Ministry of Transportation and Infrastructure

Business Case

George Massey Crossing Project

April 2021

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LIST OF ACRONYMS

Acronym	Description
ASR	Alkali-Silica Reaction
BC	British Columbia
BCR	Benefit Cost Ratio
BCTFA	BC Transportation Financing Authority
c/mvk	Collisions per million vehicle kilometres
Corridor	Highway 99 corridor between Bridgeport Road and Ladner Trunk Road
Corridor Improvements	Series of improvements to Highway 99 corridor
CPTED	Crime Prevention Through Environmental Design
DB	Design-Build
DBB	Design-Bid-Build
DBF	Design-Build-Finance
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
EAC	Environmental Assessment Certificate
EAO	British Columbia Environmental Assessment Office
ESA	Environmentally Sensitive Area
Existing Tunnel	The George Massey Tunnel
FLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
FTN	Frequent Transit Network
GP	General Purpose
GHG	Greenhouse Gas
GMC	George Massey Crossing
GMTR	George Massey Tunnel Replacement Project
GPS	Global Positioning System
ha	hectare
HOV	High Occupancy Vehicle
IDC	Interest During Construction
ITR	Independent Technical Review of the George Massey Crossing, Final Report, September 2018 by Westmar Advisors
ITT	Immersed Tube Tunnel
km	kilometre
m	metre
m^3	cubic metres
MCA	Multiple Criteria Analysis
MAE	Multiple Account Evaluation
MUP	Multi-Use Path
NPV	Net Present Value
OCP	Official Community Plan
OMR	Operations, Maintenance and Rehabilitation
ProvDB	Provisional Design-Build
ProvDBF	Provisional Design-Build-Finance
PV	Present Value
RFP	Request for Proposal
RFQ	Request for Qualifications
RGS	Regional Growth Strategy
RMB	Risk Management Branch
RTM	Regional Transportation Model
RTS	Regional Transportation Strategy
TransLink	South Coast British Columbia Transportation Authority
TFN	Tsawwassen First Nation

Acronym	Description
the Ministry	Ministry of Transportation and Infrastructure
the Project	George Massey Crossing Project
TI Corp	Transportation Investment Corporation
U.S.	United States of America
VFM	Value for Money
VFPA	Vancouver Fraser Port Authority
vph	vehicles per hour
YVR	Vancouver International Airport

EXECUTIVE SUMMARY

The George Massey Tunnel (the Existing Tunnel) is a four-lane vehicular traffic immersed tube tunnel (ITT) below the Fraser River on Highway 99 within the Metro Vancouver region. The Existing Tunnel is an essential link in a corridor of regional, provincial and national importance. In addition to connecting communities south and north of the Fraser River, the corridor provides a connection to the international transportation gateways of the region's port and airport facilities. Now more than 60 years old, the Existing Tunnel suffers from congestion and reliability challenges, particularly reflected in traffic delays and queues in the non-peak direction, and safety challenges related to the congestion, as well as seismic performance and roadway clearances.

The Existing Tunnel has operated as a retrofitted counter-flow system for the past 40 years during peak periods, with three lanes in the peak direction and one lane in the non-peak direction, to address traffic demand that has far exceeded the original design volumes. Improvements are required to alleviate congestion and to improve travel times and reliability for drivers, and enhancements to transit service and active transportation[1] options on the Highway 99 corridor are also required to provide sustainable transportation choices for all users. Action is also required to address the seismic performance of the Existing Tunnel, which is below modern standards, and findings from a recent condition assessment has determined there are a number of factors that limit extending its service life. Lastly, the lack of shoulders in the Existing Tunnel and vertical clearance constraints contribute to challenges with emergency response to incidents, as well, as limitations on movement of over-height vehicles.

This Business Case recommends the implementation of the George Massey Crossing Project (the Project), which includes replacement of the Existing Tunnel with a new eight-lane ITT (the new ITT or the Crossing) and a series of improvements (Corridor Improvements) to the Highway 99 corridor between Bridgeport Road and Ladner Trunk Road (the Corridor). The new ITT will be designed to modern standards for seismic performance and vehicle clearances (horizontal and vertical), and will also include a multi-use path (MUP) to connect pedestrians and cyclists with active transportation routes on either side of the Fraser River. The new ITT is planned to be open to traffic in 2030. The Corridor Improvements are planned to be completed in advance of commencing construction on the new ITT.

The Project represents a significant investment in multi-modal transportation improvements, and supports provincial and regional strategies, sustainability objectives, and the economic development of the region, the Province, and Canada. This Business Case establishes the need and rationale for investing in the

[1] Active transportation refers to all human-powered forms of travel; however, within the context of the Project, active transportation refers to the most common forms: walking and cycling.

Project, along with context that highlights the need to replace the Existing Tunnel and upgrade the regional transportation network.

INVESTMENT NEED

The Existing Tunnel and the Corridor are important elements in the Metro Vancouver and provincial transportation network, as well as a vital route for the movement of people and goods supporting the local, regional, provincial, and national economies. Since the Existing Tunnel opened in 1959, Metro Vancouver's population and economy have grown significantly, and the region's population is forecast to increase by more than one million people over the next 30 years, with substantial growth in the South of Fraser communities. Without improvements to this crossing and the Corridor, economic growth and regional liveability will be constrained by congestion and increasing travel times for commuters, commercial users and other traffic. Replacement of the Existing Tunnel and upgrades to the Corridor are required to address community livability issues in the South of the Fraser area, and existing challenges with the physical condition of the Existing Tunnel.

Figure 1: Community Livability Issues in the Corridor

PROJECT DEVELOPMENT

The scope of the Project was developed in response to an Independent Technical Review[2] (ITR) commissioned by the Province in 2017 to review the 2013 decision to replace the Existing Tunnel with a 10-lane bridge. In December 2018 the findings of the ITR were released, and concluded that other feasible alternatives and input from Metro Vancouver communities were not fully considered. Development of the service delivery options to meet the needs of the region and the Province commenced in January 2019 when the Ministry of Transportation and Infrastructure (the Ministry) launched a new planning process for the Project that included engagement with Indigenous groups (Section 9.6), the region, Fraser River communities, select stakeholders and the public.

Initial engagement included collaboration with 10 municipalities, 12 participating Indigenous groups, the South Coast British Columbia Transportation Authority (TransLink), and Metro Vancouver to develop a set of shared principles, goals and objectives to guide the Project. These goals included the following:

1. Support sustainability of Fraser River communities;
2. Facilitate increased share of sustainable modes of transport;
3. Enhance regional goods movement and commerce; and
4. Support a healthy environment.

Following this first phase of engagement and technical analysis by the Ministry, the Metro Vancouver Board, as a representative for regional interests, endorsed a new eight-lane ITT crossing on November 1, 2019 as its preferred option for the purposes of the Ministry's public engagement on the Project.

Key to Metro Vancouver's endorsement was consideration of the community impacts associated with a bridge, including noise, visual and shading effects, in particular to communities in both Richmond and Delta that have seen residential expansion adjacent to the crossing. There were also concerns about the long-term effects that a bridge would have on the user experience within Deas Island Regional Park. The Tsawwassen First Nation (TFN), which is represented as a member of the Metro Vancouver Board, expressed a preference for a bridge, as a result of the instream works and fisheries impacts associated with a new ITT solution. The endorsement by the Metro Vancouver Board recognized the concerns of the TFN, and recommended that the Ministry consider these factors in its assessment process. The Metro Vancouver Board also acknowledged that a new ITT could take longer and be more costly to construct

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[2] https://engage.gov.bc.ca/app/uploads/sites/52/2019/02/George-Massey-Crossing_Independent-Technical-Review_FINAL_corr.pdf

than a bridge (based on the Ministry's preliminary analysis); however, on balance, the anticipated community and long-term environmental benefits outweighed these concerns. The Metro Vancouver Board encouraged the Ministry to identify opportunities to reduce costs and to advance timing of construction.

While the Metro Vancouver Board endorsed the new ITT crossing over a bridge option, the Ministry is responsible for the final decision of the recommended crossing through its engagement and business case processes. Public information meetings were held in February 2020, and since then the Ministry has continued to meet with Indigenous groups and key stakeholders to share Project information and seek feedback on the work to date, including the planning process, service delivery options analysis and advanced works. Consultation and engagement activities were modified to accommodate public health guidelines associated with the COVID-19 pandemic. Following detailed options analysis, consideration of the goals, objectives and benefits of the Project, and consultation with regional stakeholders and Indigenous groups, the Ministry recommends construction of a new ITT to replace the Existing Tunnel. The primary benefits of the new ITT compared to a bridge are the significantly reduced visual, noise, light and shading effects to the surrounding area. These are long-term benefits that will continue over the life of the Project. During construction, the new ITT option will result in higher temporary disturbance to the Fraser River and surrounding lands as a result of excavations for the approaches and trench for the new ITT elements. However, both options will create some magnitude of disruption to the Fraser River, as removal of the Existing Tunnel is recommended for either option to protect the long-term integrity of the Richmond dyke system and the new crossing structure. Additional benefits of the new ITT are fewer impacts to important agricultural land, and full alignment of the crossing option with the navigational requirements of the Vancouver Fraser Port Authority (VFPA). In addition, the new ITT provides more favourable elevation change for drivers and active transportation users, as well as the additional protection from inclement weather for all users, particularly high winds and falling accumulations of ice and snow.

Assessment of cost and schedule for the ITT and bridge options determined that the costs of the crossing options are comparable; however, a new bridge can be completed in a shorter period, with an opening day expected in late 2028, or approximately 1.5 years sooner than the new ITT. While the bridge option benefits in the short-term from an earlier in-service date, and less disruption to the Fraser River during construction, the ITT option provides lasting, long-term benefits to the region (less impacts to agricultural land and navigation during operations) and the environment (noise, visual, light and shading). For those reasons a new ITT is recommended.

SCOPE OF THE PROJECT

To address the existing challenges in terms of mobility, reliability, and safety that users of the Corridor and Existing Tunnel face daily, the Project is comprised of two major components:

- **Crossing**: a new eight-lane ITT with a dedicated multi-use path for pedestrians and cyclists, removal of the Existing Tunnel, replacement of the existing Deas Slough Bridge with an eight-lane bridge, addition of a southbound general purpose (GP) lane on Highway 99 between Westminster Highway and Steveston Highway, and relocation of the existing BC Hydro transmission line that is within the Existing Tunnel; and

- **Corridor Improvements**: advanced works along the Highway 99 corridor to address existing challenges, and to enhance traffic, safety, and transit performance of the Corridor after completion of the Crossing.

The Corridor Improvements are comprised of four advanced works:

- **Improvement 1 – Bridgeport Road Bus Connection:** Redirection of the southbound bus services from Sea Island Way to Bridgeport Road, provision of a transit-only connection southbound to the on-ramp to Highway 99 and improved cycling and pedestrian connections.

- **Improvement 2 – Highway 99 and 17A Off-Ramp Widening:** Extension and widening the northbound Highway 99 off-ramp approach to the Highway 17A intersection, upgraded George Massey Tunnel bike shuttle stop and improvements to cycling facilities in and around the interchange.

- **Improvement 3 - Bus-on-shoulder transit lanes on Highway 99:** Extension of bus-on-shoulder facilities south of Highway 17A in both the northbound and southbound directions.

- **Improvement 4 – Steveston Highway Interchange:** Replacement of the existing two-lane overpass structure at Steveston Highway and Highway 99 to accommodate two eastbound lanes and three westbound lanes (including a left turn lane), as well as improved connections to and from the overpass for vehicles, transit users, pedestrians and cyclists.

Corridor Improvements 1, 2, and 3 are also collectively referred to as Transit and Cycling Improvements in this Business Case. The general location of the Project scope elements is provided in Figure 2.

Figure 2: Location of the Project

BENEFITS FOR THE PROVINCE

The Project will provide safe, reliable, and accessible transportation options that meets the objectives for sustainable growth for the Metro Vancouver region. Key benefits of the Project include:

- Providing congestion relief at the Existing Tunnel to the non-peak direction;
- Addressing the long-term seismic safety performance of the Existing Tunnel;
- Improving transit speed and reliability along the Highway 99 corridor;
- Establishing a dedicated active transportation connection for pedestrians and cyclists across the Fraser River on Highway 99; and
- Maintaining the current clearances for the Fraser River navigational channel.

Furthermore, the Project has the flexibility of being configured with six GP lanes and two dedicated transit lanes through the crossing, or with eight GP lanes at the crossing with transit priority queue jumps, both options serviced by extended bus-on-shoulder lanes to the crossing. These two options have a Benefit

Cost Ratio (BCR) of 0.72 and 0.95, respectively. In either case, a significant improvement to transit service could be achieved.

PROCUREMENT ASSESSMENT AND PROJECT DELIVERY

The Ministry completed a procurement assessment beginning with a discussion of the procurement objectives, followed by the identification of a suitable procurement delivery model for the Crossing and each Corridor Improvement. The selection of the potential delivery models was primarily driven by the following considerations:

- Size and scope of the work;
- Capacity and experience of both the industry and the Province with the procurement model;
- Achievement of Project specific procurement objectives; and
- Ability of the procurement model to support a timely delivery of the Project.

For the Crossing, the procurement assessment identified a Provisional Design-Build-Finance (ProvDBF) model as the recommended model to accelerate construction schedule, manage key risks effectively, and maximize competitiveness in the process. The ProvDBF model would allow for award of a fixed price contract prior to receipt of the Environmental Assessment Certificate (EAC) from the BC Environmental Assessment Office (EAO), with provision for a price adjustment if the EAC issue date is later than planned, through application of a price adjustment negotiated and agreed during procurement. Although construction would not start until after the EAC and required permits are received, this approach will enable the contractor to advance planning activities, design work and consultation programs during the period between contract award and issue of the EAC.

For the Corridor Improvements, a mix of procurement models are recommended. For the Steveston Highway Interchange replacement, a Design-Build (DB) procurement model is recommended. For the Transit and Cycling Improvements a Design-Bid-Build (DBB) procurement model is recommended based on the current level of design development and Project schedule.

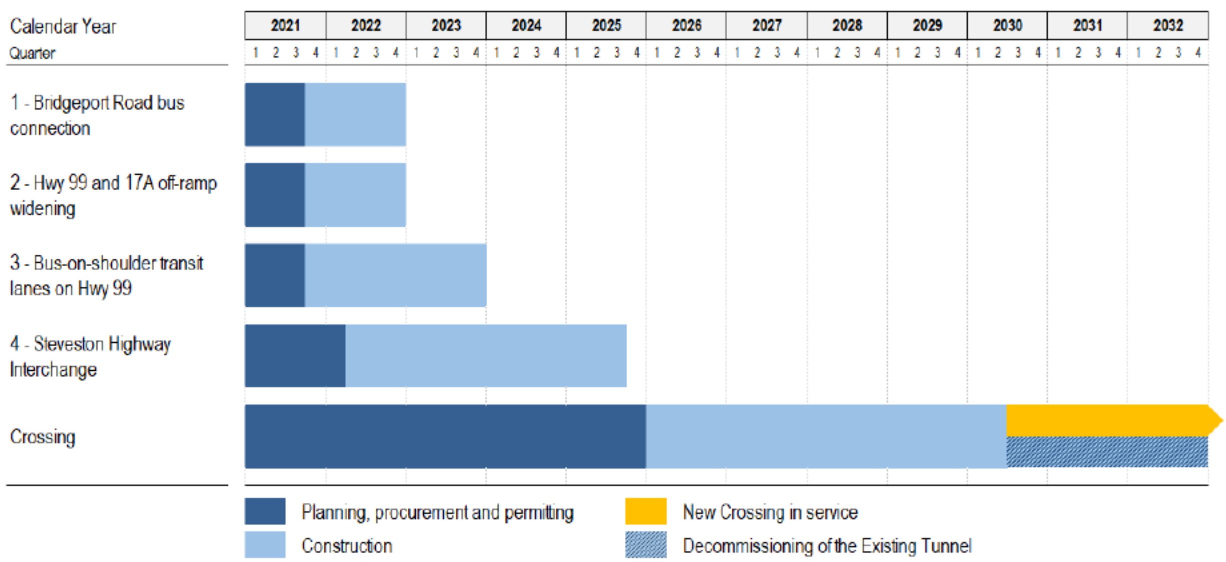
The recommended procurement models are summarized in Table 1.

Table 1: Recommended Procurement Models

Project Component	Recommended Procurement Model
Crossing	Provisional Design-Build-Finance
Steveston Highway Interchange	Design-Build
Transit and Cycling Improvements	Design-Bid-Build

The expected timeline for the Project between the beginning of the procurement period and end of the construction phase is outlined in Figure 3.

Figure 3: Project Delivery Schedule



In addition to the infrastructure and service delivery objectives, an additional Project objective is to deliver a range of community benefits, maximizing opportunities for local residents and businesses and helping to develop and grow the skilled labour workforce through opportunities for apprentices and skills training, and the provision of employment opportunities for Indigenous people, women and equity seeking groups. The Project will be structured to support these goals.

PROJECT COST ESTIMATE AND FUNDING

The Project cost estimate, including planning, procurement, construction (including capital costs relating to the decommissioning of the Existing Tunnel), and Interest During Construction (IDC) is $4.3 billion (nominal basis, 2021 as base year). Refer to Table 2 for a summary level breakdown of the Project costs.

The Province has been actively engaging the Government of Canada to cost share the Project; however, no commitment has been made to date and the Project is currently being funded by the Province.

Table 2: Project Cost Estimate

(In $ million, nominal basis, 2021 as base year)	**Crossing**	**Corridor Improvements**			**Project (Crossing + Corridor Improvements)**
		Steveston Highway Interchange	Transit and Cycling Improvements	Total	
Contractor's construction cost	[redacted]				
Owner's costs					
IDC, bid development and SPV costs (Contractor)					
Contingency / Risks					
Provincial IDC					
Total	**4,147.9**	**87.5**	**49.4**	**136.9**	**4,284.8**

1 PURPOSE AND APPROACH

1.1 PURPOSE

This Business Case establishes the need to invest in the George Massey Crossing and improve the Highway 99 corridor between Bridgeport Road and Ladner Trunk Road. It describes how the recommended service delivery option will contribute to provincial and regional objectives and strategies to improve transportation infrastructure in Metro Vancouver.

The main purpose of this Business Case is to:

- Demonstrate the need and provide background information with respect to the Project;
- Describe in detail the planning process and recommended Project scope to meet the need;
- Describe in detail the procurement assessment conducted for the Project; and
- Recommend a procurement approach and implementation strategy.

This Business Case also provides information and analysis to inform decisions on the Project.

1.2 APPROACH

The document consists of the following five main parts:

Part A – Need for Investment: Describes the need for the Project based on strategic context and transportation plans for the region, priorities for the Ministry, and current conditions associated with the Existing Tunnel and the Corridor.

Part B – Service Delivery Options Analysis: Describes the process to determine the preferred physical scope of the Project for implementation and provides a capital cost estimate based on the reference concept of the recommendation.

Part C - Procurement of the Project: Presents the analysis and results of the detailed assessment undertaken to determine the optimal approach to procure the Project.

