for container terminal noise could potentially reach 4 dB. This would correspond to a 2 - 3 dBA increase in rail noise at sites S3 - S6. Cumulative noise increases at residences near S1 and S2 would still have a negligible "Low Impact". Noise increases at residences near sites S3 - S6 could move into the "Moderate Impact" zone shown in **Figure 6.1-2** in the year 2020. Cumulative noise impacts in the year 2030 are projected to be 5 - 6 dB for container terminal noise only relative to conditions measured in 2011, based on the above assumptions. This would correspond to a 3 - 4 dBA increase in rail noise at sites S3 - S6. This could potentially cause future noise levels at some residences along the Roberts Bank Rail Corridor to move further into the "Moderate Impact" range.

8.6.3.3 Roberts Bank Rail Corridor (RBRC) Program

The Roberts Bank Rail Corridor (RBRC) Program includes the upgrading or replacement of a number of at-grade crossings and addition of sidings along the RBRC with overpasses in Surrey and Langley by 2014 to improve passing options for inbound and outbound trains and to eliminate the need for whistling (RBRC, 2011). Whistling cessation will reduce noise exposure levels in locations near crossings. However, if train speeds increase as a result of fewer at-grade crossings, these noise reductions could be offset. Furthermore, road traffic noise levels may increase more rapidly if roadway upgrades are included (e.g., Glover Road near site S6). The estimated current effect of whistling on the L_{dn} is 2 dBA at site S5, 1 dBA at site S6 and 0 dBA at the remaining sites. If train speeds do not increase, a noise benefit of 1 to 2 dBA is expected in Surrey and Langley (sites S5 and S6) due to whistling cessation, which will likely be offset by increases in road traffic resulting in a negligible net effect.

8.6.3.4 South Fraser Perimeter Road (SFPR) Project

The SFPR, currently under construction, will be in the vicinity of DTRRIP only near site S4 and most of the study area will not be affected by SFPR. In the noise component of the Application for an Environmental Assessment Certificate for the South Fraser Perimeter Road Project (Hemmera, 2006) a significant increase in the day-night average, for the year 2021, was predicted for a property on 36th Avenue in Delta. The property was located approximately 350 m from site S4 on the west side of the Roberts Bank Rail Corridor. Site S4, which represents one residence, is located at a greater distance from the SFPR alignment than the monitoring site at 36th Avenue, Delta, and as a result would experience a smaller noise increase. It is estimated that SFPR noise at S4 would yield a 5 - 7 dB increase in the overall noise exposure. In the absence of any highway noise mitigation, the noise exposure at S4 is expected to be dominated by highway traffic noise in 2020. Rail and road noise are expected to contribute equally to the total noise exposure at S4 by the year 2030. Noise increases relative to existing 2011 conditions at S4 resulting from the combined effects of SFPR and DTRRIP with or without Terminal 2 are likely to result in "High Impacts" to the one residence represented by S4.

8.6.3.5 Tsawwassen First Nations (TFN) Industrial Development

Tsawwassen First Nation prepared a land use plan (TFN, 2009) that includes proposed industrial development on the south side of the RBRC near site S3. Environmental noise exposures may increase at site S3 and a few other residences on the south side of the RBRC near 41B Street. However, due to the proposed land use change, other residences, such as previously identified 4032 28B Avenue near the proposed repair tracks, may be replaced by industrial land use. The land use plan indicates that noise impact assessments with mitigation plans would be performed as part of any proposal to develop in the area. Given the change of land use associated with the TFN proposal, some residences in the area of the site S3 receptor will likely be removed, resulting in fewer residential receptors and pathways for noise exposure.

8.6.4 Proposed Mitigation

Measures available to mitigate the potentially adverse noise cumulative effects described above are the same measures that have been described in **Section 6.1.6.3** as available for consideration for DTRRIP, including source measures, propagation measures and receiver measures. However, noise mitigation design requires detailed design information to model and evaluate options and determine the effective and appropriate mitigation approach. Additionally, in the case of cumulative effects assessment, noise exposure increases are predicted to occur sufficiently in the future in some cases that development of noise mitigation measures may be premature given current conditions and the potential for land use changes. As such, the following describes mitigation options for future consideration if and when the site specific noise impact scenarios conditions discussed in this CEA were to occur.

Should the Roberts Bank Terminal 2 Project proceed to operations, noise increases at residences near sites S3 - S6 could move into the "Moderate Impact" zone in the year 2020 in the absence of mitigation. Port Metro Vancouver is in the feasibility and early planning stages of this project and will be conducting detailed noise impact assessments. For sites S3, S4 and S6, it may be most cost effective to provide sound insulation upgrades, although some of the residential receptors in the area of S3 may not be present in 2020 as a result of the TFN industrial development proposal and other opportunities may present themselves during discussions with property owners. The noise level at S4 should be reassessed after mitigation measures, if any, are implemented as part of the SFPR project. Since site S5 represents many residences on Panorama Ridge, noise barriers would be a more cost effective mitigation approach relative to sites S3 and S4.

Noise increases, relative to existing 2011 conditions, at S4 resulting from the combined effects of SFPR and DTRRIP with or without Terminal 2 are likely, and in the absence of mitigation, would be expected to result in "High Impacts" by the year 2020 to the one residence associated with S4. However, commitments associated with the Environmental Assessment Certificate for the SFPR project, and contractual agreements with the contractor building the project are expected to ensure that SFPR related noise is mitigated. Specifically, noise modelling will be undertaken to predict the future noise condition (using 2021 traffic volumes) and guide the development of proposed mitigation. Additionally, after operation of the SFPR commences, noise monitoring will be undertaken to verify that noise mitigation is effective in mitigating traffic related noise. If the results of operational noise monitoring indicate that mitigation is not achieving noise mitigation requirements, additional noise mitigation measures will be implemented to ensure that noise mitigation commitments at S4 are met.

8.6.5 Summary

A summary of the existing and predicted noise levels with and without mitigation for 2020 and 2030 at sites S1 – S6 is presented in **Table 8-14.** The assessment of the magnitude of the effect is based on the criteria in **Section 6.1.4**. The cumulative noise impacts at sites S1 and S2 are rated as low in both 2020 and 2030 without mitigation. The cumulative noise impact at sites S3, S5 and S6 are rated as moderate in both 2020 and 2030 and as high at S4 without mitigation.

If cumulative effects noise mitigation is found to be justified and a noise reduction of 5 dBA is provided, the residual noise effects at sites S3, S5 and S6 could be reduced to the low impact range, although they may return to the moderate impact range at site S5 in 2030.

As discussed above, detailed assessments are required to determine the likely benefit of potential noise mitigation measures. Site S4 will move into a high impact rating by 2030 if the benefits of mitigation measures are limited to a 5 dBA noise reduction. A noise reduction in the order of 7 dBA is likely necessary to keep the site S4 rating within a “moderate impact”. Therefore, the noise cumulative effects at site S4 are assessed as having a “moderate” impact in 2020, which could potentially degrade to a “high” impact in 2030, depending on the performance of the selected noise mitigation measures.

Table 8-14 Summary of Existing Noise Levels, Predicted Noise Cumulative Effects before Mitigation and Impact Rating before and after Mitigation

Site No.	Total Noise Level L_{dn} (dBA)			Impact Before Mitigation (2020/2030)	Impact With Mitigation (2020/2030)*	Comment
	Existing	Predicted 2020	Predicted 2030			
S1	53	<55	<55	Low/Low	n/a	
S2	50	<55	<55	Low/Low	n/a	
S3	59	62	63	Moderate/Moderate	Low/Low	Future noise levels could be higher depending on type of industrial activities
S4	61	68	71	High/High	Moderate	Potentially degrading to High level
S5	62	65	66	Moderate/Moderate	Low/Moderate	
S6	68	71	72	Moderate/High	Low/Low	

Note: * This assumes a minimum noise reduction of 5 dBA provided by mitigation

8.6.6 Cumulative Residual Adverse Effects

The noise cumulative residual adverse effects conclusions are based on two assumptions: (1) that the SFPR project will mitigate the noise increase at S4 as necessary to keep the noise level to within a moderate impact rating; and (2) that Port Metro Vancouver will commission an additional noise impact assessment associated with the Terminal 2 development, which will consider mitigation measures at S3, S5 and S6 as necessary to keep the noise level to within a moderate impact rating in 2020 and 2030.

A summary of the characteristics of the noise cumulative residual adverse effects (predicted to still remain after mitigation) and the level of scientific certainty or confidence associated with the prediction is provided in **Table 8-15**. A discussion of the significance of the residual effects is presented in **Section 8.7.3**.

Changes to noise levels at sites chosen to represent the existing environment of noise sensitive receptors within the Study Area are considered low to moderate in magnitude and occur over the local area. The duration of the effect is considered long-term and continuous in frequency. The effect is considered reversible and the ecological context is presently modified. Based on the noise impact assessment methodology, noise measurement results and available information from the various studies conducted to date, this prediction is made with a moderate degree of confidence.

Table 8-15 Characterization of Noise Cumulative Residual Adverse Effects

Ecosystem Component (at representative sites)	Potential Cumulative Residual Effect	Year	Criteria						Level of Scientific Certainty
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological Context	
Noise S1	Increase in noise level using Ldn as the noise descriptor	2020	l	l	l	con	r	m	m
		2030	l	l	l	con	r	m	m
Noise S2		2020	l	l	l	con	r	m	m
		2030	l	l	l	con	r	m	m
Noise S3		2020	l	l	l	con	r	m	m
		2030	l	l	l	con	r	m	m
Noise S4		2020	m	l	l	con	r	m	m
		2030	h	l	l	con	r	m	m
Noise S5		2020	l	l	l	con	r	m	m
		2030	m	l	l	con	r	m	m
Noise S6		2020	l	l	l	con	r	m	m
		2030	l	l	l	con	r	m	m

Notes: Magnitude expressed as negligible (n), low (l), moderate (m), high (h).
Geographic extent expressed as negligible (n), local (assessment area) (l), regional (assessment area) (r), provincial (p).
Duration expressed as short- (s), medium-(m), long-term (l).
Frequency expressed as rare (r), uncommon (isolated) (u), common (regular basis) (com), continuous (con).
Reversibility expressed as reversible (r) or permanent (p).
Ecological context expressed as intact (i), modified (m) and highly disturbed (hd).
Level of scientific certainty expressed as low (l), moderate (m), high (h) confidence.

8.7 CONCLUSION ON SIGNIFICANCE OF RESIDUAL EFFECTS

The following sections summarize, for each of the VECs considered, the potential for the Project, in combination with other projects or activities, to cause significant adverse environmental effects.

8.7.1 Marine Environment

Cumulative effects to coastal seabirds and marine and anadromous fish from acoustic disturbance stemming from DTRRIP and other projects/activities are unlikely to adversely affect the viability of populations. Therefore this cumulative residual environmental effect is considered not significant.

The cumulative environmental effect on SRKW from acoustic disturbance from all shipping traffic to affect the long-term viability or recovery of this population cannot be accurately predicted with available scientific information. There are currently no studies quantifying the energetic costs of chronic noise disturbance on SRKW and it is therefore not known whether the cumulative environmental effect on

SRKW from all shipping traffic will affect the long-term viability or recovery of this population. This low level of scientific certainty or confidence can be improved by more research into the biological costs of acoustic disturbance, both at individual and population levels. This finding is consistent with DFO's observation that a knowledge gap exists and their recommendation that there is a need to develop an action plan to address acoustic disturbance.

As discussed in **Section 8.4.6**, Port Metro Vancouver is undertaking or proposing a number of initiatives that will contribute to improved understanding of the issue of acoustic disturbance to SRKWs and to working with government and key stakeholders to identify strategies for addressing potential underwater sound effects. As a result of such actions, it is assumed that cumulative residual effects will not be significant, however given the scientific uncertainty associated with this issue, an opinion on significance is not offered at present.

The potential cumulative effect of physical injury to marine mammals resulting from vessel strikes is not likely to affect the long-term viability or recovery of populations of species whose range includes the Regional Study Area. Therefore this cumulative residual environmental effect is considered not significant.

8.7.2 Air Quality

Based on the air quality cumulative effects assessment, and the prediction of no exceedances of the AAQO contaminant concentrations, the Project in combination with other projects and activities is not likely to cause significant adverse environmental effects.

8.7.3 Noise

Based on the noise cumulative effects assessment, the Project in combination with other projects and activities is not likely to cause significant adverse environmental effects. This assumes that the following mitigation measures are provided: (1) mitigation measures for the SFPR project are effective at S4 and keep the noise level to within a moderate impact rating; and (2) Port Metro Vancouver will commission an additional noise impact assessment associated with the Terminal 2 development, and mitigation measures will be implemented at S3, S5 and S6 as necessary to keep the noise level to within a moderate impact rating in 2020 and 2030. With mitigation, no noise cumulative effects are likely to cause a significant adverse effect to the health of residents in the immediate vicinity of sites S1 - S6.

8.7.4 Summary of Cumulative Residual Effects

With the implementation of project related mitigation and additional measures for noise related effects to marine mammals, no significant cumulative effects are predicted as a result of the potential interactions between the project and other projects and activities (**Table 8-16**).

Table 8-16 Summary of Cumulative Residual Effects

Ecosystem Component (VEC)	Potential Cumulative Residual Effect	Criteria						Level of Significance of Residual Effect	Level of Scientific Certainty
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological Context		
Marine and Anadromous Fish	Disturbance or displacement from habitat as a result of underwater noise from increases in vessel calls during the operations phase.	l	l	l	com	r	hd	NS	h
Coastal Seabirds	Disturbance or displacement from habitat as a result of in-air acoustic emissions from increases in vessel calls during the operations phase.	l	l	l	com	r	hd	NS	h
Marine Mammals	Physiological and behavioural changes as a result of acoustic disturbance from increases in vessel calls during operations phase.	h	r	l	com	r	hd	Undetermined	l
	Physical injury/direct mortality as a result of vessel strikes from increases in vessel calls during operations phase.	h	r	l	r	p	m	NS	m
Air Quality	Increase in air contaminant levels	n/l	l/r	m	con	r	m	NS	h
Noise	Increase in noise level using Ldn as the noise descriptor (overall assessment for Sites S1 to S2)	2020	l	l	l	con	r	NS	m
		2030	l/m	l	l	con	r	NS	m

Notes: Magnitude expressed as negligible (n), low (l), moderate (m), high (h)
Geographic extent expressed as negligible (n), local (assessment area) (l), regional (assessment area) (r), provincial (p).
Duration expressed as short- (s), medium-(m), long-term (l).
Frequency expressed as rare (r), uncommon (isolated) (u), common (regular basis) (com), continuous (con).
Reversibility expressed as reversible (r) or permanent (p).
Ecological context expressed as intact (i), modified (m) and highly disturbed (hd)Level of significance expressed as non-significant (NS) and significant (S).
Level of scientific certainty expressed as low (l), moderate (m), high (h) confidence.

8.8 CONSIDERATION OF A FOLLOW-UP PROGRAM

No follow-up and monitoring plan has been identified. However, it is recognized that the SKRW population may have experienced the effects of increased noise in the Straits of Georgia due to increased shipping activity. Port Metro Vancouver will consult with DFO to determine whether Port Metro Vancouver can benefit SKRW by further monitoring.

9.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

CEAA requires consideration of the potential environmental factors that may affect construction and operation of the proposed Project. Potential effects on the Project due to the environmental surroundings are discussed in this section along with measures that the Project will adopt to mitigate these potential effects.

9.1 POTENTIAL ENVIRONMENTAL FACTORS

The environmental factors that are considered in this assessment are:

- Seismic hazards
- Tsunami,
- Implications of climate changes (including changes to sea level),
- Snow and severe temperatures, erosion, and flooding.

These events and characteristics were selected from a review of the literature and from discussions in applicable study reports.

9.1.1 Seismic Hazards

Earthquakes are common in BC and more than 1,200 are recorded each year across the province. Most are too small to be felt, but an earthquake capable of causing structural damage is expected to occur somewhere in the province about once every decade (PEP, 2011). The Deltaport container terminal is located in one of the areas of higher seismic risk designations in Western Canada.

The Project design will include consideration of seismic effects. The seismic design criteria for the DTRRIP Overpass will conform to existing BC MoTI standards and criteria established for industrial use highway overpasses.

Ground improvements will be carried out along the existing causeway for the construction of the DTRRIP Overpass to meet seismic performance and settlement criteria, and will include the densification of *in-situ* soils and granular fills by dynamic compaction and vibro-replacement techniques using land based equipment. Geotechnical investigations were undertaken in fall 2011 and the soil information collected will be used to refine soil improvements and design requirements as part of final engineering design.

9.1.2 Tsunami

Similar to earthquakes, tsunamis can happen at any time of the day or night, under any kind of weather conditions, and in all seasons. Beaches exposed to the ocean, or by bay entrances, as well as tidal flats and the shores of coastal rivers or inlets exposed to the open ocean, are especially vulnerable to tsunami (PEP, 2011).

The coastal area of British Columbia has the potential of being affected by tsunamis (Bornhold *et al*., 2001 and PEP, 2008). While the southern Strait of Georgia is sheltered from Pacific Ocean generated tsunamis by Vancouver Island (PEP, 2008), tsunamis generated in local waters by earthquakes, landslides or submarine landslides could have an effect on the Roberts Bank area (Bornhold *et al*., 2001). In particular, the southern Strait of Georgia has been identified as an area at risk of tsunamis generated by submarine landslides due to the large unstable sediment mass on Roberts Bank at the edge of the Fraser River delta (Rabinovich *et al*., 2003). A failure in the cohesion of the sediment mass could allow a mass slide of sediment, which under the right conditions (volume of sediment, speed, and location) could trigger a tsunami event. There have been five such slides in the area since 1970, at which time the Roberts Bank Port facilities were in place (Rabinovich *et al*., 2003).

The maximum predicted amplitude of waves generated by undersea landslides within the Strait of Georgia is four metres. The present freeboard at the Deltaport container terminal is 3.2 metres therefore if a tsunami wave with maximum predicted amplitude were to occur under specific conditions, there could be wave overtopping at the Project site (Rabinovich *et al*., 2003). However, the existing Roberts Bank Port facilities, including Westshore Terminal and the Deltaport container terminal, have been in operation during all of the reported five previous submarine landslides at Roberts Bank and no large waves have been recorded that have overtopped the terminals.

9.1.3 Climate and Sea Level Change

An average increase in global temperature may potentially affect the Project through rising sea levels, and increased extreme weather events such as more frequent and severe precipitation and drought events.

Climate change has the potential to effect the safety of existing structures, and DTTRIP design has accounted for the predicted changes in sea level that are the result of climate change (Auld *et al*., 2006).

Based on the predictions from these climate change studies, the projected relative sea level rise in the Roberts Bank area will vary. For the purposes of this assessment, it is assumed that the projected sea level rise will be 0.5 metres by the year 2100[40]. The current Roberts Bank port facility is constructed at 7.0 metres chart datum, approximately two meters above higher high water.

9.1.4 Snow and Severe Temperatures

Along with the projected sea level rise there is an anticipated increase in the frequency and magnitude of severe storms due to climate change. Severe storms can create hazards such as downed power lines, power failures, local flooding and associated road traffic and transportation hazards and delays.

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[40] Hill, P.R., editor (in press): Biophysical impacts of sea level rise and changing storm conditions on Roberts Bank; Geological Survey of Canada, Open File.

Weather typical of winter conditions has the potential for causing unsafe road conditions. As such, maintenance of road surfaces will be required as part of regular maintenance to ensure that the road surface is clear of ice and debris which could potentially effect construction and operation activity.

The nearest[41] Environment Canada weather station to the study area is located at the Vancouver International Airport (49°11'42.000" N, 123°10'55.000" W, Climate ID: 1108447) approximately 15 kilometres to the southeast at an elevation of four metres. The average annual precipitation, based on data from 1971 to 2000 is 1,155 millimetres (Environment Canada, 2011b). Precipitation average in the area is highest in November, followed by December and January, respectively, with the highest daily precipitation of 74.2 millimetres recorded in December 1979. Snowfall average is highest in January with the highest daily snowfall of 24 centimetres recorded in December 1997. The mean daily temperature is 10.1°C and ranges from 3.3°C to 17.6°C.

9.1.5 Erosion and Flooding Hazards

Erosion and erosion protection are not considered to have significant effects on DTRRIP. The Project area is protected from shoreline erosion at Roberts Bank by pre-existing dykes. There is no erosion risk associated with the agricultural ditches within the area because they are regularly maintained.

Rising sea levels and increased precipitation in winter and early spring in the Lower Mainland are predicted to effect existing flood protection works, such as the Roberts Bank dykes on Brunswick Point and TFN land. Maintenance of infrastructure on the Fraser River is a municipal responsibility. To maintain dyke integrity, the Corporation of Delta oversees maintenance activities and construction where upgrades are required. These activities ensure that Delta's dyke network meets the Provincial Diking Authority requirements which base the infrastructure standards to a one-in-200-year flood event.

The BC MoE *Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use – Guidelines for Management of Coastal Flood Hazard Land Use* (2011b) document provides guidelines for the management of lands that are exposed to coastal flood hazards arising from their exposure to the sea and to expected sea level rise due to climate change, and will supersede the related sections of the existing Flood Hazard Area Land Use Management Guidelines, May 2004, prepared by the Ministry of Water, Land and Air Protection**.** This document provides guidelines intended to help local governments, land-use managers, and approving officers develop and implement land-use management plans and make subdivision approval decisions for lands exposed to coastal flooding hazards and Sea Level Rise (MoE, 2011b). MoE (2011b) and the companion document *Sea Dike Guidelines* (MoE, 2011c) are specific to flood hazards arising from the exposure of BC lands to the sea.

The existing drainage configurations and patterns within the intermodal yard will be maintained as services are adequate to meet the Project needs.

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[41] The Pebble Hill Station (Climate ID# 1102420) is closer to the study area, but discontinued data collection in 1996.

The roads on the causeway and modifications to Deltaport Way will be graded for storm-water to drain and infiltrate into the gravel shoulder. Storm-water runoff from the new DTRRIP Overpass will be collected and discharged directly to the ground via a standpipe, and allowed to infiltrate into the gravel.

All storm water drainage pipes crossing under rail tracks will meet the requirements of the *BC Railway Safety Act* and other applicable regulations and standards.

Any new storm water drainage systems will be designed using Ladner Intensity-Duration Frequency (IDF) data to accommodate the rainfall flows generated from a one-in-100 year rainstorm.

9.2 MITIGATION

To address seismic risks to the Project, DTRRIP Project design criteria for the DTRRIP Overpass will conform to existing BC MoTI standards and criteria established for industrial use highway overpasses (**section 9.1.1**).

The Project may be affected by tsunami and climate change events (sea level rise and more frequent/severe storms). Both of these conditions could result in waves overtopping the wharf, resulting in some terminal downtime and financial loss. The Project will be designed and constructed at seven metres chart datum or higher above higher high water sea level- . This elevation provides adequate freeboard such that if the potential tsunami, climate change and flooding events were to occur, there would be only a temporary disruption of terminal activities.

Road surface maintenance will be required as part of regular maintenance to ensure that the road surface is clear of ice and debris from severe weather conditions which could potentially effect construction and operation activity.

The Project area is protected from shoreline erosion at Roberts Bank by pre-existing dykes maintained to ensure the dyke network meets the Provincial Diking Authority requirements based to a one-in-200-year flood event standard. As such, erosion and erosion protection are not considered to have significant effect on DTRRIP.

9.3 RESIDUAL EFFECTS

Provided the mitigation measures outlined are implemented, no residual adverse effects are anticipated as a result of effects of the environment on the Project.

9.4 CONCLUSION

Based on the implementation of the proposed mitigation, external environmental factors will not likely result in significant adverse effects on DTRRIP. No residual adverse effects associated with natural events on the Project are anticipated.

10.0 SUSTAINABILITY

10.1 INTRODUCTION

Environmental assessment is understood to be a planning tool used to help identify, avoid or mitigate potential environmental effects that may arise from development. Inherent in this definition is the idea that social and economic costs and benefits, associated with proposed projects, must be considered against environmental costs and benefits. The premise that social, environmental and economic costs and benefits must be integrated, balanced and reconciled in the project decision making process is central to the concept of sustainable development.

Recent changes to CEAA (the Act) have also strengthened the requirement that consideration be given to how proposed projects achieve sustainability. The Act is a key legislative tool for the Government of Canada "*… to achieve sustainable development by conserving and enhancing environmental quality and by encouraging and promoting economic development that conserves and enhances environmental quality.*" Specifically, CEAA defines sustainable development "*as development that meets the needs of the present, without compromising the ability of future generations to meet their own needs.*"

Sustainable development objectives will play a key role in the detailed design, construction, and operation of DTRRIP. This section will collectively consider the range of social, economic and environmental costs and benefits associated with the proposed project and present an overview of how DTRIPP meets the intent and definition of sustainable development, as defined in the Act.

This section will:

- Describe the legislative framework for sustainability assessments within the Act.
- Provide some background on the state of sustainability assessments in Canada.
- Describe Port Metro Vancouver's commitments and requirements contained within corporate environmental and corporate social responsibility policies.
- Describe how sustainability will be managed and implemented throughout the project.
- Consider the range of ecological, socio-community and economic sustainability considerations potentially influenced by the construction and operation of the proposed Project that will be used as a basis for measuring sustainable development, as defined in the Act.
- Identify how ecological, socio-community and economic sustainability considerations are effected and if they compromise "the needs of future generations to meet their own needs".
- Identify additional sustainable opportunities that will have a net benefit on ecological, socio-community and economic factors.

10.1.1 Legislative Requirement

The foundation of CEAA is that "*environmental assessment provides an effective means of integrating environmental factors into planning and decision-making processes in a manner that promotes sustainable development*." As stated in the 4(1)(b) of the Act, one of the key purposes of CEAA is "*to encourage responsible authorities to take actions that promote sustainable development and thereby achieve or maintain a healthy environment and healthy economy*". In addition, the CEAA clearly states that "*environmental assessment provides an effective means of integrating environmental factors into planning and decision-making processes in a manner that promotes sustainable development*".

10.1.2 Background to Sustainable Use Assessments

The idea of development that protects resources and the long-term integrity of ecosystems, while also improving ecological and social well-being, is based on the connection and interdependence of a number of components of the environment (Gibson, 2000). These components include: ecological (biophysical), social, cultural, economic and political considerations with emphasis of the integrated nature of each of these components. Most sustainability frameworks use a number of these components, often combining one or more depending on the goals and operating environment of the project or organization. The most well known and widely used is the ecological, social and economic framework that is also the basis for 'triple bottom line' accountancy reporting.

In recent years, a greater emphasis has been placed on the concept of Sustainability Assessment. This new sustainability framework highlights the interconnected nature of the biophysical and socio-economic systems and places emphasis on providing a net benefit to the community in addition to mitigating project effects.

10.1.3 Port Metro Vancouver Environment and Corporate Social Responsibility Policies

As the project proponent, Port Metro Vancouver requires that all projects and undertakings meet the corporate sustainability related policies. Port Metro Vancouver Environment Policy requires that the organization "*shall conduct its affairs in a responsible and sustainable manner that safeguards and, where feasible and practicable, promotes continual improvement of the environment to its employees, customers and community partners*". In addition, the policy states Port Metro Vancouver *"is committed to sustainability, reducing environmental effects, minimizing environmental risk of port operations, and promoting continual environmental improvement*".

Port Metro Vancouver Corporate Social Responsibility (CSR) Policy *provides* a framework for how the organisation integrates social and environmental matters into its values, culture, decision making, strategy, development and operations in a transparent and accountable manner. The CSR policy states that Port Metro Vancouver "*shall ensure that CSR considerations are incorporated into decision-making processes and daily work activities to establish better practices within the organisation, create economic value and improve society.*"

10.2 IMPLEMENTATION OF PROJECT SUSTAINABILITY

DTRRIP is a sustainable initiative on the part of Port Metro Vancouver. The Project will optimize current container processes to realize operational gains within Deltaport Container Terminal and benefit Canadians on a local, provincial and national level. This project also addresses community requests, identified during stakeholder consultations, that Port Metro Vancouver first find efficiencies within the existing system prior to expansion.

Sustainable development will play a key role in the detailed design, construction, and operation of DTRRIP. Compliance with sustainable development objectives will be achieved by integrating a number of sustainability processes throughout the various stages of the project. These processes include:

- Aligning DTRRIP Sustainable Development Considerations with Port Metro Vancouver's CSR Policy and sustainability reporting.
- Maintaining and monitoring project mitigation and compliance.
- Integrating sustainable development objectives within the procurement process.
- Applying value engineering processes during detailed engineering and construction to identify opportunities that both optimise and add value to the project.

10.3 SUSTAINABLE DEVELOPMENT CONSIDERATIONS

The Sustainable Development Considerations is an integrated list of sustainability indicators that will measure compliance with the definition of sustainability under the Act. The Considerations, which encompass economic, environmental, and social issues, are based on Port Metro Vancouver's corporate sustainability objectives, expected effects of the Project and previous experiences from Deltaport Third Berth project. A summary of the various sustainability considerations is presented in **Table 10-1**. The considerations table will be reviewed, and revised as needed, throughout the Project detailed design and will continue into the construction phase to reflect sustainable development opportunities identified through the environmental assessment process.

Table 10-1 DTRRIP Sustainable Development Considerations

	Categories	Considerations
Economic	Economic benefit to Canada, BC and region	Economic model indicators (gdp, tax revenue, wages and salaries)
		Employment created (direct, indirect, induced)
Environmental	Biodiversity	Fish and fish habitat
		Waterfowl and coastal seabirds
		Terrestrial wildlife and habitat
		Species at risk
	Material and energy	Energy efficiency
		Energy sources
		Construction materials
		Waste
	Pollution	Criteria air emissions (PM_{10}, $PM_{2.5}$, SO_x, NO_x, HC)
		Greenhouse gas emissions
		Ambient water quality
	Overall land usage	Agricultural land use
Social	Social and community value	Local community interests and legacy
		Communities and stakeholder engagement and representation
		Regional traffic effects
	Visual and noise	Noise
		Visual aesthetics
		Light
	Safety	Dangerous/hazardous material handling and storage
		Worker and community safety
	First Nations engagement	First nations relationships
		Aboriginal rights and related interests
		Opportunities for economic, cultural, and community benefit

10.3.1 Economic Considerations

10.3.1.1 Economic Benefit to Canada, BC and Region

Economic Model Indicators

The import and export trade activity made possible by the increased container capacity adds approximately $500 million per year to Canada's gross domestic product (GDP), and $900 million in economic output. Revenue is expected to add value to the local, regional and wider economies, with economic benefits translating to added revenue to individuals, companies, municipalities and the provincial and federal governments. Through the additional employment and income generated for

individuals and companies, there is also an expected increase in associated tax revenues that can be reinvested into local critical infrastructure, resulting in socio-economic benefits for residents. As a result, the economic model indicators provide a net benefit to economic sustainability

Employment Created

As outlined in **Section 1.2.3**, there will be a net increase to employment within the surrounding communities and an overall net benefit to economic sustainability.

10.3.2 Environmental Considerations

10.3.2.1 Biodiversity

As described in the Biophysical Effect Assessment (**Section 5**), and with the implementation of the mitigation measures described in **Table 12-1**, residual adverse effects to Biodiversity associated with construction and operation of the Project are not expected.

10.3.2.2 Materials and Energy

Energy Efficiency

No residual adverse affects to energy efficiency are expected during the construction and operation of the Project. However, through collaboration with industry partners, Port Metro Vancouver will continue to identify new opportunities to achieve energy efficiency and reduce common air contaminant emissions.

Energy Sources

Overall fuel use is expected to increase as a result of construction activity construction and increased shipping, truck, rail and cargo handling activity due to the increase in containers. Although overall reductions in total fuel use are not possible during construction, construction vehicles will be required to comply with Port Metro Vancouver idling limits and engine performance criteria set out on the Port Metro Vancouver Air Action Program. In addition Port Metro Vancouver continues to work with Terminal Operators to identify opportunities for utilization of more sustainable energy sources.

Construction Material

Sustainable construction material selection will be encouraged throughout Project construction and design by implementing a sustainable procurement process. This process will ensure that, whenever possible, construction materials are sourced locally to support the local economy and minimize the environmental footprint of the project. In addition, construction materials for the expanded rail will be delivered by rail wherever possible, rather than truck to further reduce the carbon footprint associated with material transport.

Waste

Project associated construction waste is expected to consist primarily of concrete, asphalt, fill, steel and demolition waste. To reduce waste quantities an integrated sustainable waste management program will be implemented to diversify waste disposal options and divert waste from landfills. Whenever possible the Project design process will identify opportunities to eliminate waste material through alternative material selection and/or re-use on site. If a specific waste cannot be eliminated from the waste stream, further diversion efforts will be made to identify recycling opportunities at local facilities or re-use on local construction projects that provide social and/or economic benefits to the community. Contractors will also be required to submit a Waste Management Plan prior to construction to identify additional waste management opportunities and waste disposal options. With the implementation of these mitigation measures, residual adverse effects associated with waste are not expected

10.3.2.3 Pollution

Common Air Contaminant Emissions

Common air contaminant emissions consist of particulate matter, nitrogen oxides (NOx), sulphur oxides (SOx) and hydrocarbons. Any increase in air emissions are predicted to be well below the Canada-wide Standards and the most stringent BC Ambient Air Quality Objectives, with no significant residual adverse effects to the community during the construction or operation of the Project (**Section 5.5.5**).

Through collaboration with industry partners, described in **Table 12-1**, Port Metro Vancouver will continue to identify new opportunities to reduce port air emissions as part of the Air Action Program.

Greenhouse Gas Emissions

As described in **Section 5.5.4.2**, greenhouse gas emissions will increase as a result of the Projects increase in container traffic. No significant residual adverse effects are expected as a result of this increase.

Ambient Water Quality

No significant residual adverse affects to ambient water quality are expected during the construction and operation of the Project (**Section 5.2.6**). The application of best management practices described in **Table 12-1** will further minimize the possibility of adverse effects resulting from accidental spills and malfunctions.

10.3.2.4 Overall Land Usage

Effects to community land-use are limited to agricultural land within the Option Lands on the Agricultural Land Reserve where the rail expansion and rail yards will be constructed. Through the implementation of mitigation measures described in **Table 12-1** and future engagement with the Agricultural Land Commission and Delta Farmers Institute, it is anticipated that there will be no residual adverse effects associated with agricultural land use.

10.3.3 Social Considerations

10.3.3.1 Social and Community Value

Communities and Stakeholder Engagement and Representation

Port Metro Vancouver has conducted extensive public engagement with a wide range of stakeholders potentially effected by the project (**Table 3-1**). To ensure continued community dialogue and the sustainability of DTRRIP, the consultation process will continue after construction is complete through various liaison committees and the implementation of initiatives identified in the Table of Mitigative Measures and follow-up.

Regional Traffic Effects

There will be residual effects as a result of the increase in traffic during the construction and operation of the Project. These increases in traffic have the potential to effect traffic flow and community connections. However, through the implementation of mitigative measures and potential traffic congestion easing initiatives identified in **Section 6.4.4.5** and **Table 12-1**, significant traffic related residual adverse affects to the community would not be expected.

10.3.3.2 Visual and Noise

Noise

There will be residual adverse effects as a result of the increase noise levels from increased cargo handling and rail activity during operation of the Project (**Section 6.1.7**). The implementation of mitigative measures identified in **Table 12-1** will further reduce noise related effects that may effect the community.

Visual Aesthetics

As outlined in **Section 6.2.5**, there will be no residual adverse effects to visual aesthetics as a result of the construction and operation of the Project.

Light

No residual adverse affects from light are expected during the construction and operation of the Project (**Section 6.3.7**). The implementation of standard best management practices described in **Table 12-1** will further minimize the possibility of any adverse effects to local residents and wildlife.

10.3.4 Safety

10.3.4.1 Dangerous/Hazardous Material Handling and Storage

As summarized in **Table 7-1**, hazardous material spills have the potential to occur during the construction and operation of DTRRIP, representing a potential threat to the community, workers and the surrounding biophysical environment. Potential effects are not anticipated to be significant once the mitigative measures identified in **Table 12-1** are implemented

10.3.4.2 Worker and Community Safety

Worker and Community safety may be effected by a number of different factors, including an increase in traffic, spills and leaks and transportation of dangerous goods (**Section 7.3**). It is anticipated that risks to worker and community safety will be significantly reduced once mitigative measures and best management practices, identified in **Table 12-1**, are implemented.

10.3.4.3 First Nations Engagement

Port Metro Vancouver is currently involved in stakeholder engagement and consultation with First Nation Communities related to DTRRIP. Additional information on the First Nation consultation process is covered in **Section 11**.

10.4 SUSTAINABILITY INITIATIVES

DTRRIP provides a number of opportunities to provide a net benefit to economic, environmental and social aspects within the community over and above standard mitigative measures that ensure the needs of future generations are not compromised. These additional initiatives address the evolving, but yet to be legislated, definition of Sustainable Development which requires that socio-economic and ecological systems derive some benefit from the project. A summary of these initiatives is described below.

10.4.1 Social Licence Opportunities

Social License, through strategic funding opportunities, support corporate initiatives that improve ecological systems and provide a socio-economic benefit to residents. The Port Metro Community Benefits program, included in the Port Metro Vancouver Corporate Social Responsibility Policy, provides potential funding for improving access to academic studies and career training, enhancing knowledge and care of the environment and supporting social, cultural and economic opportunities within affected communities.

10.4.2 Value Engineering Opportunities

The value engineering process embedded within the DTRRIP design process identifies value-added opportunities for engineering and construction plans, methods, and material management. This includes identification of standards and practices that may enhance the efficiency of processes or provide alternative construction standards that provide project enhancements not necessarily related to effect mitigation.

This integration will serve as one of the vehicles for recommending sustainable opportunities for consideration in the detailed design and construction phases. Value engineering opportunities can come from a number of different sources including public consultation, design opportunities identified during the detailed design process and sustainability workshops. Feasible improvements will be implemented with the support of the applicable partners, consultant and contractor.

10.4.3 Shorepower

Port Metro Vancouver is currently conducting technical and economic feasibility studies to determine the feasibility of shorepower at Deltaport for ocean going vessels. Shorepower, also known as cold ironing or alterative marine power, would allow for container vessels moored at Deltaport to “plug” into the landside electric grid and thereby shut off their main and auxiliary engines. Shorepower offers a number of sustainable benefits, including reductions in air emissions (NO_x, SO_x, and particulate matter) and greenhouse gases (CO_2,), fuel consumption, and vessel generated noise. The feasibility of shorepower is dependent upon the ability to supply clean, “green’ electricity, the shorebased infrastructure, the standardization of the “ship to shore” connection and the availability of vessels equipped to plug in. .

10.4.4 Sustainable Procurement

Sustainable procurement is a key part of sustainable development within a project by maximizing value for goods and services purchased for the project and supporting more sustainable companies and products.

The goal of a comprehensive, sustainability based procurement policy will be to support local business and/or sustainable supply chains while encouraging companies to provide more environmentally friendly alternatives. Sustainable procurement practices and sustainable purchasing will also ensure that Port Metro Vancouver corporate sustainability philosophy is integrated into the final design and eventual construction of the project.

10.4.5 Sustainability Reporting

Port Metro Vancouver issued its first independently verified Global Reporting Initiative (GRI) Sustainability Report in 2011. GRI based indicators provide a widely accepted standard for the disclosure of an organisation’s non-financial performance according to best practices. Port Metro Vancouver will report on key sustainability indicators to ensure sustainability commitments are maintained throughout the project and track the organisation’s economic, environmental and social performance. This requirement, over and above regulatory requirements, will serve to improve transparency and accountability within the community and augment environmental management plans.

10.4.6 Noise Monitoring Network

Port Metro Vancouver is planning to implement a land side noise monitoring program with permanent noise monitoring stations on the South Shore of Burrard Inlet in 2012. Pending the results of the initial “pilot” program, Port Metro Vancouver will evaluate expanding the program to other communities including Delta.

10.4.7 Traffic Improvements

Port Metro Vancouver is currently involved in traffic improvements and funding partnerships with the Corporation of Delta with the goal of improving traffic management and community safety. These initiatives are the result of previous projects or partnerships and beyond the scope of DTRRIP and are being lead by the Corporation of Delta. The traffic improvement projects are described below.

10.4.7.1 34b Avenue Improvements

Port Metro Vancouver is providing funding and support to the Corporation of Delta for the proposed improvement of both the south-east and north-east corner of 34b Avenue. The project will improve the sight line problems and ensure safe passing in both directions, reducing the possibility of a side collision. The improvement will also include a dedicated left-turn lane on Arthur Drive and curve widening of 34b Avenue. Port Metro Vancouver is participating in the engineering design and project delivery.

10.4.7.2 80th Street Overpass

The 80th Street project is a two-lane railway grade separation overpass, which serves as the primary access to Boundary Bay Airport. The existing street level rail crossing currently presents challenges to the community when accessing the airport and also affects rail efficiency. Port Metro Vancouver has provided funding and input into the design of the overpass. The completed project will also complement anti-whistling initiatives through the implementation of rail advanced warning systems that eliminate train whistling requirements at this portion of the Roberts Bank rail corridor.

10.5 CONCLUSION ON SIGNIFICANT EFFECTS

DTRRIP is a sustainable initiative that will optimize current container processes to realize operational gains within Deltaport, while providing various benefits to surrounding communities on a local, provincial and national level.

Effects on the sustainability of community infrastructure such as community and emergency services are considered to be neutral. For some socio-community issues such as air quality, noise and traffic, DTRRIP will have an adverse effect on some parts of the surrounding community. However, the contributions of the Project are small in relation to the existing background conditions and mitigation will minimize these direct effects on sustainability. Overall, DTRRIP will not likely inhibit the community to access clean air, quiet or congestion-free roads, but it is widely recognised that broad community involvement and support is required to resolve these wider issues.

Based on the review of potential effects to the sustainability considerations and the legislated definition of sustainability stated in the CEAA, it is not likely that there will be effects that will compromise the ability of future generations to meet their own needs. Similarly, sustainability initiatives which consist of works over and above legislative requirements will likely have a long-term positive net benefit to the community.

11.0 FIRST NATIONS CONSIDERATIONS

11.1 INTRODUCTION

Port Metro Vancouver recognises that First Nations may have a distinct interest in the proposed Project and is committed to continued and active engagement with First Nations whose interests could be potentially affected by the Project. Port Metro Vancouver has therefore developed and is undertaking a specific First Nations consultation process in relation to the Project (see **Section 3.3**).

Pursuant to the CEAA, this section of the screening identifies the potential for indirect effects on the existing use of lands and resources for traditional purposes by aboriginal people due to the potential for direct environmental effects related to the proposed Project. In general, it is understood that fishing, hunting and gathering of foods and medicines may be of interest to area First Nations and could be affected should there be environmental effects on specific resources of interest. This section first provides an overview of First Nations with an interest in the proposed Project area, and then will draw on the results of **Section 5.3**: Fish and Fish Habitat, **Section 5.4**: Marine Resources and **Section 5.1**: Vegetation and Wildlife for a discussion of potential indirect effects on sustenance fishing, hunting and harvesting activities.

Further, the study of traditional land use and archaeology (**Section 6.4**) is intended to satisfy the CEAA requirement for the Project to be developed with consideration for First Nations resource values in the area of the Project.

11.2 OVERVIEW OF AREA FIRST NATIONS

DTRRIP falls within or is in close proximity to the traditional territories, either asserted, or in the case of TFN, settled by treaty, of the following First Nations:

- Tsawwassen First Nation
- Musqueam Indian Band
- Semiahmoo First Nation
- Tsleil-Waututh Nation
- Katzie First Nation
- Sto:lo Nation
- Hulquminum Treaty Group

11.2.1 Tsawwassen First Nation

The Tsawwassen First Nation's traditional territories extend throughout the Fraser River delta to Point Roberts and the Gulf Islands, and northeast along the Pitt River to the Pitt Lake area. It includes Boundary Bay and many other slough and stream drainages of the lower Fraser River Valley, Roberts Bank and adjacent sea areas. Treaty Lands include 724 ha owned by the Tsawwassen First Nation, as per the Tsawwassen Final Agreement; including segments of land on the Fraser River and Boundary Bay. The Tsawwassen First Nation community is located on approximately 290 ha of land (former reserve lands) situated along the shores of Roberts Bank, between the Tsawwassen BC Ferry Terminal and Deltaport.

Given the proximity of DTRRIP to the Tsawwassen First Nation, TFN treaty rights, and the legal requirements to consult with First Nations under CEAA, Port Metro Vancouver has been consulting with the Tsawwassen First Nation and considers TFN to have a strong interest in the Project.

According to the 2009/2010 TFN Annual Report, TFN membership totals 405, of which about half live on Tsawwassen Lands with the remainder in BC's Lower Mainland, Whatcom County (Washington), the interior of BC and elsewhere in Canada

The *Tsawwassen First Nation Final Agreement Act* identifies a range of rights to access and harvest resources within TFN lands including gathering plants; harvesting fish, aquatic plants, bivalves, crabs; and harvesting terrestrial wildlife and migratory birds.

In 2004, the Tsawwassen Band signed an agreement with the Vancouver Port Authority (predecessor to Port Metro Vancouver) that allowed for the expansion of Deltaport (DP3) in exchange for defined benefits and opportunities. In addition, Band members operate numerous businesses, mainly in service and retail, on-Reserve locations. Through the Naut'sa mawt Tribal Council, the Tsawwassen also share ownership in the Naut'sa Mawt Resource Group, a diversified company with oil & gas, construction, manufacturing, and project management divisions. TFN have several businesses including: port-related services, commercial services: Tsatsu Gas, Park N'Go, NorDean's RV and Boat Sales and Storage, a Native art gallery, Raven Contracting and catering services.

11.2.2 Musqueam Indian Band

Musqueam asserted traditional territory encompasses the Cities of Vancouver and Richmond and parts of Burnaby, Port Moody, North Vancouver, and West Vancouver. As of 2011, the registered population of the Musqueam Indian band consists of 1,269, with over half living on reserve communities. Three main reserves are located in the Lower Mainland area within Musqueam territory. Musqueam's central community (Indian Reserve (IR) #2) is located in the southwest corner of the City of Vancouver, on 190 ha along the Fraser River. Other communities are IR 3 and 4, also located near the mouth of the Fraser River, combining for a total 63 ha (AANDC, 2011).

Traditional resources considered important to the Musqueam Indian Band include wildlife and vegetation, and archaeology; however fisheries resources remain the most significant aspect of Musqueam traditional culture, influencing the development of society, economy, and Musqueam cultural identity. Salmon represents the most important resource, harvested from rivers, including the Fraser River and its tributaries; however shellfish, eulachon, trout, waterfowl and halibut also represent important traditional resources, harvested from the Burrard Inlet, Boundary Bay and other coastal areas (EAO, 2011).

Land management and planning remain important considerations for the Musqueam Indian Band, whose land use planning objectives are focused on the conservation of traditional resources within their asserted traditional territory. Musqueam is actively involved in the protection and preservation of archaeological resources within Musqueam territory and has expressed interest in ensuring DTRRIP has no adverse effects on archaeological values in the project area. Economic development is also an important priority for Musqueam, and a topic for continued discussion during project consultation.

The Musqueam Indian Band is included in the consultation for the Project due to the proximity of DTRRIP to Musqueam's traditional territory and to Musqueam IR#4, and have been identified as having a potential interest in the Project.

11.2.3 Semiahmoo First Nation

Semiahmoo is located on Semiahmoo Bay, bordering the City of Surrey and the City of White Rock. Semiahmoo First Nation is not engaged in the BC Treaty Commission process at this time but had previously expressed interest in entering the process in an alliance with other First Nations collectively known as the Sencot'en Alliance. Semiahmoo First Nation has 80 registered members, 49 of whom live on-Reserve. The Band has one Indian Reserve totaling 129.1 hectares. The Semiahmoo are closely related to the Lummi and Samish people from the US and to the Lekwammen and T'sou-ke from across the Strait of Georgia. The Semiahmoo asserted traditional territory extends from Boundary Bay, up to the Fraser River Mainstem and over through the Gulf Islands to Vancouver Island.

Semiahmoo are included in consultation for the Project due to their proximity to the Project and for potential interactions between project activities and traditional land and resource use.

The Semiahmoo continue to undertake traditional activities such as gathering foodstuffs from the Fraser River and its estuary and the collection of medicinal plants (EAO, 2011). They continue to harvest crab but the bivalve harvesting in Boundary Bay has been adversely affected by contamination.

11.2.4 Sto:lo Nation

The Sto:lo Nation's asserted traditional territory extends from the mouth of the Fraser River up to the Lower Fraser Canyon, covering almost 17,000 km^2. Geographically, this territory extends from the US border in the south, to Garibaldi Provincial Park in the north, and from the City of Vancouver in the west to just past the community of Hope in the east.

The Sto:lo Nation represents Aitchelitz, Leq'a:mel, Matsqui, Popkum, Shxwha:y Village, Skawahlook, Skowkale, Squiala, Sumas, Tzeachten, and Yakweakwioose.

The Sto:lo Nation provides services to eleven Fraser Valley First Nations bands, focusing on social and economic development through the provision of facilities and programs in the areas of education, health and social development. Total membership population is estimated at approximately 2,200 people, of which approximately 50 percent live on-Reserve. The Sto:lo Nation asserted traditional territory extends from Hope to Boundary Bay.

The Sto:lo are broadly interested in stewardship of the Fraser River, fisheries habitat enhancement and sustaining traditional cultural activities and practices in their territory

11.2.5 Hul'qumi'num Treaty Group

The Hul'qumi'num Treaty Group (HTG) represents six First Nations primarily located on the southeastern side of Vancouver Island, including: Chemainus First Nation, Cowichan Tribes, Halalt First Nation, Lake Cowichan First Nation, Lyackson First Nation, and Penelakut Tribe. The HTG represents over 6,600 members. The Hul'qumi'num core territory includes southeastern Vancouver Island, the Gulf Islands, and the lower Fraser River. It encompasses the land and waters in and around the watersheds of the Cowichan, Koksilah, Goldstream, Chemainus, and south Nanaimo river systems on Vancouver Island, the Gulf Islands and the mouth and south arm of the Fraser River to Douglas Island. The marine territory includes all the waters of the Strait of Georgia, the Fraser River south of Yale, Juan de Fuca Strait, and upper Puget Sound.

Of the member groups in the HTG, the Cowichan Tribes make up the greatest proportion of registered members with 60 percent of the HTG population. The Cowichan have a total registered population of over 4,400 members. Cowichan reserves and settlements are concentrated between Duncan and Cowichan Bay, with a few smaller reserves farther up the valley. The Cowichan Tribes total reserve size is approximately 2,390 ha, which is comprised of nine Reserves. Cowichan 1 is the largest with 2,291 ha (AANDC, 2011). Cowichan 9 is situated near the mouth of Koksilah River at the head of Cowichan Bay. Est-patrolas is located approximately 3.2 kilometres south of Cowichan Bay. Kakalatza 6 and Tzartlam 5 are situated on the left bank on the Cowichan River. Kil-Pah-Las 3 and Theik 2 are located on the south shore of Cowichan Bay. Skutz 7 is situated on the left bank of the Cowichan River at Skutz Canyon and Skutz 8 at the head of Skutz Canyon.

The Halalt First Nation is located near Crofton, approximately 55 kilometres northwest of Victoria, on Vancouver Island (two reserves on 165.8 ha).

The Halalt people are Coast Salish and originate from the village of xeláltxw, which means 'marked houses' or 'painted houses', a reference to the fact that the houseposts in this village were decorated. Historically, the Halalt First Nation had villages on Willy Island (offshore from the town of Chemainus) and in the lower Chemainus Valley. Today, Halalt reserves are found on Willy Island and in the lower Chemainus Valley (although only the latter reserve is occupied). Halalt First Nation members have traditionally utilised Bonsall Creek, the Chemainus River, the Salish Sea, and the Strait of Georgia.

The Stz'uminus (Chemainus) First Nation has a total registered population of 1,179 with about half living on four reserves, totalling 1,218.3 ha (AANDC, 2011). The largest community is on Chemainus Indian Reserve #13, situated between Ladysmith Harbour and Stuart Channel. Oyster Bay 12 is situated at the head of Ladysmith Harbour on the west shore. Say-La-Quas 10 is situated on the left bank of the Chemainus River and Squaw-Hay-One 11 is located approximate 3.7 kilometres southeast of the community of Chemainus.

The Lake Cowichan First Nation is affiliated with the Hul'qumi'num Treaty Group. The Lake Cowichan community has one reserve of 39 ha located on the north shore of Cowichan Lake.

The Lyackson have historically lived on Valdes Island and had three permanent winter villages along the southwest coast of Valdes Island. Another historical winter village was located at the mouth of the Cowichan River, on Vancouver Island. However, due to difficult access and lack of infrastructure, the villages on Valdes Island are unoccupied today. The Lyackson First Nation have a registered population of 200 members (AANDC, 2011) and three reserves totalling 744.6 ha. The largest reserve is Lyacksun 3 (710.60 ha) and is situated near the north end of Valdes Island. Porlier Pass 5 is located at the south tip of Valdes Island and Shingle Point 4 is situated at Shingle Point on the west shore of Valdes Island.

The Penelakut First Nation have four reserves, totalling 635.7 ha and a total registered population of 893 members (AANDC, 2011). Penelakut peoples account for about 13 percent of the Hul'qumi'num Nation population. The Penelakut First Nation historically occupied villages on Kuper Island, Galiano Island, and near the mouth of the Chemainus River. Present day Penelakut reserves are located on Kuper Island, Tent Island, Galiano Island, and a small reserve on the lower reaches of the Chemainus River.

11.2.6 Tsleil-Waututh Nation

The Tsleil-Waututh Nation has an asserted traditional territory that includes areas between the Fraser River and Mamquam Lake, near Squamish (TWN, 2011). The Tsleil-Waututh First Nation has approximately 426 Band members, with 259 living in three reserve communities (AANDC, 2011). This includes IR 3 on the north side of the Burrard Inlet, near the Second Narrows Bridge. The communities of Inlailawatash IR 4 and Inlailawatash IR 4A are both located on Indian Arm.

The Tsleil-Waututh First Nation has not identified specific areas valued for traditional purposes within the Project area, however it is understood that the water and land surrounding the Burrard Inlet and Indian Arm is the most used area within their asserted traditional territory (EAO, 2011). The Tsleil-Waututh, Musqueam and Tsawwassen First Nations share Aboriginal Fishing Boundaries along the Fraser River, located between the mouth of the river and the Port Mann Bridge.

Tsleil-Waututh First Nation has a protocol agreement with Port Metro Vancouver and the parties are currently developing a consultation agreement. Tsleil-Waututh Nation has been included in DTRRIP consultation based on its consultative boundary map and previously articulated interests in the project area. Tsleil-Waututh First Nation is committed to stewardship and the protection and promotion of Tsleil-Waututh culture and values.

11.2.7 Katzie First Nation

The Katzie First Nation has an asserted traditional territory that includes large portions of Garibaldi Park. Coquitlam, Maple Ridge, Surrey, White Rock, Fort Langley, Delta, and Richmond, extending from the headwaters of Pitt River south, encompassing Boundary Bay (Katzie, 2002). There are five Reserves within Katzie territory, the closest to the Project are Katzie IR 1 and IR 2 located near Pitt Meadows, and Katzie IR 3 on Barnston Island (AANDC, 2011). Katzie traditional land use practices are focused on the harvesting of wildlife, plant and fish resources, especially along major waterways located within their asserted traditional territory.

There are a total of 438 registered members of the Katzie First Nation, of which one third is licensed to actively fish along the Fraser River. There are an estimated 120 Katzie vessels that use the Fraser River to harvest fish in a given year. This reflects the important relationship that the Katzie have with the Fraser, which supplies species of salmon and a gillnet fishery, of which up to 100 boats are used during fishery openings between Derby Reach and the Port Mann Bridge, with openings lasting between six and twelve hours at a time (EAO, 2011). These openings represent important opportunities for the Katzie First Nation to harvest traditional resources. Katzie net fisheries are located in designated areas, and their fishing area is considered within the Katzie community to be one of the most productive areas along the lower Fraser River. Some harvesting of waterfowl also occurs in the areas of Katzie asserted traditional territory along the Fraser River, on the north and east ends of Barnston Island.

11.3 BIOPHYSICAL STUDIES OF INTEREST

The Project is located in an area that has been subject to numerous previous developments. This includes the existing Deltaport Way and causeway construction and infrastructure components relating to the operation of the Deltaport container terminal, as well as the use of the surrounding areas for significant rail and road infrastructure as well as agricultural activities.

Biophysical studies relating to the Project that will be of interest to First Nations are related to the physical, bio-physical and perceived interactions with the Project area and activities. This includes activity relating to the construction and operation of the project, and the potential for environmental effects on resources that could indirectly affect the existing use of land and resources for traditional purposes, such as sustenance fishing, hunting, and harvesting. The following studies included in this EA report will be of interest to First Nations as they provide a discussion of potential direct environmental effects on resources of interest:

- Fish and Fish Habitat (Section 5.3)
- Marine (Section 5.4)
- Vegetation and Wildlife (Section 5.1)

The assessments in these sections, including potential effects and recommended mitigation, indicate the potential for interactions with traditional First Nation activities in proximity to the proposed Project. A summary of potential effects related to First Nations interests is provided in **Table 11-1**.