Part D - Implementation Plan and Funding: Describes the plan to implement the Project, based on the recommended procurement models and Project Schedule, and presents the estimated Project budget and potential funding sources.

Part E – Decision Request: Provides the overall recommendation to proceed with the Project.

PART A – NEED FOR INVESTMENT

This part of the Business Case describes the need for the Project. The discussion highlights the strategic context and transportation plans for the region, priorities for the Ministry, and current conditions associated with the Existing Tunnel and the Corridor, including urban mobility, physical condition of the Existing Tunnel, traffic safety, transit speed and reliability, and active transportation.

2 STRATEGIC CONTEXT

2.1 METRO VANCOUVER

Metro Vancouver is one of Canada's most diverse and livable regions, with vibrant communities and an internationally recognized high quality of life. It is the third-largest urban area in Canada, with 2.6 million residents and 1.3 million jobs across a diversified economy[3]. Baseline scenario forecasts estimate that by 2050, population and jobs within Metro Vancouver will increase by about 1 million and 460,000, respectively.

The location of Metro Vancouver makes it an ideal centre for international trade, connecting British Columbia and Canada with the United States, Asia and the rest of the world. The Metro Vancouver region plays a vital role as one of Canada's west coast gateways, connecting Canada to Asia-Pacific trading partners through a reliable transportation network, including the region's international port and airport facilities. Gateway-related goods movement is forecast to grow and drive the regional, provincial and national economies, increasing the need for a reliable and efficient regional transportation network. The Highway 99 corridor, which includes the Existing Tunnel, is a key component of this transportation network.

Transportation planning in the Metro Vancouver region is guided by a number of overarching strategies, including: Metro Vancouver's Metro Vancouver 2040 Regional Growth Strategy (RGS), TransLink's Regional Transportation Strategy (RTS), as well as Moving the Economy: A Regional Goods Movement Strategy for Metro Vancouver. These regional strategies seek to balance social, economic, and environmental objectives and address challenges common to urban regions. Metro Vancouver's role as one of Canada's West Coast trade gateways amplifies the importance of balancing community livability with economic viability supported by a transportation system that serves local residents and businesses as well as the growing volume of gateway-related trips passing through the region to markets beyond our borders.

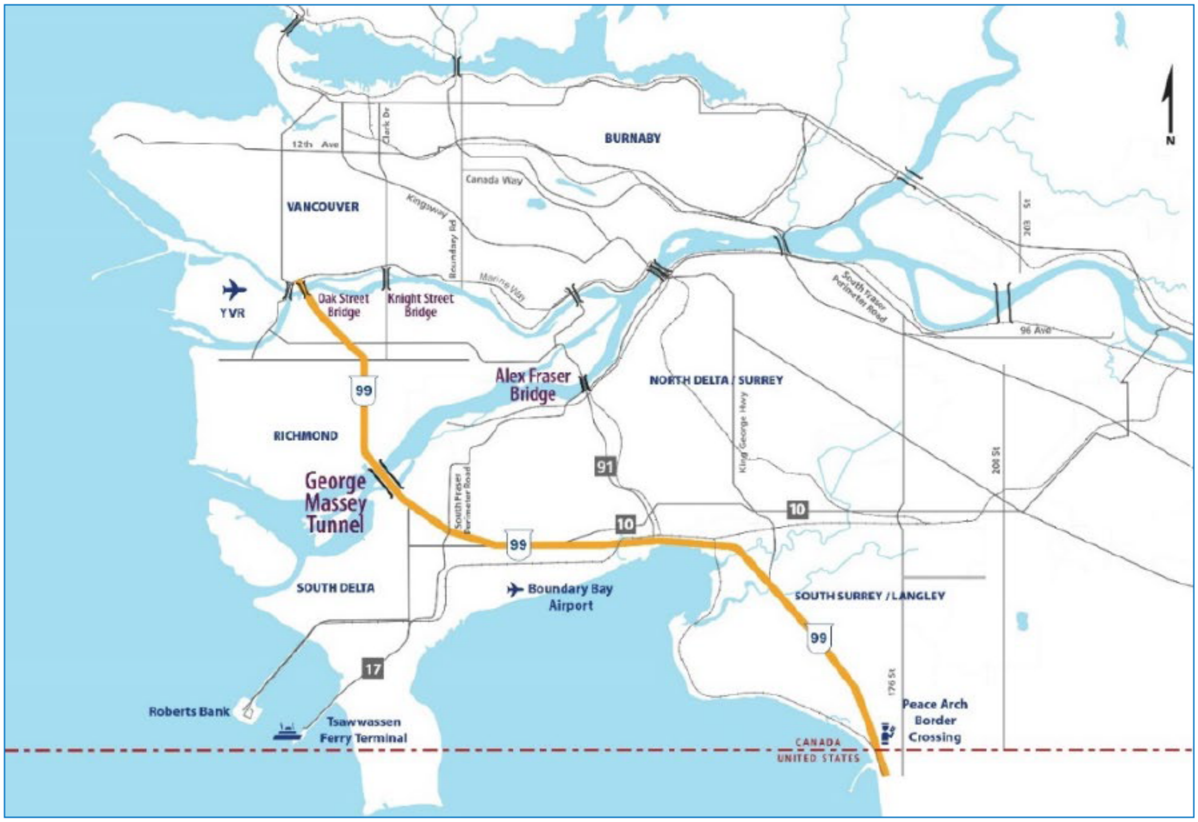
2.2 THE EXISTING TUNNEL AND HIGHWAY 99 CORRIDOR

Within Metro Vancouver, Highway 99 is a major north-south corridor that serves urban and rural communities on each side of the Fraser River (Figure 4). The corridor is a gateway for regional, provincial, national, and international travel, and provides connections to the Vancouver International Airport (YVR), the Peace Arch and Pacific Canada-U.S. border crossings, BC Ferries' Tsawwassen terminal, Deltaport and the Boundary Bay Airport. It also serves as a primary commuting corridor

[3] https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/index-eng.cfm

between south of Fraser and north of Fraser communities, and is a key access point for businesses in Delta, Richmond, Surrey and TFN.

Figure 4: Highway 99 Corridor Map



The Existing Tunnel, constructed in 1959, is a vital link on the Highway 99 corridor connecting the municipalities of Delta and Richmond. Currently, an average of 86,000 vehicles pass through the Existing Tunnel each day; however, this daily volume typically varies from 79,000 during fall and winter to 92,000 during summer. Truck traffic accounts for approximately 12% of the daily average weekday traffic volume, with midday truck traffic typically higher, approaching 18%. During peak periods, transit traffic through the Existing Tunnel approximates 1.5% of vehicle traffic; however, transit accounts for up to 18% of people passing through the Existing Tunnel during these periods.

Although the Existing Tunnel was originally designed and constructed as a divided four-lane roadway, for almost 40 years it has operated in a retrofitted counterflow operation to address peak demand that has significantly exceeded the original configuration of two-lanes per direction. Without improvements to this crossing, economic growth and regional livability will be further constrained by congestion and increased travel times for commuters, commercial users and other traffic.

2.3 THE FRASER RIVER

The Fraser River is the longest river in BC, flowing 1,375 km from its headwaters in the Rocky Mountains of central BC to the Strait of Georgia, and supports a variety of marine uses, including international and domestic shipping, commercial and recreational fishing, Indigenous fishing and cultural practices, and recreational boating and moorage. Construction of works in, on, over, under, through or across navigable waters, including new construction or removal of existing works, are regulated under the *Canadian Navigable Waters Act* by Transport Canada through the federal Navigation Protection Program. Management of lands and waters that make up the Port of Vancouver, including the harbour operations within the Fraser River navigational channel and facilities is under the federal jurisdiction of the VFPA. This management includes an annual dredging program on the south arm of the Fraser River to maintain the navigation channel and flood protection levels for the Richmond dyke system. Due to high sediment loads during the spring freshet, approximately three million cubic meters of sediment are dredged annually from the Fraser River under this maintenance program.

The lower Fraser River and estuary provide important habitat for fish species of high ecological, social, cultural, and commercial value important to Indigenous groups and stakeholders. Fish species important to the viability of commercial, recreational, and Indigenous fisheries include Pacific salmonids, eulachon, and sturgeon. The lower Fraser River is an important migratory corridor for anadromous species as they migrate to and from marine and estuarine habitats to upstream freshwater habitats during adult spawning migration, juvenile outmigration to marine environments, and rearing and overwintering in brackish habitats in the Fraser River estuary. Meandering reaches and side-channels in the lower Fraser River also provide spawning and rearing habitats for resident white sturgeon. In addition to the importance of fishing and fisheries to Indigenous groups, the lower Fraser River serves as a key cultural resource and travel corridor.

2.4 PROVINCE OF BRITISH COLUMBIA

The Ministry plans transportation networks, provides transportation services and infrastructure, develops and implements transportation policies, and administers many related acts, regulations and federal-provincial funding programs. The Ministry strives to build and maintain a safe and reliable transportation system and provide affordable, efficient and accessible transportation options for all British Columbians. This work includes investing in road infrastructure, public transit, the coastal and inland ferry service, active transportation network improvements and other green modes of transportation.

The Ministry's immediate priority is to support economic recovery from the effects of the COVID-19 pandemic in communities across BC by continuing to build important infrastructure projects, ensuring that infrastructure investments deliver benefits for local communities and workers, and moving ahead with a replacement for the Existing Tunnel.

Strategic direction of the Ministry is provided by the Government of British Columbia, which remains focused on five key commitments to British Columbians: putting people first, reconciliation, equity and anti-racism, fighting climate change, and a strong, sustainable economy that works for everyone. Key initiatives underpinning these strategic priorities are the implementation of:

- The ***Declaration on the Rights of Indigenous Peoples Act*** and the Truth and Reconciliation Commission Calls to Action, demonstrating support for true and lasting reconciliation, and
- The ***CleanBC plan***, putting BC on the path to a cleaner, better future – with a low carbon economy that creates opportunities while protecting our clean air, land and water.

United Nations Declaration on the Rights of Indigenous Peoples

The provincial government passed legislation in November 2019 to implement the United Nations Declaration, which the Truth and Reconciliation Commission confirms as the framework for reconciliation. The new ***Declaration on the Rights of Indigenous Peoples Act*** creates a path forward that respects the human rights of Indigenous peoples while introducing better transparency and predictability in the work we do together. BC is the first province to put the United Nations Declaration into action through legislation.

Climate Change

Transportation accounts for 37% of BC's total emissions. The Province is undertaking multiple strategies to address climate change and reduce greenhouse gas (GHG) emissions, including the development of new 2030 climate change targets. Investing in new transportation infrastructure in the region will support the achievement of the Province's climate change target.

Delivering an active transportation strategy was identified as a goal in CleanBC, and in June 2019 the Ministry launched ***Move. Commute. Connect.: B.C.'s Active Transportation Strategy*** to support and increase safe walking, cycling and other forms of active transportation. The goal of this strategy is to double the percentage of trips people take by active transportation modes by 2030.

3 EXISTING CHALLENGES

This section highlights key challenges along the Corridor, as discussed in the following categories:

- Urban mobility and reliability;
- Physical condition of the Existing Tunnel;
- Traffic safety performance;
- Transit speed and reliability; and

- Active transportation.

3.1 URBAN MOBILITY AND RELIABILITY

Mobility generally reflects the typical travel times and delays experienced during peak and off-peak periods, whereas reliability reflects the variability of travel times from one day to the next. Both mobility and reliability of the Corridor affect GP traffic and commercial vehicles, as well as transit in areas where priority lanes do not exist and/or are shared with other traffic including High Occupancy Vehicles (HOV). Today the Existing Tunnel is at or over capacity in both the peak and non-peak directions, even with the counter-flow system in operation.

Peak and non-peak directions refer to the commuting traffic pattern at the crossing, with peak northbound traffic in the morning, and southbound in the afternoon. During peak periods, the Existing Tunnel operates a counterflow with three lanes in the peak direction and one lane in the non-peak direction to address traffic demand that has far exceeded the original design volumes. During counterflow operations, traffic volumes are particularly suppressed in the non-peak direction when only one lane is available, and capacity is well below demand. In off-peak periods, the Existing Tunnel operates with two lanes in each direction.

Congestion related delays are observed in both the northbound and southbound directions (with and without the counterflow system in operation) immediately preceding, during and following peak periods. These delays can be exacerbated by slight increases in traffic demand to the Existing Tunnel as well as by incidents on Highway 99 or other routes across the Fraser River, and in particular the Alex Fraser Bridge. The Alex Fraser Bridge and the Existing Tunnel work together as a couplet to move traffic across the Fraser River, and incidents that result in blockage on one will result in increased congestion on the other. These delays and uncertainty in travel times are negatively impacting commuters and commercial users of the Corridor.

Congestion patterns relative to typical travel time delays and travel time variability for each travel direction are discussed in the following subsections. The patterns discussed are based on travel time data for the months of September, October and November[4], which generally represent average annual conditions, which peak in the summer and decline in the winter. The variability in the travel times observed includes days with minor or routine traffic incidents; however, the observed patterns excluded incidents that resulted in full closure of Highway 99 for long periods of time.

[4] Travel time data for September, October and November, 2019 provided by TransLink.

3.1.1 Northbound

For northbound traffic, congestion delays are significant during both the morning and afternoon peaks. On a representative weekday, without incidents, morning delays in the northbound direction (peak direction) were typically 13 to 15 minutes, and as high as 33 minutes. In the afternoon, when only a single lane is available, the average northbound delay is around 10 minutes with a maximum of 23 minutes observed.

3.1.2 Southbound

Similar to the northbound direction, congestion delays in the southbound direction are also significant during both the morning and afternoon peaks. On a representative weekday, without incidents, delays in the southbound morning single-lane direction (non-peak direction) were typically observed to be between 10 to 15 minutes. In the afternoon three-lane southbound configuration, congestion related delays of 5 to 9 minutes, and as high as 22 minutes, were observed.

3.2 PHYSICAL CONDITION OF THE EXISTING TUNNEL

The Existing Tunnel has been in service for over 60 years, and while it was constructed to the design standards of its time, the roadway clearances and seismic performance of the tunnel are below modern standards. In addition to these issues, the Existing Tunnel is also exhibiting signs of approaching end of service conditions, which limit its future use as a long-term crossing solution.

3.2.1 Horizontal and Vertical Clearances

The horizontal and vertical clearances, and other design standards of the Existing Tunnel pose a number of challenges to commuters and commercial traffic within the Metro Vancouver region.

The roadway through the Existing Tunnel is divided into two two-lane tubes with 3.66 m wide lanes, no shoulders and, in the event of an incident within the Existing Tunnel, the current levels of congestion and lack of a shoulder hinders first responders' ability to efficiently respond and to manage traffic.

Although the Corridor contains multiple vertical clearance restrictions under 5.0 m, the posted vertical clearance of the Existing Tunnel, 4.15 m, is the lowest clearance point on the Corridor, and over-height traffic must divert to the Alex Fraser Bridge to cross the Fraser River. In addition, the movement of dangerous goods through the Existing Tunnel is prohibited and these trips must also divert to the Alex Fraser Bridge.

3.2.2 Seismic Risk

While considered operationally safe, the anticipated response of the Existing Tunnel to large seismic events is below current standards for new structures, and below performance levels of other infrastructure built to earlier design standards, primarily due to the risk of soil liquefaction[5]. The return period of an earthquake that the Existing Tunnel could currently tolerate without life safety damage is estimated to be between 150 to 240 years[6], which is well below the current design standard of a 2,475-year return period for a crossing structure of this significance. To manage the seismic risk of the Existing Tunnel, the Ministry installed an early warning system (emergency road closure system) in 2008 to prevent traffic from entering the Existing Tunnel and to allow traffic to safely exit after the detection of seismic waves of sufficient amplitude. Failure of the Existing Tunnel under a large seismic event is expected to result in cracking and eventual flooding of the Existing Tunnel, and the potential for the elements to become buoyant in the liquefied foundation. This buoyancy effect may induce flotation of elements and disruption to the navigational channel of the Fraser River post-failure.

3.2.3 Condition Survey and Service Life Assessment

As further discussed later in Section 4.6, although a number of serviceability challenges with the aging tunnel can be addressed through enhanced maintenance and rehabilitation, the presence of alkali-silica reaction (ASR)[7] cannot be rehabilitated. ASR typically leads to a progressive disintegration of affected concrete, and within a subaqueous tunnel setting there is no recognized method of eliminating future ASR development. Although, the current level of ASR does not present an immediate safety concern, or a significant concern for the duration of the time necessary to construct a replacement structure, the Ministry does not consider it feasible to include the Existing Tunnel in the long-term solution for the crossing. The current physical condition of the Existing Tunnel does not meet the Ministry's requirement of an additional 50-years of service.

3.3 TRAFFIC SAFETY PERFORMANCE

The collision rate for the Highway 99 segment between the Highway 17A and Steveston Highway Interchanges is the highest on the corridor (0.582 collisions per million vehicle kilometres (c/mvk)), and nearly twice the provincial average of 0.327 c/mvk for the urban-freeway-divided-4-lane+ classification. Directional incidents are significantly higher northbound (0.740 c/mvk) compared to southbound (0.477 c/mvk). The Steveston Highway Interchange and the Existing Tunnel occupy the top two spots for collision occurrences on the Highway 99 corridor and adjacent intersections. High congestion, speeding significant movements to/from the Corridor at the adjacent intersections, and operational complexity of the counterflow system are likely to be the primary contributors to the high collision rate in this segment.

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[5] Liquefaction takes place when loosely packed, water-logged sediments at or near the ground surface lose their strength in response to strong ground shaking (https://www.usgs.gov/faqs/what-liquefaction).
[6] Buckland & Taylor Ltd., George Massey Tunnel #1509, Prediction of Tunnel Performance with No Ground Improvement, January 14, 2009.
[7] Alkali-Silica Reaction (ASR) is a chemical reaction between cement and certain types of reactive silica minerals present in some aggregates that can lead to cracking of concrete structures.

3.4 TRANSIT SPEED AND RELIABILITY

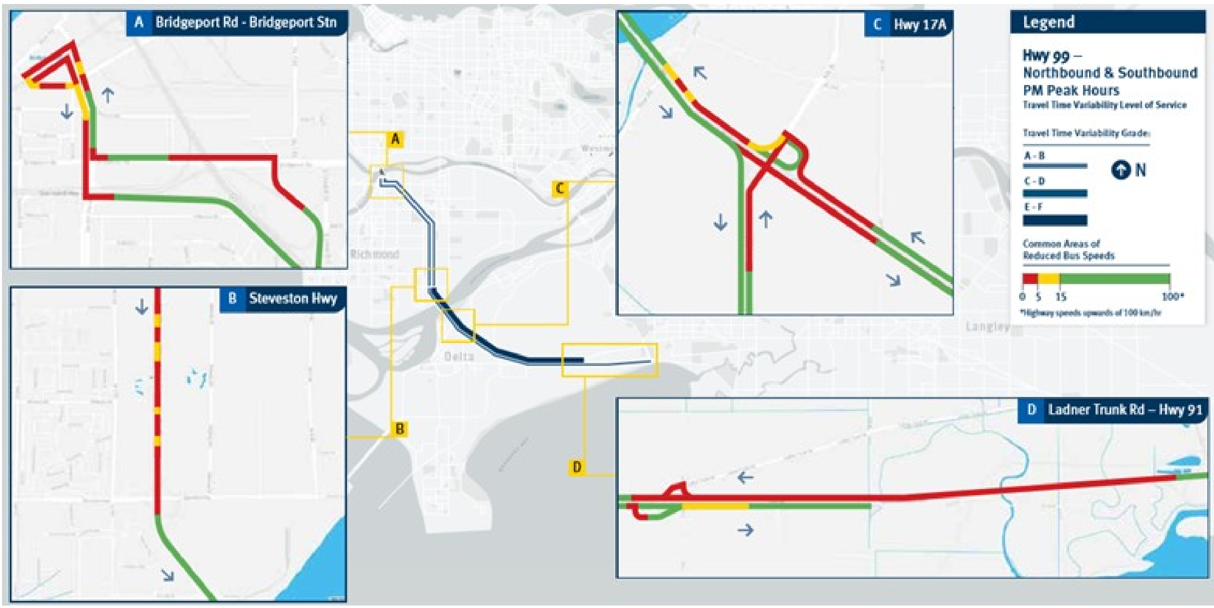
Highway 99 is part of the Frequent Transit Network[8], connecting the Canada Line's Bridgeport Station to South Delta, North Delta, South Surrey, White Rock and Tsawwassen Ferry Terminal. Transit connections include Ladner Exchange, South Surrey Park & Ride and Scottsdale Exchange. Planning and management of transit services in the Metro Vancouver region is the responsibility of TransLink.

Priority to transit service is provided through a mix of bus-on-shoulder lanes and shared bus/HOV lanes along the Highway 99 corridor. Although center median side lanes are conventional practice for bus/HOV lanes in highway environments, this arrangement works well if buses do not have to move from the center median lane for the duration of the highway trip. In the Highway 99 corridor where buses must move to the curb to leave and re-enter the highway for passenger exchange, the center median lanes cannot be utilized effectively, particularly in the highly congested portions of the corridor such as those approaching the Existing Tunnel or Oak Street Bridge. Although interchange ramps to/from the center median side lanes can be considered, this arrangement is generally avoided due to costs and complexity of operation. With respect to the Highway 99 corridor, both the ITR and the Ministry's 2009 Highway 99 (King George Highway to Oak Street Bridge) Corridor Assessment[9] recommended against center median side lanes due to the limited benefits and high costs associated with median stops and interchange ramps.

During peak periods, transit operates every two minutes along the corridor and through the Existing Tunnel, carrying approximately 900 to 950 passengers per hour in the morning and afternoon peak directions. Current operating status of the transit service within the corridor during afternoon peak hours is demonstrated in Figure 5. Red and yellow lines indicate sections where bus speed has dropped below 5 and 15 km/h, respectively, based on GPS data.

[8] Metro Vancouver's Frequent Transit Network (FTN) is a network of corridors where transit service runs at least every 15 minutes in both directions throughout the day and into the evening, every day of the week.
[9] Ministry of Transportation and Infrastructure, Highway 99 (King George Highway to Oak St. Bridge) Corridor Assessment, Draft V 1.5, January, 2009.

Figure 5: Highway 99 Corridor Transit Profile[10]



Bus service on Highway 99 has high average speeds, but is subject to high variability, with trips taking between 30 to 55 minutes during peak periods despite having bus-on-shoulder lanes for much of the corridor. Northbound, congestion points on the corridor are generally related to the single lane off-ramp and shared transit/HOV on-ramp lane at the Highway 17A Interchange. However, north of the Existing Tunnel, delays at both the Steveston Highway and Bridgeport Road Interchanges for GP traffic can affect transit travel times and reliability where no transit priority treatments exist. In areas where transit priority measures or bus-on-shoulder lanes are not in place; transit users experience the same inconsistent travel times as general traffic. In planning their trips, most customers need to allow additional time to reach their destination, rather than relying on median travel times along the Corridor.

The congestion points southbound occur mostly north of Steveston Highway where buses share the shoulder lane with HOV vehicles as well as vehicles that are taking the Steveston Highway off-ramp. As observed in the figure above, the buses tend to operate at an acceptable operating speed once they have entered the Existing Tunnel.

Elsewhere on the Corridor, within the vicinity of Bridgeport Station, delays to buses are generally attributed to roadway congestion, right turns by motorists, and delays caused by uncontrolled traffic

[10] South Coast British Columbia Transportation Authority (TransLink), 2019 Bus Speed and Reliability Report.

signals. Between the Highway 91 Interchange and the Ladner Trunk Rd interchange, delays in the northbound direction are caused by roadway congestion.

3.5 ACTIVE TRANSPORTATION

The Existing Tunnel cannot safely accommodate cyclists or pedestrians, and therefore, travel by these modes is prohibited, which limits connectivity of multi-use paths and active transportation routes in Richmond and Delta, as well as further active transportation connections to key destinations, such as the Tsawwassen Ferry Terminal. The Ministry offers a shuttle service for cyclists, which has limited hours of operation and is frequently oversubscribed in the summer months. There is no pedestrian crossing across the lower Fraser River west of the Alex Fraser Bridge.

3.6 CAPITAL INVESTMENT NEED

A significant number of studies have been undertaken to review and validate the social and economic need for a long-term crossing solution. Given the current deficiencies with the Existing Tunnel geometry and seismic resiliency, traffic conditions, pedestrian and cyclist facilities, and transit speed and reliability, capital investment is needed. The Ministry has assessed a number of crossing options and Corridor Improvements to address the above-noted needs. These are discussed in Part B.

PART B – SERVICE DELIVERY OPTIONS ANALYSIS

This part of the Business Case describes the process to determine the preferred physical scope of the Project for implementation and provides a cost estimate based on the reference concept of the recommendation.

The Ministry led the Project through the conceptual development and planning phases. The Province will build the Project and will own and operate the asset upon completion.

4 BACKGROUND

4.1 INDEPENDENT TECHNICAL REVIEW

Development of service delivery options for the Project builds upon findings and recommendations from an ITR commissioned by the Province to review the 2013 decision to replace the Existing Tunnel with a 10-lane bridge. The 10-lane bridge project (the George Massey Tunnel Replacement Project, or the GMTR Project), also included replacement of the Steveston Highway, Westminster Highway and Highway 17A interchanges, construction of center median transit/HOV lanes between Bridgeport Road and Highway 91 and decommissioning of the Existing Tunnel. The proposed GMTR Project was the subject of a number of concerns raised by Metro Vancouver communities, specifically that the 10-lane bridge concept and other improvements were too large and complex, had too many lanes and did not align with Metro Vancouver's RGS.

At the time the ITR was announced in September 2017, the GMTR Project was in the procurement stage, and this procurement was cancelled at that time to ensure that a future crossing solution reflected input from the region and fit into the overall vision for Metro Vancouver. By November 2017, the Province announced it had retained Westmar Advisors Inc. to lead the review and focus on what level of improvement is needed in the context of regional and provincial planning, growth, and vision [11]. The ITR, completed in September 2018, concluded that there are options that would reduce the scale, complexity, and cost of the crossing and improvements along the Corridor, and better align with regional objectives. Key findings are as follows:

- There is a need to increase the existing capacity of the crossing, and to improve travel time reliability in the non-peak direction during peak hours.
- While ten lanes would have resulted in no congestion through 2045, either six or eight lanes will accommodate the majority of the 2045 predicted traffic, but with delays in the peak direction in 2045 similar to today.
- The Steveston Highway interchange is currently congested with poor service levels and should be a required component of any future project.
- Reducing the number of highway lanes to six or eight, combined with elimination of the median transit stations would significantly reduce the complexity and cost of the Steveston Highway and Highway 17A interchanges.

[11] Ministry of Transportation and Infrastructure, Terms of Reference, Independent Technical Review – George Massey Crossing Project, November 1, 2017.

- Retrofitting the Existing Tunnel to modern seismic standards is expected to be technically feasible, and construction of an ITT for the new crossing either on its own or in conjunction with retrofit of the Existing Tunnel is feasible and cost-competitive with a bridge.

The ITR also identified that the absence of community alignment, community livability, and cost in the Project goals, and the solutions to address them, contributed to stakeholder concerns related to the GMTR Project.

In December 2018, the Minister of Transportation and Infrastructure released the results of the ITR and indicated that the Province would engage with regional municipalities and Indigenous groups to identify a crossing solution that better aligns with regional interests.

4.2 GEORGE MASSEY CROSSING PROJECT

Based on the results of the ITR, the Ministry commenced planning for the Project in January 2019. This included a technical program, an engagement program with Indigenous groups, and a consultation program with regional and local governments, key stakeholders and the public. The Ministry established a three-part engagement process to support project planning as described below:

- **Principles, Goals and Objectives (January – April 2019)** – Work with Indigenous groups, regional and local governments and select external stakeholders to develop and achieve regional consensus on Project principles, goals and objectives.
- **Options Analysis (May 2019 – Spring 2020)** – Consult with the region to identify and shortlist potential crossing options and conduct a Multiple Account Evaluation (MAE) of the shortlisted options, as well as ongoing engagement with identified Indigenous groups and key stakeholders.
- **Business Case (Fall 2020)** – Complete the Business Case for the recommended crossing option.

A summary of the ITR recommendations and the Ministry's engagement program is provided in Appendix A

4.3 INDIGENOUS GROUPS ENGAGEMENT

The Ministry engaged with participating Indigenous groups on each part of the three-part engagement process noted in Section 4.2. In addition, workshops specific to Indigenous fisheries interests were held, and advanced environmental works led by Indigenous groups are occurring. In total, the Project team has had over 475 points of contact with participating Indigenous groups, including 37 meetings.

Key themes from the Indigenous engagement were as follows:

- Concerns with in-river works and impacts on fish and fish habitats;
- Strong support for improved transit and pedestrian mobility;
- The Project location has very high value from Indigenous perspectives and interests;
- Concerned with potential visual, noise, and light impacts; and
- Concerns related to cumulative impacts and coordinated approaches to assessing cumulative impacts with other infrastructure projects in the lower Fraser.
- Concerned with potential impacts accessing the Project area or passing through the Project area to fish, conduct traditional practices, and knowledge transfer;
- Acknowledgment of the need to replace the existing crossing;
- Support for the Project's preliminary principles, goals and objectives;
- Support for traffic congestion improvement measures; and
- Two Indigenous communities expressed concerns with the level of information sharing by the Province in regards to the decision making process for the Project.

Translation of this initial engagement with Indigenous groups into principles, goals and objectives for the Project is discussed in Section 4.5.

4.4 STAKEHOLDER ENGAGEMENT

As part of the engagement from January to April 2019, the Ministry collaborated with key regional stakeholders to develop shared principles, goals, and objectives for the Project. A total of 23 formal stakeholder meetings were conducted.

Key themes from this early engagement were as follows:

- Strong support for the Project with a desire to see it move forward as soon as possible;
- Strong desire for immediate traffic congestion relief measures while Project planning is underway;
- Desire to see a Project that is aligned with Metro Vancouver's RGS which aims to address social, economic and environmental challenges common to urban regions;
- Strong desire for Project planning to consider the South of Fraser portion of the Highway 99 corridor;

- Support for improved transit, including immediate improvements and ensuring future rail rapid transit can be accommodated;
- Support for protection of the Agricultural Land Reserve and the health of the Fraser River;
- Desire for more information on funding sources for the Project; and
- General consensus that potential trade-offs may be required to ensure the preferred option best serves the needs of the region.

Translation of this initial engagement with stakeholders into principles, goals and objectives for the Project is discussed in Section 4.5.

4.5 PROJECT PRINCIPLES, GOALS AND OBJECTIVES

4.5.1 Project Principles

Consistent with its mandate to deliver a multi-modal transportation network that is reliable, affordable, safe, and efficient, and in recognition of feedback from initial engagement meetings, the Ministry identified the following principles for the Project:

- Align with existing regional plans and respect Indigenous groups' interests;
- Safety;
- Reliability; and
- Connectivity.

The principles transcend all of the goals and were endorsed by a working group comprising representatives from Metro Vancouver, TransLink, participating municipalities, the Metro Vancouver Board, and TFN. The principles were also presented and discussed with all participating Indigenous groups in May 2019 and were subsequently acknowledged as appropriate context for Project development by the Metro Vancouver Board.

4.5.2 Project Goals and Objectives

Engagement input was considered in the development of the following four Project goals, each of which included a number of objectives that were used to create evaluation criteria for the potential crossing solutions. Additional information is available in the 2019 Engagement Summary Report [12] on the GMC Project website [13]. Project goals and objectives were determined as follows:

[12] https://engage.gov.bc.ca/app/uploads/sites/52/2020/02/GMC_PGO_Engagement-Summary-Report_FINAL.pdf
[13] https://engage.gov.bc.ca/masseytunnel

Table 3: Project Goals and Objectives

Project Goal	Project Objective
1 - Support sustainability of Fraser River communities	○ Improve safety for all modes of travel; ○ Improve access to designated development centres; ○ Manage congestion on the corridor; ○ Respect the cultural values of communities; ○ Enhance connections between communities; ○ Maintain agricultural productivity; ○ Avoid impacts to agricultural land; ○ Move forward quickly; and ○ Adopt a shared decision-making approach with the Metro Vancouver Mayors' Task Force [14] and participating Indigenous groups.
2 - Facilitate increased share of sustainable modes of transport	○ Enhance transit service convenience and facilitate future expansion; ○ Provide safe, convenient and comfortable options for pedestrians and cyclists; ○ Encourage higher occupancy modes of travel; and ○ Ensure potential for future rail rapid transit. [15]
3 - Enhance regional goods movement and commerce	○ Improve travel reliability for business and regional goods movements; ○ Support the BC tourism industry; ○ Protect the Fraser River for fishing and transportation; ○ Support industrial land productivity; and ○ Reduce congestion-related delays for priority goods and services trips.
4 - Support a healthy environment	○ Avoid loss of habitat for fish, wildlife, birds and marine mammals; ○ Improve habitat quality and protect water quality; ○ Enhance land and marine-based recreation; and ○ Reduce greenhouse gas emissions and other air contaminants.

[14] http://www.metrovancouver.org/services/economic-prosperity/business-plan/Pages/default.aspx
[15] Refer to Section 4.5.3.

4.5.3 Further Consideration of Future Rapid Transit in the Corridor

In 2020, the Ministry, in consultation with TransLink staff, completed a review of transit demand and rapid transit alternatives along the Highway 99 corridor. This Rapid Transit Review included the crossing, as well as bus and rail service delivery options, and concluded that rail rapid transit would not be aligned with the future demand. Consequently, the objective relating to potential for future rail rapid transit was not included in the final evaluation of service delivery options. A copy of the Rapid Transit Review is attached as Appendix B.

The Rapid Transit Review also considered regional plans for transit, land use, forecasts for population and employment growth south of the Fraser, as well as potential rapid transit technologies. The service delivery assessment considered service periods, frequencies, trip patterns and service expansion plans. This information was considered in relation to generally recognized industry thresholds, or capacities (passengers per hour), associated with different service delivery technologies (i.e. bus, rapid bus or rail rapid transit). The review determined that population levels in the Corridor are not sufficient to support rail rapid transit, and that peak transit demand for the Project crossing is forecast to be approximately 1,350 passengers per hour per direction in 2050, which can be adequately served by bus-on-shoulder or dedicated bus-lane options. This represents an approximate 50% increase in the number of passengers during peak hours than existing conditions. By comparison, rail rapid transit would generally require approximately 4,000 passengers per hour per direction to support investment in rail technology.

The review also determined that, regardless of the crossing technology, significant investment would be required to provide sufficient clearances and provisions for a future retrofit for rail rapid transit, both on the crossing itself and at interchanges, and along the entire corridor alignment. Based on an assessment of the potential cost and limited future demand forecast, the overall BCR of future provisional space for rail rapid transit is low. This finding is consistent with conclusions of the ITR.

In addition to the rapid transit study, TransLink, in collaboration with Metro Vancouver and the Ministry, assessed the long-term transit demands based on 2080 projections for population growth and land-use. The assessment modelled the forecasted demand for rail rapid transit (i.e. SkyTrain) connections and highly favourable level of service between Richmond Canada Line and White Rock Centre, Tsawwassen Town Centre and Tsawwassen Ferry/ TFN. Peak hourly demand across the crossing was projected to be 3,100 person per hour in the peak direction in 2080, or about 30% of the rail rapid transit service capacity provided under favourable conditions (approximately 10,000 passengers per hour per direction). In addition to estimate of transit ridership, the study assessed the impact of SkyTrain level service on traffic volumes; the study found SkyTrain level service had a marginal, 1.5% reduction, in traffic volumes at the crossing during peak hours. The study concluded that the capacity and cost of rail rapid transit is significantly in excess of demand and could be more effectively served by a high-quality highway bus rapid transit network.

4.6 CONSIDERATION OF THE EXISTING TUNNEL FOR FUTURE USE

For the Existing Tunnel to be part of the new crossing infrastructure, the Ministry has determined that the Existing Tunnel must provide an additional 50-year service life and be upgraded to seismic performance standard consistent with other legacy structures that do not meet requirements for new infrastructure.

While considered operationally safe, the response of the Existing Tunnel to large seismic events is below current standards for new structures, and below performance levels of other infrastructure built to earlier design standards, primarily due to the risk of soil liquefaction. In 2001, structural retrofit and ground improvement works were recommended to improve the safety of the Existing Tunnel for large seismic events. The structural retrofit was completed by 2006, and while this retrofit increased the seismic resiliency of the Existing Tunnel, it did not increase the response to levels consistent with the design standard for new infrastructure in the early 2000s. In addition to the structural retrofit, larger pumps and drainpipes were also installed during this work to increase the rate at which water could be removed from the Existing Tunnel and increases the time available for evacuation after a large seismic event.

Related ground improvements, however, were not undertaken due to uncertainty with the effectiveness of the proposed solution [16]. At the time, the proposed works were considered state-of-the-art, and rare in tunnel applications. To manage the seismic risk of the Existing Tunnel, the Ministry installed an early warning system (emergency road closure system) in 2008 to prevent traffic from entering the Existing Tunnel and to allow traffic to safely exit after the detection of seismic waves of sufficient amplitude. Further seismic improvements were deferred as plans for a new crossing were advanced.