11.3.1 Biophysical Effects

The development of land associated with the Project is unlikely to have a direct effect on First Nations resource harvesting rights and interests as all components planned for are within previously developed land used for agriculture and/or transportation infrastructure rights-of-way. The various biophysical studies carried out to identify the potential environmental effects of the Project are summarised below:

11.3.1.1 Fish and Fish Habitat

The fish and fish habitat assessment (**Section 5.3**) describes the potential for the presence of fish in the DTRRIP study area, and documents the occurrence of fish species and habitat within the study area. The fish and fish habitat assessment also assess the potential occurrence of at-risk and resident fish species that could be affected by the Project.

The potential effects of construction activities on fish and fish habitat are anticipated to be infrequent, reversible and localised within the study area. With the implementation of mitigation measures, including best management practices, there is a low likelihood that Project activities will result in additional effects to fish and fish habitat. No residual adverse effects are expected for fish and fish habitat from DTRRIP, and thereby no residual adverse effects are anticipated with respect to fish harvesting by area First Nations.

11.3.1.2 Marine Environment

The assessment of the marine environment in **Section 5.4** describes potential effects on marine species in the Project area. Since construction does not require any marine works, only activities associated with the operations phase of the Project were considered in the assessment of potential effects. The assessment of potential marine environment effects reviewed the potential effects of increased shipping activity on marine vegetation, invertebrates, marine and anadromous fish, coastal birds, and marine mammals.

As per the assessment of potential marine effects, no residual adverse effects on marine vegetation and marine invertebrates are anticipated. As there is no reasonable ability for increased shipping traffic to result in adverse changes to long-term viability of marine vegetation communities, or marine invertebrates in the Project area, no environmental effects are expected (**Section 5.4.5**).

Effects to marine and anadromous fish are not expected, as Roberts Bank supports high volumes of marine traffic with existing fisheries, suggesting that routine vessel traffic will not affect the abundance of marine or anadromous fish species (**Section 5.4.5**).

The marine assessment describes that coastal birds typically present within the Project area year-round are habituated to human presence, and are presumed to have tolerance for industrial activities, such as marine transportation. Noise from increased vessel traffic, is not expected to result in long-term effects (**Section 5.4.5**).

Risks to marine mammals include acoustic disturbance and vessel strikes. Based on the small size of the Project study area, effects to marine mammals as a result of acoustic disturbance from Project-related increases in vessel traffic are expected. While the risk of marine mammals-vessel strikes was assessed as low, the SARA listing of several cetaceans known to reside or transit through the Strait of Georgia raises concern, however mitigation measures proposed in **Section 5.4.5.5** are expected to adequately address this issue.

Overall, no significant residual adverse effects have been identified in relation to marine resources within the study area. Additionally, no changes to the access to marine resources is expected to occur as a result of the Project, resulting in no significant residual adverse effects anticipated to the traditional use of marine resources by area First Nations. Ongoing consultation efforts with First Nations will seek to confirm assumptions related to existing use of lands and resources for traditional purposes.

11.3.1.3 Vegetation and Wildlife

The vegetation and wildlife assessment focused on a local and regional study area encompassing 1,878 ha from the base of the Roberts Bank causeway to 72nd Street. It is composed of mainly agricultural land, ditches and existing infrastructure. The assessment included a review of existing conditions including for vegetation, rare plants, at-risk plant communities, sensitive ecosystems, wildlife (mammals, invertebrates, amphibians, reptiles, birds, and mammals. See **Section 5.1.4** for a description of existing conditions.

The direct effects assessed were the potential for habitat loss and habitat fragmentation; habitat degradation; changes in wildlife movement and wildlife mortality. Indirect effects included the potential for sensory disturbance such as noise, olfaction, vibration, and visual (e.g. lighting, presence of construction crews).

With the implementation of the mitigation measures described in **Section 5.1.7**, the vegetation and wildlife assessment concludes that there will be no residual adverse effects associated with construction and operation of the Project. As such, there are no anticipated residual effects on traditional activities related to vegetation and wildlife within the study area. Through further consultation and First Nations review of the vegetation and wildlife assessment results, Port Metro Vancouver will seek to confirm that there will be no anticipated residual effects on traditional activities of this nature.

11.4 SOCIO-COMMUNITY AND CULTURAL EFFECTS

Socio-community and cultural effects that may affect the identified First Nations will relate to the creation of employment opportunities, strain or improvement to local infrastructure and effects to cultural heritage and traditional use sites. Long-term economic benefits are expected to result from the construction and operation of the Project. Temporary opportunities during the construction phase include the provision of equipment, labour and supply, and person-years of work will result. Port Metro Vancouver is committed to working with First Nations to explore opportunities for mutual benefit associated with DTRRIP and will continue to discuss economic benefits, and socio-community and cultural effects with First Nations participating in the ongoing DTRRIP consultation program.

11.5 SUMMARY OF EFFECTS

To date, First Nations have indicated an interest in ensuring that any archaeological resources within the project area are protected. Findings from the archaeological assessment suggest that no residual effects to archaeological resources are anticipated (see **Sections 6.6**). In addition, there are no significant residual adverse effects to bio-physical resources anticipated as a result of the project, and hence no residual effects to traditionally used resources within the study area. Through further consultation, the use of information collected in these studies will help to identify potential cultural effects with respect to area First Nations, and guide in the development of any additional mitigation measures required. Based on the fact that the location of the Project has been subject to a number of previous developments, significant disturbance, and an understanding that there has been no recent access to the area for harvesting activities, it is unlikely that related effects will occur. Fish and fish habitat, marine environment, and vegetation and wildlife studies suggest that no significant residual adverse effects will occur as a result of DTRRIP. As previously noted, assumptions have been made based on a existing understanding of traditional aboriginal activities within the project area. Input from First Nations with respect to the environmental studies and existing use of lands and resources for traditional purposes will be sought through ongoing consultation in an effort to confirm these findings and related understandings.

Table 11-1 Summary of Biophysical Residual Adverse Effects

Environmental Component	Residual Adverse Effects	Potential Effects to First Nations Access/Use	Assessment of Potential Effects on First Nations Interests
Fish and Fish Habitat	None anticipated following mitigation	None	No potential effects
Marine Environment	None anticipated following mitigation	None	No potential effects
Vegetation and Wildlife	None anticipated following mitigation	None	No potential effects

12.0 SUMMARY OF EFFECTS, MITIGATIONS, AND RESIDUAL EFFECTS

Detailed biophysical and socio-community/socio-economic studies were undertaken as part of this screening-level environmental assessment to enable the potential effects of DTRRIP to be fully assessed. The Project-related effects were deemed to be not significant, or in the case of some socio-economic effects were deemed to be significant but positive. Where potential effects were identified, mitigation measures have been recommended and, if required, environmental compensation applied.

This section summarises the potential effects, mitigation and compensation measures (if required) in tabular form (**Table 12-1**). The detailed finding of the studies, assessment of effects, and associated significance criteria (where appropriate) for each discipline study are provided in the early sections of this EA report, and are not reproduced here.

The residual effects identified (**Table 12-1**) are discussed further in the cumulative effects assessment (**Section 8.0**).

Table 12-1 Summary of Potential Effects, Proposed Mitigation and Residual Adverse Effects

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Vegetation (including at-risk species)				
Construction	Loss of ditch-side and hedge vegetation from site preparation and clearing activities.	Minimise vegetation clearing and footprint. Demarcate locations where vegetation is to be retained on both construction drawings and on the ground prior to the start of construction. Replant denuded areas with native vegetation, or native plant species (such as black cottonwood, willow or red alder) that improve bank stabilisation and reduce the incidence of soil erosion. This activity should be completed after the construction activity has ceased. Spring is an optimal period for replanting. Removal and appropriate disposal of any invasive plants encountered during site clearing and preparation. The construction EMP will include vegetation management measures necessary to control invasive species. Implement vehicle and equipment inspection and cleaning protocol to avoid invasive plant species reestablishment. Identify vegetation clearing boundaries on Project design plans/maps and flag boundaries before heavy equipment access, clearing and site preparation to avoid construction encroachment outside areas where clearing is required.	None anticipated	n/a
	Loss of agricultural land with the Option Lands site preparation and clearing activities.	See Agriculture mitigation and compensation measures below.	None anticipated	n/a
	Sedimentation of existing vegetation from preload and aggregate material beyond the existing boundaries of construction activities.	Installing sediment and erosion control silt fencing to reduce the chance of preload or aggregate spill beyond the boundaries of Project construction works. Implement standard spill prevention and contingency measures (to be included in a construction EMP).	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Vegetation (including at-risk species)				
Construction	Accidental clearing of at-risk plants, potentially Vancouver Island beggarticks or streambank lupine, during clearing activities.	If at-risk vegetation is found, relocate the plants to areas not affected by the Project if seasonal conditions are favourable (spring), or collect seed for future propagation if seeds are available (late summer to early fall). The location of the at-risk vegetation should be reported to the appropriate personnel, i.e., Environmental Monitor, and appropriate government agencies.. Qualified environmental personnel should conduct the relocation activity.	None anticipated	n/a
Operation	Effects from roadside or rail maintenance activities, specifically mowing and/or hedge trimming.	Management plans to avoid potential effects to at-risk plant species within the LSA will coincide with existing programs conducted by the rail operator.	None anticipated	n/a
	At-risk species may colonise within the maintenance right-of-way during the life of the Project.		None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Mammals (including at-risk species)				
Construction	Habitat loss and/or fragmentation Changes in wildlife movement Wildlife mortality Sensory disturbance	Minimise vegetation clearing and Project footprint to minimise habitat loss. Minimise interactions between wildlife and the work site. Store garbage, fuel, oil and lubricant appropriately to minimise odour and access. Install sediment and erosion control fencing on the banks of watercourses and on the preload boundaries to prevent encroachment of aggregate and materials onto potential wildlife habitat and to prevent accidental mortality.	None anticipated	n/a
	Habitat loss and/or fragmentation Changes in wildlife movement Wildlife mortality Sensory disturbance	Prior to construction, conduct site surveys to mark specific wildlife habitat features/environmentally sensitive areas within the footprint identified in this assessment. These sites are to be identified in design/construction drawings. The construction EMP will include a Wildlife Habitat Management Plan to outline site-specific avoidance and mitigation measures that are to be addressed during construction, including fueling procedures and appropriate storage and secondary containment of petroleum hydrocarbons. Monitoring of the efficacy of mitigations will be completed by an environmental monitor and guided by the EMP.	None anticipated	n/a
Operation	Disturbance and potential mortality from roadside or rail maintenance activities, specifically mowing and/or hedge trimming. Noise and visual effects from maintenance and rail operations will likely cause temporary changes in movement and/or avoidance of the area. Collision with road and/or rail traffic may occur from an increase in rail and road traffic accessing the terminal.	Minimise interactions between wildlife and the work site. Store garbage, fuel, oil and lubricant appropriately to minimise odour and access. Minimise maintenance activities, such as accumulated material and debris removal, in ditches and associated riparian habitat to reduce the incidence of wildlife mortality.	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Herpetiles (including at-risk species)				
Construction	Loss of aquatic ditch habitat, hedgerow and ditch vegetation from site preparation and clearing activities or during ditch relocation/alignment. Loss of agricultural land from site preparation and clearing activities, or from construction staging and laydown areas. Sedimentation of watercourses and accidental spills of deleterious substances including hydrocarbons.	Follow MoE's "Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments (MWLAP, 2004b)." Adhere to Schedule C work windows – no instream works are to occur between May 1 and August 15 (CoD, 2003). Conduct instream works in the dry, where possible. Where instream works take place during herpetile breeding periods, egg mass and tadpole searches should be carried out prior to any works occurring to ensure native and/or at-risk herpetiles species are not affected. Fish and amphibian salvage and relocation efforts should be implemented if native and/or at-risk species are positively identified. Obtain *BC Wildlife Act* permit if salvage and relocation efforts are required. Minimise ditch and vegetation clearing activities wherever possible . Re-plant native vegetation along banks of relocated and realigned ditches to provide amphibians and reptiles with refuge from predation and high temperatures.	None anticipated	n/a
Operation	Effects from normal and routine roadside or rail maintenance activities, specifically mowing and/or hedge trimming. Effects from noise and visual disturbance from maintenance and operations. Mortality from road and/or rail traffic or maintenance activities.	As above for construction.	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Birds (including at-risk species)				
Construction	Habitat loss from site preparation and clearing activities resulting in the removal of larger trees and/or hedgerow vegetation that can be used as perch locations for raptors. Habitat loss (nesting, roosting and foraging habitat) from a variety of construction activities including Gulf repair yard, laydown and staging areas. Noise and visual sensory disturbance from all construction activities. Mortality from vegetation and site clearing activities or collision with construction vehicles.	Adopt MoE's "Best Management Practices for Raptors in Urban and Rural Environments (LGL and Biolinx, 2005a)." Avoid vegetation clearing during the breeding bird window which occurs between March 15 and August 15. If vegetation clearing is scheduled within the bird breeding window, nest surveys must be completed by a qualified environmental professional to ensure that no active nests are present in the area that is scheduled to be cleared. Consider the use of hedgerows on either side of the rail line, or on the banks of relocated ditches to facilitate high flight paths for birds (raptors and at-risk birds such as herons and barn owls) across the footprint to avoid collision mortality. Hedgerows also provide nesting habitat for songbirds and refuge from predation and inclement weather for songbirds, waterfowl and great blue heron. Reduce light spill by pointing lights downward and place task lighting as close to the repair work as possible. Only use additional task lighting when necessary.	None anticipated	n/a
	Habitat loss from site preparation and clearing activities resulting in the removal of larger trees and/or hedgerow vegetation that can be used as perch locations for raptors. Habitat loss (nesting, roosting and foraging habitat) from a variety of construction activities including Gulf repair yard, laydown and staging areas. Noise and visual sensory disturbance from all construction activities, including locations on the causeway and within the terminal footprint. Mortality from vegetation and site clearing activities or collision with construction vehicles.	Where possible, schedule DTRRIP Overpass construction to avoid or minimize activities during spring and fall migration to reduce effects on shorebirds and waterfowl. Potential to install fencing prior to the commissioning of the DTRRIP Overpass to force birds to fly high and minimise the incidence of bird collision with vehicles. Alternatively, light poles and additional diversion poles may be installed to encourage a higher flight path for birds. Install signage to indicate an environmentally sensitive and/or biodiverse area.	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Birds (including at-risk species)				
Operation	Effects from roadside or rail maintenance activities associated with vegetation and brush clearing Sensory effects from lighting of the Gulf Repair Yard and DTRRIP Overpass Collision with road and/or rail traffic, including truck traffic on the DTRRIP Overpass.	As above for construction.	None anticipated	n/a
Invertebrates (including at-risk species)				
Construction	Loss of aquatic ditch habitat, ditch side and hedge vegetation. Loss of agricultural land (within a portion of the Option Lands) from site preparation and clearing activities. Sedimentation of watercourses and accidental spills of deleterious substances including hydrocarbons.	Conduct instream works in the dry, where possible Minimise vegetation clearing activities. Mark vegetation clearing limits on design drawings and in the field to avoid over clearing. Minimise dredging and maintenance activities to reduce disturbance to riparian and emergent ditch vegetation.	None anticipated	n/a
Operation	Roadside or rail maintenance activities, specifically mowing and/or hedge trimming. Accidental introduction of deleterious material, such as oils, gas and lubricant, into the watercourses.	As above for construction.	None anticipated	n/a
Water Resources				
Construction	Alteration to surface water flow	Maintain existing drainage during Project construction. Implement sediment and erosion control measures. During detailed design, locations of upgraded culvert crossings, new culvert crossings locations, and the requirement for ditch realignment/relocation will be confirmed. Culverts will be sized and designed in accordance with standards required to carry flows of agricultural drainage, and meet the requirements of the BC *Railway Safety Act* and other applicable regulations and standards.	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Water Resources				
Construction	Alteration to surface water flow	The realignment/relocation of any of the irrigation ditches in the study area to accommodate the Project will require detailed hydraulic assessments; water quality monitoring at both upstream and downstream locations; and close coordination with the local farmers and the Corporation of Delta. (i.e., the Delta Irrigation Enhancement Project). Notification or Approval under Part 7 of the BC *Water Act* will be submitted following detailed design for any instream works.	None anticipated	n/a
	Effects to surface water quality	Follow standard best management practices for erosion and sediment control, such as those outlined in the Land Development Guidelines for the Protection of Aquatic Habitat (DFO 1992). Install sediment barriers on the banks of watercourses to avoid the introduction of sediment or other deleterious material to the watercourses. Locate soil and preload stockpiles away from watercourses and minimise the amount of exposed soil onsite. Conduct any instream works in-the-dry if possible. Revegetate and stabilise watercourse banks as soon as possible following the completion of any instream works. Conduct water quality monitoring at discharge sites (locations to be determined once detailed design is complete) and upstream to ensure that sediment control procedures are effective during construction. Develop a detailed erosion and sediment control plan as part of the construction Environmental Management Plan (EMP) prior to construction, based on the final design and contractor plans.	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Water Resources				
Construction	Effects to surface water quality	Monitor the above measures during construction, with further site-specific mitigation undertaken where required. Measures to mitigate effects of accidents and/or malfunctions are summarised in **section 7.0** Accidents and Malfunctions.	None anticipated	n/a
	Effects to groundwater	Measures to mitigate effects of accidents and/or malfunctions are summarised in **section 7.0** Accidents and Malfunctions.	None anticipated	n/a
Operation	Effects to surface water and groundwater quality	Measures to mitigate effects of accidents and/or malfunctions are summarised in **section 7.0** Accidents and Malfunctions.	None anticipated	n/a
Fish and Fish Habitat				
Construction	Surface water quality effects on fish	Apply best management practices for erosion and sediment control prior to and during construction, including: • Installation of silt and/or exclusion fencing in key areas to prevent additional riparian effects beyond the permitted area. • Installation of sediment barriers on the banks of watercourses to avoid the introduction of sediment or other deleterious material to the watercourses.	None anticipated	n/a
	Surface water quality effects on fish	Measures to mitigate effects of accidents and/or malfunctions are summarised in **section 7.0** Accidents and Malfunctions.	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Fish and Fish Habitat				
Construction	Loss/disturbance of fish habitat	New ditches are proposed to be designed and constructed parallel to the Project footprint for water run-off during operations. These new ditches will replace the existing ditches and swales that will be in-filled during construction. The new ditches will provide equivalent or improved habitat for displaced resident fish. Details on the location of these ditches will be provided during the detailed design phase. Notification or Approval under Part 7 of the BC *Water Act* will be submitted for any instream works. Avoid, where possible, instream work works between May 1 and August 15. Minimise the extent of disturbance to aquatic and riparian areas. Conduct environmental monitoring, with a focus on works that have the potential to effect fish/wildlife habitats and water quality. Construct drainage ditches adjacent to the new rail line for the purpose of receiving excess water and run-off during wetter periods. Newly constructed ditches can act as resident fish habitat and be considered compensation for ditch loss during construction. Plant native vegetation to replace the riparian vegetation that is to be cleared during construction to promote fish presence.	None anticipated	n/a
	Accidental mortalities	Flows will be maintained on any flowing watercourses during instream works (via pumping around the isolated work area or a similar method). Fish salvage, where required, will be conducted where fish may be present. A BC *Wildlife Act* permit must be acquired prior to fish/amphibian salvage.	None anticipated	n/a
Operation	Riparian and ditch vegetation clearing during routine and on-going maintenance activities may effect fish habitat through water quality and habitat degradation.	Avoid, where possible, instream work works between May 1 and August 15.	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Marine Vegetation				
Operation	Changes in habitat quality and availability due to increased frequency of ballast water release incidents (including introduction of contaminants and non-native species into the marine environment).	Vessels arriving at the terminal are required to exchange ballast not less than 200 nautical miles from shore or have a TC approved ballast water treatment technology as dictated by Transport Canada's "*A Guide to Canada's Ballast Water Control and Management Regulations, TP 13617E".*	None anticipated	n/a
	Changes in habitat quality and availability due to inappropriate disposal of garbage and discharge of sewage and oily bilge.	Vessels arriving at the terminal are required to adhere to pollution prevention regulations under the *Canada Shipping Act*. Vessels are not allowed to discharge sewage within Port Metro Vancouver's jurisdiction and are required to adhere to Transport Canada's Non-Pleasure Craft Sewage Pollution Prevention Regulations outside of Port jurisdiction. When vessels are in Port Metro Vancouver jurisdiction there is no discharge of oily bilge, including the sealing of bilge pumps when vessels are in Port. Further, in accordance with Transport Canada's Oil Pollution Prevention Regulations, no oil or oily mixture shall be discharged from a vessel in waters under Canadian jurisdiction. No bunkering or fueling of vessels at Roberts Bank is permitted by Port Metro Vancouver	None anticipated	n/a
Marine Invertebrates				
Operation	Changes in habitat quality/availability, changes in behaviour and physical injury/death due to increased frequency of ballast water release incidents (including introduction of contaminants and non-native species into the marine environment).	See Marine Vegetation	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Marine and Anadromous Fish				
Operation	Changes in habitat quality/availability, changes in behaviour and physical injury/death due to increased frequency of ballast water release incidents (including introduction of contaminants and non-native species into the marine environment).	See Marine Vegetation	None anticipated	n/a
	Changes in habitat quality/availability, changes in behaviour and physical injury/death due to increase in acoustic emissions.	None recommended	Yes	Not significant
Coastal Birds				
Operation	Changes in behaviour due to increase in acoustic emissions.	No mitigation proposed.	Yes	Not significant
Marine Mammals				
Operation	Changes in habitat quality/availability, changes in behaviour and physical injury/death due to increase in acoustic emissions.	No mitigation proposed.	Yes	Not significant
	Increased vessel strikes	No mitigation proposed.	Yes	Not significant

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Air Quality				
Construction	Effects to the local air quality	Apply water to exposed soils and haul roads to reduce fugitive dust emissions. Apply environmentally compatible soil stabilisers and dust suppressants to maintain soil moisture levels in exposed soils. Limit vehicles to moderate and appropriate speeds to minimise dust. Minimise the areas of disturbed soils. Compaction of disturbed soils when not being worked. Wind breaks to reduce wind erosion. Cover steep slopes with netting or mulch to reduce wind erosion. Track-out controls to prevent dirt or mud from being spread by trucks leaving the construction site. These may include: • Asphalt paving or gravel at driveway access points. • Removal of dirt or mud deposited on paved roads. • Limiting load size and covering the loaded trucks when hauling material off-site. • Watering or chemical stabilisation of loads. Maintain construction equipment in good working order and operate equipment at optimum rated loads. All heavy-duty diesel on-road vehicles (i.e., licensed vehicles, such as dump trucks) are in good working order while operating on the project site. Operate equipment and vehicles so as to minimize exhaust emissions by restricting idling of machinery when not in use.	None anticipated	n/a
Operation	Effects to the local and regional air quality	Port Metro Vancouver and TSI, the terminal operator, will work together to pursue further initiatives to reduce air emissions related to operation of the existing Deltaport Terminal and the Project. Port Metro Vancouver will continue to collaborate with other ports, the marine industry and with government agencies to develop a data baseline, promote efficiency, implement technologies and support regulatory changes to reduce air emissions as part of the Air Action Program.	Yes	Not significant

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Noise and Vibration				
Construction	Increased noise resulting from operation of construction machinery.	A noise management plan will be incorporated into the construction EMP and will include: • Equipment noise control – A maximum allowable noise emission from each type of machinery will be set prior to construction • Awareness and training – Provision of training to ensure that construction workers are aware of the noise created during construction (e.g., idling, back up alarms) and are appropriately trained to minimise noise where possible Noise Complaints - Port Metro Vancouver will continue operating its 24-hour Community Complaint Line to deal with noise and nuisance complaints that may arise from construction activities.	None anticipated	n/a
	Increased ambient noise levels, which can constitute a disturbance to wildlife.	See Wildlife	See Wildlife	See Wildlife
	Health and safety effects on workers from construction machinery noise.	Hearing protection will be required by on-site workers to limit the effects on these people to acceptable levels in accordance with Workers Compensation Board standards.	None anticipated	n/a
	The potential for building damage from vibration.	A distance of at least 7.6 metres will be maintained between the roller and any nearby structure.	None anticipated	n/a
Operation	Increased operational noise from increased cargo handling equipment and increased rail activity.	Follow procedures in the Port-wide Noise and Nuisance Management Plan. Respond to noise complaints consistently and efficiently.	Yes	Not significant
Visual				
Construction	Visual effects due to construction work in the terminal area to erect the additional cranes. Visual effects due to equipment and materials necessary to construct the DTRRIP Overpass on the causeway.	No mitigation proposed.	No	n/a
Operation	Visual effect due to permanent structures.	No mitigation proposed.	No	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Lighting				
Construction	Lighting during construction is anticipated to have minimal effects on local residents.	Ensure lighting equipment is pointed north and west as much as possible (to reduce effects to residents who are typically located east and south of the Roberts Bank port facility). Implement shielding on construction lighting. Maintain 24-hour Community Complaint Line and email address. Post and/or distribute Project updates (e.g., construction schedule and timing of nighttime construction activities).	None anticipated	n/a
Operation	Lighting during operations is anticipated to have minimal effects on local residents.	All luminaires will have full cut-off optics to reduce effects on local residents. Use of lighting control systems to reduce the intensity of lighting in selected areas during periods of low activity. Install a lighting control system on the arms of the new ship-to-shore gantry cranes to automatically shut the lighting off after 15 minutes when the arm is raised. Ensure task lighting equipment (when needed) is pointed north and west as much as possible (to reduce effects to residents who are typically located east and south of the Roberts Bank port facility). Continue to maintain Port Metro Vancouver's 24-hour Community Complaint line and email address.	None anticipated	n/a
Socio-Community: Employment and Economics				
Construction	Approximately 1,200 person years of construction work (1,330 direct construction jobs) will be generated over the construction of DTRRIP.	Port Metro Vancouver is committed to maximising local and First Nations employment and procurement opportunities during construction and will work with the contractor(s) selected to build the Project to ensure local and First Nations employment is a priority.	Yes (positive)	Not significant
Operation	Indirect and induced employment related to the operation of the Project is estimated at between 2,500 and 2,700 person-years across Metro Vancouver, of which approximately 900 will be jobs in Delta.	No mitigation proposed.	Yes (positive)	Significant (positive)

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Socio-Community: Population and Demographics				
Operation	There will likely be some increase in population in Delta associated with the more long term job opportunities that arise due to increased capacity at Deltaport as result of the Project in operation, estimated at approximately 225 workers relocating to Delta permanently.	No mitigation proposed.	Yes (positive)	Not significant
Socio-Community: Land Use and Land Use Planning				
Construction	Modification to existing land-use or land use designation (also, see Agriculture).	Any land no longer used for construction purposes, such as staging areas will be returned to their original status.	None anticipated	n/a
Socio-Community: Community Services				
Construction	Approximately a dozen calls on local hospital and medical services per year may be required.	A health and safety plan will be implemented to minimise use of local hospital and emergency services.	Yes	Not significant
	Requirement for an increase in patrolling of the active construction site as such sites are often the target of vandalism and mischief.	The construction site will have security to minimise the need for additional patrols from the Delta Police Department.	None anticipated	n/a
	Potential increase in fire department callouts.	The contractor will be required to maintain an appropriate level of fire protection on-site.	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Socio-Community: Traffic and Transportation				
Construction	Increase in construction vehicles and workers travelling to the site.	A temporary off-causeway truck staging area will be provided, if required, to reduce the effect of truck queuing on Deltaport Way during construction. A traffic management plan will be prepared in conjunction with the BC Ministry of Transportation and Infrastructure (MOTI) and the Corporation of Delta, to manage construction traffic during Project construction. This plan will include a public communications plan.	Yes	Not significant
Operation	Increased truck traffic	The Project will reduce traffic congestion on the causeway, and at the existing at-grade crossings, as vehicles no longer have to wait for trains to pass by to continue their journey. The increase in Deltaport's container capacity has been anticipated, aligned with, and accounted for in road and rail improvements that are currently underway, including the South Fraser Perimeter Road (SFPR) and the Roberts Bank Rail Corridor Program (RBRC). Port Metro Vancouver has been working to identify additional measures that might reduce truck congestion such as its Truck Licensing System (TLS) that serves to regulate truck movements, driver behaviour and manage a reduction in truck emissions.	Yes	Not Significant
Socio-Community: Rail				
Operation	Increase in rail traffic	The DTRRIP Overpass will separate road and rail traffic, thereby improving safety, easing community connections and minimising train whistling. The DTRRIP Overpass will also improve efficiency of rail operations and, in turn, the overall efficiency of the Deltaport container terminal.	None anticipated	n/a
Socio-Community: Marine				
Operation	Increase in marine traffic	The projected increase in container vessel size calling on Deltaport will mitigate for the potential increase in vessel traffic that would otherwise be associated with an increase in container throughput. No additional mitigation is proposed.	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Agriculture				
Construction	Permanent loss of agricultural lands: direct loss of 8.33 ha of ALR lands, of which 6.46 ha are cultivated.	Development and implementation of a Topsoil Conservation Program.	None anticipated	n/a
	Permanent loss of agricultural lands: direct loss of 8.33 ha of ALR lands, of which 6.46 ha are cultivated.	Potential compensation measures will be discussed with farmers potentially affected by the Project, the ALC, the Delta Farmers Institute (DFI) and the DIEP project team throughout Project detailed design stage and as part of ongoing consultations regarding ALC approval for the Project. In addition to the mitigation measures, possible compensation projects will be considered to: • Support agricultural capacity development by providing bursaries or research funding. • Provide additional funding for the development and maintenance of the DIEP. • Provide additional funding to the construction and/or monitoring and maintenance of the DIEP. • Provide funding to the supply of irrigation water to Westham Island which is does not currently benefit from the DIEP.	None anticipated	n/a
	Effects on irrigation, drainage, and farm infrastructure in the vicinity of the Project, including: • Loss of major irrigation/drainage ditch on NW boundary of BCR property #6 (Felix Farms). • Loss of minor drainage ditch on NE boundary of BCR property #6. • Disruption of three major irrigation/drainage ditch crossings of Deltaport Way along the north boundary of BCR property #6 (Felix Farms). • Loss of minor drainage ditch on north boundary of BCR property #7 (currently leased).	During on-going Project design studies, the DWSM will be updated with more current and more accurate information on the drainage and irrigation features in the vicinity of the Project. It will be used for establishing base line hydraulic performance parameters, evaluating the potential effects of the project, developing measures for mitigating potential effects and supporting the design of the various features selected for implementation. During the detailed design phase, the DTTRIP team will work closely with the local farmers to ensure that the existing ditch system is reconfigured in a manner that will improve the overall level of service of the drainage and irrigation systems.	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Agriculture				
Construction	Removal of fencing	Existing field fences will be replaced with appropriate fencing.	None anticipated	n/a
	Loss of direct access with removal of 46A Street overpass	Once the 46A Street overpass is removed, the north-south movement of farm equipment over Deltaport Way will use the new 41B Street overpass. In order to minimise the effect of the increased time required to cross Deltaport Way, construction of additional infrastructure that compliments the existing 41B overpass is proposed to expedite the movement of farm vehicles over Deltaport Way. This includes construction of a gravel access road along the south side of the new BCR tracks within the BCR right-of-way, construction of a gravel access road along the south side of the Felix Farms fields north of Deltaport Way and constructing a connections to the 41B Street Overpass.	None anticipated	n/a
Construction/ Operation	Indirect effects potentially occur within the adjacent lands surrounding the Project footprint (right-of-way) include: • Aesthetic effects • Noise effects • Risks to livestock • Severance or isolation of farm fields.	Construction of fences to reduce risks to livestock. Regular liaison with farm operators during Project construction to address issues that might arise related to access, noise and aesthetics to ensure they are addressed in a timely manner.	None anticipated	n/a

VEC/VSC and Phase	Potential Effect	Proposed Mitigation	Residual Adverse Effects	Significance of Residual Adverse Effects
Archaeology Resources				
Construction	Areas of moderate archaeological potential have been identified along the segment of the Project from Arthur Drive to 72nd Avenue. Potential effects may occur to undiscovered archaeological sites as a result of ground disturbance.	All Project works will be confined to the existing railway right-of-way. Construction crews will participate in Archaeological Awareness training. Construction monitoring will be conducted by experienced First Nations technicians in areas identified in the AOA that contain moderate archaeological potential. If archaeological resources are identified, construction activities in the immediate area will be halted until an archaeologist undertakes an assessment of the archaeological significance and potential effects. Following this, the archaeologist will make further recommendations regarding the necessary avoidance or mitigation measures for the identified archaeological materials.	None anticipated	n/a

13.0 CONCLUSION

This CEAA screening-level EA for the Project concludes that the Project, as described in **Section 2.0** Project Description, is not anticipated to cause any significant biophysical or socio-economic Project-related residual adverse effects, or cumulative residual effects.

This conclusion is supported by the assessment of effects on biophysical or socio-community components as described below which followed the methodology described in **Section 4.0**.

Key conclusions to each of the biophysical studies are:

- With the implementation of mitigations measures described in **Section 5.1**, no residual adverse effects on vegetation and wildlife VECs are anticipated as a result of Project construction and operation.
- With the implementation of mitigation measures described in **Section 5.2**, no residual adverse effects on water resources are anticipated as a result of construction and operation.
- With the implementation of mitigation measures described in **Section 5.3**, no residual adverse effects on fish and fish habitat are anticipated as a result of construction and operation.
- Construction will not occur within the marine environment, and therefore the construction phase of the Project will have no effect on the marine environment. With the implementation of mitigation measures described in **Section 5.4**, no residual adverse effects on marine vegetation or marine invertebrates are anticipated as a result of operation. The residual environmental effect of acoustic disturbance from increased vessel traffic is considered to be not significant for marine and anadromous fish, coastal birds, and marine mammals. The residual environmental effects of vessel strike on marine mammals are considered to be not significant (**Section 5.4**).
- With the implementation of mitigation measures described in **Section 5.5**, no residual adverse effects on air quality are anticipated as a result of construction. With the implementation of mitigation measures, as well as ongoing initiatives described in **Section 5.5**, the residual environmental effect of changes in air quality is considered to be not significant during operation. All maximum concentrations predicted for Project operation, including 98th percentile background values, are less than applicable Canada-wide Standards and the most stringent Metro Vancouver and AAQO's.

Key conclusions to each of the socio-community studies are:

- With the implementation of the proposed mitigation measures described in **Section 6.1**, no residual effects of noise and vibration associated with construction are anticipated. With the implementation of noise mitigation measures proposed, as well as Port Metro Vancouver's ongoing initiatives to manage port-related noise, residual effects of noise during operation are not considered to be significant. There are no residual effects of vibration associated with DTRRIP operations.
- As described in **Section 6.2**, Port Metro Vancouver will work with communities adjacent to the Project to identify the need for mitigation of visual effects. If any mitigation measures are identified and implemented, it is anticipated that the residual effects after mitigation may be marginally reduced from the estimated initial effects concluded in this report. It is anticipated that residual effects would be considered to be not significant.

- Lighting during Project construction and operation is anticipated to have minimal effects on local residents, and with the implementation of mitigation measures described in **Section 6.3**, no residual effects are anticipated.
- Employment and economic opportunities are considered to be positive during both Project construction and operation. There will likely be some increase in population in Delta associated with more long-term job opportunities as a result of DTRRIP, but this effect is generally considered to be a positive outcome and estimated to be low in magnitude. Some transportation and traffic related effects are anticipated during both construction and operation however, with implementation of mitigation measures described in **Section 6.4**, no residual adverse effects are anticipated.
- Direct effects will occur within the Project footprint on agricultural lands, resulting in the loss of 8.33 ha of ALR lands. However, following implementation of proposed mitigation and compensation measures, no residual effects to agriculture are anticipated
- Studies indicate minimal archaeological resources within the Project footprint. As such, following mitigation measures described in **Section 6.6**, no residual effects on archaeology resources are anticipated to result from DTRRIP. Monitoring is recommended during construction, and is not required during operation as no ground disturbances will occur outside of the Project construction footprint.

All of the identified effects from the above studies and the mitigation measures proposed to avoid or mitigate the effects are summarised in **Section 12.0.**

A communications and consultation program to describe the Project and seek feedback from local residents, First Nations, non-government organisations, corporate stakeholders, governments (municipal, regional, provincial and federal) and government agencies was undertaken by Port Metro Vancouver. The schedule and outcome of the consultation activities to date is outlined in **Section 3.0**.

The likelihood of accidents or malfunctions associated with the Project that have environmental effects is anticipated to be low. The risks associated with potential accidents and malfunctions during the Project can be addressed with appropriate construction and operational environmental management, spill response, health and safety and emergency response plans (**Section 7.0**). Provided such plans are in place and are updated for the Project, no residual effects to the environment or human health and safety are likely to occur.

A cumulative effects assessment (**Section 8.0**) undertaken as part of the environmental assessment considered residual effects (i.e., effects remaining after the application of mitigation) carried forward from the environmental assessment. The scope of the cumulative effects assessment focused on:

- Marine and anadromous fish – Disturbance or displacement from habitat as a result of underwater noise from increases in vessel calls during the operations phase.
- Coastal seabirds – Disturbance or displacement from habitat as a result of in-air acoustic emissions from increases in vessel calls during the operations phase.

- Marine mammals – Physiological and behavioural changes as a result of acoustic disturbance from increases in vessel calls during operations phase and physical injury/direct mortality as a result of vessel strikes from increases in vessel calls during operations phase.
- Air quality – Increases in ambient concentrations of air contaminant.
- Noise – Increases in noise level at sensitive receptors adjacent to the Project.

With the implementation of project related mitigation and additional measures no significant cumulative effects are predicted as a result of the potential interactions between the Project and other projects and activities.

An assessment was conducted as per CEAA requirements on the potential environmental factors that may affect construction and operation of DTRRIP. Environmental factors considered in the assessment included seismic hazards, tsunami, implications of climate change, snow and severe temperatures, erosion and flooding. Based on the implementation of proposed mitigation measures described in **Section 9.0**, no residual effects associated with natural events on the Project are anticipated.

Based on the review of potential impacts to sustainability considerations (**Section 10**), and the legislated definition of sustainability stated in the CEAA, there will be no project-related effects that compromise the ability of future generations to meet their own needs. Similarly, sustainability initiatives, which consist of works over and above legislative requirements, will likely have a long-term positive net benefit to the community.

The potential for direct effects on the current use of lands and resources for traditional purposes by aboriginal people was evaluated in **Section 11.0**. Findings from studies conducted for this document indicate that there are no residual effects to biophysical resources (**Table 11-1**), and hence no residual effects to traditionally used resources within the study area. First Nations have indicated an interest in ensuring that any archaeological resources within the Project area are protected. Accordingly, the archaeological assessment conducted suggests no residual effects to archaeological resources are anticipated. Input from First Nations with respect to the environmental studies and current use of lands and resources for traditional purposes will be sought through ongoing consultation in an effort to confirm these findings and related understandings.

Based on the environmental assessment undertaken, the proposed Project is predicted to have low biophysical and social-economic effects on the environment, while providing economic benefits in local communities, throughout the Lower Mainland, and across the country. This screening-level EA report documents the process undertaken to meet or exceed regulatory requirements and concludes that, with the implementation of proposed mitigation measures, the Project is not likely to cause significant adverse environmental, socio-economic / community or cumulative effects.

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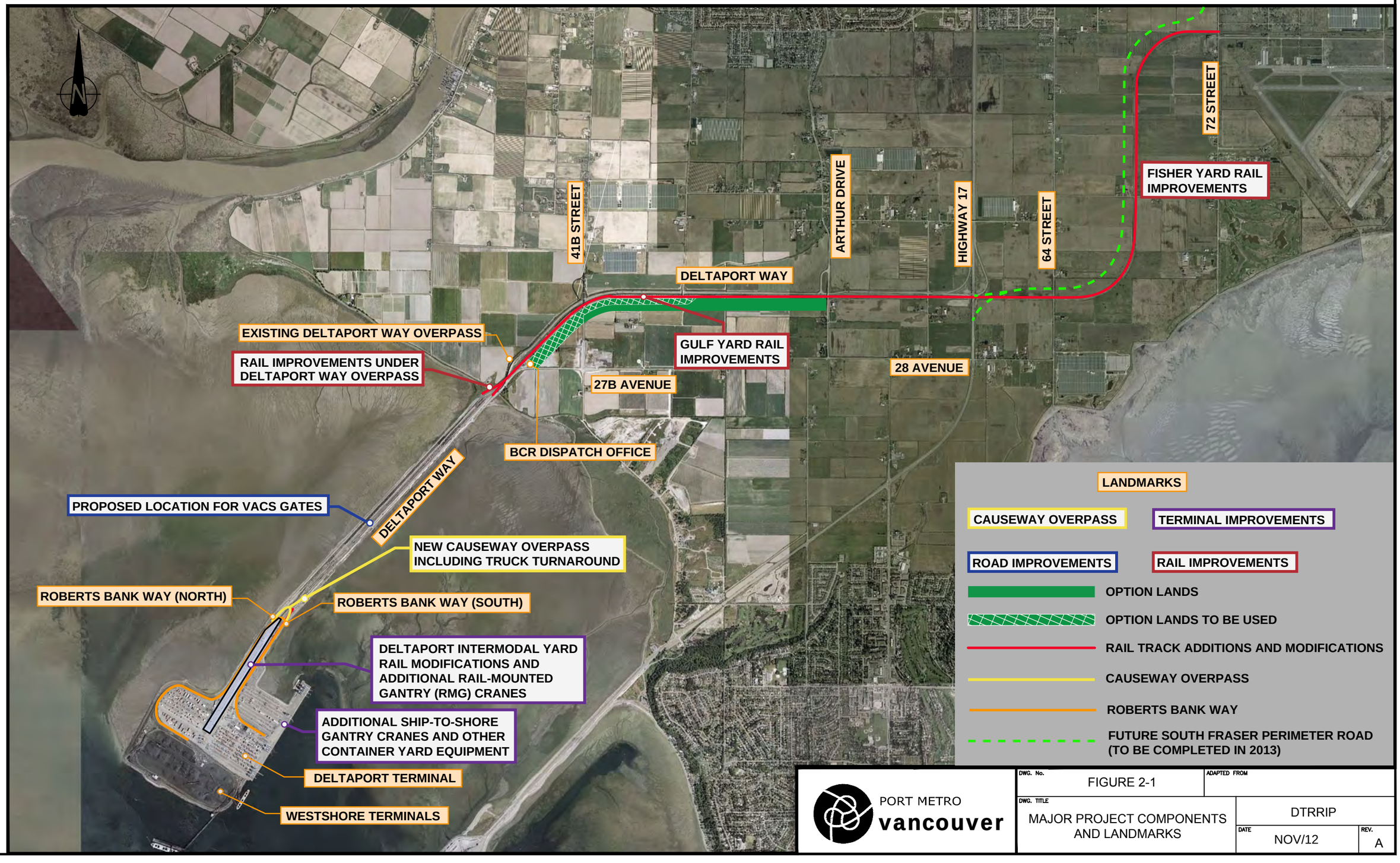
FIGURES

PORT METRO vancouver

DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

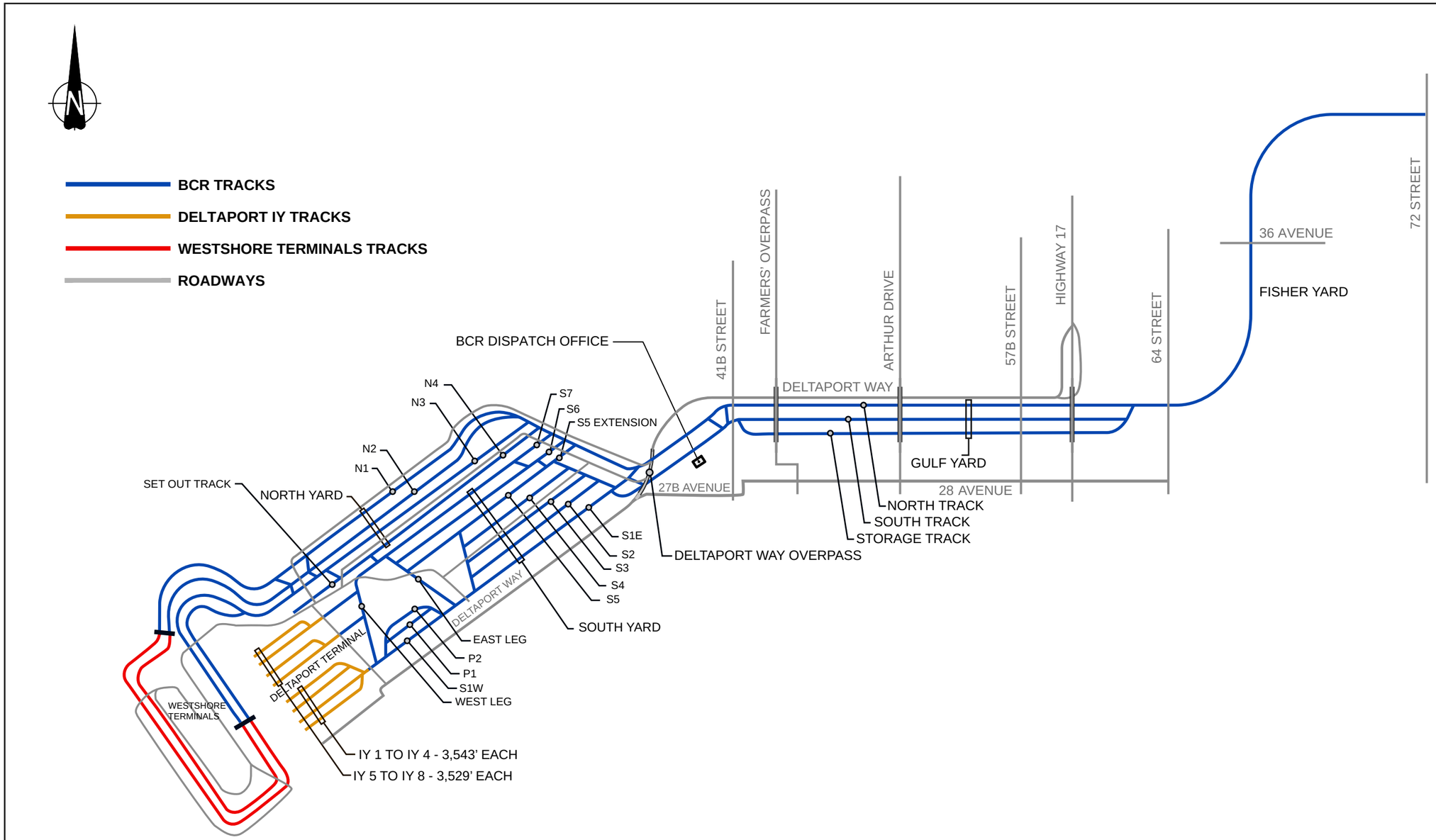
SITE LOCATION

Project No.		
1246-001.04	November 2012	FIGURE 1-1



PORT METRO vancouver

DWG. No.	FIGURE 2-1
ADAPTED FROM	
DWG. TITLE	MAJOR PROJECT COMPONENTS AND LANDMARKS
	DTRRIP
DATE	NOV/12
REV.	A



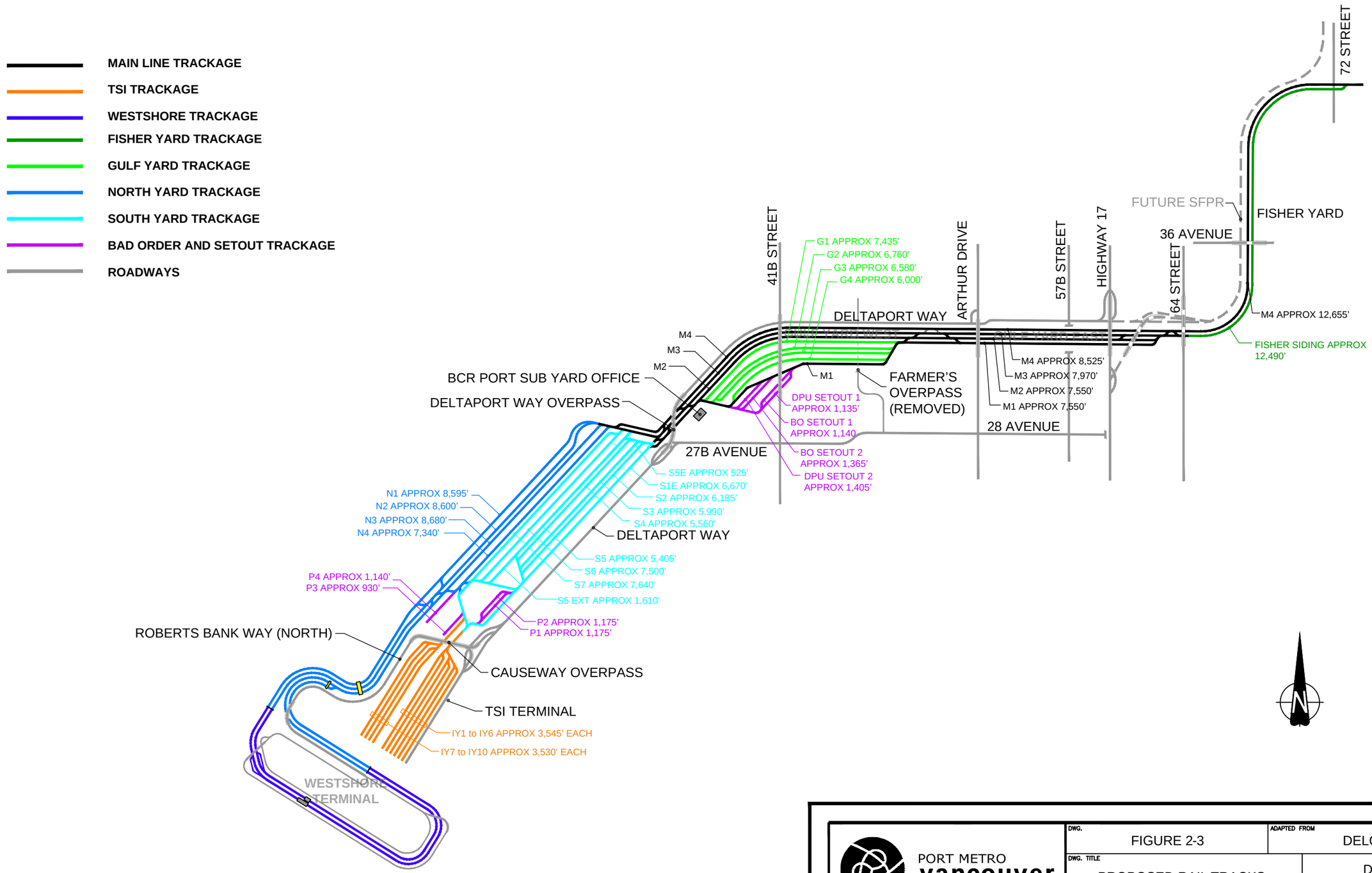
PORT METRO vancouver

DWG.	ADAPTED FROM
FIGURE 2-2	BCR

DWG. TITLE: EXISTING RAIL TRACKS ON RBRC AND CAUSEWAY

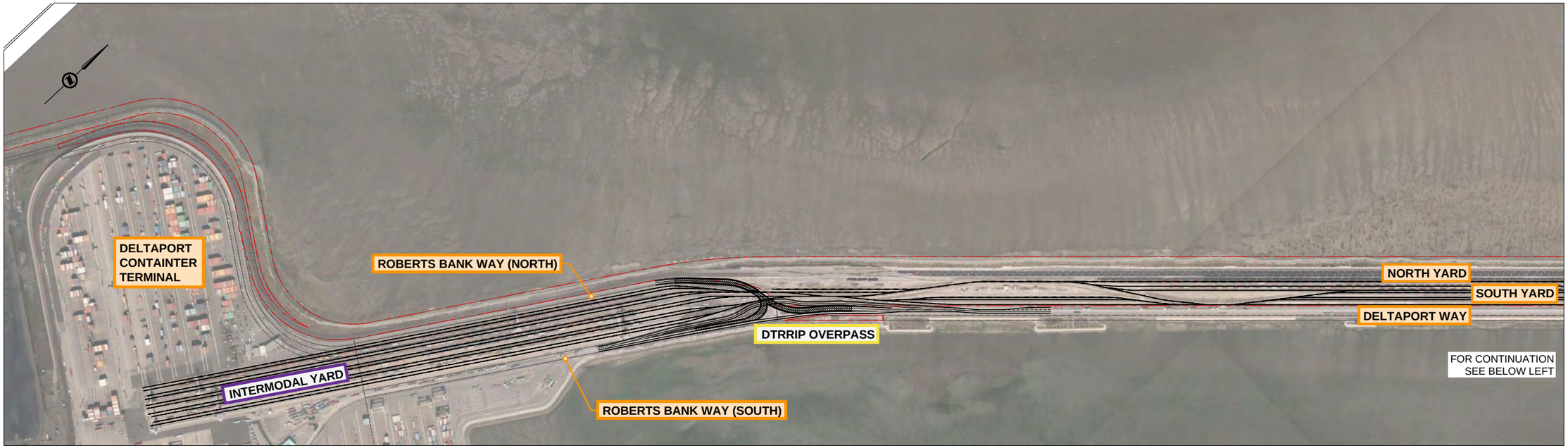
DTRRIP

DATE	REV.
NOV/2012	A



PORT METRO vancouver

DWG.	FIGURE 2-3
ADAPTED FROM	DELCAN
DWG. TITLE	PROPOSED RAIL TRACKS ON RBRC AND CAUSEWAY
	DTRRIP
DATE	NOV/12
REV.	A



LANDMARKS

RAIL IMPROVEMENTS

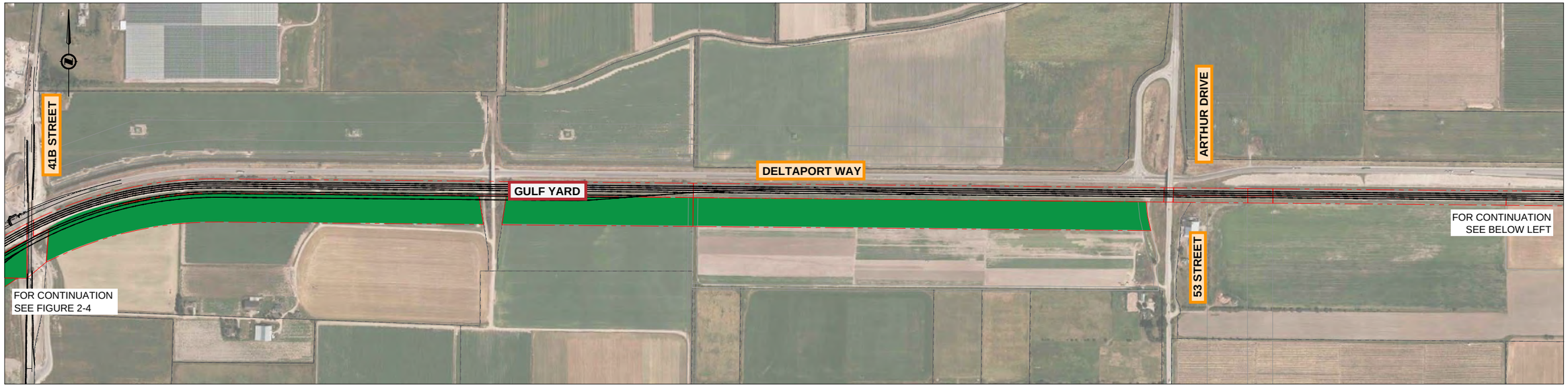
DTRRIP OVERPASS

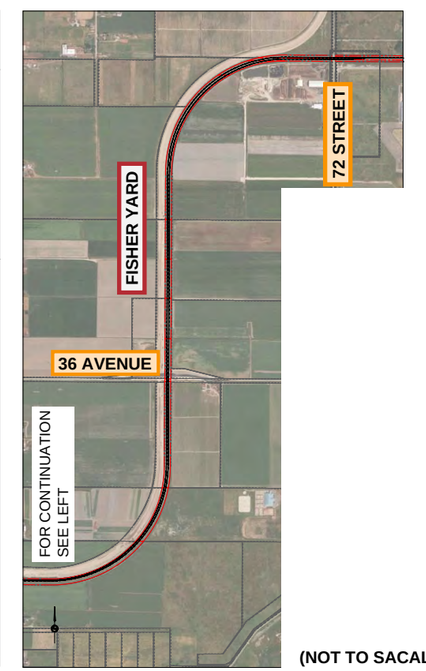
TERMINAL IMPROVEMENTS

OPTION LANDS

PORT METRO vancouver

DWG. FIGURE 2-4	ADAPTED FROM
DWG. TITLE DTRRIP PROJECT COMPONENTS	DTRRIP
	DATE NOV/12





(NOT TO SACALE)