As part of the Ministry's response to the ITR, a service life assessment of the Existing Tunnel's concrete structures was completed to enable a fulsome consideration of the physical condition of the Existing Tunnel as part of the crossing solution. The assessment included coring of concrete samples to assess chloride ingress, carbonation depth, and petrographic analyses. Findings of the assessment identified three processes that negatively affect the future service life of the Existing Tunnel: ASR, reinforcement corrosion, and water leakage. An enhanced regular maintenance and rehabilitation program can be implemented to address the reinforcement corrosion and water leakage issues with the Existing Tunnel; however, the forecast of future ASR damage cannot be confirmed with the available data. In early 2000s, ASR levels in the Existing Tunnel were determined to be insignificant, and recent testing has confirmed minor levels of ASR in the elements, with higher levels of ASR measured in the infill concrete between joints of the elements, and within the approaches to the Existing Tunnel. Although the level of ASR within the Existing Tunnel is within a minor level of severity, lithology examination of the concrete aggregates did indicate significant potential reactivity in all cores and there is no recognized method of eliminating

[16] EVM Project Services Limited. Value Engineering Study – Project 11469-0002: George Massey Tunnel Seismic Densification [Report], April 20, 2007.

future ASR expansion within a subaqueous tunnel setting [17]. Replacement or rehabilitation of the Existing Tunnel precast elements is not considered possible if more significant signs and impact of ASR occur in the future. Consequently, the additional 50-year service life target cannot be guaranteed; therefore, the Existing Tunnel was not further considered for inclusion in the new crossing solution.

At the time the Existing Tunnel was built, the risk of ASR was not well understood. The aggregates used for the Existing Tunnel were tested by means of a rapid chemical test that has since been found to not accurately predict potential reactivity, and therefore the test method was withdrawn. Current material testing standards have been updated to incorporate significant advancements in the understanding of ASR, and aggregate suppliers regularly test to these new standards on an ongoing basis to address the risk of ASR.

An additional assessment was completed to review long-term options for the Existing Tunnel in consideration of all traffic crossing the Fraser River on a new structure. The assessment concluded that removal of all elements of the Existing Tunnel, and backfilling of the approaches is recommended to mitigate potential risks to a new crossing and the Richmond dyke system from the seismically deficient Existing Tunnel. Previously, the GMTR Project concluded that partial removal of the Existing Tunnel, which included the removal of the central four of six elements, would be required; however, this recommendation was based on a reference concept for a bridge structure with towers straddling the Existing Tunnel and providing confinement to the elements on each abutment. With a preferred upstream crossing alignment, this confinement is not provided with either a new bridge or ITT, and complete removal of all elements is recommended.

4.7 SHORTLISTING OF CROSSING OPTIONS

Following the release of the ITR, the Ministry Project team identified 18 potential crossing solutions, incorporating either an ITT, a bridge, or a bored-tunnel solution. Consistent with Provincial and regional commitments to transit and active transportation, all options assumed transit infrastructure enhancements and provisions for cycling and walking. Through a process of analysis and engagement with the Metro Vancouver Mayors' Task Force, these options were shortlisted to either a new eight-lane ITT or eight-lane bridge. In November 2019, based on the analysis presented, the Metro Vancouver Board endorsed the eight-lane ITT option with multi-use path (MUP), including two transit lanes, as the preferred option for the Project for the purposes of public engagement.

[17] U.S. Department of Transportation, Federal Highway Administration, Report on the Diagnosis, Prognosis, and Mitigation of Alkali-Silica Reaction (ASR) in Transportation Structures, January 2010.

5 SERVICE DELIVERY OPTIONS

5.1 APPROACH

The primary consideration for the Project's service delivery options analysis is to ensure the crossing meets future service delivery needs for the Highway 99 corridor. In addition to the crossing, the service delivery options analysis also considered other improvements to transportation infrastructure along the Highway 99 corridor, such as transit priority and interchange upgrades, to address priority challenges on the Corridor and provide future benefit to an upgraded crossing. The service delivery options analysis has been structured in the following manner to address these considerations:

1. The service delivery options analysis confirms the number of lanes and configuration, such as GP or transit only lanes, for each shortlisted crossing technology (new bridge and new ITT);
2. A detailed assessment of the crossing options is completed in accordance with the Ministry's MAE process to determine the recommended crossing option (the Crossing);
3. An assessment of costs, benefits and other factors is made of corridor improvements that support the Crossing and/or address priority challenges on the Corridor; and
4. Lastly, the Crossing MAE analysis is updated for the full project, Crossing and Corridor Improvements, to reflect the total impact of the Project across the Ministry's standard MAE accounts.

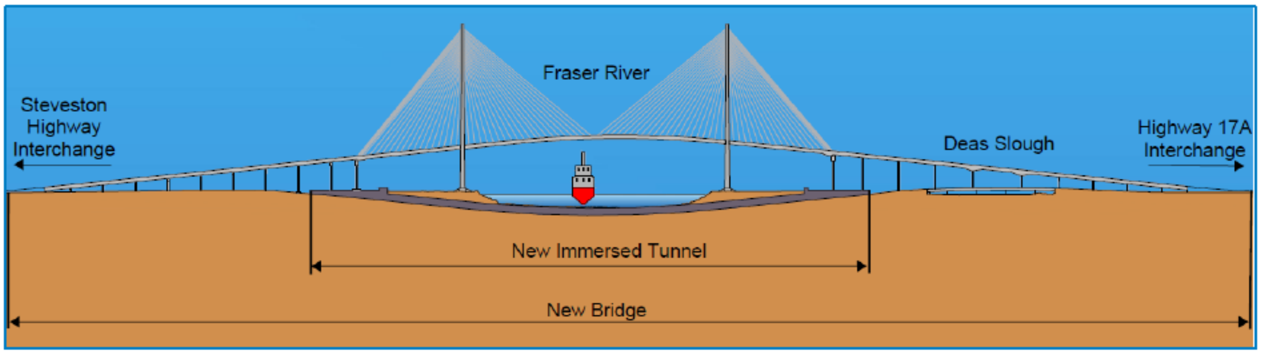
A full MAE analysis for each Corridor Improvement was not completed, as each improvement generally represents an incremental upgrade to the Project, and would have no material impact to the overall Project MAE relative to the Base Case when the crossing option is factored in. However, for completeness of this Business Case, a MAE for the Project (Crossing + Corridor Improvements) was determined using the accounts from the crossing MAE.

5.2 CROSSING CONFIGURATION

To support selection of the Crossing technology choice for the service delivery options, a crossing configuration analysis was completed to determine the recommended number and allocation of lanes, such as dedicated transit or GP for either a new bridge or new ITT structure. The analysis assessed configurations from six to eight lanes, including configurations with and without reversible lane (counterflow) systems. Configurations that incorporated the Existing Tunnel were not included based on potential limitations of achieving the required service life (refer to Section 4.5). Pursuant to the findings of the ITR and input from the consultation and engagement process, a 10-lane configuration was not further considered as a viable solution for the crossing, as this configuration was not aligned with the interests or vision of the region.

Results of the crossing configuration analysis determined that a symmetrical eight-lane crossing (i.e. four lanes in each direction) would best achieve the Project's goals and objectives, for either a new bridge, or a new ITT crossing (Figure 6). This configuration provides a flexible approach, which could be used to provide four GP lanes in each direction if vehicular traffic operations are to be optimized to manage congestion, or the crossing could be configured with three GP lanes and one dedicated transit lane in each direction to encourage transit use.

Figure 6: Crossing Technology Alternatives



Either condition will address the primary congestion issue related to a single lane available in the non-peak direction during peak periods, and drivers will benefit from capacity gains due to modern lane widths and geometry, elimination of the counterflow system, and a potential separation of transit from GP lanes, such that buses will not use the GP lanes, thereby improving capacity of the GP lanes through the crossing. Transit services will also benefit in each scenario, with dedicated transit lanes on the rossing providing some additional travel time benefits for transit users, and creation of levels of congestion necessary to further incentivize transit or HOV use.

5.3 CROSSING TECHNOLOGY MULTIPLE ACCOUNT EVALUATION

This section provides a detailed assessment of the crossing technology choices in accordance with the Ministry's MAE process. The MAE process provides for the evaluation of both quantitative and qualitative indicators across options in terms of five different accounts:

1. Financial;
2. Customer Service;
3. Social/Community;
4. Economic Development; and
5. Environmental.

Through the established MAE process, an MAE framework has been developed (refer to Appendix C for further details) so that each account could be assessed through one or more indicators that represent the important implications of each option against the identified Project Goals and Objectives, and demonstrate the trade-offs involved in selecting one option in relation to the others. Thus, the MAE analysis considers the costs, benefits and other impacts of each option in relation to the base case scenario (Base Case), which reflects the current operating conditions of the Existing Tunnel.

5.3.1 Crossing Options Analyzed

The Base Case and Crossing Options (new ITT or new Bridge) analyzed for the Project are summarized in Table 4.

Table 4: Description of Crossing Scenarios

Scenario	Description
Base Case **Continue to use the Existing Tunnel**	This option assumes the continued use of the Existing Tunnel under current operating conditions (e.g., 4.15 m vertical clearance; 3.66 m lane widths with no shoulders; no accommodation of dangerous goods movement; no MUP for pedestrians and cyclists; and counterflow lanes during peak periods). An enhanced level of operations and maintenance is required to maintain serviceability of the Existing Tunnel.
Option 1 **eight-lane ITT with decommissioning of the Existing Tunnel**	This option assumes the construction of a new eight-lane ITT with the following key features: • One dedicated bi-directional MUP for pedestrians and cyclists to use the crossing; • Four lanes in each direction, each 3.7 m wide with 1.12 m inner and outer shoulders; • 5.0 m vertical clearance and accommodation of dangerous goods movement to support commercial users; • Replacement of the existing Deas Slough bridge; • No change to the water draft of the Fraser River navigational channel (i.e. aligns with water draft of the Existing Tunnel and meets the navigational requirements of the VFPA); • Requirement for a new Environmental Assessment (EA) review; • Decommissioning and removal of the Existing Tunnel; and • Relocation of the existing BC Hydro transmission line in the Existing Tunnel.

Scenario	Description
<u>Option 2</u> **eight-lane bridge with decommissioning of the Existing Tunnel**	This option assumes the construction of a new eight-lane bridge with the following key features: • Two dedicated unidirectional multi-use paths for active transportation in the crossing; • Four lanes in each direction, each 3.7 m wide with 1.0 m inner and outer shoulders; • No vertical clearance or dangerous goods restrictions to support commercial users; • Introduces a navigational air draft restriction to the lower Fraser River with a nominal clearance of 62.5 m; • Requirement for a complex amendment to the existing EAC for the GMTR Project; and • Decommissioning and removal of the Existing Tunnel; and • Relocation of the existing BC Hydro transmission line in the Existing Tunnel.

Connections for the new crossing to the existing Highway 99 alignment are made south of Steveston Highway on the north side of the crossing, and north of Highway 17A on the south side of the crossing as shown in Figure 7. For a new bridge, connections with the Highway 99 alignment are similar to the ITT option; however, there is greater elevation change associated with the bridge option. As a consequence of this elevation gain and maintain a comparable grade to the ITT, the bridge connections are closer to the adjacent interchanges on each side of the crossing for Option 2 due to the longer ramps needed to accommodate the additional height.

Figure 7: Crossing Alignment

Under both Crossing Options, the transmission line currently located in the Existing Tunnel will need to be relocated. As owner of the transmission line, this relocation will be determined by BC Hydro's capital projects approval process.

Further details regarding the Crossing options are provided in Appendix D.

5.3.2 Crossing MAE Results Summary

The detailed results of the MAE analysis relating to the Crossing Options are summarized in Table 5, and discussed in the following subsections.

Table 5: Crossing MAE Summary Results

	Indicators [1]	Base Case (existing 4-lane Tunnel)	Option 1 (8-lane ITT)	Option 2 (8-Lane Bridge)
Financial	Capital costs (nominal [2], $M)	Nil	[redacted]	[redacted]
	Capital costs (PV, $M)	Nil	[redacted]	[redacted]
	Salvage value (PV, $M)	Nil	[redacted]	[redacted]
	OMR costs (PV, $M)	[redacted]	[redacted]	[redacted]
	Project delivery schedule (Opening Day) (excludes decommissioning of Existing Tunnel)	n/a	Q2 2030	Q4 2028
	Total Agency Costs (PV, $M)	[redacted]	**1,762**	**1,912**
Customer Service	Travel time savings (PV, $M)	0	917	950
	Travel time reliability (PV, $M)	0	192	195
	Improved seismic resiliency (PV, $M)	0	139	137
	Safety savings (PV, $M)	0	68	66
	Savings in Vehicle Operating. Costs (PV, $M)	0	(54)	(58)
	Emergency response	○	●	●
	Network connectivity	○	●	●
	Total Road User Benefits (PV, $M)	**0**	**1,262**	**1,290**
	Benefit Cost Ratio	**n/a**	**0.72**	**0.67**
	NPV (Benefits – Costs, $M)	[redacted]	**(500)**	**(622)**
Social /Community	Transit ridership (additional trips per year)	0.0	~0.8 million	~0.8 million
	Consistency with local, regional and provincial plans	○	●	●
	Modal integration for cyclists and pedestrians	○	●	●
	Parks and recreation takings (ha)	0	0.24	0.13
	Parks and recreation impacts	○	○	○
	Residential properties takings (full / partial)	0 / 0	0 / 0	0 / 1
	Residential properties impacts	○	●	●
	Visual aesthetics	○	○	●
	Noise and light	○	○	●
Econ omic	Economic agglomeration (PV, $M)	0	192	205
	Marine navigation during construction	○	●	●

	Indicators [1]	Base Case (existing 4-lane Tunnel)	Option 1 (8-lane ITT)	Option 2 (8-Lane Bridge)
	Marine navigation during operations	Neutral	Neutral	Somewhat worse
	Agricultural land takings (ha)	0	4.1	6.2
	Agricultural land impacts	Neutral	Somewhat better	Somewhat better
	Business takings (full / partial)	0 / 0	0 / 8	0 / 3
	Business impacts	Neutral	Significantly better	Significantly better
Environment	Regional air quality	Neutral	Somewhat better	Somewhat better
Environment	Local air quality	Neutral	Somewhat better	Significantly better
Environment	Aquatic species and habitat	Neutral	Significantly worse	Somewhat worse
Environment	Wildlife and terrestrial habitat	Neutral	Somewhat worse	Somewhat worse

[1] "PV,$M" indicates the values are in $ million on a present value basis, 2021 as base year.

[2] In nominal dollars (2021 as base year), excludes IDC and risk allowances associated with the recommended procurement model mentioned in Section 7.

Legend: Significantly worse Somewhat worse Neutral (same as Base Case)
Somewhat better Significantly better

The estimated total capital cost, measured on a present value basis, shows the new ITT is [redacted]% lower when compared to a new bridge. This difference is also a result of the application of the discounting method as the service delivery timelines are different between the Options (opening day Q2 2030 for the new ITT, and Q4 2028 for the new bridge). However, when measured in nominal terms (excluding estimated IDC and risk allowance), the total cost estimate for both Crossing Options are comparable, with the new ITT at $[redacted] million approximately [redacted]% less than the new bridge cost at $[redacted] million.

Quantified road user benefits for Crossing Options are captured under the Customer Service account. In general, the road user benefits were similar for each option, reflecting an eight-lane crossing for each option; however, as noted above for the Project costs, the present value basis reflects differences in the service delivery timelines between the options. Together with the costs from the Financial account, the Benefit Cost Ratio was determined for each Crossing Option, with 0.72 and 0.67 for the ITT and bridge, respectively.

Local and regional plans inform regional and provincial transportation policies and initiatives for people and goods movement. These policies include strong support for increased public transit and alternates to single-occupancy vehicles (Metro Vancouver RGS, Richmond Official Community Plan, Delta Official Community Plan, TransLink Regional Transportation Strategy). Both Crossing Options are relatively consistent with these high-level policies as they provide for increased capacity, reliability, ridership and mode share on the Corridor. However, the new ITT benefits from the endorsement of the Metro Vancouver Board, save for TFN, as the preferred option for alignment with the overall vision of the region.

Regarding the other indicators under the social community account, the results in terms of visual aesthetics, noise, and light levels are less favorable for a new bridge compared to a new ITT, which generally reflects similar operational impacts as the Existing Tunnel. Also, based on the comments offered at public engagement meetings, a new ITT structure is preferred by cyclists due to lower exposure to wind and perceived accessibility issues that would result from a new bridge option. With respect to land takings and accessibility of parks and recreation areas, the impacts are similar across the Crossing Options and generally low impact to the overall parks and recreation areas.

From an economic development perspective, the differentiators pertain to the constraints on marine traffic, and the number of required business takings. For the purposes of this MAE, a new ITT assumes industrial/commercial property is acquired for construction of a casting basin in order to provide a reasonable upper bound of impacts for the Project, noting that options to reduce or eliminate development of a new casting basin are available through casting of multiple litters, offsite options, floating dry docks, or casting in the approaches for a new ITT. Although a new ITT would require significantly more land for the Project, it would require 50% less agricultural land than a new bridge. This increase in the requirement for agricultural land for the bridge is due to its length, need for access ramps, and close proximity to the concentration of agricultural land at the Project site.

With respect to marine traffic, the new ITT option would require careful management to maintain safe passage of vessels. During immersion operations, a complete restriction of river traffic would be required between 24 to 48 hours for each element and this will require in depth communication with stakeholders and Indigenous groups. For construction of the bridge, only minor disruptions to marine traffic are expected for occasional hoisting of equipment/materials from barges. During the operations phase, the new ITT is favourable as it maintains the current navigational channel on the Fraser River, whereas, a new bridge would introduce an air draft restriction to the lower part of the river.

Finally, all environmental considerations pointed out in the MAE are expected to be effectively mitigated through commitments set out in the EAC. However, the bridge structure presents lower environmental impacts as a whole due to less invasive instream works during construction.

In consideration of the MAE analysis and results, it is recommended that a new ITT (Option 1) be the recommended Crossing Option for the Project to move forward to procurement. Further details on the assessment of each account for the crossing are provided in the subsections below.

5.3.3 Financial

This account measures the present value of the capital costs (less salvage value), and operating, maintenance and rehabilitation costs determined under each option. The ratio of quantified user benefits to agency costs provides the BCR for each option. Additionally, an estimate of the delivery schedule for each Crossing Option is provided within the Financial Account.

The capital, operations, maintenance and rehabilitation costs, in nominal terms, are slightly higher for a new bridge. Also, due to a more compressed construction period (until Q4 2028 vs Q2 2030 for a new ITT, excluding works associated with the decommissioning of the Existing Tunnel), the discounted total cost value is highest for a new bridge. The different timeline required to obtain the EAC and relevant permits between the options is the primary contributing factor in the different schedule durations. The Project schedule for a new ITT is also subject to annual constraints for working in windows for least risk to fish and fish habitat, and “low flow” conditions for instream activities.

5.3.4 Customer Service

This account includes quantitative and qualitative measures of the benefits to road users of each option. The quantitative measures are generally those that provide a reduction in network travel times and user costs for each option relative to the Base Case scenario; they are:

- Travel time savings;
- Travel time reliability;
- Impact on collision costs due to better safety performance;
- Effect on vehicle operating costs; and
- Improved seismic resiliency.

Qualitative benefits are assessed relative to the Base Case in terms of each Option’s:

- Emergency response improvements; and
- Network connectivity.