LANDMARKS

RAIL IMPROVEMENTS

OPTION LANDS

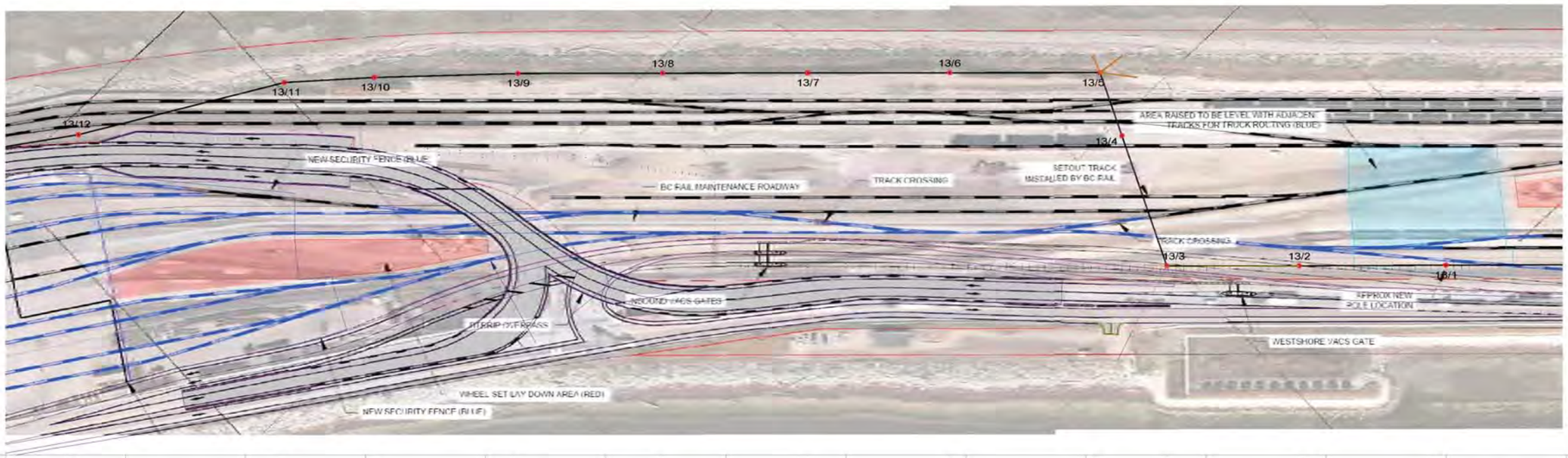
PORT METRO vancouver

DWG. FIGURE 2-5	ADAPTED FROM	
DWG. TITLE DTRRIP PROJECT COMPONENTS	DTRRIP	
	DATE NOV/12	REV. A

PLS-CADD DRAWING

NOTES:

1. ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
2. 69KV CONDUCTOR: - 636.0 MCM ASC "ORCHID"
3. FOR FURTHER CONDUCTOR AND STRUCTURE INFORMATION SEE SUMMARY OF REQUIREMENTS SR-XX
4. GROUND AND STRUCTURE DATA ARE FROM LIDAR DATA
5. LINE ANGLE DEFLECTION LOOKING FROM: ARNOTT SUB INDICATED AS FOLLOWS:
   + RIGHT DEFLECTION
   - LEFT DEFLECTION
6. STRUCTURE NOTES:
   69KV STRUCTURE CODE DESIGNATION AS FOLLOWS:
   (IE: PT CL -1 60' POLE)
   PT - STRUCTURE TYPE
   60' - POLE HEIGHT
   CL -1 - POLE CLASSIFICATION
7. MAXIMUM 60 KV DESIGN LOAD FOR CONDUCTOR TENSION 13400 N @ 12.5MM ICE, 400N/M2 WIND, -20 DEG. CELSIUS (CSA - HEAVY)
8. DISTRIBUTION PRIMARY CONDUCTOR: 266.8 MCM ACSR "PARTRIDGE" NEUTRAL CONDUCTOR: 1/0 ACSR "RAVEN"
9. TRANSMISSION CONDUCTOR SHOWN AT 90 DEG. CELSIUS
10. DISTRIBUTION PRIMARY SHOWN AT 90 DEG. CELSIUS
11. DISTRIBUTION NEUTRAL SHOWN AT 50 DEG. CELSIUS

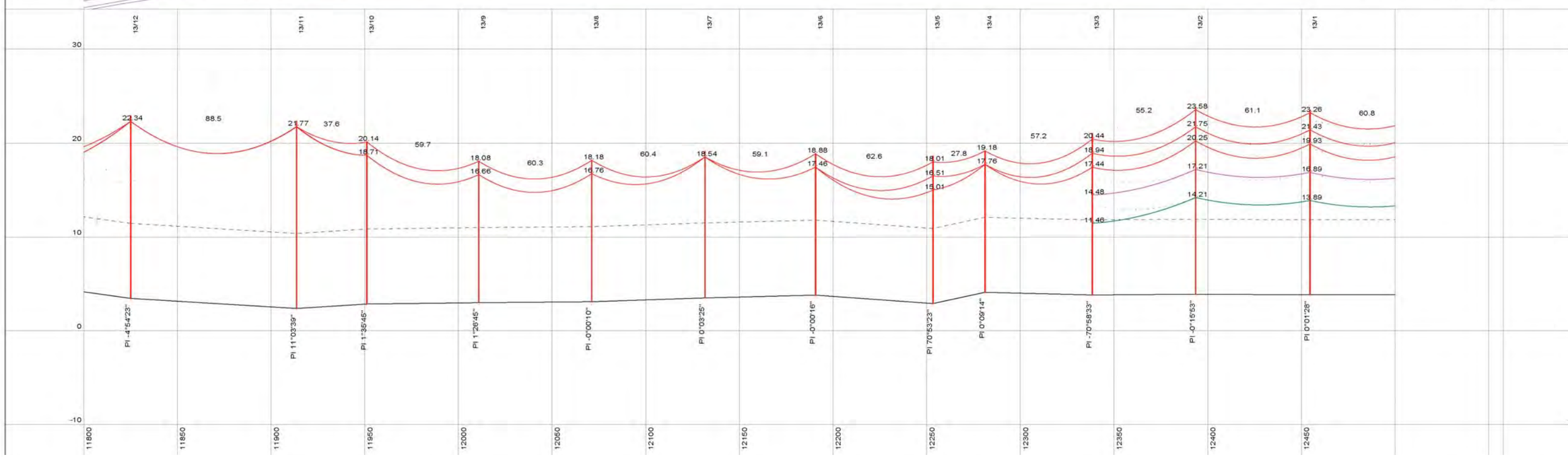


SCALES

NORTH

20.0 M HORIZ. SCALE

4.0 M VERT. SCALE



Original Figure: Pole Relocations for MOT,
No: 60L058-T07-BXX SH 1 of 1

PORT METRO vancouver

DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

HYDRO POLE RELOCATION PLAN AND PROFILE

PROJECT No.		
1246-001.04	November 2012	FIGURE 2-6

Legend

- Local Study Area (LSA)
- Regional Study Area (RSA)
- Project Footprint

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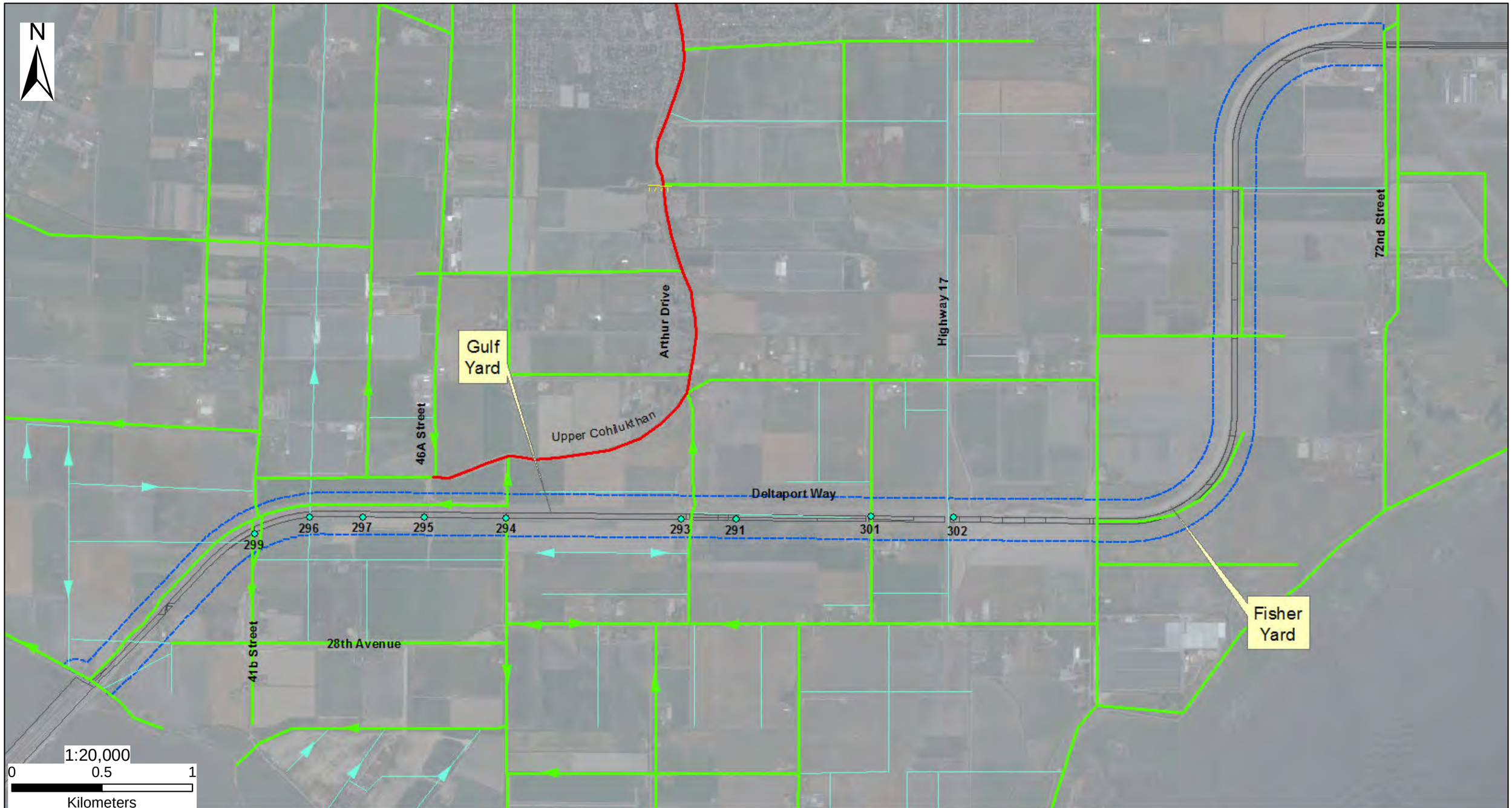
DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

VEGETATION & WILDLIFE LSA & RSA

Project No.		
1246-001.04	November 2012	FIGURE 5.1-1



Legend

- Minnow trap & water sampling location
- Salmonid barrier
- Schedule 'A' watercourse
- Schedule 'C' watercourse
- Municipal watercourse
- Direction of flow
- Existing Rail ROW
- Local Study Area

PORT METRO vancouver

DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT ENVIRONMENTAL ASSESSMENT REPORT

SURFACE WATER AND FISH SAMPLING LOCATIONS

Project No.		
1246-001.04	November 2012	FIGURE 5.2-1

Legend

Local Study Area

Aquifer Boundary

PORT METRO vancouver

DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

EXTENT OF THE AQUIFER IN THE DTRRIP LSA

Project No.		
1246-001.04	November 2012	FIGURE 5.2-2

Legend

- Northeast Limit
- Northwest Limit
- Southeast Limit
- Southwest Limit

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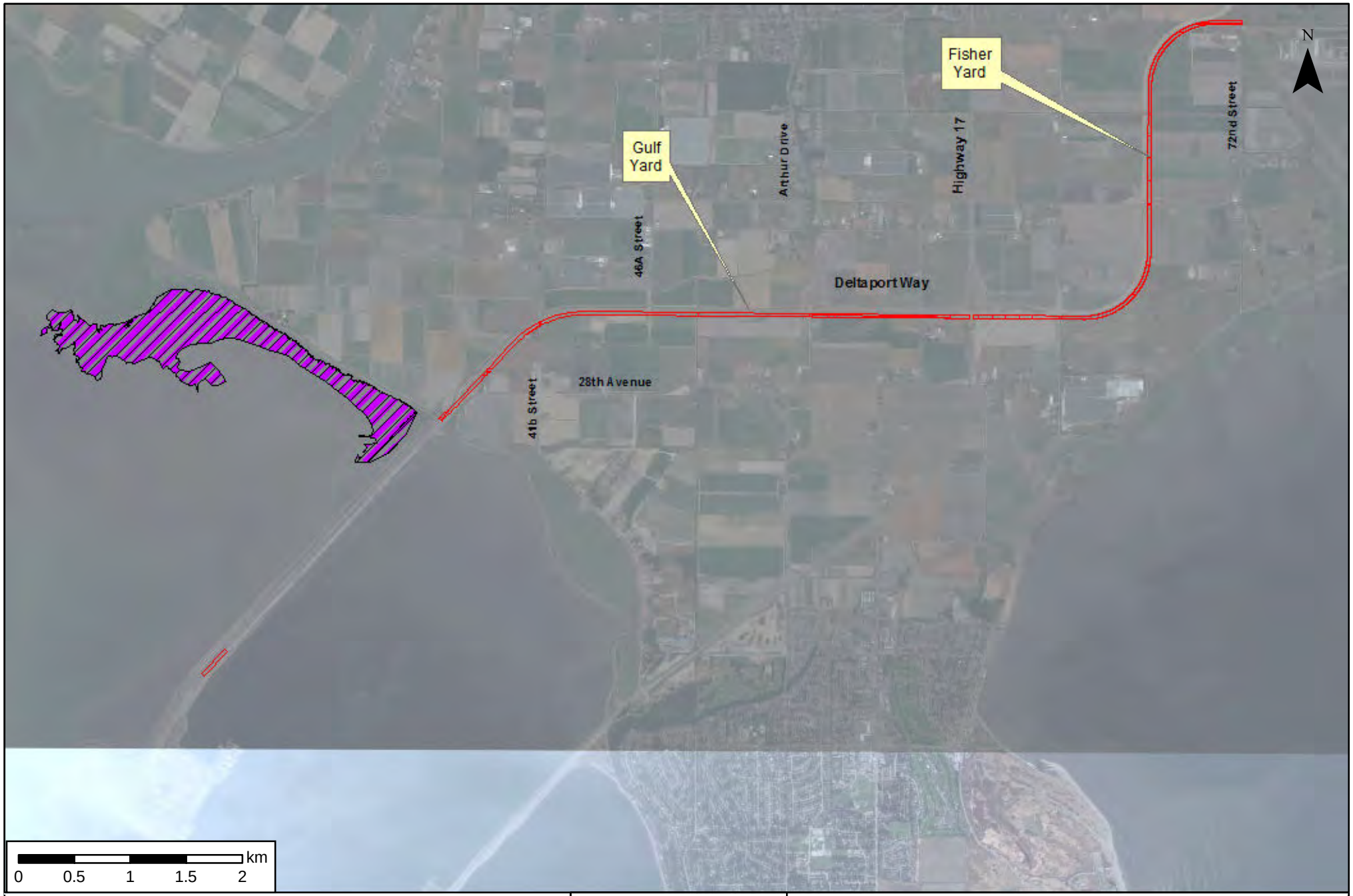
DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT ENVIRONMENTAL ASSESSMENT REPORT

MARINE ENVIRONMENT STUDY AREA

PROJECT No.		
1246-001.04	November 2012	FIGURE 5.4-1



Legend

- Biofilm (as taken from RSBRO 2010)
- Project Footprint

PORT METRO vancouver

DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT ENVIRONMENTAL ASSESSMENT REPORT

LOCATION OF BIOFILM IN RELATION TO THE PROJECT FOOTPRINT

Project No.		
1246-001.04	November 2012	FIGURE 5.4-2

Legend

Local Emissions Inventory Area

Local Study Area

N

0 250 500 750 1,000

Metres

NAD 1983 UTM Zone 10N

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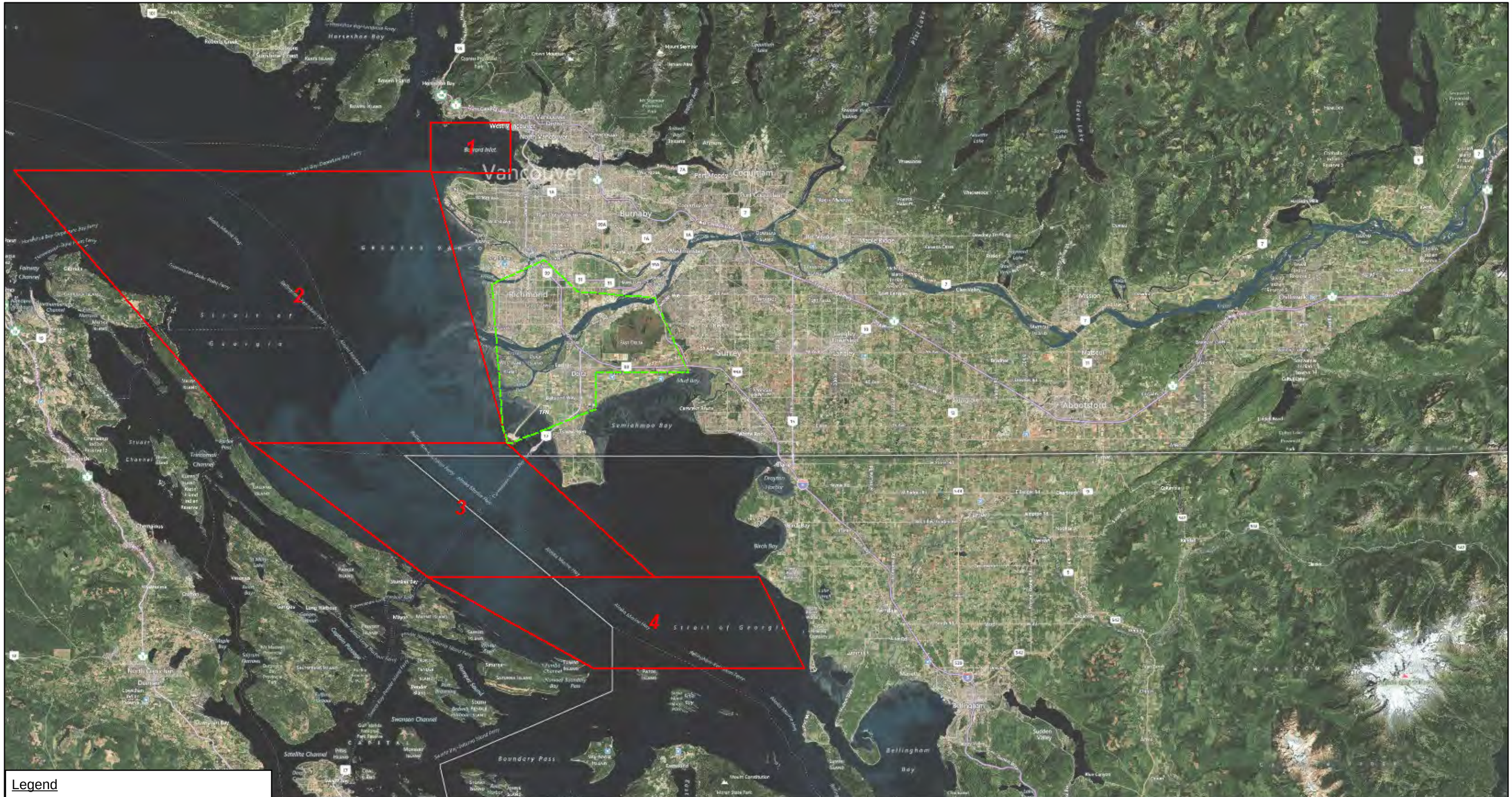
DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

AIR QUALITY ASSESSMENT
LOCAL STUDY AREA

Project No.		
1246-001.04	November 2012	FIGURE 5.5-1



Legend

Canada / USA Border

Regional Emission Inventory Area:

🟥 1 Marine

🟩 Road and Truck

N

0 5 10 15 20
Kilometers

NAD 1983 UTM Zone 10N

PORT METRO
vancouver

DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

AIR QUALITY ASSESSMENT REGIONAL
STUDY AREA IN THE LOWER FRASER VALLEY

Project No. 1246-001.04	November 2012	FIGURE 5.5-2

Legend

- Noise Monitoring Locations
- Project Corridor

Site No.	Address
S1	476 Tsawwassen Beach Rd, Tsawwassen
S2	Tsawwassen First Nations Longhouse 2148 Tsawwassen Dr N, Tsawwassen
S3	3044A 41B St, Delta
S4	6900 36 Ave, Delta
S5	12726 Southridge Dr, Surrey
S6	6270 Glover Rd, Langley

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DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

Overview of Project Corridor and Baseline Sites S1 - S6

Project No.		
1246-001.04	November 2012	FIGURE 6.1-1

N

SITE PLAN
0 1:10000 400

SITE PLAN
0 1:10000 400

LEGEND

- Lux - Measure of Illumination (1 Lux = moonlight)
- Candela - Level of Lighting Brightness
- Defined outline of lighting area (Typ.)

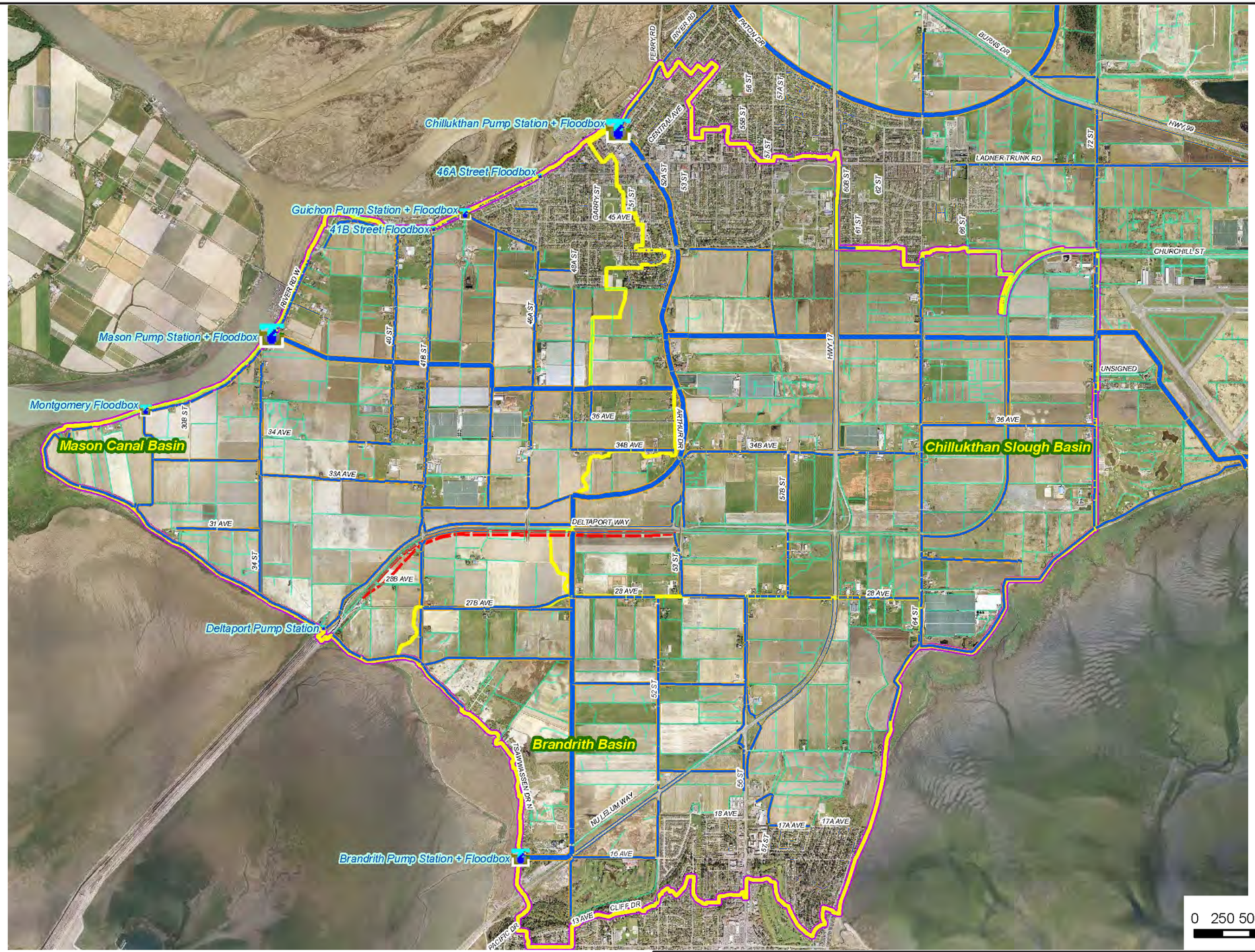
NOTE: Reference plan provided by DMD & Associates Ltd., plan number 3600a-11-05

PORT METRO vancouver

Deltaport Terminal,
Road and Rail Improvement Project
Environmental Assessment Report

Lighting Assessment - Spill Lighting and Brightness Zones

PROJECT No.		
1246-001.04	November 2012	FIGURE 6.3-1



N

0 250 500 1,000 1,500 Meters

LEGEND

Outfalls

- < 30,000 m3
- 30,000 - 100,000 m3
- 100,000 - 200,000 m3
- 200,000 - 500,000 m3
- 500,000 - 1,000,000 m3
- 1,000,000 - 2,000,000 m3
- > 2,000,000 m3

Delta Ditches

- Primary
- MAJOR
- MINOR
- Delta Secondary Ditches

- Study Area
- Southwest Delta Drainage Basins
- Southwest Delta Watershed

Original Figure: Southwest Delta Drainage System, Figure 7.
Created by GMV Engineering, December 2011

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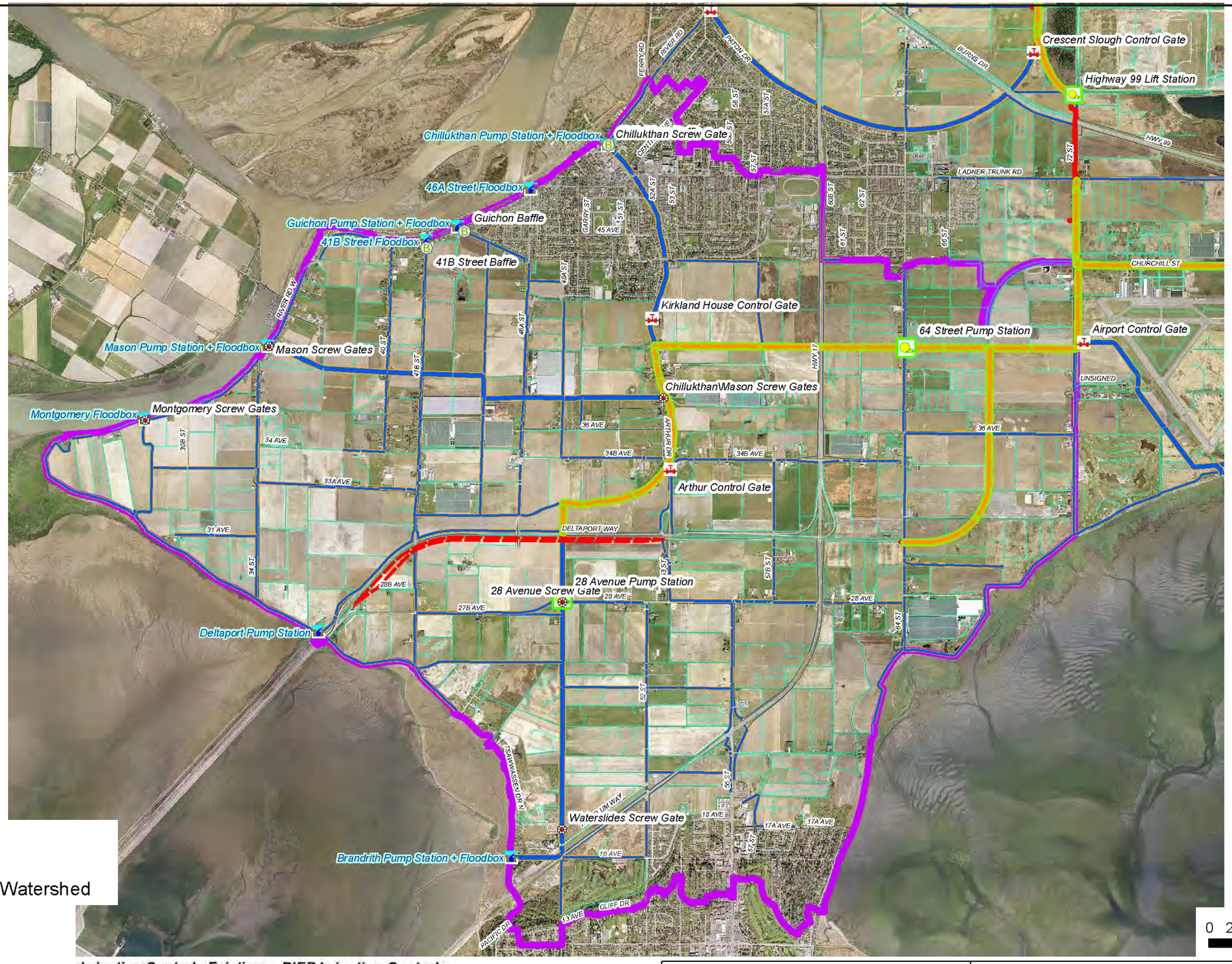
DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT ENVIRONMENTAL ASSESSMENT REPORT

SOUTHWEST DELTA DRAINAGE SYSTEM

PROJECT No.		
1246-001.04	November 2012	FIGURE 6.5-1



LEGEND

- Study Area
- Southwest Delta Watershed

Delta Ditches

- Primary
- MAJOR
- MINOR
- Delta Secondary Ditches

Irrigation Controls Existing

- Baffle
- Screw Gate
- Irrigation Pump Station

DIEP Irrigation Controls

- Lift Station
- Pump Station
- Control Gate
- Automated Control Gate
- DIEP Irrigation Channels
- DIEP Irrigation Conduits
- Outfalls

Original Figure: Southwest Delta Irrigation System, Figure 8.
Created by GMV Engineering, December 2011

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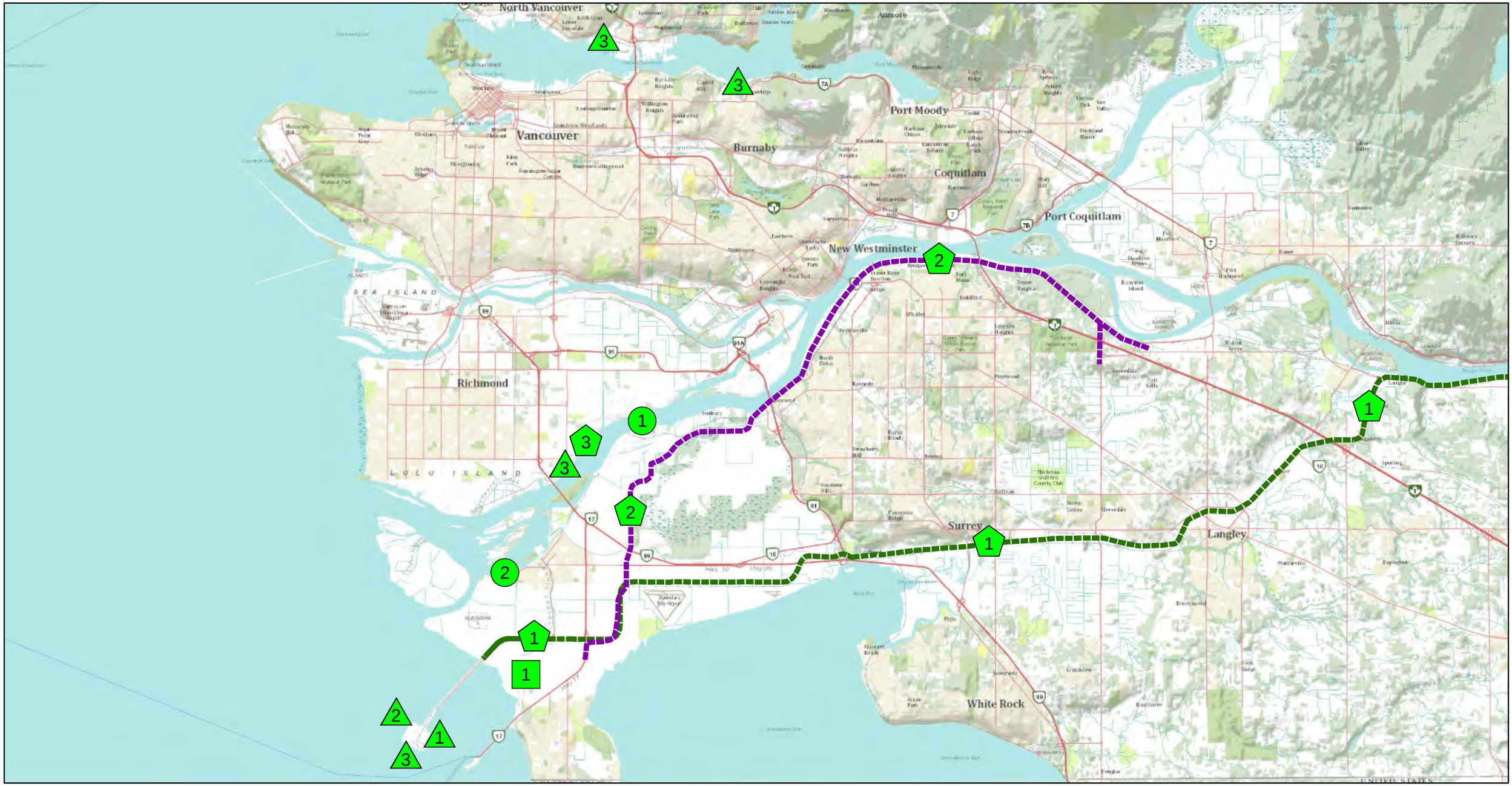
DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

SOUTHWEST DELTA IRRIGATION SYSTEM

PROJECT No.		
1246-001.04	November 2012	FIGURE 6.5-2



Deep Sea Terminals

1. Deltaport with DTRRIP
2. Roberts Bank Terminal 2 project
3. Terminal upgrades and operational changes

Costal/Riparian Modifications

1. Fraser River shipping channel dredging
2. Marina development

Railways, Roads, and Airports

1. Roberts Bank Rail Corridor Program
2. South Fraser Perimeter Road
3. Vancouver Airport Fuel Delivery Project

Residential/Retail and Indutrial Developments

1. Tsawwassen First Nation Land Use Plan Area

N

0 1,000 2,000 3,000 4,000
Metres

NAD 1983 UTM Zone 10N

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Deltaport Terminal, Road and Rail Improvement Project
Environmental Assessment Report

Locations of Projects included in the Assessment of Cumulative Environmental Effects

Project No.		
1246-001.04	November 2012	FIGURE 8-1

APPENDIX A

BC Hydro Protocol Agreement for Work in and around Water

PROTOCOL AGREEMENT

FOR WORK IN AND AROUND WATER

Associated with BC Hydro & BCTC Infrastructure

Between: BC Hydro, British Columbia Transmission Corporation, BC Ministry of Environment, and Fisheries and Oceans Canada

Canada

BRITISH COLUMBIA

BC Transmission CORPORATION

BC hydro

Protocol Agreement for Work In and Around Water Associated with BC Hydro & BCTC Infrastructure

Between: BC Hydro (BCH)

And: British Columbia Transmission Corporation (BCTC)

And: BC Ministry of Environment (MoE)

And: Fisheries and Oceans Canada (DFO)

(The Partners)

Whereas:

A) DFO is responsible, through the *Fisheries Act*, for the management of fish and fish habitat, and ensuring the long-term sustainability of the fisheries resources of Canada;

B) MoE is responsible, through the provisions of the *Water Act*, for the management and protection of fresh water including changes in and about a stream;

C) BCH and BCTC are independent and responsible, through the BC *Utilities Commission Act*, for providing a reliable supply of electricity through the Province's power system while ensuring public and worker safety;

D) The authority of BCH and BCTC to conduct their business is derived from the *Hydro and Power Authority Act* and the *Transmission Corporation Act* respectively. BCTC is responsible for management of transmission assets, whereas BCH is responsible for the generation and distribution of electricity;

E) BCH and BCTC recognize the vital physical and ecological roles fulfilled by aquatic, marine and riparian ecosystems; further, they recognize the importance of protecting these ecosystems from harmful alteration, disruption or destruction and ensuring their long-term sustainability; and

F) Effective co-operation among the Partners will lead to certainty and predictability for managing environmental issues.

Therefore:

G) The Partners will ensure the protection and sustainability of these fresh water, marine and riparian ecosystems, while streamlining regulatory activities;

H) The Partners agree that, once signed by the Partners, the Approved Work Practices documents listed in Table 1, which are appended to this Agreement or to be added at a later date, represent acceptable activities associated with BCH's and BCTC's installations, replacements, reconfigurations and routine repair and maintenance activities in and around water;

I) BCH and BCTC will endeavour to undertake work according to the Approved Work Practices;

J) DFO and MoE agree that work done according to the Approved Work Practices constitutes an accepted practice and is not subject to formalized regulatory approval; and

K) Work proposed that is not fully consistent with the Approved Work Practices is subject to review and may require approvals, acceptance of notification, letters of advice or Authorization.

Policies and Legislation:

1. Nothing in this Agreement:

a) alters the legislatively mandated roles, responsibilities and duties of the Partners; or

b) relieves BCH and BCTC of any obligations either of them may have to obtain EAO, CPCN or CEAA approvals.

2. This Agreement does not apply to the installation by BCH or BCTC of new transmission, distribution or generation infrastructure or assets other than those described in the Approved Work Practices.

Approvals and Notifications:

3. Where necessary and appropriate, the DFO Area Manager, Habitat Management or delegate will grant to BCH and BCTC appropriate approvals under the *Fisheries Act* for proposed work that is not fully consistent with the Approved Work Practices.

4. Where necessary and appropriate, the MoE Habitat Officer will accept appropriate notifications and the Water Stewardship Division will grant approvals for Changes In and About a Stream (*Water Act Section 9*) for proposed work that is not fully consistent with the Approved Work Practices.

Implementation and Co-ordination Meetings:

5. The Partners agree to an annual review of the general effectiveness and workability of this Agreement and the Approved Work Practices. This review will be undertaken by a Governance Management Committee comprised of representatives from each of the Partners.

6. The Partners agree to schedule and attend, at a minimum, regional meetings every second year with local area staff. BCH and BCTC will facilitate these meetings at, or in the vicinity of, five main organizational areas (Vancouver Island, Lower Mainland, Southern Interior, North Coast and Northern Interior). The purpose of these meetings will be to review the following information:

a) results of any monitoring reports of the previous year's work and associated actions (if any) conducted under this Agreement;

b) plans for work in the upcoming year relevant to the Approved Work Practices;

c) site-specific prescriptions for work that is not fully consistent with the Approved Work Practices;

d) on-site visits of previous and/or planned works; and

e) other items of mutual interest.

For years when no meetings are planned, BCH and BCTC will provide DFO and MoE Regional Protocol Agreement Leads with a summary of proposed works covered by Approved Work Practices documents signed by the Partners.

7. The Partners agree that informal meetings between regional staff may take place as needed at a local area level in regards to site-specific issues and annual work plans.

8. The Partners agree to participate in working groups in the development phase of new work practices, amendments or renewals. If a Partner declines participation in a working group, the Partner shall confirm its intention to do so in writing to the Governance Management Committee and such Partner's participation in the working group shall terminate upon receipt thereof by the Governance Management Committee.

Sub-Agreements:

9. Differences in biogeoclimatic zones and local work conditions may necessitate specific amendments to the Approved Work Practices. Where necessary, the Partners agree to establish locally specific sub-agreements to accommodate these differences.

10. Regional Protocol Agreement Leads from the Partners' regional offices will accept in writing each sub-agreement.

11. Once accepted, sub-agreements will form an attachment to the associated Approved Work Practices appendix and be communicated to the Partners at the Governance Management Committee level.

Development and Sharing of Resources and Information:

12. The Partners commit to develop and share educational resources and scientific information, where appropriate and resources allow.

Dispute Resolution:

13. The Partners will try to resolve differences regarding this Protocol Agreement at a regional level on an equitable and timely basis. If a dispute cannot be resolved satisfactorily at the local level, the issue will be raised to increasingly senior levels until the dispute is resolved. If the dispute remains unresolved, the Partners agree to participate in an external dispute resolution process facilitated by an independent third party.

Term:

14. This Agreement, associated appendices and sub-agreements will continue in full force until:

a) it is superseded by written agreement of the Partners; or
b) it is terminated by written agreement of the Partners.

15. Any Partner may opt out of the Agreement by providing six (6) weeks notice to the other Partners as well as the reasons for opting out. In such an event, the Agreement will continue in full force between the Partners who have not opted out of the Agreement.

Signatories:

Janet Woodruff
President
British Columbia Transmission Corporation

Ralph Archibald
Assistant Deputy Minister
Environmental Stewardship Division
Ministry of Environment

Raymond Stewart
Chief Safety, Health & Environment Officer
and Director of Dam Safety
BC Hydro

Paul Sprout
Regional Director General
Pacific Region
Fisheries and Oceans Canada

Table 1 - List of Approved Work Practice Documents

Document Title	Document Location
Approved Work Practices for Managing Riparian Vegetation	Appendix A
Approved Work Practices for Road and Water Crossing Maintenance and Upgrades	Appendix B
Approved Work Practices for Submarine Cable Maintenance	Appendix C
Approved Work Practices for Pole and Steel Tower Maintenance and Line Decommissioning	Appendix D
Approved Work Practices for Boat Launches in Freshwater Reservoirs and Associated Waterways	Appendix E
Approved Work Practices for Dredging & Excavation in Freshwater	Appendix F
Approved Work Practices for Bank Stabilization	Appendix G
Approved Work Practices for Beach Recontouring in Freshwater Environments	Appendix H
Approved Work Practices for Dewatering in Freshwater	Appendix I

APPENDIX B

Federal Coordination for the Proposed DTRRIP

PORT METRO
vancouver

To: Coral Deshield: Head, Conservation Service Delivery, Environment Canada

Barry Jeffrey: Manager, Environmental Assessment & Marine Programs, Environment Canada

Herbert Antill: A/Regional Manager, Environmental Services, Transport Canada

Corino Salomi: Area Manager, Fisheries and Oceans Canada

Carl Alleyne: Regional Environmental Assessment Coordinator, Health Canada

John Woodward, Senior Environmental Officer, Canadian Transportation Agency

Cc: Lisa Walls: Director Regional, Canadian Environmental Assessment Agency, Pacific and Yukon Regional Office

From: **Carrie Brown, Vancouver Fraser Port Authority**
Port Metro Vancouver
100 The Pointe, 999 Canada Place
Vancouver, BC Canada V6C 3T4
direct: 604.665.9081 mobile: 778.231.7460
PMV: 604.665.9000 fax: 1.866.284.4271
carrie.brown@portmetrovancouver.com

Date: 15 November 2011

Subject: **Federal Coordination for the Proposed Deltaport Terminal, Road, Rail Improvement Project (DTRRIP)**

The Vancouver Fraser Port Authority, doing business as Port Metro Vancouver is working to design and implement the Deltaport Terminal, Road and Rail Improvement Project ("DTRRIP" or the "Project") in Delta, British Columbia. This project is being undertaken with the Province of British Columbia (including the British Columbia Railway Company (BCRC), as part of the Ministry of Transportation and Infrastructure) and Terminal Systems Inc. (TSI) the Deltaport Container Terminal operator. The Project will provide Port Metro Vancouver with upgraded road and rail infrastructure that will optimize productivity within the Deltaport Container Terminal, and will increase the container capacity at Deltaport by 600,000 TEUs (twenty-foot equivalent unit containers) to a total of 2.4 million TEUs.

The Project will require a screening-level environmental assessment (EA) under the Canada *Port Authority Environmental Assessment Regulations* of the *Canadian Environmental Assessment Act* (CEAA) because it is deemed a physical work with federal funding provided by Port Metro Vancouver. Port Metro Vancouver will conduct the assessment as a Canada Port Authority.

Based on the current information, DTRRIP consists of four main components:

1. An overpass on the existing Roberts bank causeway to separate road and rail traffic;
2. Reconfiguration of rail track in the Deltaport Intermodal Yard and the addition of terminal equipment;
3. Additional rail track within the existing British Columbia Rail Company (BCRC) right-of-way and Options Lands; and
4. Road improvements on Deltaport Way to improve the movement of container trucks at Deltaport.

In accordance with the *Regulations Respecting the Coordination of Federal Authorities on Environmental Assessment Procedures and Requirements* under the *Canadian Environmental Assessment Act* (CEAA), Port Metro Vancouver requests that you indicate your determination with respect to this project.

As indicated in the attachment below, you are requested to indicate whether your department is, or anticipates identifying a responsibility under Section 5(1) of CEAA to assess the environmental effects of the project, i.e., whether you are a Responsible Authority (RA). You are further requested to indicate whether you intend to provide specialist advice on the proposed project pursuant to Section 12(3) of CEAA, i.e., whether you are Expert Federal Authority (FA).

This letter initiates the process of identifying potential responsible authorities and expert federal authorities with an interest in this project. Please review the attached project description and complete the form below, **by 01 December 2011,** and return it via fax back to PMV at 1-866-284-4271. The rationale for the short turn-around time is so that we may have your response prior to our multi-stakeholder meetings and public open houses, scheduled for the period December 6-10, 2011.

I look forward to working with you on this project.

Yours truly,

Carrie Brown, P. Geo.
Manager, Environmental Programs

EF/--

Encl 1: Project Description: Deltaport Terminal Road Rail Improvement Project (DTRRIP)

FEDERAL COORDINATION REGULATIONS – Section 4
Record of Determination

Proposed Deltaport Terminal Road and Rail Improvement Project Project (DTRRIP)

In accordance with the *Regulations Respecting the Coordination by Federal Authorities of Environmental Assessment Procedures and Requirements* (Federal Coordination Regulations), please indicate (by checking the appropriate box) **by 01 December 2011,** whether or not your department/agency:

a) Has, or anticipates, identifying a responsibility under Section 5(1) of CEAA to assess the environmental effects of the project (i.e. are an Responsible Authority (RA));

YES _____NO _____

b) Can provide specialist advice pursuant to Section 12(3) of CEAA with respect to an environmental assessment of the proposed project (i.e. are an Expert Federal Authority (FA)).

YES _____ NO _____

c) Requires additional information to make a determination referred to in a) or b) above
YES _____ NO _____

-if the answer is yes, please forward the request for additional information **within 10 days** after making the determination.

If your answer to **a)** above is YES, please indicate:

- The trigger
_____
_____

- The following contact information:

Name:
_____

Address:
_____
_____
_____

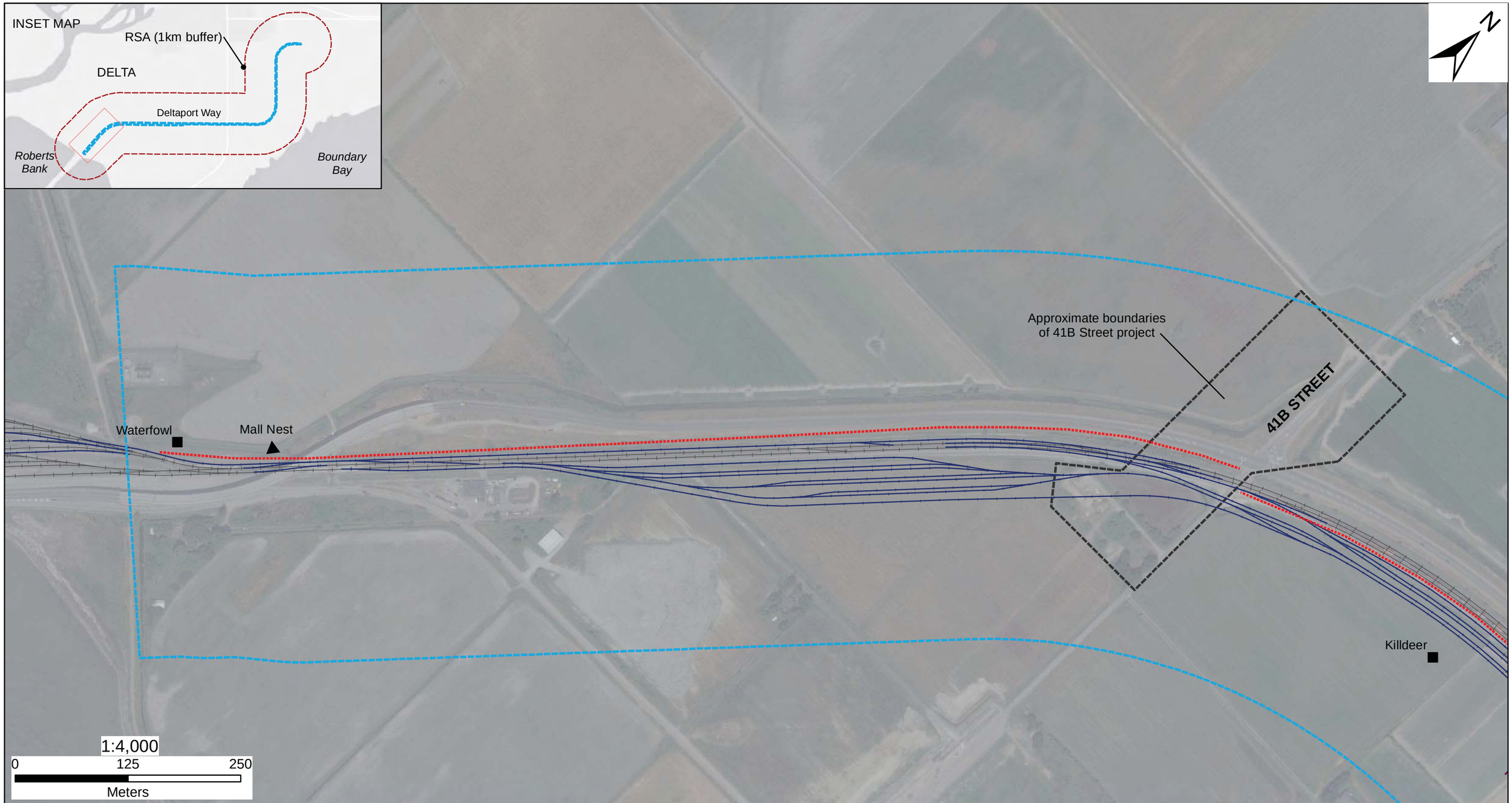
Telephone: _____ Facsimile: _____

E-Mail: _____

Please advise what role your department plans to play in this review by email to Carrie Brown carrie.brown@portmetrovancouver.com or FAX at 1-866-284-4271 by **01 December 2011.**

APPENDIX C

Ecological Attribute Mapping within the Study Area



Legend

- Local Study Area
- Vegetation Transect
- Proposed Rail
- Existing Rail
- Nest Location
- Other Bird Sighting

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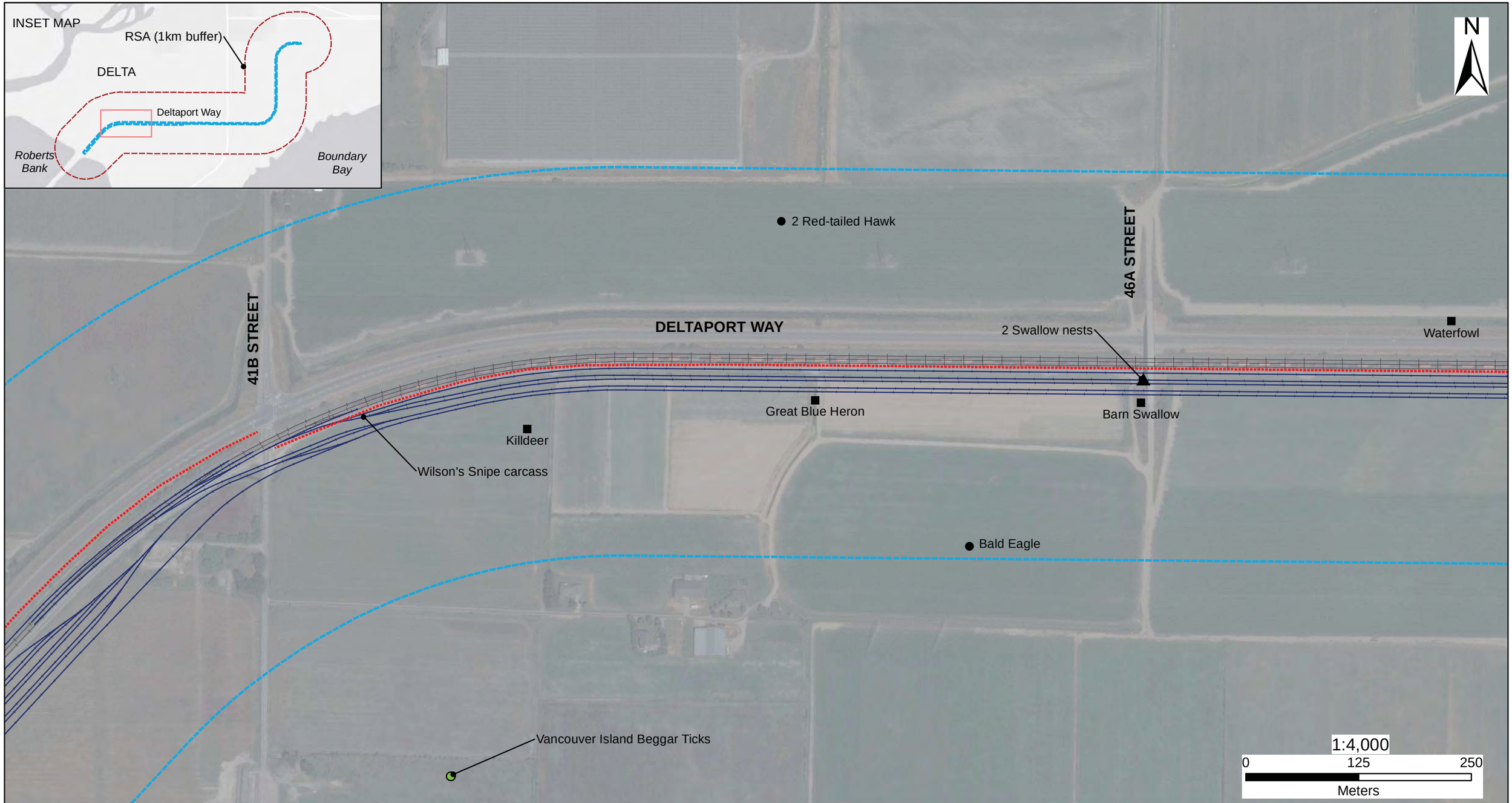
DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

VEGETATION AND WILDLIFE MAPPING

Project No.		
1246-001.04	November 2012	**Sheet 1**



Legend

- Local Study Area
- Vegetation Transect
- Proposed Rail
- Existing Rail
- Nest Location
- Other Bird Sighting
- Raptor Sighting
- Rare Plant Location

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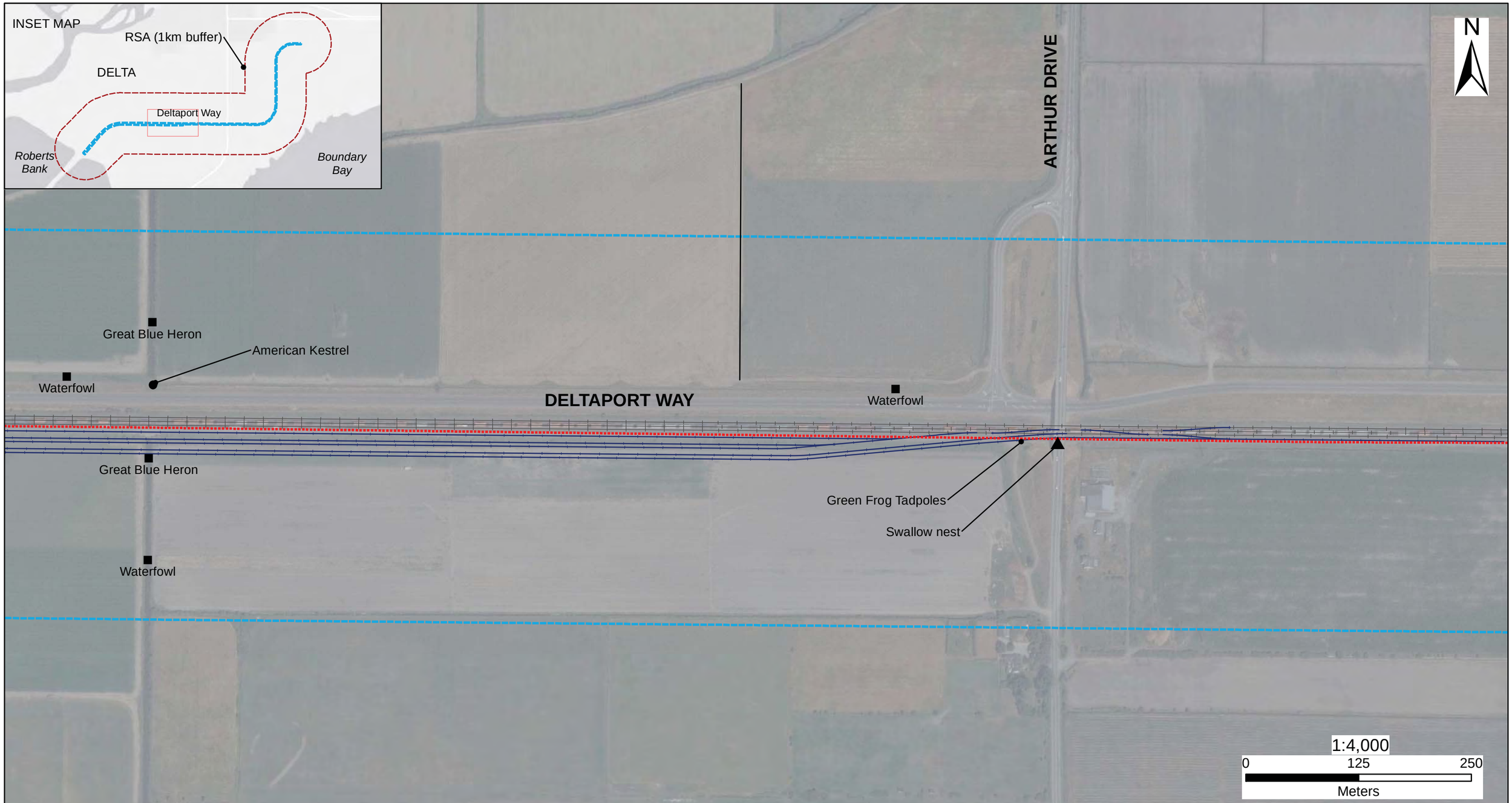
DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