Under the existing traffic modelling assumptions, a comparative analysis of the Crossing Options against the Base Case scenario for each customer service account indicator includes the following:

- **Travel time savings**: The majority of the savings are derived from the improved capacity and laning along the Highway 99 corridor (~70% is allocated to passenger vehicles; ~30% to trucks and transit users). The travel time savings are monetized using the value of travel time and application of the consumer surplus method within the Regional Transportation Model (RTM). The network equilibrium capability of the RTM allows for capture of congestion relief on the Alex Fraser Bridge and the Highway 91 corridor as vehicles divert to Highway 99. Enhanced expansion factors were applied to estimate future benefits as the current specification of the RTM uses fixed time slices to estimate peak period traffic demands and congestion levels. In other words, if no improvements were made to Highway 99, then the current peak period would grow beyond levels observed today which is not specifically accounted for in the RTM. The differences observed when measuring the benefits in monetary terms relate to the application of the discounting method for the assessment with the new ITT option starting operations in Q2 2030; whereas, the new bridge option would start operations in Q4 2028. The travel time savings analysis considered that the difference in vertical climb between the Crossing Options (30 m for the ITT, and 75 m for the bridge), and concluded that the travel time for either option will be similar based on climbing lane analysis for heavy vehicles.

- **Travel time reliability**: Replacing the Existing Tunnel with either a new ITT or new bridge would allow for reduced variability in travel times. The reliability benefits account for both passenger and commercial vehicles. The differences observed when measuring the benefits in monetary terms relate to the application of the discounting method for the assessment with the new ITT starting operations in 2030 while the new bridge starts in Q4 2028.

- **Safety Savings**: A modern design of the crossing for either Crossing Option is anticipated to generate safety savings from a reduction in vehicle collisions through improved geometry, reduced congestion, wider lanes and addition of shoulders. Because of the large number of changes, and in order to simplify the methodology, a benchmark of collision reductions on the Port Mann/Highway 1 corridor was utilized. The collision rate on Port Mann/Highway 1 was reduced by 25% based on a review of historical collision data along this corridor before and after the Port Mann/Highway 1 upgrade. An adjusted rate for Highway 99 was developed based on the physical attributes of the Existing Tunnel with counter-flow lanes and opposing traffic in one tube. Accident rates by various roadway and highway types were multiplied by vehicle volumes using the RTM to estimate the network-wide effects on the total number of accidents. For both methods, the monetary value of fatal/injury and property damage only accidents ratio was applied to estimate total net safety savings.

- **Savings in vehicle operating costs**: The new Crossing Options present benefits in terms of savings in vehicle operating costs at a similar level as they allow for more efficient route choice. The total vehicle kilometres travelled metric was multiplied by the per kilometre vehicle operating cost rate to monetize operating cost savings. During the construction phase, the savings in vehicle operating costs associated with each new Crossing Option are dependent on the traffic management plans in place. During operations, the benefits are likely to be similar for both options as they will have a similar impact on traffic patterns. Also, the forecast vehicle operating costs in the long-term will be strongly influenced by the rate of adoption of electric and autonomous vehicles (which may drive the cost of fuel consumption to lower levels).

- **Improved seismic resiliency**: Both Crossing Options provide significant seismic safety benefits, relative to the Base Case scenario. The estimated monetary benefits are similar for both Crossing Options, consistent with each option being engineered to achieve a 2,475 year return period seismic event (against a maximum of 240 year return period associated with the Existing Tunnel).

- **Emergency response**: The emergency response capabilities for both new Crossing Options would be significantly improved over the Existing Tunnel conditions. Either new Crossing Option would be built to modern design standards with 3.7 m wide lanes and approximate 1.0 m shoulders on the inside and outside on each side of the roadway. The additional lanes and shoulders will reduce the impact of incidents as compared to the Existing Tunnel, which has two 3.66 m lanes and no shoulders in each direction. When compared to the Existing Tunnel, a new ITT would include wider roadway tubes with shoulders for better traffic management and accessibility, as well as enhanced lighting and fire life safety systems. A new bridge would provide some additional accessibility benefits for emergency response over a new ITT as each direction of the roadway is not confined to a separate tube and is open to air.

- **Network connectivity**: All Crossing Options would bring substantial improvements to the Richmond and South of Fraser area from a network connectivity perspective as a new crossing structure will provide increased vehicle capacity and incentivize active transportation through MUPs and dedicated transit lanes when compared to existing conditions. In addition, both new options will improve mobility for commercial users with higher vertical clearance than the Existing Tunnel, and the accommodation of dangerous goods. It is expected that a portion of the traffic observed on the Alex Fraser Bridge will be diverted to the crossing relieving congestion levels on the network as a whole. In addition, an improved crossing will reduce queuing on the municipal network accessing Highway 99 providing enhanced network connectivity to and from key neighborhoods and municipal town centre areas.

In addition to the overall view of network connectivity above, the Project team specifically examined the estimated impacts to the Alex Fraser Bridge, Oak Street Bridge and Knight Street Bridge in order to ensure the Project is not creating new issues elsewhere in the regional network. Results of this examination demonstrated the following:

- **Alex Fraser Bridge:** An improved crossing will divert traffic from Alex Fraser Bridge to the Highway 99 corridor as trips take advantage of improved travel times and reliability. Non-peak direction trips, such as those in the southbound direction during the morning peak, will see the highest level of diversion from Highway 91 to Highway 99 since many trips avoid using the single non-peak lane on the Existing Tunnel, which sees some of the highest levels of congestion and queuing in the region today. The opening of a seventh zipper lane in December 2019 on Alex Fraser Bridge has provided congestion relief to the Highway 91 corridor in the peak direction. With trips diverted to the crossing, the remaining Alex Fraser Bridge users will see additional travel time savings and reliability benefits with lowered traffic volumes.

- **Oak Street Bridge:** The Oak Street Bridge is already congested today with about 3,500 vehicles per hour (vph) in the peak direction and approximately up to 2,500 vph in the non-peak direction. This bridge will see about a 10% increase in traffic volumes by 2050 in both directions and time periods due to regional background growth contributing to increased congestion and queuing. In the peak direction, the additional capacity of the Crossing will result in limited additional traffic to Oak Street Bridge as existing congestion in this direction limits growth, and a significant portion of traffic across this bridge are existing trips diverted to the new Crossing from Highway 91 via the Alex Fraser Bridge crossing, and not additional trips across Oak Street Bridge. Limited growth in the peak direction and Oak Street Bridge is also due to the majority of users, 80 to 85%, of the Crossing exiting the Corridor prior to Oak Street Bridge. Due to available capacity in the non-peak direction on Oak Street Bridge, this direction will see an increase of about 8 to 9% with improved capacity on the Corridor and some people commuting to jobs in the South of Fraser area.

- **Knight Street Bridge**: The Knight Street Bridge currently processes about 3,500 vph in the morning peak in both directions and about 3,800 in the afternoon peak. This bridge will see 7 to 12% growth in traffic volumes by 2050 due to regional background growth contributing to increased congestion and queuing. Following completion of the Crossing, the Knight Street Bridge will see marginal increases to future traffic volumes with the exception of the southbound direction in the morning which will see an increase of 5% as some people commute to jobs in the South of Fraser area with reduced access costs across the Fraser River.

5.3.5 Social/Community

This account captures the potential external effects of each Crossing Option on the communities impacted, including local values, goals and specific needs. For the Project, those effects are understood in terms of a number of quantitative and qualitative measures. Quantitative measures include:

- Transit ridership;
- Recreational area impacted; and
- Residential property takings (full and partial).

Qualitative measures include:

- Alignment of the Project with local, regional and provincial transportation plans;
- Modal integration for transit, pedestrians and cyclists;
- Visual aesthetics impacts; and
- Noise and light near residential and commercial areas.

A comparison of the Crossing options amongst each Social/Community indicator includes the following:

- **Transit ridership**: In support of CleanBC goals, an annual increase in transit trips across the region is observed if any of the new Crossing Options are implemented. The overall operation of buses along Highway 99 improves, resulting in faster travel times and improved overall service reliability. The increase in ridership is also associated with the provision of extended highway shoulder bus lanes along Highway 99 which provide queue jumpers at key congestion points that incentivize the increased use of transit. An additional 800,00 trips per year are anticipated by 2050 with a new Crossing, as determined by the RTM ridership forecasts.

- **Consistency with local, regional, and provincial plans**: Metro Vancouver has confirmed that an eight-lane crossing with transit priority and provision for active transportation is consistent with its RGS, and the Metro Vancouver Board endorsed a new ITT on the basis of the preliminary technical analysis presented. TransLink has advised that both Crossing Options are consistent with Transport 2040 – the current RTS – and the Southwest Area Transportation Plan, which aims to expand rapid transit across the South Arm of the Fraser River to serve travel between Richmond and Delta. TransLink has further advised that Transport 2050 (the next RTS) will assume an eight-lane crossing with transit priority and provision for active transportation. Both a new ITT and bridge are generally consistent with the stated goals of Delta and Richmond's Official Community Plans (OCP). However, it is noted that Richmond Council supports a new ITT and opposes a new bridge; given the greater visual impact associated with a new bridge. TFN advised that a new ITT would have a negative impact on the achievement of its Strategic Plan as it would further delay community economic development. TFN has also communicated significant concerns that a new ITT would have greater environmental impacts and therefore greater impacts on their Indigenous rights and interests.

- **Modal integration for pedestrians and cyclists**: Both a new ITT and bridge would improve active transportation access and better support CleanBC goals as compared with the Base Case. A new ITT provides the most convenient connection for pedestrians and cyclists with approximately 60% less elevation to climb, and protection from inclement weather through the crossing, as compared to a bridge. It is noted that during the public and stakeholder engagement, some participants asked about measures to protect personal safety when traveling through a tunnel of such a distance. Consistent with best practice, a new ITT includes plans for closed circuit television, lighting, emergency call boxes, good sightlines, and use of colour, texture and potential for public art to help support an "eyes on the street" Crime Prevention Through Environmental Design (CPTED) approach for the MUP design. It is also noted that on balance, HUB Cycling and other cycling stakeholders expressed a slight preference for a new ITT (with appropriate CPTED principles) over a bridge because of the convenience associated with travel through a tunnel. Although a new bridge presents similar overall active transportation benefits, a bridge would expose users to the elements (strong wind, in particular, was noted as a concern in the engagement process) and require significant vertical climb in comparison to a new ITT.

- **Residential takings and impact**: Both a new ITT and bridge would generate construction and operation-related disturbances. The alignment associated with a new ITT moves north of the Existing Tunnel and closer to residential properties on River Road in Delta; however, no residential property takes are required. A new bridge, for having an elevated structure, will negatively impact the nearby properties as well. A residential property take (one partial) is required for the new bridge option.

- **Parks and recreation takings and impact**: The impact on existing recreational facilities in terms of takings can be considered low for both a new ITT and bridge. As the estimated impacted area is located outside of any developed portion of the Deas Island Park (park and trail system), only minimal disturbance and related restoration costs are expected. Although both a new ITT and bridge appear to offer the opportunity for offsets to recreational land takes through the transfer of unrequired land in the current highway right-of-way, a new ITT has a greater impact on designated recreational lands due to the excavations required for the approaches of the new ITT. With respect to accessibility of parks and recreational facilities, both a new ITT and bridge affect accessibility to these lands during construction; however, during operations, the overall impact is considered similar to the current situation.

- **Visual aesthetics impacts**: A new ITT is not anticipated to substantially change the visual aesthetic from the existing conditions (Base Case), which is also an ITT. A new bridge would change the appearance of the crossing, and be highly visible at Deas Island, the marina, and nearby residences, as well as moderately visible from regional viewpoints.

- **Noise and light impacts**: Noise and light emanating from current Highway 99 sources influence ambient conditions in Richmond and Delta. Elevated structures, such as a bridge, disperse both noise and light over greater distances when compared to at-grade sources (new ITT). A new ITT will have noise and light influences similar to that currently generated by the Existing Tunnel. Residential land, parks and environmentally sensitive areas are affected more by noise and light as compared to commercial and agricultural areas. A new bridge impacts approximately double the land area, particularly environmentally sensitive areas (ESA) and water areas, when compared to the new ITT option. Participating Indigenous groups have noted noise and light impacts may adversely affect their rights and interests through impacts on migrating birds, wildlife, and their ability to conduct cultural practices.

5.3.6 Economic Development

Given the importance of this crossing for moving goods and people within Metro Vancouver, as well as to key gateway connections, including Port of Vancouver marine terminals, YVR, Boundary Bay Airport, BC Ferries Tsawwassen Terminal, and international road and rail connections, the nature and scope of network connectivity is expected to have relevant economic development implications. Measures identified as most relevant to the MAE analysis include the extent to which each Crossing Option:

- Constrains marine transportation during construction and operations; and

- Impacts agricultural land and business properties.

Quantitative measures include:

- Number of agricultural land takings; and
- Number of business takings (full and partial).

A comparison of the Crossing Options amongst each Economic Development indicator includes the following:

- **Impact to marine navigation during construction**: The new ITT construction is the only Crossing Option expected to result in significant impacts to marine traffic on the Fraser River due to the restrictions on transit through and use of the crossing area during instream works. In particular, immersion of each new ITT element (six in total) will require a 24- to 48-hour temporary closure of all river traffic to complete placement of each element, including protective cover. With respect to a new bridge, limited impacts to marine navigation are anticipated during construction. It is anticipated that the bridge segments and concrete slabs would be completed from the bridge deck, and minimal support from marine equipment and facilities would be required.
- **Impact to marine navigation during operation**: A new ITT will maintain the existing clearances (i.e. water draft) of the navigational channel of the South Arm of the Fraser River, whereas a new bridge would introduce an air draft restriction to the lower part of the river. Assessment by the Ministry indicates that this air draft (nominal 62.5 m) would meet the navigational needs of the VFPA and Transport Canada. It is noted that the bridge option would significantly increase the air draft in Deas Slough.
- **Agricultural land area and impacts**: In terms of property takings for agricultural land, a new bridge affects the greatest area due to land required for the longer approaches associated with the higher bridge crossing to meet marine navigational needs. During construction, there will be access limitations and restrictions associated with both a new ITT and bridge; however, during operations, improvements to access routes for agricultural goods and equipment movement are anticipated for both Crossing Options.
- **Business takings**: Only partial takings have been identified as required for both the scenarios under consideration. The highest impact is expected to occur for a new ITT due to the need for a long-term lease of a substantial land portion for the casting basin operation, and the potential effects on the private harbour used for cannery operations during construction. Business takings for a new bridge are expected to be moderate.
- **Business impacts**: Both a new ITT and bridge provide significantly better business accessibility when compared to the existing conditions. Largely due to the property required for a casting basin in a suitably zoned area, a new ITT affects more industrial and commercial land than a new bridge. Access to industrial lands will be affected during construction under both a new ITT and

bridge; however, during operations, access improvements will be observed, particularly the new River Road access to Highway 99.

- **Economic agglomeration impacts**: Estimates from TransLink's RTM relating to productivity gains, measured in terms of gross domestic product variation associated with the construction of a new crossing (either a new ITT or bridge), are very similar. Therefore, no significant difference from this perspective between a new ITT or bridge is observed under this indicator.

5.3.7 Environmental

This account assesses the relative nature, degree and mitigation of environmental impacts associated with each Crossing Option. Quantitative measures include:

- Volume of criteria air contaminants emissions; and
- Volume of GHG emissions.

Qualitative measures include potential:

- On-land environmental effects for wildlife and habitat; and
- Instream environmental effects for aquatic species and habitat.

A comparison of the Crossing Options amongst each Environmental indicator includes the following:

- **Effects on air quality**: A new bridge has marginally higher annual emissions estimates during operations due to the greater changes in elevation and longer distances for vehicles to travel at the crossing. However, a new bridge provides better air dispersion of vehicle emissions, which reduces potential effects on air quality associated with localized concentrations, which can be observed at the tunnel portals for a new ITT. A new ITT has also a higher carbon footprint due to the greater volume of concrete used in the construction of the tunnel elements and portals as compared to a bridge option. While the air quality for the Base Case and new Crossing Options will benefit from continued improvements in vehicle emission standards and replacement of older vehicles over time, in the long-term, both a new ITT and bridge would present further improvements in terms of volume of air contaminants and GHG when compared to the Base Case due to reduced congestion and associated vehicle idling.

- **Instream environmental effects for aquatic species and habitat**: The fisheries habitat affected by both a new ITT and bridge is a combination of low-, moderate- and high-productivity river (aquatic) and riparian habitat supporting a wide diversity of fish species, including salmonid, sturgeon, and eulachon. The majority of instream effects are temporary and occur during the construction period for both options, however both a new ITT and bridge have a permanent riparian footprint of 2 ha, largely due to the instream and riparian effects of piers in Deas Slough.

Creation of new instream habitat in association with the decommissioning of the Deas Slough Bridge may offset much of this effect. A new ITT has a significantly greater construction impact on aquatic and riparian fish habitat than a new bridge. Excavation and dredging for a new ITT foundation, and construction of the required casting basin for tunnel element construction will affect approximately 15 ha of aquatic and riparian fish habitat, as compared to the approximately 2 ha of impact on fish habitat from a new bridge, however a bridge would result in long-term shading impacts to moderate- and high-productivity riparian and aquatic habitats in the shadow of the elevated structure along the shoreline of the Fraser River and in Deas Slough. The dredging required for a new ITT is approximately 750,000 m^3 while a new bridge does not require dredging. For context, the annual maintenance dredging required to maintain navigation channels and flood protection on the Fraser River is approximately 3,000,000 m^3. Greater impacts on fish habitat from the construction of a new ITT would result in some permitting challenges as issuance of a Fisheries Act Authorization by Fisheries and Oceans Canada (DFO) would be dependent upon retaining sufficient areas of fish habitat offsetting. Concern with impacts on fish and fish habitats has consistently been noted by Indigenous groups as an important factor, which the Project will have to address through engagement, mitigation, and accommodation, as well as the EAO process.

- **On-land environmental effects for wildlife, and habitat**: A new ITT has the greatest footprint effect on wildlife habitat, with 4.6 ha of direct footprint effect on forests in and adjacent to Deas Island Regional Park, and forest and wetland, including rare wetland habitat in and around Green Slough. Most of the effects are in Delta. A new bridge affects about half the area impacted by a new ITT. Construction-related indirect noise and other disturbance effects on forests and wetlands are similar across both a new ITT and bridge. However, the new bridge option being elevated has a long-term collision potential effect for migratory birds transiting along the Fraser River and on resident bird species utilizing the Fraser River for foraging, which is avoided by the at-grade tunnel options (Base Case and new ITT). A new bridge also has greater long-term noise emissions resulting in behavioural effects on wildlife during operations as its elevated structure allows wider dispersion of noise emissions during operations. Indigenous groups have noted concerns with noise and light effects on migrating birds and their ability to practice traditional harvesting.

5.4 CORRIDOR IMPROVEMENTS MULTI-CRITERIA ANALYSIS

This section provides the assessment of the Corridor Improvements identified for the Project. Corridor Improvements consist of works to support the Crossing and/or address priority challenges on the Highway 99 corridor. In accordance with the recommendations of the ITR, each potential Corridor Improvement is independently evaluated on a basis of costs, benefits and other qualitative factors, such as regional or Provincial priorities.

In 2019, the Ministry undertook a collaborative process with the City of Richmond, City of Delta, TFN, TransLink, and Metro Vancouver to identify and shortlist improvements to the Highway 99 corridor that met the following criteria:

- Provide congestion relief along the Corridor;
- Provide transit and cycling incentives;
- Can be built within three to four years;
- Align with the new Crossing;
- Demonstrate progress while the construction of the new Crossing is underway; and
- Will be supported by local governments and TransLink.

Twenty-one potential corridor improvement projects were identified and evaluated using traffic analyses and preliminary engineering in order to determine their overall best value.

A result of this collaborative process was the development of an Options Identification and Screening Report to highlight the technical assessment used to support communications efforts with local and regional agency stakeholders and TFN to identify and review candidate Corridor Improvements on Highway 99 as part of the Project. The intent of the process and analysis was to:

- Identify all possible improvement ideas to address key issues and challenges;
- Assess their technical feasibility and potential to address key issues; and
- Identify a shortlist of improvement concepts to advance through to further design, evaluation, and business case as suitable.

A summary table highlighting the technical assessments for each of the alternatives that were either shortlisted and carried forward for further development and evaluation versus those that were not shortlisted is available in Appendix E, where the alternatives have been grouped relative to their physical location.

5.4.1 Description of the Corridor Improvements

The Corridor Improvements recommended in this Business Case include the following:

- **Improvement 1 – Bridgeport Road Bus Connection:** Redirection of the southbound bus services from Sea Island Way to Bridgeport Road, and provision of a transit-only connection southbound to the on-ramp to Highway 99.

- **Improvement 2 – Highway 99 and 17A Off-Ramp Widening:** Extension and widening the northbound Highway 99 off-ramp approach to the Highway 17A intersection.
- **Improvement 3 - Bus-on-shoulder transit lanes on Highway 99:** Extension of bus-on-shoulder facilities south of Highway 17A in both the northbound and southbound directions.
- **Improvement 4 – Steveston Highway Interchange:** Replacement of the existing two-lane overpass structure at Steveston Highway and Highway 99 to accommodate two eastbound lanes and three westbound lanes (including a left turn lane), as well as improved connections to and from the overpass for vehicles, pedestrians and cyclists.

The Corridor Improvements no. 1, 2, and 3 are also named Transit and Cycling improvements in this Business Case.

5.4.2 Assessment of the Corridor Improvements

Costs, benefits and key factors for each Corridor Improvement are summarized in Table 6.

Table 6: Assessment of Corridor Improvements

Corridor Improvement [1]	Total Agency Cost	Total Road User Benefits [2]	Rationale for the investment	Primary Driver
1 - Bridgeport Road bus connection	[redacted]	15.5	This improvement addresses significant transit vehicle travel time delays and poor reliability returning to the Highway 99 corridor from Bridgeport Station.	Current conditions
2 – Highway 99 and 17A off-ramp widening	[redacted]		Widening the off-ramp and extending storage and access to turn lanes would reduce vehicle queues and delays and improve reliability for priority vehicles such as transit and HOVs / EVs	Current conditions
3 – Bus-on-shoulder transit lanes on Highway 99	[redacted]	2.8	Extending transit priority treatments south from the Existing Tunnel through to Ladner Trunk Road / Highway 10 will improve long-term mobility and reliability for transit travel and support higher capacity transit services along the corridor between South Surrey and the Bridgeport Station.	Current conditions
4– Steveston Highway Interchange	[redacted]	65.9	This improvement would address current and forecast 2050 mobility and vehicle queuing for Highway 99 traffic at Steveston Highway, as well as east-west travel across Richmond. The investment would also improve access to transit stops within the interchange as well as pedestrian and cycling connections across the Highway 99 overpass.	Current conditions
Total	**111.6**	**84.2**		

[1] Figures are in $ million on a present value basis, 2021 as base year.

[2] Does not include economic agglomeration benefits, which are estimated to be at $11.0 million on a present value basis, 2021 as base year.

5.5 SERVICE DELIVERY RECOMMENDATION

As a result of the planning, development, engagement and analysis previously described, it is recommended that a new eight-lane ITT crossing and the Corridor Improvements described in Section 5.4.1 move forward to procurement.

Although Metro Vancouver Board endorsed the new ITT crossing over a bridge, the Ministry is responsible for the final decision of the recommended crossing through its engagement, technical analysis, and business case processes. Since endorsement from the Metro Vancouver Board in November 2019, the Ministry has continued to meet with Indigenous groups and key stakeholders to share information on the Project and to seek feedback on the work to date, including the planning process, service delivery options analysis and advanced works.

Details of the capital cost estimate and MAE for the Project (which includes the sensitivity analysis for the Project BCR) are presented in the following sections.

5.6 PROJECT PHYSICAL ASSET SCOPE

This section summarizes the physical scope of the Project, including the Crossing and the Corridor Improvements.

5.6.1 Crossing

The scope of the Project includes replacement of the Existing Tunnel with a new ITT. More specifically, the scope of the Crossing includes:

- Construction of an offsite casting basin to support fabrication of the new reinforced concrete tunnel elements;
- Construction of an eight-lane ITT with two four-lane roadway tubes, and a single 5.0 m wide tube for a bi-directional MUP;
  - Each four-lane roadway tube element will include three GP lanes and one dedicated transit lane;
  - Lane widths will be 3.7 m with 1.12 m shoulders in each direction;
  - The vertical clearance of the roadway tubes will be 5.0 m.
  - The water draft of the new ITT is based on the 11.5 m draft of the Existing Tunnel and meets the requirements of the VFPA for navigation on the Fraser River.
- Construction of a new eight-lane bridge over Deas Slough;

- Construction of additional multi-use paths to connect to existing active transportation routes;
- Decommissioning of the Existing Tunnel through full removal of its elements, and backfilling of the approaches following opening of the new ITT; and
- Decommissioning of the offsite casting basin.

As shown in the Figure 8, the new ITT will be located upstream (east) of the Existing Tunnel and tie into the existing Highway 99 alignment south of Steveston Highway on the north end of the crossing, and north of Highway 17A on the south end. This alignment allows the new ITT crossing to optimize the use of existing highway infrastructure and improve community connections. Constructing the crossing parallel to the Existing Tunnel will also allow the continuous operation of the Existing Tunnel until the new ITT is open.

Figure 8: Crossing Physical Asset Scope

5.6.2 Corridor Improvements

The Project encompasses the following works along the Highway 99 corridor to support the Crossing and to address priority issues on the corridor:

5.6.2.1 Bridgeport Road Bus Connection

The following components comprise the Bridgeport Road bus connection:

- Construction of a new dedicated bus lane connection from Bridgeport Road to the Highway 99 southbound on-ramp, including a new transit activated signal at Sea Island Way;
- Widening of the Highway 99 southbound on-ramp to accommodate bus lane merges; and

- Construction of a new MUP connecting Patterson Road to Highway 99 northbound (Oak Street Bridge).

Figure 9: Bridgeport Road Bus Connection

5.6.2.2 Highway 99 and 17A Off-Ramp Widening

The following components comprise the Highway 99 and 17A off-ramp widening:

- Widening of Highway 99 northbound off-ramp to add a right-turn to allow for bus priority;
- Widening of Highway 99 northbound on-ramp to add a second lane for bus/HOV priority;
- Widening of Highway 17A to support reconfiguration of the eastbound lanes for bus/HOV priority;
- Improvements to the existing George Massey Tunnel bike shuttle stop; and
- Improved cycling facilities on Highway 17A.

Figure 10: Highway 99 and 17A Off-Ramp Widening

5.6.2.3 Bus-On-Shoulder Transit Lanes on Highway 99

Components of the bus-on-shoulder lanes on Highway 99 improvement include:

- In the northbound direction, the new bus-on-shoulder lane would extend from Ladner Trunk Road to just south of the Highway 17 interchange where the shared bus/HOV lane currently begins (approximately 2.4 kilometers extension); and
- In the southbound direction, the new bus-on-shoulder lane would be extended from the Highway 17A Interchange through to the interchange at Ladner Trunk Road (approximately 7.5 kilometers).

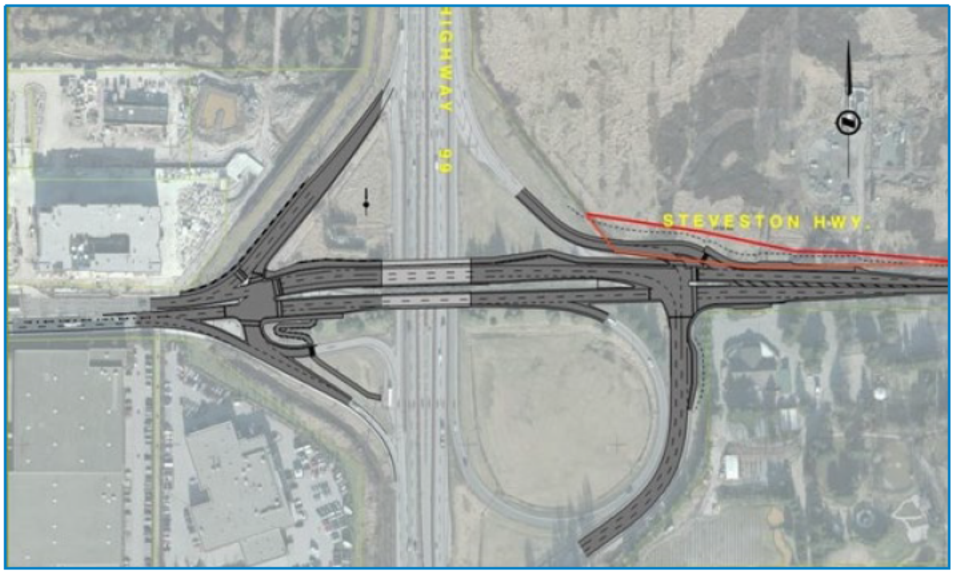
Figure 11: Bus-On-Shoulder Transit Lanes on Highway 99

5.6.2.4 Steveston Highway Interchange

The proposed changes to the Steveston Highway interchange are:

- Replacement of the existing two-lane 60-year old bridge structure to accommodate two eastbound lanes and three westbound lanes (including a left turn lane);
- Widen the northbound Highway 99 off-ramp to accommodate double left-turn lanes and a right-turn lane;
- Widen the southbound off-ramp at Steveston Highway to accommodate a double right-turn lane and signal;
- Improved transit facilities and transit user connectivity; and
- New multi-use path connections across the overpass to integrate with transit and regional active transportation networks.

Figure 12: Steveston Highway Interchange Improvements



5.7 OPERATION, MAINTENANCE AND REHABILITATION

Future operations, maintenance and rehabilitation for the Crossing and Corridor Improvements will be the responsibility of the Ministry.

5.8 PROJECT COST ESTIMATE

Table 7 presents the total Project cost estimate (in nominal terms and including IDC) which was prepared based on the physical asset scope described in Section 5.6 and detailed through concept drawings prepared by the Project team.

Table 7: Project Cost Estimate

Cost Category [1]	Crossing (new ITT)	Corridor Improvements			Project (ITT Crossing + Corridor Improvements)
		Steveston Hwy Interchange	Transit and Cycling Improvements	Total	
Contractor's construction cost	[redacted]				
Design, mgmt. and overhead					
Tunnel structure, fit out, Deas Slough and roadworks					
Decommissioning of the Existing Tunnel					
Owner's cost					
Project mgmt., BCIB administration and procurement					
Environmental					
Property acquisition					
IDC, bid development and SPV (Contractor)					
Contingency / Risks					
Subtotal					
Provincial IDC					
Total Project Cost	**4,147.9**	**87.5**	**49.4**	**136.9**	**4,284.8**

[1] Figures in $ million, nominal basis, 2021 as base year

5.9 PROJECT MULTIPLE ACCOUNT EVALUATION SUMMARY

The MAE for the Project (Crossing + Corridor Improvements) is presented below Table 8. Where applicable, each indicator from the Crossing MAE has been updated to incorporate impacts of the Corridor Improvements. The Base Case crossing and Crossing only MAE results are included for comparative purposes.

Table 8: Project MAE Summary Results

	Indicators [1]	Base Case (existing 4-lane tunnel)	Option 1 (ITT Crossing)	Project (ITT Crossing + Corridor Improvements)
Financial	Capital costs (nominal [2], $M)	Nil	[redacted]	[redacted]
	Capital costs (PV, $M)	Nil	[redacted]	[redacted]
	Salvage value (PV, $M)	Nil	[redacted]	[redacted]
	OMR costs (PV, $M)	[redacted]	[redacted]	[redacted]
	Project delivery schedule (Opening Day) (excludes decommissioning of Existing Tunnel)	n/a	Q2 2030	Q2 2030
	Total Agency Costs (PV, $M)	[redacted]	**1,762**	**1,874**
Customer Service	Travel time savings (PV, $M)	0	917	983
	Travel time reliability (PV, $M)	0	192	203
	Improved seismic resiliency (PV, $M)	0	139	139
	Safety savings (PV, $M)	0	68	72
	Savings in Vehicle Operating. Costs (PV, $M)	0	(54)	(51)
	Emergency response	○	🟢	🟢
	Network connectivity	○	🟢	🟢
	Total Road User Benefits (PV, $M)	**Nil**	**1,262**	**1,346**
	Benefit Cost Ratio	**n/a**	**0.72**	**0.72**
	NPV (Benefits – Costs, $M)	**n/a**	**(500)**	**(527)**
Social /Community	Transit ridership (additional trips per year)	0.0	0.8 million	0.8 million
	Consistency with local, regional and provincial plans	○	🟢	🟢
	Modal integration for cyclists and pedestrians	○	🟢	🟢
	Parks and recreation takings (ha)	0	0.24	0.24
	Parks and recreation impacts	○	○	○
	Residential properties takings (full / partial)	0 / 0	0 / 0	0 / 0
	Residential properties impacts	○	🟡	🟡
	Visual aesthetics	○	○	○
	Noise and light	○	○	○
Economic Development	Economic agglomeration (PV, $M)	0	192	203
	Marine traffic during construction	○	🔴	🔴
	Marine traffic during operations	○	○	○
	Agricultural land takings (ha)	0	4.1	4.2

	Indicators [1]	Base Case (existing 4-lane tunnel)	Option 1 (ITT Crossing)	Project (ITT Crossing + Corridor Improvements)
	Agricultural land impacts	○ Neutral	● Somewhat better	● Somewhat better
	Business takings (full / partial)	0 / 0	0 / 8	0 / 8
	Business impacts	○ Neutral	● Significantly better	● Significantly better
Environment	Regional air quality	○ Neutral	● Somewhat better	● Somewhat better
	Local air quality	○ Neutral	● Somewhat better	● Somewhat better
	Aquatic species and habitat	○ Neutral	● Significantly worse	● Significantly worse
	Wildlife and terrestrial habitat	○ Neutral	● Somewhat worse	● Somewhat worse

[1] "PV, $M" indicates the values are in $ million on a present value basis, 2021 as base year.

[2] In nominal dollars (2021 as base year), excludes IDC and risk allowances associated with the recommended procurement models mentioned in Section 7.

Legend: ● Significantly worse ● Somewhat worse ○ Neutral (same as Base Case) ● Somewhat better ● Significantly better

5.10 PROJECT BENEFIT COST SENSITIVITY ANALYSIS

A sensitivity analysis was conducted on the Project Benefit Cost Ratio using the discount rate, total cost amount and traffic growth as independent variables. Table 9 below shows the results of this analysis.

Table 9: Project BCR Cost Sensitivity Analysis

MAE Indicator [1]	Project (Crossing + Corridor Improvements)	Laning configuration	Discount rate		Total Capital Cost Estimate		Traffic Growth	
		8GP	4%	8%	-25%	+25%	-20%	+20%
Capital cost	[redacted]							
Salvage value								
OMR cost								
Total Agency Costs	**1,873**	**1,873**	**1,840**	**1,803**	**1,412**	**2,334**	**1,873**	**1,873**
Travel time savings	983	1,294	1,456	681	983	983	885	1,207
Travel reliability	203	338	303	139	203	203	174	258
Seismic resiliency	139	139	163	121	142	137	139	139
Safety savings	72	73	105	50	72	72	72	81
Savings in VOCs	(51)	(79)	(76)	(36)	(51)	(51)	(48)	(58)
Total Road User Benefits	**1,346**	**1,766**	**1,951**	**956**	**1,348**	**1,343**	**1,222**	**1,627**
BCR	**0.72**	**0.94**	**1.06**	**0.53**	**0.95**	**0.58**	**0.65**	**0.87**
Net Present Value	**(527)**	**(108)**	**111**	**(848)**	**(64)**	**(991)**	**(652)**	**(246)**

[1] Figures in $ million on a present value basis, 2021 as base year.

5.11 ACHIEVEMENT OF PROJECT GOALS

The MAE, presented in Section 5.9, outlines the benefits associated with the Project when compared to the existing conditions reflected under the Base Case scenario, and outlines how the Project is expected to perform against its goals and objectives through the indicators under consideration.

6 PROJECT STATUS

6.1 TECHNICAL PLANNING

Initial technical planning pertaining to the new ITT was focused on determining the scope and cost of this option, including details regarding alignment, cross-section and key quantities. These studies helped inform the location and configuration of the crossing, as well as development of a preliminary design basis in consultation with the Ministry's Chief Engineer. This initial technical planning supported early assessment of options, including consultation and engagement activities.

Since then, further technical analysis for the crossing has been undertaken, including:

- Assessment of options and locations for fabrication of the ITT elements;
- Estimate of river velocities during immersion windows;
- Constructability assessment of casting, transport and immersion activities;
- Ongoing engagement with the VFPA on impacts to river navigation during construction;
- Assessment of active transportation connections and alignments;
- Engagement with international transportation authorities that have recently constructed, or are in the process of procuring delivery of an ITT crossing; and,
- Identification of key risks and opportunities for the Project; and
- Assessment of potential environmental, agricultural, recreational, and community effects.

With respect to the Corridor Improvements, key technical planning activities have included:

- Geotechnical investigations;
- Traffic modelling;
- Investigation of utility relocation requirements;
- Drainage investigations; and
- Assessment of potential environmental, agricultural, recreational, and community effects.

6.2 GEOTECHNICAL WORKS

A number of geotechnical investigations have been completed over time in the vicinity of the Existing Tunnel and the Corridor Improvements to characterize the ground conditions and to support current and previous design activities, including estimates of preload for structures associated with the Corridor Improvements. Preloading is generally required for new roadways and structures to reduce future settlement of compressible soils typical to the Project area. Durations for preloading generally range between three to twelve months, depending on the size of the structure and the site-specific conditions.

Sufficient geotechnical information from previous studies, particularly those studies for the GMTR Project, was available to develop the crossing concept and further investigations were undertaken to support designs for the Corridor Improvements. With respect to the Crossing, additional geotechnical investigations are planned to support the refinement of the reference concept, including strategies for the management of excavated materials.