VEGETATION AND WILDLIFE MAPPING

Project No.		
1246-001.04	November 2012	**Sheet 2**



Legend

- Local Study Area
- Vegetation Transect
- Proposed Rail
- Existing Rail
- Nest Location
- Other Bird Sighting
- Raptor Sighting

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DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

VEGETATION AND WILDLIFE MAPPING

Project No.		
1246-001.04	November 2012	Sheet 3

Legend

- Local Study Area
- Vegetation Transect
- Proposed Rail
- Existing Rail
- Nest Location
- Other Bird Sighting
- Raptor Sighting

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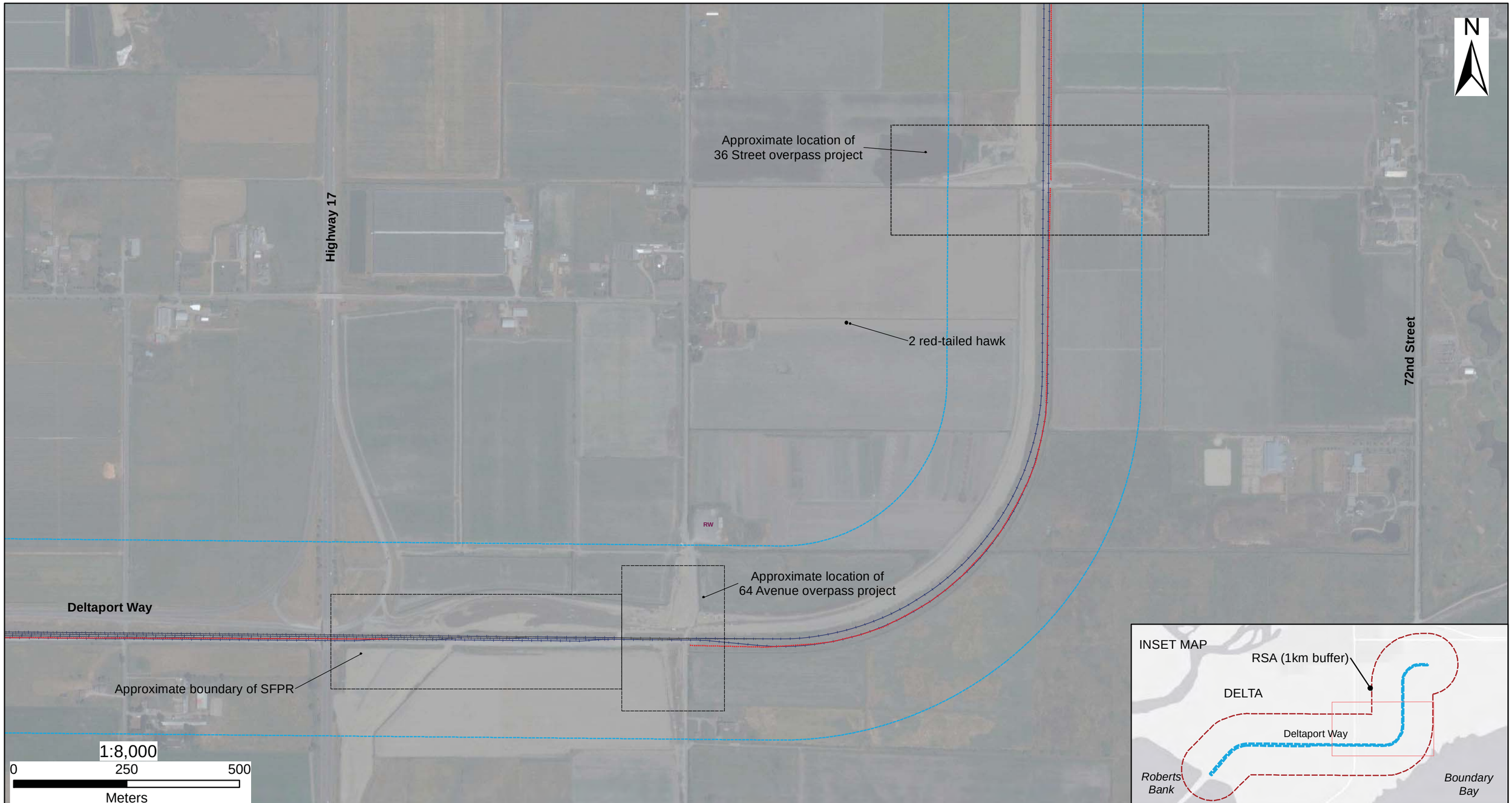
DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

VEGETATION AND WILDLIFE MAPPING

Project No.		
1246-001.04	November 2012	Sheet 4



Legend

- Local Study Area
- Vegetation Transect
- Proposed Rail
- Existing Rail
- Raptor Sighting

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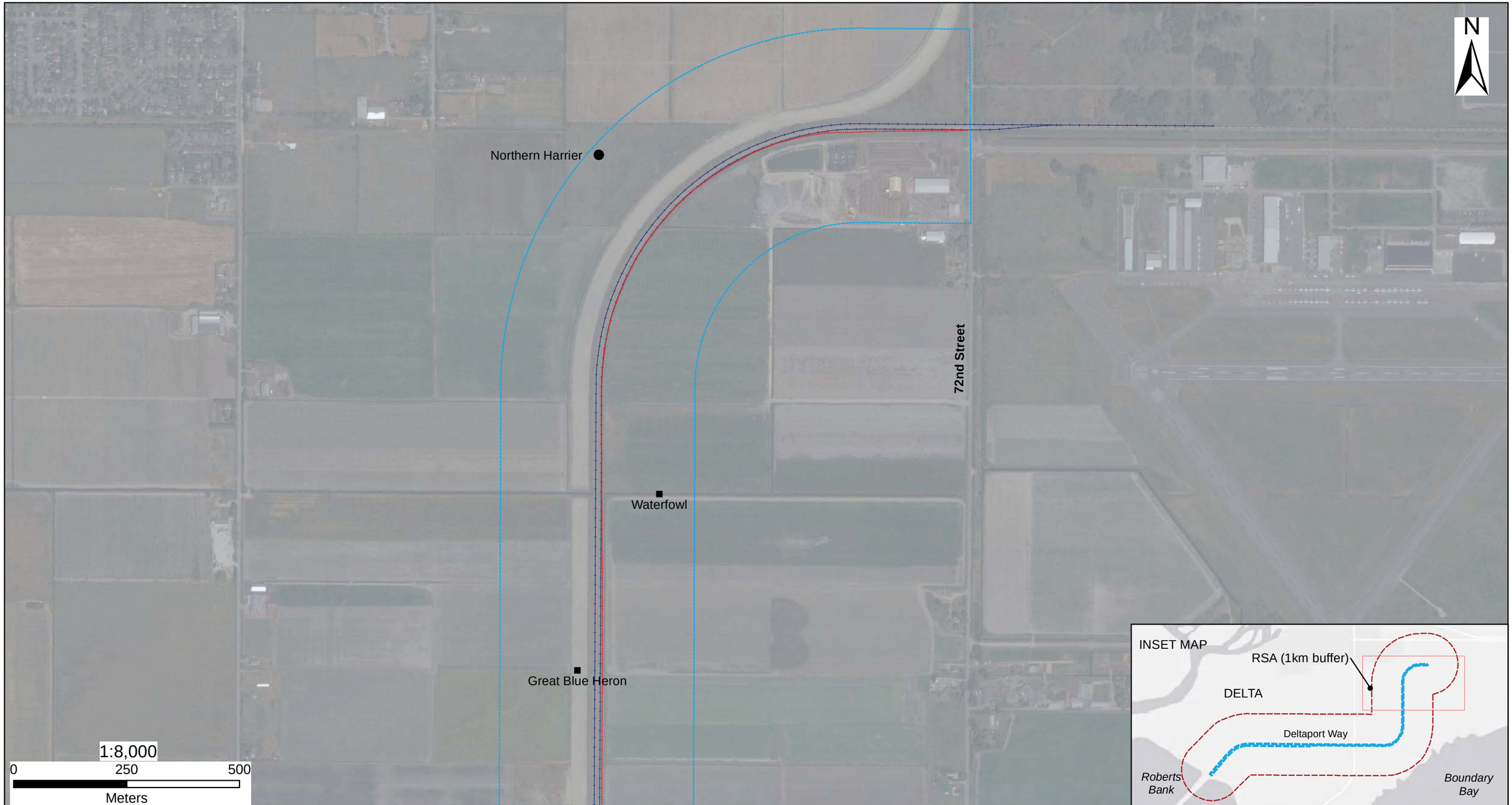
DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

VEGETATION AND WILDLIFE MAPPING

Project No.		
1246-001.04	November 2012	Sheet 5



Legend

- Local Study Area
- Vegetation Transect
- Proposed Rail
- Existing Rail
- Other Bird Sighting
- Raptor Sighting

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DELTAPORT TERMINAL, ROAD AND RAIL IMPROVEMENT PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

VEGETATION AND WILDLIFE MAPPING

Project No.		
1246-001.04	November 2012	Sheet 6

APPENDIX D

Rare Plant Report

Rare Vascular Plant Inventory Deltaport Terminal, Road and Rail Improvement Project Study Area – FINAL DRAFT

Matt Fairbarns

Aruncus Consulting

2130 Kings Road

Victoria, BC V8R 2P9

April 2012

Prepared for Hemmera Envirochem Inc.

EXECUTIVE SUMMARY

Botanical surveys were conducted in an area adjacent to BC Rail facilities in Delta, British Columbia. The study area occurs within the moist maritime subzone of the Coastal Douglas-fir biogeoclimatic zone. Natural environments have been eliminated from most of the study area although some fragments of semi-natural salt marsh and saline strand habitats may still be found along the shoreline. Despite the scarcity of natural plant communities, there was a modest chance of finding some of the rare species which persist in similar modified habitats in the region.

Several rare vascular plant species have been reported from the Metro Vancouver Regional District and while many are restricted to habitat types not found in the study area, several are suited to local conditions.

Field studies were conducted on July 19, July 22, August 17 and September 19, 2011 in order to examine the area during the key flowering dates for each species on the target list.

No federally-protected species were encountered, nor were any species on the BC provincial red or blue lists detected.

Climatic conditions were unusual in 2011. There were several hard frosts in February, when some rare winter annuals normally germinate. An unusually heavy snowfall on February 23, 2011 also constituted an atypical stress on the local flora. The spring and early summer were much wetter than normal and temporary ponds may not have dried out as much as normal, thus failing to provide an extended period of suitable habitat for some rare summer annual plant species found in such microsites. Nevertheless, the results to date and the scarcity of habitat types likely to support rare plant species suggest that no further surveys are required.

TABLE OF CONTENTS

TABLES

1.0 INTRODUCTION AND OBJECTIVES

The Deltaport Terminal Road and Rail Improvement Project (DTRRIP) study area contains BC Rail facilities in Delta, British Columbia. It occurs within the moist maritime subzone of the Coastal Douglas-fir biogeoclimatic zone. Natural environments have been eliminated from most of the study area although some fragments of semi-natural salt marsh and saline flats may still be found along the shoreline. Despite the scarcity of natural plant communities, there was a modest chance of finding some of the rare species which persist in similar modified habitats in the region.

This report outlines the results of a 2011 project to survey and describe the distribution and characteristics of rare plant populations in the area. Specifically, the project undertook to:

1. Conduct a rare vascular plants inventory throughout the study area,
2. For any federally-protected[1] or provincially listed[2] vascular plant species, collect GPS coordinates and population data, list leading associated plant species, and note environmental characteristics (e.g. slope, aspect, terrain surface shape and approximate depth of soil), and
3. Indicate any immediate threats to the persistence of any federally or provincially listed vascular plant species.

2.0 METHODS

The survey met guidelines generally established for such work (e.g., Alberta Native Plant Council 2000).

A preliminary list was prepared of rare plant species known to occur in the Coastal Douglas-fir zone within the Metro Vancouver Regional District, based on a search of the BC Conservation Data Centre database (B.C. Conservation Data Centre 2011). The preliminary list was modified by removing species restricted to habitat types that would not occur in the study area (e.g., high elevation sites) and adding species which might be expected to occur in the area although not yet reported (Table 1). The habitat preferences and peak survey times of target species were determined by reference to herbarium label information and records from previous collections, reports and studies. The BC Conservation Data Centre database was also used to identify appropriate periods for field surveys, and to determine the local habitat preferences of target rare species.

Regional floras and recent taxonomic works were consulted in order to flag key characters useful in differentiating rare species from similar common species and identify general biological characteristics of target rare plant species.

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[1] In this document, the term federally-protected species means species legally protected under the federal species at risk act (SARA)

[2] Species at risk in BC, as provided in the provincial red and blue lists provided by the BC Conservation Data Centre

Table 2-1. Target Species List

Scientific Name	English Name	Global Status [a]	Prov Status	BC List
Alopecurus carolinianus	Carolina Meadow-foxtail	G5	S2	Red
Anagallis minima	Chaffweed	G5	S3	Blue
Bidens amplissima	Vancouver Island Beggarticks	G3	S3	Blue
Callitriche heterophylla ssp. *heterophylla*	Two-edged Water-starwort	G5T5	S2S3	Blue
Caltha palustris var. radicans	Yellow Marsh-marigold	G5TNR	S2S3	Blue
Cardamine parviflora var. *arenicola*	Small-flowered Bitter-cress	G5T5	S1	Red
Carex amplifolia	Bigleaf Sedge	G4	S3S4	Yellow
Carex interrupta	Green-fruited Sedge	G4	S2	Red
Carex scoparia	Pointed Broom Sedge	G5	S2S3	Blue
Carex vulpinoidea	Fox Sedge	G5	S2S3	Blue
Claytonia washingtoniana	Washington Springbeauty	G2G4	S2	Red
Cuscuta campestris	Field Dodder	G5	S2S3	Blue
Elatine rubella	Three-flowered Waterwort	G5	S2S3	Blue
Eleocharis parvula	Small Spike-rush	G5	S2S3	Blue
Eleocharis rostellata	Beaked Spike-rush	G5	S2S3	Blue
Eutrochium maculatum var. *bruneri*	Joe-Pye Weed	G5T4T5Q	S1	Red
Glyceria leptostachya	Slender-spiked Mannagrass	G3	S2S3	Blue
Helenium autumnale var. *grandiflorum*	Mountain Sneezeweed	G5T3T5	S2S3	Blue
Isoetes nuttallii	Nuttall's Quillwort	G4?	S3	Blue
Juncus oxymeris	Pointed Rush	G5	S2S3	Blue
Lilaea scilloides	Flowering Quillwort	G5?	S2S3	Blue
Lupinus rivularis	Streambank Lupine	G2G4	S1	Red
Myriophyllum ussuriense	Ussurian Water-milfoil	G3	S3	Blue
Navarretia intertexta	Needle-leaved Navarretia	GNR	S2	Red
Pleuropogon refractus	Nodding Semaphoregrass	G4	S3	Blue
Rubus nivalis	Snow Bramble	G4?	S3?	Blue
Rupertia physodes	California-tea	G4	S3	Blue
Sidalcea hendersonii	Henderson's Checker-mallow	G3	S3	Blue

Note: [a] When the global status rank of the provincial status rank is followed by "?" the question mark indicates that NatureServe has expressed reservation about the exact numeric rank

High-resolution air photographs were reviewed to help locate habitats with the highest potential for rare plant species. The rare plant surveys were conducted across the entire study area, which consisted of two components.

Component 1 consisted of a stretch of land south of the existing rail line between the base of the

causeway leading to the Roberts Bank facility and the railway crossing at 72nd Street, as well as a small area north of the railway and west of the BC Rail building near the base of the causeway. The surveyed area along the south side of the railway was 65 m wide west of Arthur Drive ("Gulf Yard") and 30 m wide between Arthur Drive and 72nd Street ("Fisher Yard").

Component 2 consisted of a 30 m wide stretch of land north of Deltaport Way, from Arthur Drive west to partway along the causeway.

Frank Lomer conducted a preliminary survey over both components on July 19, 2011. More detailed surveys were conducted by Matt Fairbarns, along Component 1 on July 22 and September 19, and on Component 2 on August 17. These dates were chosen in order to examine the area during the key flowering dates for each species on the target list. The primary surveyor (Matt Fairbarns) has over 25 years experience as a botanical field investigator, has demonstrated the taxonomic experience to identify (in the field) most plant species he comes across in the survey area, and the remainder later through taxonomic determination, has an extensive knowledge of plant ecology and has over 18 years experience studying the local flora and with an emphasis on the rare species which potentially exist within the habitats surveyed. The secondary surveyor, Frank Lomer, is a botanist specializing in the flora of British Columbia and is widely recognized as a leading expert on the flora of the Lower Mainland.

Surveys were conducted by walking transects along the midline of the survey bands, scanning left and right using a pair of binoculars. Any promising habitat found along the survey bands was examined in detail by conducting detailed searches at intervals of approximately 5 m.

3.0 SUMMARY OF RESULTS

No federally-protected rare plant species were detected during the surveys, nor were any provincially listed species encountered.

Much of the habitat within a 400m wide corridor on either side of the project footprint has been profoundly altered by agricultural use and is unlikely to support plant species at risk. There are, however, two exceptions that are significant with respect to rare plant conservation:

1. Some small, wet depressions within farm fields have been avoided by farmers and still provide pockets of natural habitat for rare species. For example, Vancouver Islands Beggarticks (*Bidens amplissima*) has been observed in just such a wet pocket approximately 500 m south of the project footprint and it is quite possible undetected subpopulations occur elsewhere in the area. Vancouver Islands Beggarticks is currently listed as a species of Special Concern under the Canada Species at Risk Act and evidence is gathering that this species is in decline and may warrant up-listing to an even higher conservation priority.

2. The complex mosaic of shoreline ecosystems, though heavily impacted by invasive species, contains many pockets of relatively high-quality salt marsh vegetation and salt stand habitat and a few small pockets of sandy beach habitat. A number of species at risk are known to occur in such habitat types and may be present. For example, Silky Beach Pea (*Lathyrus littoralis*) has been reported from a small sandy pocket on the shores of Swishwash Island, a sandy island also in the outer Fraser Delta. Silky Beach Pea is currently being assessed by COSEWIC (The Committee on the Status of Endangered Wildlife in Canada) and will likely be added to the schedule of species protected under the Species at Risk Act. Henderson's Checker-mallow (*Sidalcea hendersonii*), a provincially blue-listed plant of salt marsh habitats, is also known Swishwash Island. Both Silky Beach Pea and Henderson's Checker-mallow have the potential to occur in areas of suitable habitat at the base of causeway leading to the Deltaport facility.

4.0 RECOMMENDATIONS

Surveys can not conclusively prove the absence of rare species from a study area but the survey reported in this document met guidelines established for rare species surveys. Although weather conditions in 2011 were somewhat unusual, the results to date and the scarcity of habitat types likely to support rare plant species suggest that no further surveys are required.

5.0 LITERATURE CITED

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APPENDIX E

Plant Species Documented within the Study Area

Table 1 Plant Species Documented within the DTRRIP Study Area

English Name	Latin Name
Yarrow	*Achillea millefolium*
Redtop	*Agrostis gigantea*
Silver hairgrass	*Aira caryophyllea*
Redroot pigweed	*Amaranthus retroflexus*
Silver burweed	*Ambrosia chamissonis*
Pearly everlasting	*Anaphalis margaritacea*
Common chamomile	*Anthemis arvensis*
Aster sp.	*Aster* sp.
Orache	*Atriplex patula*
Brome	*Bromus* sp.
Sedge	*Carex* sp.
Diffuse knapweed	*Centaurea diffusa*
Field chickweed	*Cerastium arvense*
Lamb's-quarters	*Chenopodium album*
Canada thistle	*Cirsium arvense*
Common hawthorn	*Crataegus monogyna*
Scotch broom	*Cytisus scoparius*
Flixweed	*Descurainia sophia*
Fireweed	*Epilobium angustifolium*
Purple-leaved willowherb	*Epilobium ciliatum* ssp. *ciliatum*
Common horsetail	*Equisetum arvense*
Fescue sp.	*Festuca* sp.
Cleavers	*Galium aperine*
Hawkweed	*Hieraceum* sp.
Common St. Jonh's-wort	*Hypericum perforatum*
Common rush	*Juncus effuses*
Wall lettuce	*Lactuca muralis*
Prickly lettuce	*Lactuca serriola*
Pacific crab apple	*Malus fusca*
Pineapple weed	*Matricaria discoidea*
White sweet-clover	*Melilotus alba*
Field forget-me-not	*Myosotis arvensis*
Reed canarygrass	*Phalaris arundinacea*
Common timothy	*Phleum pretense*

English Name	Latin Name
Pine	*Pinus* sp.
Ribwort	*Plantago lanceolata*
Common plantain	*Plantago major*
Common knotweed	*Polygonum aviculare*
Black cottonwood	*Populus balsamifera* ssp. *Trichocarpa*
Silverweed	*Potentilla anserine* ssp. *Pacifica*
Domestic cherry	*Prunus* sp.
Meadow buttercup	*Ranunculus acris*
Creeping buttercup	*Ranunculus repens*
Creeping yellow cress	*Rorippa sylvestris*
Himalayan blackberry	*Rubus armeniacus*
Evergreen blackberry	*Rubus laciniatus*
Sheep sorrel	*Rumex acetosella*
Willow sp.	*Salix* sp.
Red elderberry	*Sambucus racemosa* ssp. *pubens*
American bulrush	*Scirpus americanus*
Common groundsel	*Senecio vulgaris*
Canada goldenrod	*Solidago canadensis*
Common sow-thistle	*Sonchus oleraceus*
Hardhack	*Spiraea douglasii*
Chickweed	*Stellaria media*
Common tansy	*Tanacetum vulgare*
Common dandelion	*Taraxacum officinale*
Clover	*Trifolium* sp.
Common cattail	*Typha latifolia*
Tamarack	*Larix* sp.
Cedar	*Thuja* sp.
Common vetch	*Vicia sativa*

Table 2 Rare Plants of the CDFmm within the Metro Vancouver Region

English Name	Latin Name	**COSEWIC	*SARA	***BC List
Carolina meadow-foxtail	*Alopecurus carolinianus*	-	-	Red
Roell's brotherella	*Brotherella roellii*	E (Nov 2010)	-	Red
small-flowered bitter-cress	*Cardamine parviflora* var. *arenicola*	-	-	Red
green-fruited sedge	*Carex interrupta*	-	-	Red
Washington springbeauty	*Claytonia washingtoniana*	-	-	Red
Joe-pye weed	*Eutrochium maculatum* var. *bruneri*	-	-	Red
streambank lupine	*Lupinus rivularis*	E (Nov 2002)	1-E (Jan 2005)	Red
needle-leaved navarretia	*Navarretia intertexta*	-	-	Red
-	*Physcomitrium immersum*	-	-	Red
-	*Pseudephemerum nitidum*	-	-	Red
-	*Alsia californica*	-	-	Blue
Chaffweed	*Anagallis minima*	-	-	Blue
Vancouver Island beggarticks	*Bidens amplissima*	SC (Nov 2001)	1-SC (Jun 2003)	Blue
-	*Brachythecium holzingeri*	-	-	Blue
-	*Bryum canariense*	-	-	Blue
two-edged water-starwort	*Callitriche heterophylla* ssp. *Heterophylla*	-	-	Blue
yellow marsh-marigold	*Caltha palustris var. radicans*	-	-	Blue
pointed broom sedge	*Carex scoparia*	-	-	Blue
field dodder	*Cuscuta campestris*	-	-	Blue
-	*Discelium nudum*	-	-	Blue
-	*Drepanocladus aduncus*	-	-	Blue
three-flowered waterwort	*Elatine rubella*	-	-	Blue
small spike-rush	*Eleocharis parvula*	-	-	Blue
beaked spike-rush	*Eleocharis rostellata*	-	-	Blue
-	*Epipterygium tozeri*	-	-	Blue
-	*Fissidens ventricosus*	-	-	Blue
slender-spiked mannagrass	*Glyceria leptostachya*	-	-	Blue
mountain sneezeweed	*Helenium autumnale* var. *grandiflorum*	-	-	Blue
Nuttall's quillwort	*Isoetes nuttallii*	-	-	Blue
pointed rush	*Juncus oxymeris*	-	-	Blue
flowering quillwort	*Lilaea scilloides*	-	-	Blue
Ussurian water-milfoil	*Myriophyllum ussuriense*	-	-	Blue

English Name	Latin Name	**COSEWIC	*SARA	***BC List
-	*Orthotrichum cupulatum*	-	-	Blue
-	*Orthotrichum striatum*	-	-	Blue
-	*Physcomitrium pyriforme*	-	-	Blue
-	*Platyhypnidium riparioides*	-	-	Blue
nodding semaphoregrass	*Pleuropogon refractus*	-	-	Blue
-	*Ptychomitrium gardneri*	-	-	Blue
snow bramble	*Rubus nivalis*	-	-	Blue
California-tea	*Rupertia physodes*	-	-	Blue
Henderson's checker-mallow	*Sidalcea hendersonii*	-	-	Blue

Table 3 At-risk Plant Communities within the CDFmm in the Metro Vancouver Region

English Name	Latin Name	***BC List	Biogeoclimatic Units
Lyngbye's sedge herbaceous vegetation	*Carex lyngbyei Herbaceous Vegetation*	Blue	CDFmm/Em05;CWH/Em05
tufted hairgrass - Douglas' aster	*Deschampsia cespitosa ssp. beringensis - Aster subspicatus*	Blue	CDFmm/Ed02;CWH/Ed02
tufted hairgrass - meadow barley	*Deschampsia cespitosa* ssp. *beringensis - Hordeum brachyantherum*	Blue	CDFmm/Ed01;CWH/Ed01
common spike-rush Herbaceous Vegetation	*Eleocharis palustris* Herbaceous Vegetation	Blue	BGxw2/Wm04;CDFmm/Wm04;CWH/Wm04;ESSFdvd/Wm04;ESSFdv/Wm04;IDFxm/Wm04;SBSdk/Wm04;SBSmk2/Wm04
buckbean - slender sedge	*Menyanthes trifoliata - Carex lasiocarpa*	Blue	CDFmm/Wf06;CWHws1/Wf06;ICHwk1/Wf06;IDFdk2/Wf06;SBSdk/Wf06
common cattail Marsh	*Typha latifolia* Marsh	Blue	BGxh1/Wm05;BGxh2/Wm05;BGxw1/Wm05;CDFmm/Wm05;CWHdm/Wm05;CWHxm1/Wm05;CWHxm2/Wm05;IDFdk1/Wm05;IDFdk2/Wm05;IDFdk3/Wm05;IDFdk5/Wm05;IDFdm1/Wm05;IDFdm2/Wm05;IDFmw1/Wm05;IDFmw2/Wm05;IDFxh1/Wm05;IDFxh2/Wm05;IDFxk/Wm05;PPdh2/Wm05;PPxh1/Wm05;PPxh2/Wm05
grand fir / dull Oregon-grape	*Abies grandis / Mahonia nervosa*	Red	CDFmm/04
grand fir / three-leaved foamflower	*Abies grandis / Tiarella trifoliate*	Red	CDFmm/06
red alder / slough sedge [black cottonwood]	*Alnus rubra* / *Carex obnupta* [*Populus balsamifera* ssp. *trichocarpa*]	Red	CDFmm/14
red alder / skunk cabbage	*Alnus rubra / Lysichiton americanus*	Red	CDFmm/11
slender sedge - white beak-rush	*Carex lasiocarpa - Rhynchospora alba*	Red	CDFmm/Wf53;CWHmm1/Wf53;CWHmm2/Wf53;CWHxm1/Wf53;CWHxm2/Wf53
seashore saltgrass Herbaceous Vegetation	*Distichlis spicata var. spicata* Herbaceous Vegetation	Red	CDFmm/Em03
three-way sedge	*Dulichium arundinaceum* Herbaceous Vegetation	Red	CDFmm/Wm51;CWHmm1/Wm51;CWHxm2/Wm51;ICHwk1/Wm51
arctic rush - Alaska plantain	*Juncus arcticus - Plantago macrocarpa*	Red	CDFmm/Ed03;CWH/Ed03
dune wildrye - beach pea	*Leymus mollis* ssp. *mollis - Lathyrus japonicas*	Red	CDFmm;CWHdm;CWHds1;CWHms2;CWHvh1;CWHvh2;CWHvm;CWHvm1;CWHwh1;CWHwm;CWHws1;CWHxm1;CWHxm2

English Name	Latin Name	***BC List	Biogeoclimatic Units
sweet gale / Sitka sedge	*Myrica gale / Carex sitchensis*	Red	CDFmm/Wf52;CWHmm1/Wf52;CWHmm2/Wf52;CWHvh2/Wf52;CWHwm/Wf52;CWHxm1/Wf52;CWHxm2/Wf52
lodgepole pine / peat-mosses CDFmm	*Pinus contorta / Sphagnum* spp. CDFmm	Red	CDFmm/10
Douglas-fir – arbutus	*Pseudotsuga menziesii - Arbutus menziesii*	Red	CDFmm/02
Douglas-fir / dull Oregon-grape	*Pseudotsuga menziesii / Mahonia nervosa*	Red	CDFmm/01
beaked ditch-grass Herbaceous Vegetation	*Ruppia maritima Herbaceous Vegetation*	Red	CDFmm/Em01;CWH/Em01
American glasswort – sea-milkwort	*Salicornia virginiana - Glaux maritime*	Red	CDFmm/Em02;CWH/Em02
Sitka willow - Pacific willow / skunk cabbage	*Salix sitchensis - Salix lucida ssp. lasiandra / Lysichiton americanus*	Red	CDFmm/Ws51;CWH/Ws51;ICH/Ws51
western redcedar - Douglas-fir / Oregon beaked-moss	*Thuja plicata - Pseudotsuga menziesii / Eurhynchium oreganum*	Red	CDFmm/05
western redcedar / vanilla-leaf	*Thuja plicata / Achlys triphylla*	Red	CDFmm/12
western redcedar / Indian-plum	*Thuja plicata / Oemleria cerasiformis*	Red	CDFmm/13
western redcedar / common snowberry	*Thuja plicata / Symphoricarpos albus*	Red	CDFmm/07

Notes: * The species at risk designation is assigned at the federal level under the *Species at Risk Act* (SARA). COSEWIC, an independent scientific advisory body, is mandated under SARA to assess candidate vegetation and wildlife species that may be assigned to at-risk categories and to put forth recommendations to the Government of Canada when establishing the legal list of wildlife species at risk (Schedule 1). The at-risk status categories include:.