6.3 ENVIRONMENT

An EAC was approved in 2017 for the GMTR Project (EAC#T17-01), and within the context of this existing certificate, the Project team has engaged with key regulators, including the EAO to determine likely regulatory paths for the Project.

The recommended Crossing is substantially different than the GMTR Project concept and, as a result, it is required to undergo a new EA process which is estimated to take approximately 3.5 years for the issuance of the EAC following the approval of this Business Case. Following receipt of an EAC, the Project team anticipates up to an additional year to obtain regulatory permits before construction activities can commence. Receipt of an EAC is a necessary condition for regulators to complete their permitting processes.

With respect to the Corridor Improvements, as the works are similar in nature and location to improvements contemplated in the GMTR EAC, a full EA process is not required; however, an amendment to the GMTR EAC is required to address design changes. The expected timeline for an amendment to the GMTR EAC is six-months from approval of this Business Case and is expected to require public engagement activities. However, no additional technical studies are anticipated.

The Project team continues to engage with regulatory authorities on the scope, anticipated construction methodologies, and potential effects of the Project. Following approval of this Business Case, the Project team will inform the relevant regulatory agencies and initiate the formal assessment process (refer to Section 9.5. for further details).

6.4 ARCHAEOLOGY

Existing archaeological sites data was obtained from the GMTR Project, and consists of a desktop literature review, a field inventory of heritage resources, and results of 413 subsurface tests in 16 of 18 field inventory areas. Two of the 18 field inventory locations could not be accessed due to existing environmental and infrastructure constraints. The majority of the local assessment area for the GMTR project was characterized as having low potential, and this area generally encompasses the site for the new Crossing, except for the offsite casting basin for the tunnel elements. The casting basin facility location is not yet confirmed; however, the Ministry is in discussions with potential landowners to secure a site for the casting basin facility.

It was noted in the EAO's Assessment Report for the GMTR Project that no historical or archaeological heritage sites were identified in the local assessment area for the GMTR Project. However, there is potential for archaeological or heritage resources to be identified during project activities. The report also noted that Indigenous groups identified potential archaeological sites in areas adjacent to the proposed GMTR Project bridge footings, and in and around Deas Slough and Deas Island Regional Park. Indigenous groups also noted that mourning rituals may have been practiced at Deas Island and/or Westham Island.

The Ministry has completed a gap analysis for archaeological information requirements on the Highway 99 corridor, which has recommended additional archaeology studies occur for the Corridor Improvements and the Crossing. These studies will be conducted during the amendment and EA processes to assess the potential impacts to archaeological resources due to the extent of disturbance for the Corridor Improvements, the Crossing, and the offsite-casting basin.

6.5 ENGAGEMENT WITH INDIGENOUS GROUPS

Upholding the commitment of the Province to reconcile with Indigenous groups, the Ministry has developed its Indigenous engagement approach based on the B.C *Declaration on the Rights of Indigenous Peoples Act* and the *2010 Updated Procedures for Meeting Legal Obligations When Consulting with First Nations.*

Since 2019, the Ministry has engaged the following twelve identified Indigenous groups regarding the Project:

- Tsawwassen First Nation;
- Musqueam Indian Band;
- Tsleil-Waututh First Nation;
- Halalt First Nation;
- Katzie First Nation;
- Kwantlen First Nation;
- Penelakut Tribe;

- Semiahmoo First Nation;
- Stz'uminus First Nation;
- Cowichan Tribes;
- Lake Cowichan First Nation; and
- Lyackson First Nation.

The Ministry has largely completed the three phases of its Indigenous engagement plan, most recently providing final technical updates regarding the Crossing Options and summarizing Indigenous inputs to the Business Case. Engagement with Indigenous groups was modified in early 2020 to accommodate public health guidelines associated with the COVID-19 pandemic. The Ministry has adapted its consultation approach to meet the current circumstances and is working to schedule regularly occurring meetings with all the identified Indigenous groups using remote meeting tools.

The Ministry has initiated advanced environmental studies aimed at advancing the understanding of key environmental and cultural components at the site of the Crossing by Indigenous groups through fisheries workshops. All Indigenous groups participated in the planning of the advanced environmental studies, which will be delivered by the TFN, Musqueam Indian Band, and Tsleil-Watuth Nation entirely or in partnership with the Ministry. The Ministry is also in the preliminary phases of identifying opportunities for economic development, mitigation of Project related effects, and cultural recognition.

Two Indigenous groups have noted concerns with information sharing and requested additional engagement to satisfy their interests. The Ministry is working to meet this request and is confident these concerns will be meaningfully addressed.

The Ministry's current focus is on delivering the advanced environmental studies and engaging Indigenous groups in planning for engagement following Treasury Board review of this business case. Primary among these efforts are building consensus on the upcoming engagement process and preparing for the Environmental Assessment.

6.6 COMMUNITY ENGAGEMENT

Two stages of formal community engagement took place between January 2019 and April 2020. The initial phase focused on meetings with select community and business stakeholder groups while the second stage included follow-up meetings with these groups, public information sessions, and an online feedback form. The Project also maintained a website and general inquiry email to receive and respond to community input and feedback throughout both stages of engagement.

During this engagement process, twelve stakeholder group meetings were held, 188 people signed up to receive Project emails, 97 enquiries/written submissions were received, two public information sessions were held (380 attendees) and 1,032 feedback forms were submitted. Community input was considered in finalizing the Project principles, goals and objectives, and in evaluating and shortlisting the Crossing Options.

6.7 COMMUNITY BENEFITS

In addition to infrastructure related objectives, transportation capital projects can play an important role in bringing improvement in the lives of people in BC communities by maximizing opportunities for local residents and businesses and helping to develop and grow the skilled labour workforce through opportunities for apprentices and skills training, and the provision of employment opportunities for Indigenous people, women and equity seeking groups.

The province has identified a number of different strategies for achieving community benefits. These can include the implementation of a Project Labour Agreement (either through the Community Benefits Agreement, where a unionized labour force is supplied through BC Infrastructure Benefits Inc., which is a provincial crown corporation, or through other forms of labour agreement with a construction union or group of unions); specific objectives can also be made a contract term requirement or target for the contractor to achieve. [redacted]

6.8 PROPERTY

A desktop review has been completed to assess the potential impacts on residential, commercial, and agricultural lands, based on the concept level designs for the Crossing and Corridor Improvements. This study also included an initial identification of the preliminary requirements for both temporary and permanent lands. These requirements will be continually updated as the Project reference concept is refined.

6.9 UTILITIES

Discussions have been initiated with BC Hydro, Metro Vancouver, municipal and utilities agencies in order to identify the potentially impacted utility assets and define the requirements for their relocation and accommodation when applicable.

A key challenge relates to the relocation of the transmission line currently located in the Existing Tunnel and under administration of BC Hydro. Following the Project approval, the utilities coordination will be performed in three phases: preliminary engineering, detailed design / procurement, and construction. The Project team will then notify BC Hydro and provide the relevant reference concept to begin developing a project relocation agreement which aims to facilitate the respective coordination and planning works.

PART C – PROCUREMENT OF THE PROJECT

Part C presents the analysis and results of the detailed assessment undertaken to determine the optimal approach to procure the Project.

7 PROCUREMENT OF THE CROSSING

7.1 PROCUREMENT MODELS

In identifying which procurement models align with the goals and procurement objectives for the Crossing component of the Project, a key consideration was the speed with which the need could be addressed. The current capacity constraints and congestion at the crossing are impacting economic activity and regional livability. Addressing these challenges is a priority for the Ministry and therefore procurement models that aid in accelerating the construction schedule were selected for assessment.

Another key consideration in the identification of procurement options is the complexity and risk profile of the Crossing. An urban setting with an active navigational channel, along with large excavation quantities, high seismicity, liquefiable soils, important environmental considerations, permitting requirements, instream works, and active Indigenous, recreational, and commercial fisheries present inherent challenges to construction costs and schedule. The attractiveness of the opportunity and ultimate project cost require consideration of the risk allocation regime. Procurement models that offer flexibility to achieve an optimal risk profile were also selected for assessment.

Six procurement options were initially identified as feasible for delivering the Crossing: [18]

- Design-Build;
- Design-Build-Finance;
- Provisional Design-Build;
- Provisional Design-Build-Finance;
- Progressive Design-Build; and
- Competitive Alliance Contracting.

A comparative analysis of all six options was conducted and is summarized in the Procurement Options Identification Report (Appendix G). Four of these models were deemed to warrant more detailed analysis in the Business Case. The four models analysed in this Part C, all of which are variations of design-build, are:

- **Design-Build (DB)** – A fixed price, performance-based contract with commercial terms based on precedent agreements and a contract awarded following the issuance of the EAC. The

[18] The BC Hydro transmission line relocation is not included in the Crossing scope for procurement and will be delivered directly by BC Hydro.

competitive selection process selects up to three proponents to prepare preliminary designs and a price proposal based on a definitive project agreement.

- **Design-Build-Finance (DBF)** – Similar to the DB model, but with the addition of a portion of private financing, invested early in the construction phase and repaid at one or more completion milestones. Private finance provides a liquid form of performance security and the owner benefits from lenders' due diligence both during procurement and implementation.

- **Provisional Design-Build (ProvDB)** – A DB in all respects except that the contract price, provisional at award on the basis of an assumed EAC date, is subject to an adjustment based on the timing of the actual EAC approval. The price adjustment formula, negotiated and agreed during procurement, will be applied when the EAC is issued, based on the difference in timing between the assumed and actual EAC dates. Any unanticipated scope changes resulting from the EAC will be addressed through the commercial terms of the project agreement. The adjustment will include incremental costs of the delay, including escalation, overhead and other operational costs that cannot be mitigated. Once calculated and applied, the revised contract price will be fixed for the remainder of the term. If the actual EAC date is the same as the assumed EAC date, no adjustment is required. The provisional adjustment allows for a contract to be awarded up to one year earlier than the DB or DBF models. This early contract award allows the contractor to advance design, consultation, property acquisition and other permit preparation activities while the environmental assessment is in its final stages.

- **Provisional Design-Build-Finance (ProvDBF)** - The same as the ProvDB but with the addition of a portion of private financing, invested early in the construction phase and repaid at one or more completion milestones. As noted in the DBF section above, private finance provides a liquid form of performance security and the owner benefits from lenders' due diligence both during procurement and implementation.

The two options not carried forward for further analysis (Progressive Design-Build and Alliance Contract) involved more collaborative and less competitive processes. While they each offered the potential for schedule acceleration, they are most effective when there is uncertainty as to technical requirements and, in the case of the Alliance model, when there are risks that bidders cannot price cost effectively or at all. Through market sounding, the technical nature of the Crossing-specific project work was seen to be consistent with what the Ministry would normally procure under a design-build approach and therefore the increased collaboration occurring at the expense of a more robust competition was not deemed to be justified.

7.1.1 Procurement Options Analysis Overview

The four shortlisted procurement options were analyzed and compared using both quantitative and qualitative assessment techniques. The comparative analyses included the following:

- **Multiple Criteria Analysis (MCA) –** A qualitative evaluation method that compares the relative merits of each option in terms of how well it aligns with the procurement objectives of the Crossing. Details are provided in Section 7.2;

- **Risk Analysis –** A comprehensive risk matrix is identified for each phase of the Project. For the procurement options analysis, a select subset of these risks is quantified and compared across all four procurement options, reflecting the differences in value and allocation of risk inherent in each approach. This subset of quantified risks is an input to the financial modelling for comparative analysis and also assists in determining an appropriate overall contingency for delivery of the Crossing. A summary of the risk analysis for the Crossing is provided in Section 7.3;

- **Financial Modelling** – With inputs including the risk quantification, project financing assumptions, timing assumptions and project costs, a financial model is developed to simulate how the Province and a potential contractor would be expected to price the Crossing under each procurement approach. The financial modelling allows for differences in timing and costs associated with each procurement option to be evaluated and compared. Key financial modelling assumptions are provided in Section 7.4;

- **Value for Money (VFM) Calculation –** Value for Money is estimated by comparing the nominal risk adjusted cost of the Project under each of the DBF, ProvDB and ProvDBF procurement options to the nominal risk adjusted cost of the Project under the DB model. This calculation and interpretation are set out in Section 7.5; and

- **Market Sounding** – This activity includes a series of interviews held with general contractors, specialist contractors and lenders, chosen based on their previous involvement with relevant project procurements in Canada and internationally. The results of this activity are summarized in Section 7.6.

The objective of the procurement options analysis is to identify the recommended approach to procuring the Crossing in terms of which option offers the greatest value on both a qualitative and quantitative basis. The options analysis undertaken compared a DB model to a DBF model, a DB model to a ProvDB model and a DB model to a ProvDBF model.

7.2 MULTIPLE CRITERIA ANALYSIS

The methodology and results of the qualitative procurement options analysis undertaken for the Crossing are presented in this section.

The analytical framework for assessing the relative qualitative merits of each procurement option is based on an MCA approach. The qualitative assessment sets out criteria based on the procurement objectives identified for the Crossing. Each criterion represents a desired outcome and is assessed on the extent to which the procurement option achieves the desired outcome.

The selected procurement options were assessed in terms of how well each achieves the Crossing procurement objectives, which are:

1. **Timely project delivery:** The shortest overall timeline (planning through to service commencement) for delivery of the Crossing.
2. **Cost effective implementation (design and construction) & attainable within fiscal constraints:** Provides a cost-effective method to deliver the Crossing and supports achieving the approved budget.
3. **Allocate key risks to the party best able to manage and mitigate them:** Ensure key Crossing risks are allocated in the most cost-effective way to the party that is best suited to manage them.
4. **Attractive, marketable transaction:** Ensure a transaction that is fair, transparent and attracts broad interest from qualified firms with a keen interest to participate and the capability to deliver a project of this size and complexity.
5. **Contributes positively to the environmental and permitting process:** A number of requirements will be determined by the EAC and permitting conditions, which are not yet defined, the procurement should address the need for flexibility to indeterminate requirements.
6. **Ensure strong competition providing innovation and efficient approaches:** The procurement model should consider an approach that optimizes competitive tension, providing innovation and best value.

Table 10 demonstrates the scoring framework used to indicate the relative merits of each procurement objective in relating to each identified procurement model:

Table 10: Qualitative Assessment Scoring Framework

Scale	Assessment	Description
x	Not Met	Fails to meet basic requirements of the Crossing.
✓	Low	Minimally meets the Crossing procurement objective.
✓✓	Medium	Adequately meets the Crossing procurement objective.
✓✓✓	High	Provides a highly efficient and effective delivery solution for the Crossing based on its procurement objectives.

The MCA summary is provided below in the table immediately below Table 11.

Table 11: Qualitative Assessment Summary

Procurement Objective	DB	DBF	ProvDB	ProvDBF
Timely project delivery	✓½	✓✓	✓✓½	✓✓✓
Cost effective implementation (design and construction) & attainable within fiscal constraints	✓✓	✓✓	✓✓½	✓✓½
Allocate key risks to the party best able to manage and mitigate them	✓✓	✓✓	✓✓	✓✓
Attractive, marketable transaction	✓✓✓	✓✓½	✓✓	✓½
Contributes positively to the environmental and permitting process	✓	✓	✓½	✓½
Ensure strong competition providing innovation and efficient approaches	✓✓½	✓✓½	✓✓½	✓✓½

The ProvDB and ProvDBF models provide for the contractor to advance pre-construction design, consultation, and other pre-permitting preparation activities prior to the issuance of the EAC. The accelerated schedule is expected to result in earlier start and finish dates for construction. The inclusion of private finance, with associated lender due diligence, schedule risk mitigation and security, further benefits the ProvDBF.

The DB, DBF, ProvDB and ProvDBF models were assessed as to which would provide the highest likelihood of obtaining competitive pricing with up to three proponents participating in the procurement through to final award. The ProvDB and ProvDBF models, by moving up the infrastructure's in-service date by up to one year, are expected to have a lower overall cost and less contingency associated with permitting risks and timing.

Since all four models are variations on a DB, the ability to allocate risks effectively is not a differentiator. However, the DB and DBF models were assessed to offer the market familiar procurement approaches, contract terms and contractor obligations. The less familiar models, ProvDB and ProvDBF, are fundamentally consistent with the DB and DBF models, but involve unique features that may be perceived to introduce procurement risks. These risks will require mitigation through effective communication and process development to affirm bidders' interest.

There was little to differentiate amongst the procurement models for their positive contribution to permitting. A slight advantage was assessed for the ProvDB and ProvDBF due to the opportunity each provides for proponents to better understand and mitigate the risks to cost and schedule resulting from permit requirements, while developing the price adjustment mechanism.

Competition leading to innovation and efficiency was not seen to differentiate amongst the four procurement models, with up to three proponents participating in the procurement through to final award.

The ProvDBF provides many of the same benefits as the DB and DBF models. The procurement is intended to result in a fixed-price, performance-based contract. The provisional price adjustment mechanism is negotiated and agreed during procurement and could be modeled from similar approaches undertaken in other jurisdictions. The schedule benefits, if realized, are expected to sufficiently outweigh any impact of the cost uncertainty that the provisional price formula represents, recommending the ProvDBF approach on the basis of the MCA.

7.3 RISK ANALYSIS

Project risk is defined as the chance of an event or condition happening which could cause the actual project circumstances to differ from those assumed when forecasting project outcomes or objectives. Risk is an inherent part of any project, and to ensure a successful project outcome, risk must be effectively managed. The identification, allocation, measurement, and treatment of risk each form a key part in quantifying project risk. The goal is to identify and allocate project risks to the party best able to manage them at a reasonable cost to the project. An efficient or optimal allocation of risk between the Ministry and the contractor will ultimately provide the best value.

The following subsections summarize the process and results of the risk analysis and quantification undertaken for the Crossing. Additional details of the Crossing risk analysis are provided in the Crossing Risk Report in Appendix J.

7.3.1 Risk Approach and Methodology

A comprehensive assessment of Crossing-specific risks was conducted in accordance with the Provincial Government's risk management guidance, developed in conjunction with the Province's Risk Management Branch (RMB) of the Ministry of Finance. These guidelines are generally consistent with the principles, framework and process described in the ISO 31000:2009 Risk Management Principles and Guidelines.

This risk management guidance takes a systemic approach to risk, estimating the range of potential impacts on a risk-by-risk basis through the Project's planning, procurement, design and construction, and operating phases. Risk analysis is dynamic and should be revisited throughout the lifecycle of the project.

7.3.2 Risk Identification and Allocation

The risk assessment process began with the identification of potential material risks and consequences that could impact the project during any of the stages of the Crossing's life cycle. This was completed through a series of risk workshops involving members of the Project team and various subject matter experts. The goal of the identification phase is to create a comprehensive list of risks which could affect (either positively or negatively), the project outcome.

Subsequently, each identified risk was evaluated to determine which party (the Ministry or the contractor) would be responsible under each procurement option. From the perspective of the Ministry, a risk can be retained by the Ministry, or transferred to or shared with the contractor. Each specific risk is viewed through the lens of which party is best able to manage or mitigate the risk at the lowest cost. This allocation was completed for the DB, DBF, ProvDB, and ProvDBF options.