- **Extirpated (Ex):** A wildlife species that no longer exists in the wild in Canada, but exists elsewhere.
- **Endangered (E):** A wildlife species facing imminent extirpation or extinction.
- **Threatened (T):** A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
- **Special Concern (SC):** A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
- **Data Deficient (DD):** A category that applies when the available information is insufficient (a) to resolve a wildlife species' eligibility for assessment or (b) to permit an assessment of the wildlife species' risk of extinction.
- **Not at Risk (NAR):** A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances
- **Candidate (C)**: A wildlife species that is a candidate for evaluation by COSEWIC for an at-risk designation.

** There are three schedules under SARA. **Schedule 1** is the official list of species that are classified as 1-Ex, -1-E, 1-Tand 1-SC. **Schedule 2** (2-E and 2-T) and **Schedule 3** (3-SC) list vegetation and wildlife species with an at-risk designation, but have yet to undergo a SARA-listing process to be added to the official list of species under Schedule 1. Only Schedule 1 species are protected under SARA.

*** In BC, **Red-listed** species are designated as Endangered, Threatened, Extirpated or are candidates for these status designations. **Blue-listed** species are considered to be of Special Concern. **Yellow-listed** species are not at risk. Red- and blue-listed species, their residences or their critical may be afforded legal designation and special protection under the BC *Wildlife Act* enabling habitat protection and stricter penalties for harming a legally designated red- or blue-listed species.

APPENDIX F

Species at-Risk Potential Occurrence within the Study Area

Table 1 Species at-Risk Potential Occurrence in the LSA

Latin Name	English Name[1]	COSEWIC Status[2]	BC Status[3]	SARA[4]	Habitat[5]	Potential Occurrence	Rationale
Plants							
Bidens amplissima	Vancouver Island beggarticks	SC (Nov 2001)	Blue	1-SC (Jun 2003)	Narrow alluvial shoreline margins of rivers and ponds, bogs and willow wetlands, tidal reaches of the Fraser River	High	Suitable habitat exists.
Lupinus rivularis	Streambank lupine	E (Nov 2002)	Red	1-E (Jan 2005)	Found along creeks and streambanks on the coast in southwestern BC. Occupies sandy/gravelly substrate in areas that are periodically flooded. Suitable habitat is also adjacent to railway beds and dykes.	High	Suitable habitat exists.
Mammals							
Aplodontia rufa rufa	Mountain beaver, rufa subspecies	SC (May 1999)	Blue	1-SC (Jun 2003)	Occupy forested areas from near sea level to timberline. Most abundant near water courses in early to mid-seral stages vegetated by second growth tree species, shrubs and forbs, and containing debris left form earlier forests.	Low	Suitable habitat not present within the LSA
Sorex bendirii	Pacific water shrew	E (Apr 2006)	Red	1-E (Jun 2003)	A riparian habitat specialist; associated with wet forests, marshes, and areas adjacent to water (streams/springs). They are generally found in areas of coniferous or mixed forest with downed logs.	Low	Suitable habitat not present within the LSA
Myotis keenii	Keen's long-eared myotis	DD (2003)	Red	3 (Nov 2003)	Associated with coastal forest habitat, mature forest but is not restricted to old growth. Roosts in rock crevices, tree cavities, bark crevices and buildings, and among geothermal rocks.	Low	Suitable habitat not present within the LSA

Latin Name	English Name[1]	COSEWIC Status[2]	BC Status[3]	SARA[4]	Habitat[5]	Potential Occurrence	Rationale
Corynorhinus townsendii	Townsend's Big-eared Bat	-	Blue	-	Maternity and hibernation colonies typically are in caves and mine tunnels. Prefers relatively cold places for hibernation, often near entrances and in well-ventilated areas. On West Coast found regularly in forested regions and buildings, and in areas with a mosaic of woodland, grassland, and/or shrubland.	Low	Suitable habitat not present within the LSA
Myodes gapperi	Southern red-backed vole	-	Red	-	Palustrine and terrestrial habitats. Associated with mature forests. Found in northwest corner of Burns Bog. Associated with coniferous and mixed forests with shore pine, salal, Labrador tea.	Low	Suitable habitat not present within the LSA
Lepus americanus washingtoni	Snowshoe hare-*washingtoni* subspecies	-	Red	-	Palustrine and terrestrial habitats. Young coniferous forest with dense understorey	Low	Suitable habitat not present within the LSA
Mustela frenata altifrontalis	Long-tailed weasel – *altifrontalis* subspecies	-	Red	-	Old coniferous or mixed forest with closed canopy, sparse understory, abundant woody debris, roots and logs for dens	Low	Suitable habitat not present within the LSA
Sorex rowheri	Olympic shrew	-	Red	-	Shorepine or mixed forests of various seral stages. Has been captured in reed canarygrass within 15 m of a ditch next to a mixed forest.	Low	Suitable habitat not present within the LSA
Sorex trowbridgii	Trowbridge's shrew	-	Blue	-	Mature forest, ground litter abundant, swampy woods, associated with deep grasses near salmonberry thickets, riparian fringe areas, but not streamside. Insectivore that feeds on seeds of Douglas-fir, pine and other plants, especially in winter.	Moderate	Suitable habitat not present within the LSA

Latin Name	English Name[1]	COSEWIC Status[2]	BC Status[3]	SARA[4]	Habitat[5]	Potential Occurrence	Rationale
Amphibians and Reptiles							
Anaxyrus boreas	Western toad	SC (Nov 2002)	Blue	1-SC (Jan 2005)	Breed in shallow, littoral zones of lakes, temporary and permanent pools and wetlands, bogs, and fens, and roadside ditches. Summer home ranges can include forests, wetlands, clearcuts, and grasslands.	Low	Suitable breeding habitat is present, but the lack of upland habitat limits their potential for occurrence. , and no known occurrence records exist within the study area
Rana aurora	Northern red-legged frog	SC (Nov 2004)	Blue	1-SC (Jan 2005)	Occur in a variety of aquatic and terrestrial habitats. They breed in shallow, littoral areas of lakes, temporary and permanent pools and wetlands, and bogs and fens in close proximity to forest. Tadpoles associate with benthic habitats.	Low	Suitable habitat not present within the LSA
Chrysemys picta pop. 1	Western painted turtle – Pacific Coast population	E (Apr 2006)	Red	1-E (Dec 2007)	Prefer habitat with muddy substrate, ample emergent aquatic vegetation, exposed cattail mats, logs, open banks and water depth less than 3 m. Highly associated with water.	Low	Suitable habitat not present within the LSA
Birds							
Accipiter gentilis laingi	Northern goshawk, *laingi* subspecies	T (Nov 2000)	Red	1-T (Jun 2003)	Prefer extensive forests with large stands of mature trees and dense canopies, but with an open understorey. Large trees are important for providing nesting and perching platforms.	Low	Sub-optimal habitat
Ardea herodias fannini	Great blue heron, *fannini* subspecies	SC (Mar 2008)	Blue	1-SC (Feb 2010)	Large colonies in deciduous trees or small and dispersed colonies can encompass several hectares. Require abundant and accessible prey within 10 km of a breeding location. Important foraging habitats include tidal mudflats, riverbanks, lakeshores and wetlands.	High	Known occurrence within study area

Latin Name	English Name[1]	COSEWIC Status[2]	BC Status[3]	SARA[4]	Habitat[5]	Potential Occurrence	Rationale
Brachyramphus marmoratus	Marbled murrelet	T (Nov 2000)	Blue	1-T (Jun 2003)	Found in coastal areas, as far as 5 kilometers off shore. May also be found along rivers and lakes within 20 km of the ocean, especially during breeding season.	Low	Sub-optimal habitat
Hirundo rustica	Barn swallow	T (May 2011)	Blue	-	Nests in barns or other buildings, under bridges, in caves or cliff crevices, usually on vertical surface close to ceiling. Commonly reuses old nests. Usually returns to same nesting area in successive years; yearlings often return to within 30 km or closer to natal site	High	Known occurrence within study area
Falco peregrinus anatum	Peregrine falcon, *anatum* subspecies	SC (Apr 2007)	Red	1-T (May 2003)	Occurs in areas where prey concentrate, including farmlands, marshes, lakeshores, river mouths, tidal flats, dunes and beaches, broad river valleys, cities, and airports	High	Known occurrence within study area
Contopus cooperi	Olive-sided flycatcher	T (Nov 2007)	Blue	1-T (Feb 2010)	Breed in various forest and woodland habitats. Most nesting sites contain dead standing trees, which are used as feeding perches.	Low	Sub-optimal habitat
Megascops kennicottii kennicottii	Western screech-owl, *kennicottii* subspecies	SC (May 2002)	Blue	1-SC (Jan 2005)	Prefer woodland habitats, particularly broadleaf and riparian woodland, and scrub. Readily nests in natural tree cavities.	Low	Sub-optimal habitat
Patagioenas fasciata	Band-tailed pigeon	SC (Nov 2008)	Blue	1-SC (Feb 2011)	Often found in temperate, mountain coniferous and mixed forests, and woodlands, especially pine-oak woodlands.	Low	Sub-optimal habitat
Tyto alba	Barn owl	T (Nov 2010)	Blue	1-SC (Jun 2003)	Prefer low elevation, open country. Often associated with agricultural land, especially pasture. Nests in buildings, hollow trees and cliff cavities.	High	Known occurrence within 1 km of study area

Latin Name	English Name[1]	COSEWIC Status[2]	BC Status[3]	SARA[4]	Habitat[5]	Potential Occurrence	Rationale
Asio flammeus	Short-eared Owl	SC (Mar 2008)	Blue	3 (Mar 2005)	Broad expanses of open land with low vegetation for nesting and foraging are required. Known occurrence on saltwater marshes on Tsawwassen First Nation Land.	High	Known occurrence within 1 km of study area
Botaurus lentiginosus	American Bittern	-	Blue	-	Primarily large freshwater and (less often) brackish marshes, including lake and pond edges where cattails, sedges, or bulrushes are plentiful and marshes where there are patches of open water and aquatic-bed vegetation.	Low	Suitable habitat not present within the LSA
Butorides virescens	Green Heron	-	Blue	-	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons. Eggs are laid in platform nest in tree, thicket, or bush over water or sometimes in dry woodland or orchard; nests in both freshwater and brackish situations.	Low	Suitable habitat not present within the LSA
Dendragapus fuliginosus	Sooty Grouse	-	Blue	-	Forest-dwelling and present in CDFmm	Low	Suitable habitat not present within the LSA
Hydroprogne caspia	Caspian Tern	NAR (May 1999)	Blue	-	Seacoasts, bays, estuaries, lakes, marshes, and rivers. Pacific coast populations formerly nested mainly in inland marshes, now mainly on human-created habitats (e.g., salt pond dikes and levees) along coast	Low	Suitable habitat available within the intercauseway area of Roberts Bank but not within the DTRRIP LSA.
Phalacrocorax auritus	Double-crested Cormorant	NAR (May 1978)	Blue	-	Lakes, ponds, rivers, lagoons, swamps, coastal bays, marine islands, and seacoasts; usually within sight of land. Nests on on coastal cliffs	Low	Suitable habitat not present within the LSA
Progne subis	Purple Martin	-	Blue	-	A wide variety of open and partly open situations, frequently near water or around towns.	Low	Suitable habitat exists but there are no known occurrences.

Latin Name	English Name[1]	COSEWIC Status[2]	BC Status[3]	SARA[4]	Habitat[5]	Potential Occurrence	Rationale
Nycticorax nycticorax	Black-crowned Night-heron	-	Red	-	Marshes, swamps, wooded streams, mangroves, shores of lakes, ponds, lagoons; salt water, brackish, and freshwater situations. Roosts by day in mangroves or swampy woodland.	Low	Suitable habitat not present within the LSA
Invertebrates							
Allogona townsendiana	Oregon forestsnail	E (Nov 2002)	Red	1-E (Jan 2005)	Associated with mixed wood and deciduous forests. Associated with bigleaf maple and stinging nettle.	Low	Sub-optimal habitat
Carychium occidentale	Western thorn		Blue		Associated with undisturbed leaf litter in low-elevation forests	Low	Sub-optimal habitat
Cryptomastix devia	Puget Oregonian	XT (Nov 2002)	Red	1-X (Jan 2005)	Associated with mature forests.	Low	Sub-optimal habitat
Monadenia fidelis	Pacific sideband	-	Blue	-	Associated with western hemlock, swordfern and red alder forests. (SCCP 2010)	Low	Sub-optimal habitat
Omus audouini	Audouin's night-stalking tiger beetle	C (Jul 2011)	Red	-	Twelve specimens captured in undisturbed grassland habitat near the Boundary Bay Airport in 1989.	Low	Suitable habitat not present within LSA
Prophysaon vanattae	Scarletback taildropper	-	Blue	-	Aboreal species found on moss-covered trunks and shrub and tree branches mixed woods.	Low	Sub-optimal habitat
Zonitoides nitidus	Black gloss	-	Blue	-	Found in marshes, edges of sloughs, lakes rivers and ponds	Low	Not within known geographic range

Latin Name	English Name[1]	COSEWIC Status[2]	BC Status[3]	SARA[4]	Habitat[5]	Potential Occurrence	Rationale
Fish							
Acipenser medirostris	Green sturgeon	SC (May 1987)	Red	1-SC (Aug 2006)	Spend most of their lives in coastal marine waters, estuaries, and the lower reaches of large rivers. Rivers to spawn. Spawning and rearing habitats are poorly known.	Low	Suitable habitat not present within the LSA
Acipenser transmontanus pop. 4	White Sturgeon (Lower Fraser River population)	E (Nov 2003)	Red	-	Not known to be anadramous. Lower Fraser River population is found in the section below Hell's Gate	Low	Suitable habitat not present within the LSA
Oncorhynchus clarkii clarkii	Cutthroat Trout, clarkii subspecies	-	Blue	-	Requires small, low gradient coastal streams and estuarine habitats In marine habitats, generally remains close to the coast, usually remaining within estuary. Spawns in streams on clean, small gravel substrates.	Low	Suitable habitat not present within the LSA
Salvelinus malma	Dolly Varden	-	Blue	-	Anadromous individuals occur in coastal seas (2-3 years) and in deep runs and pools of creeks and small to large rivers.	Low	Suitable habitat not present within the LSA

Notes:

1 Results of query of SARA Schedule 1 and the BC Conservation Data Centre for listed species potentially occurring in the and Coastal Douglas-fir (CDF) biogeoclimatic zone within the Metro Vancouver Region, BC and associated potential of occurring within the DTRRIP study area.

2 COSEWIC – Committee on the Status of Endangered Wildlife in Canada: T = Threatened (a wildlife species likely to become endangered if limiting factors are not reversed); SC = Special Concern (a wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats); XT = Extirpated (a wildlife species is no longer found in its distributional range); C = Candidate species for Schedule 1.

3 BC Status, Conservation Data Centre: Red = Species that are extirpated, endangered, or threatened; Blue = Species of special concern; Yellow = all species not found on the red or blue lists.

4 SARA – *Species at Risk Act*: Schedule 1 is the official list of wildlife species at risk in Canada. It includes species that are extirpated (extinct in Canada), endangered, threatened, and of special concern.

5 B.C. Conservation Data Centre. 2011. BC Species and Ecosystems Explorer. B.C. Minist. of Environ. Victoria, B.C. Available: http://a100.gov.bc.ca/pub/eswp/ (accessed September 15, 2011).

APPENDIX G

Bird Species Occurring within the Study Area

Appendix G Bird Species Occurring within the DTRRIP Study Area and Associated Habitat Affinities

Group	English Name	Latin Name	Agricultural Ditches	Agricultural Fields	Ditch Vegetation	Causeway Shoreline	Inter-causeway Area
Gulls and Terns	Bonaparte's gull	*Chroicocephalus Philadelphia*					X
	California gull	*Larus californicus*				X	X
	Caspian tern	*Hydroprogne caspia*					X
	Glaucous-winged gull	*Larus glaucescens*	X	X		X	X
	Herring gull	*Larus argentatus*					X
	Mew gull	*Larus canus*		X		X	X
	Ring-billed gull	*Larus delawarensis*		X			X
	Thayer's gull	*Larus thayeri*					X
	Western gull	*Larus occidentalis*					X
Heron	Great blue heron	*Ardea Herodias*	X	X		X	X
Rails and Coots	American coot	*Fulica Americana*		X			
Passerine	American goldfinch	*Spinus tristis*		X	X		
	American robin	*Turdus migratorius*		X	X		
	Barn wwallow	*Hirundo rustica*	X	X	X	X	X
	Belted kingfisher	*Megaceryle alcyon*			X	X	X
	Bewick's wren	*Thryomanes bewickii*		X	X		
	Black swift	*Cypseloides niger*		X			
	Black-capped chickadee	*Poecile atricapillus*		X	X		
	Brandt's cormorant	*Phalacrocorax penicillatus*					X
	Brewer's blackbird	*Euphagus cyanocephalus*	X	X	X	X	
	Brown-headed cowbird	*Molothrus ater*	X	X	X	X	
	Bushtit	*Psaltriparus minimus*		X	X		
	Cedar waxwing	*Bombycilla cedrorum*		X	X		
	Common yellowthroat	*Geothlypis trichas*		X	X		
	Common raven	*Corvus corax*				X	
	Dark-eyed junco	*Junco hyemalis*		X	X		

Group	English Name	Latin Name	Agricultural Ditches	Agricultural Fields	Ditch Vegetation	Causeway Shoreline	Inter-causeway Area
Passerine	Downy woodpecker	*Picoides pubescens*			X		
	European starling	*Sturnus vulgaris*	X	X	X	X	
	Fox sparrow	*Passerella iliaca*		X	X		
	Golden-crowned kinglet	Regulus satrapa		X			
	Golden-crowned sparrow	*Zonotrichia atricapilla*		X	X		
	House finch	*Carpodacus mexicanus*		X	X		
	House sparrow	*Passer domesticus*		X	X		
	Mourning dove	*Zenaida macroura*		X			
	Marsh wren	*Cistothorus palustris*	X	X	X		
	Northern flicker	*Colaptes auratus*		X			
	Northern shrike	*Lanius excubitor*		X			
	Northwestern crow	*Corvus caurinus*		X		X	
	Pine siskin	*Carduelis pinus*		X			
	Purple finch	*Carpodacus purpureus*		X	X		
	Red-winged blackbird	*Agelaius phoeniceus*	X	X	X		
	Rock pigeon	*Columba livia*		X		X	
	Rufous hummingbird	*Selasphorus rufus*			X		
	Ruby-crowned kinglet	*Regulus calendula*		X			
	Savannah sparrow	*Passerculus sandwichensis*		X	X		
	Song sparrow	*Melospiza melodia*		X	X		
	Spotted towhee	*Pipilo maculates*					
	Tree swallow	*Tachycineta bicolor*		X	X		
	Violet-green swallow	*Tachycineta thalassina*		X	X		
	White-crowned sparrow	*Zonotrichia leucophrys*		X	X		
	White-throated sparrow	*Zonotrichia albicollis*		X	X		
	Winter wren	*Troglodytes troglodytes*		X			
	Yellow-rumped warbler	*Dendroica coronate*		X	X		
	Varied thrush	*Ixoreus naevius*		X			

Group	English Name	Latin Name	Agricultural Ditches	Agricultural Fields	Ditch Vegetation	Causeway Shoreline	Inter-causeway Area
Raptor	American kestrel	*Falco sparverius*		X			
	Bald eagle	*Haliaeetus leucocephalus*		X		X	X
	Merlin	*Falco columbarius*		X		X	
	Northern harrier	*Circus cyaneus*		X			
	Osprey	*Pandion haliaetus*				X	
	Peregrine falcon	*Falco peregrines*		X		X	
	Red-tailed hawk	*Buteo jamaicensis*		X		X	
	Rough-legged hawk	*Buteo lagopus*		X		X	
	Sharp-shinned hawk	*Accipiter striatus*		X			
	Short-eared owl	*Asio flammeus*		X			
	Snowy owl	*Nyctea scandiaca*		X			
Shorebird	Baird's sandpiper	*Calidris acuminate*				X	X
	Black oystercatcher	*Haematopus bachmani*				X	X
	Black turnstone	*Arenaria melanocephala*				X	
	Black-bellied plover	*Pluvialis squatarola*		X		X	X
	Dunlin	*Calidris alpine*		X		X	X
	Greater yellowlegs	*Tringa melanoleuca*				X	
	Killdeer	*Charadrius vociferous*		X		X	X
	Least sandpiper	*Calidris minutilla*				X	X
	Long-billed dowitcher	*Limnodromus scolopaceus*				X	X
	Marbled godwit	*Limosa fedoa*				X	
	Red-necked phalarope	*Phalaropus lobatus*					X
	Sanderling	*Calidris alba*					X
	Semipalmated plover	*Charadrius semipalmatus*				X	X
	Western sandpiper	*Calidris mauri*				X	X
	Wilson’s snipe	*Gallinago delicate*		X		X	

Group	English Name	Latin Name	Agricultural Ditches	Agricultural Fields	Ditch Vegetation	Causeway Shoreline	Inter-causeway Area
Waterfowl and Seabirds	American wigeon	*Anas Americana*		X		X	X
	Barrow's goldeneye	*Bucephala islandica*					X
	Blue-winged teal	*Anas discors*					X
	Bufflehead	*Bucephala albeola*	X	X			X
	Canada goose	*Branta Canadensis*	X	X		X	X
	Brant goose	*Branta bernicla*				X	X
	Common goldeneye	*Bucephala clangula*		X			X
	Common loon	*Gavia immer*					X
	Common merganser	*Mergus merganser*		X			X
	Common murre	*Uria aalge*					X
	Double-crested cormorant	*Phalacrocorax auritus*					X
	Eurasian wigeon	*Anas Penelope*	X	X			X
	Gadwall	*Anas strepera*					X
	Greater scaup	*Aythya marila*					X
	Green-winged teal	*Anas crecca*		X		X	X
	Harlequin duck	*Histrionicus histrionicus*					X
	Hooded merganser	*Lophodytes cucullatus*		X			X
	Horned grebe	*Podiceps auritus*					X
	Lesser scaup	*Aythya affinis*		X			
	Long-tailed duck	*Clangula hyemalis*					X
	Mallard	*Anas platyrhynchos*	X	X		X	X
	Northern pintail	*Anas acuta*	X	X		X	X
	Northern shoveler	*Anas clypeata*					X
	Pacific loon	*Gavia pacifica*					X
	Pelagic cormorant	*Phalacrocorax pelagicus*					X
	Pigeon guillemot	*Cepphus Columba*					X

Group	English Name	Latin Name	Agricultural Ditches	Agricultural Fields	Ditch Vegetation	Causeway Shoreline	Inter-causeway Area
Waterfowl and Seabirds	Red-breasted merganser	*Mergus serrator*					X
	Red-necked grebe	*Podiceps grisegena*					X
	Red-throated loon	*Gavia stellata*					X
	Rhinoceros auklet	*Cerorhinca monocerata*					X
	Snow goose	*Chen caerulescens*		X			
	Surf scoter	*Melanitta perspicillata*					X
	Trumpeter swan	*Cygnus buccinator*		X			
	Western grebe	*Aechmophorus occidentalis*		X			X
	Whimbrel	*Numenius phaeopus*				X	
	Wood duck	*Aix sponsa*	X	X			
	White-winged scoter	*Melanitta fusca*					X

APPENDIX H

Invertebrate Species Documented within the Study Area

Appendix H Insect Species Documented within the LSA

English Name	Latin Name
-	*Aeshna mulitcolor*
-	*Agabus discors*
-	*Agabus lutosus*
-	*Amara sp.*
-	*Anacaena limbata*
-	*Berosus fraternus*
-	*Berosus striatus*
-	*Calathus fuscipes*
-	*Calathus ingratus*
Blaisdell's Waterboatman	*Cenocorixa blaisdelii*
Sevenspotted Ladybird Beetle	*Coccinella septempunctatus*
-	*Coccinella undecimpunctata*
-	*Corisella inscripta*
-	*Corisella inscripta*
Bluet sp.	*Enallagma carrunculatum sp.*
-	*Enochrus califonicius*
-	*Enochrus diffusus*
-	*Enochrus hamiltoni*
European Earwig	*Forficula auricularia so.*
-	*Gerris buenoi*
-	*Gerris incognitus*
-	*Gerris incognitus*
-	*Gyrinus bifarius*
-	*Gyrinus picipes*
-	*Gryllus pennsylvanicus*
-	*Haliplus (Liaphlus) sp.*
-	*Haliplus immaculicollis*
Southern Ladybird Beetle	*Harmonia axyridis*
Blueeyed Darner	*Blueeyed Darner Hemerobius sp.*
-	*Hesperocorixa atopodonta*
-	*Helophorus sp.*
-	*Hydrobius fuscipes*
-	*Hydroporus sp.*
-	*Hydroporus notabilis*
-	*Hydroporus sinuatipes*
-	*Hygrotus sayi sp.*
-	*Hygrotus impressopunctatus*
Pacific Forktail	*Ischnurs cervula*

English Name	Latin Name
-	*Laccophilus maculosus descipiens*
Fourspotted Skimmer	*Libellula quadrimaculata*
Kirby's Backswimmer	*Notonecta kirbyi*
-	*Notonecta undulata*
-	*Orius minutus*
-	*Peltodytes callosus*
-	*Pteroctichus melanarius*
-	*Rhantus binotatus*
California Darner	*Rhinaeschna californica*
Blueeyed Darner	*Rhinaeschna multicolor sp.*
-	*Saldula sp.*
-	*Sigara omani*
-	*Stictotarsus striatellus*
Variagated Meadowhawk	*Sympertrum corruptum*
-	*Sympertrum illotum*
Cardinal Meadowhawk	*Sympertrum illotum sp.*
-	*Sympertrum illotum sp.1*
-	*Sympertrum illotum sp. 2*
-	*Sympertrum illotum sp. 3*
-	*Trechus obtusus sp.*
-	*Trichocorixa verticalis*
-	*Trichocorixa verticalis n.ssp.*
-	*Triousternus columbianus*
-	*Triousternus lateralis marginatus*
Anise Swallowtail	*Papilio zelicaon*
Western Tiger Swallowtail	*Papilo rutulus*
Margined White	*Pieris marginalis*
Cabbage Butterfly	*Pieris rapae*
Purplish Copper	*Lycaena helloides*
Western Pine Elfin	*Callophrys eryphon*
Western Spring Azure	*Celastriana ladon*
Satyr Anglewing	*Polygonia satyrus*
Mourning Cloak	*Nymphalis antiopa*
Milbert's Tortoise Shell	*Nymphalis milberti*
Painted Lady	*Vanessa cardui*
Lorquin's Admiral	*Limenitis lorquini*
Arctic Skipper	*Carterocephalus palaemon*
European Skipper	*Thymelicus lineola*
Woodland Skipper	*Ochlodes sylvanoides*