7.3.3 Quantified Risks

During risk quantification, selected risks are valued to ensure sufficient risk reserve is included in the Project's total budget. This risk adjustment included within the budget must account for both transferred risks (which the contractor will include within its bid) and retained risks (which will form part of the Ministry's contingency). If a risk is transferred, it is quantified from the perspective of the contractor and what the Project team estimates would be included in a reasonable and competitive financial proposal. If a risk is retained, it is quantified from the perspective of the Ministry and the cost impact the risk would have on the project.

Risks were selected for quantification based on:

- Differences in quantified value amongst procurement options;
- Materiality;
- Ability to quantify;
- Risk rating; and
- Consideration of past precedent projects.

A total of [redacted] risks were quantified for the risk analysis. Of these, [redacted] differentiate amongst the procurement options being analyzed and [redacted] are material but apply equally to all procurement models.

For each of the risks identified, best, worst and most likely outcomes should each risk materialize were estimated. These scenarios were used to run Monte Carlo analysis. Monte Carlo analysis (facilitated by @Risk software) utilizes the three possible scenarios provided by the experts for each risk and runs 1,000 scenarios involving all risks. The Monte Carlo simulation quantifies the total value of risk and each of the total retained and transferred risks. Once the quantified values were calculated, these impacts were incorporated into the financial model as described below.

7.3.4 Incorporation into Financial Analysis

For each procurement model, an amount of transferred and retained risk was added as a cost item to the financial model as a contractor or Ministry cost. In this analysis, the 80th percentile of total risk was added to the model to reflect a prudent level of risk aversion given the stage of Project planning and number of unknowns related to the Project. Selecting the 80th percentile is equivalent to saying that the Project has sufficient risk money included in the budget approximately four of out every five times.

7.3.5 Summary of Risks Analysis Results

The results of the risk analysis are provided in Table 12, which presents probabilistic values for the selected key risks under both procurement options.

Table 12: Summary of Risk Values

Financial Model Risk [1]	DB	DBF	ProvDB	ProvDBF
Capital Risk	**($millions)**			
Transferred risk added to the construction contract by the contractor	[redacted]			
Risks retained by the Province				
Total Risk Value				

[1] Based on nominal dollars accounting for the 80th percentile.

[redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

7.4 FINANCIAL MODELLING

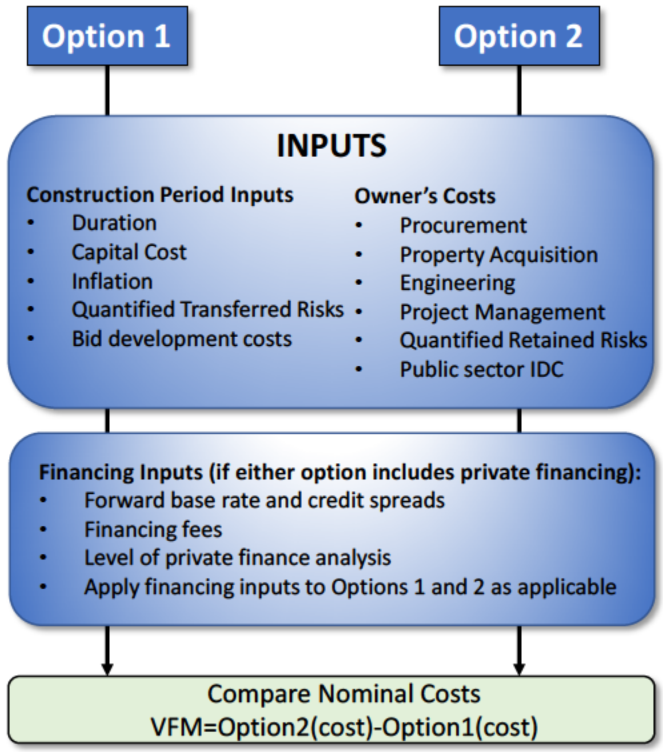
The VFM analysis involves a detailed quantitative analysis that compares the risk-adjusted costs of the Project under each of the alternative procurement model scenarios being analyzed: DB, DBF, ProvDB and ProvDBF. The VFM methodology involves selecting a base case scenario and layering on costs that differentiate amongst the other scenarios to ascertain the relative costs of each as compared to the base case. The analysis provides a means of comparison but is not intended to provide a basis for building a project budget for the non-base case scenarios. The project budget, which includes scenario-specific risk values, should be developed independently of the VFM analysis.

Value for money is expressed quantitatively as the difference in the nominal risk-adjusted Project costs between two options. Three VFM calculations were carried out:

- DB compared to DBF;
- DB compared to ProvDB; and
- DB compared to ProvDBF.

The financial modelling methodology is summarized in Figure 13 below.

Figure 13: Overview of VFM Approach



The nominal costs of both public sector financing and private finance is included in the cost of the Project. The base rate, spreads and fees used to calculate these costs were provided on a forward-looking basis.

The VFM analysis also involved a comprehensive risk analysis, as described in Section 7.3. Risk-adjusted cash flow models were prepared for the DB, DBF, ProvDB and ProvDBF options. In addition, the Province's costs, including project management, were estimated for each procurement option. The financial models assume the ProvDB and ProvDBF options will be delivered in ten years, while the DB and DBF options will be delivered in eleven years. All options are required to be delivered to the same specifications and performance expectations.

The results of these quantitative comparisons, together with the qualitative criteria, are considered in recommending the procurement method that provides the best overall value for money.

7.4.1 Project Financial Assumptions

The DB and DBF procurement scenarios were prepared assuming the contract will be awarded during the Q2 2025. The ProvDB and ProvDBF procurement scenarios assume the contract will be awarded during the Q2 2024.

GST is not included in the capital cost estimate. The financial model does not take into account GST movements since it is a working capital item and the value is immaterial to the analysis (for purchases, GST is paid on items and is subsequently refunded; for billings, GST is collected and then remitted).

The DBF and ProvDBF scenarios assume that the private sector will finance approximately one quarter of the contract value. The modeling shows the private finance amount invested early in the term at a rate of 90% of monthly progress until it is fully invested. The level of private finance assumption is generally consistent with past projects and is expected to provide security in the form of unfunded value in the ground in the event construction challenges are encountered prior to substantial completion. The private financing is repaid at one or more completion milestones. A final recommendation on the appropriate level of private finance in the transaction will be confirmed prior to issuing the Request for Qualifications (RFQ).

Table 13 below shows the project financing assumptions used in the VFM analysis. These assumptions have been developed through discussions with Project advisors with input from Transportation Investment Corporation (TI Corp).

Table 13: Project Financial Assumptions

Assumption	
Private Financing Assumptions	
Debt/Equity Ratio	100:0
Timing of Private Finance	At a rate of 90% of private partner expenditure until the total amount of private finance is reached
Total Amount of Private Finance	25% of contract value
Private Sector Debt Type and Amount	
Type	Construction Term Debt
Base Interest Rate	1.95%
Forward buffer	0.50%
Interest Rate Spread	150 bps
Swap Credit Spread	10 bps
All-in rate	4.05%
Arrangement Fee	1.50%
Commitment Fee	0.53%
[redacted]	[redacted]

7.5 VALUE FOR MONEY CALCULATION

The different timing, risk and financing cost assumptions of each procurement model were compared on a nominal basis. The results of the VFM assessment are summarized in Table 14

Table 14: Value for Money Analysis Summary

Project Costs $millions (nominal)	DB	DBF	ProvDB	ProvDBF
Construction Progress Payments (including private finance costs)	[redacted]			
Transferred Risk				
Total Progress Payments				
Completion Payments [assumes 25%]				
Total Contractor Costs				
Owner Costs				
Retained Risk				
Province Interest Cost (full)				
Total Owner Costs				
Total Risk-Adjusted Costs for VFM	4,212	4,216	4,117	4,128
Value for Money – Absolute Difference to DB		-4	95	84
Value for Money – Relative to DB		-0.08%	2.26%	2.00%

Value for money is shown graphically for each of the DB to DBF, DB to ProvDB, and DB to ProvDBF comparisons in Figure 14, Figure 15 and Figure 16 respectively. The total risk-adjusted costs for VFM pertaining to the non-base case scenarios indicate relative costs calculated in accordance with the VFM quantitative methodology and will not necessarily align with the total project budget build up summarized in Table 7.

Figure 14: VFM Comparison Graph - DB to DBF

[redacted]

Figure 15: VFM Comparison Graph - DB to ProvDB

[redacted]

Figure 16: VFM Comparison Graph - DB to ProvDBF

[redacted]

7.5.1 VFM Updating

The Project team will prepare a new capital cost estimate, risk assessment and VFM analysis refresh whenever significant new information is available regarding the scope, design, stakeholders, funding and risks associated with the Project. The following are points in time when a VFM refresh may be appropriate based on new information:

- Prior to issuing procurement documents, as new information derived from the Project development and advance work is obtained.
- Once a preferred proponent has been selected, taking into account the proponent's technical and financial proposals as well as any preliminary comments they may have provided on the draft Project Agreement.
- Immediately after contract execution based on the signed contract and finalized price for the Project.
- At the completion of the competitive selection process, a Project report will be produced describing the selection process, the outcome and the final Project cost.

7.6 MARKET SOUNDING

Market sounding is a structured interaction with market participants, undertaken during the planning stages of the Project, to both generate interest in the Project and gather specific feedback on Project attributes and proposed contracting strategy and methodology.

7.6.1 April 2020 Business Case Market Sounding

An initial market sounding was undertaken in April 2020. This market sounding sought feedback on the robustness of the ITT market, different project delivery models for ITT projects, and commercial and financial considerations. The market sounding confirmed that the expected timing of Project procurement and implementation does not pose any obstacles to participation in the competition. While there are a number of large projects currently in or nearing procurement across Canada and in the United States, participants indicated they had adequate capacity and expressed a strong interest in the Project.

Market participants provided valuable feedback that will be considered further in the in development of Project documentation and processes. Feedback included views on suggested technical investigative work, the mitigation of risks in relation to permitting, the mitigation of risks in relation to third parties (and third party interfaces), risk allocation between owner and the contractor, traffic management, financing, timelines (including construction windows), and geotechnical baselining. There continues to be strong interest in the Project among all market participants interviewed.

Suggestions from the participants regarding Project planning, technical works, and procurement documents, included:

- Conducting geotechnical studies, utility relocations, and other advanced works along the Project alignment where reasonable;
- Liaising with utility owners and other stakeholders;
- Strategic acquisition of permanent and temporary lands in advance of the procurement, including a casting basin area; and
- Developing Project specifications related to traffic management that would clearly define the traffic management regime relating to allowable traffic modifications in advance of procurement.

Based on suggestions and concerns from the market, the Project team will endeavor to clearly define not only the specific and functional requirements that the base design must meet, but also those scope items open to innovation, including how much innovation would be acceptable. The Project team will also ensure available data relating to utilities and geotechnical conditions are made available to bidders during the procurement phase.

7.6.2 October 2020 Business Case Market Sounding

Additional market sounding was conducted between August and October of 2020 based on forms of ITT service delivery. The purpose of the market sounding was to advance the teams understanding of ground improvement methodology, to test commercial and procurement assumptions and to interface with two identified tunnel asset owners. The market sounding re-affirmed strong interest in the project from the earlier market soundings.

Information gathered regarding the ground improvement generally supported previous assumptions and confirmed the feasibility of the planned work.

A number of commercial and procurement concepts were discussed with participants, including their opinion and considerations for a number of procurement models. The participants were largely in agreement about the validity of the DB model for the project, and favoured forms of early engagement. The DBF model was largely seen as favourable and well-understood; however, a small minority of firms are moving away from construction financing contract structures. Progressive DB and Alliance models garnered mixed feedback due to the relative lack of precedents in BC; however, both were generally seen to be feasible models for delivery.

Notable information and lessons learned from this market sounding included:

- The insurance market is undergoing rapid changes, and insurance coverage, amounts and costs are difficult to predict; and
- Provision of long-term warranty (5-10 years) was considered infeasible.

7.6.3 November 2020 Business Case Market Sounding

In early November 2020, market sounding was conducted with financiers to seek feedback on the proposed ProvDBF model.

Discussions included, among other topics, the capacity for financial institutions to provide and hold committed financing for a period of 6-12 months prior to the price adjustment, whether there may be a premium on holding the financing commitment, and the potential risk of an EAC delay as well as other Project risks. The possibility of a financing competition following the issue of the EAC was also discussed and was generally seen as more attractive to the participants than providing committed financing with a negotiated future financing adjustment at the request for proposal (RFP) stage.

Market participants also provided valuable feedback on the proposed ProvDBF approach, including the following notes:

- Capacity for construction period financing is likely sufficient for the Project at under $1 billion;
- Market interest will fluctuate as credit spreads rise and fall with the market and in relation to other opportunities available to lenders; and

- Tunneling risk will likely impact the credit rating of the project but is not necessarily a deterrent to participation of lenders.

7.7 RECOMMENDED PROCUREMENT MODEL FOR THE CROSSING

The purpose of the procurement options analysis is to identify the procurement model offering the best overall value to taxpayers. Based on this qualitative and quantitative analysis summarized in Table 15, the ProvDBF model is recommended for the Crossing.

Table 15: Qualitative and Quantitative Factors Considered in Procurement Assessment

Procurement Objectives and VFM	DB	DBF	ProvDB	ProvDBF
Timely project delivery	✓½	✓✓	✓✓½	✓✓✓
Cost effective implementation (design and construction) & attainable within fiscal constraints	✓✓	✓✓	✓✓½	✓✓½
Allocate key risks to the party best able to manage and mitigate them	✓✓	✓✓	✓✓	✓✓
Attractive, marketable transaction	✓✓✓	✓✓½	✓✓	✓½
Contributes positively to the environmental and permitting process	✓	✓	✓½	✓½
Ensure strong competition providing innovation and efficient approaches	✓✓½	✓✓½	✓✓½	✓✓½
Value for money relative to DB	--	-0.08%	2.26%	2.00%

Based on the information summarized above, the ProvDBF ranks equal to or greater than the other models in all qualitative criteria except one. Since the ProvDB model will be less familiar to the market than the DB and DBF models, it scored slightly lower in terms of attracting broad interest from the market. The pre-EAC award further complicates the inclusion of private finance and will likely require a funding competition to be carried out after the EAC, a step not common in the BC market. However, these challenges can be addressed through pre-procurement preparation, broad marketing of the opportunity, and further market engagement. This criterion has not been incorporated into the quantitative analysis given the planned mitigations described.

The quantitative analysis reflects the assumptions made in evaluating certain of the qualitative criteria. Specifically:

- Timely project delivery – The ProvDB construction schedule is assumed to shift ahead one full year while the overall schedule, including procurement, is assumed to be one year shorter than the DB. The escalation savings associated with each of the ProvDB and ProvDBF models is included in the analysis. No other benefits (i.e. economic, environmental) associated with earlier delivery have been accounted for in the quantitative analysis.

- Cost effective implementation (design and construction) & attainable within fiscal constraints – The DB procurement model, which is the basis for all four models evaluated, involved a fixed price, performance-based contract. The procurement model was a factor in the development of the base cost estimates.

- Allocate key risks to the party best able to manage and mitigate them – Risks were allocated and quantified on the basis of assumptions regarding how each is impacted by the specific procurement model analyzed. Differentiation in the value of risks amongst the options was a key component of the quantitative analysis.

The qualitative criterion concerned with contributing positively to the environmental and permitting process is not captured in the quantitative analysis. While the ProvDB and ProvDBF models are expected to enable early engagement with regulators that may benefit the project, no cost adjustments were made to attach quantitative value to this benefit.

All the models analyzed scored similarly in terms of the quantitative value for money analysis. Relative to the DB, the DBF model generally results in lower overall transferred risk values due to the delay risk mitigation that comes from lenders' involvement. In this project, however, the incremental effect is relatively small, since schedule is already highly constrained by in-water work restrictions and delay risk mitigation activities in addition to lenders' oversight will be considerable.

The ProvDB and ProvDBF models score slightly better than the DB in the quantitative analysis. The accelerated schedule results in lower escalation and an overall cost advantage. The risk analysis, however, includes ProvDB/ProvDBF specific risks, primarily related to the negotiation and implementation of the price adjustment mechanism, that increase the overall risk valuation for these models relative to the DB. In effect, the additional risks offset the reduced cost escalation, resulting in VFM values of 2.26% and 2.00% respectively. The difference between these values is immaterial. The ProvDB-specific risks have been quantified using conservative assumptions and are expected to be mitigated further with planned market engagement and pre-procurement preparations.

Since the quantitative analysis does not indicate a significant nominal cost advantage of the ProvDBF relative to the DB, the ProvDBF model is recommended for procurement of the Crossing primarily based on qualitative considerations. These are:

- Potential for up to one year of schedule acceleration relative to a DB or DBF approach; and

- Performance security and lenders' due diligence from inclusion of private finance at risk during construction relative to DB and ProvDB; and Risk-adjusted nominal cost of the ProvDBF is not expected to be greater than the risk-adjusted nominal cost of the DB.

8 PROCUREMENT FOR CORRIDOR IMPROVEMENTS

8.1 PROCUREMENT MODELS

As discussed in Part B, the Corridor Improvements are viewed in terms of two components:

- Steveston Highway Interchange improvement; and
- Transit and Cycling improvements.

An analysis of procurement models for the Corridor Improvements, for which each component was considered separately, was undertaken by the Ministry, including the application of the Design-Build Procurement Screen developed by Infrastructure BC (formerly Partnerships BC). The screen uses a qualitative method of analysis to evaluate the suitability of a DB procurement model for a project considering, among other things, project risks, capital value, potential for innovation, cost, schedule, and market capacity.

8.1.1 Procurement Options Analysis Overview

Based on the results of the Ministry's DB Procurement Screens and assessment of procurement models utilized on several recent Ministry projects, DB and DBB were shortlisted for further consideration for the Corridor Improvements, including both quantitative and qualitative comparison techniques utilizing multiple criteria assessment, risk analysis, and market sounding.

8.2 MULTIPLE CRITERIA ANALYSIS

Table 16 highlights the merits of each procurement option in order to:

- Address stakeholder commitments;
- Manage and mitigate key project risks;
- Maximize competition, providing innovation and efficiencies;
- Maximize corridor service quality and full life asset performance; and
- Maximize cost and schedule certainty over the full life of the asset. Including the level of design completed and the recognition a DB would require a change of approach for the transit and cycling improvements that would delay the project.

Table 17 relates to the qualitative assessment scoring framework.

Table 16: Qualitative Assessment Summary

Improvement	**Steveston Highway Interchange**		**Transit & Cycling Improvements**	
Assessment Criteria	DBB	DB	DBB	DB
Stakeholder concerns and commitments are addressed. Consistency and thoroughness in communications and addressing stakeholder commitments.	✓✓✓	✓✓	✓✓✓	✓✓
Key Project Risks are allocated to the party best able to manage and mitigate them.	✓✓	✓✓½	✓✓	✓✓½
Competition, providing innovation and efficiencies is maximized. Attractiveness and marketability of the project opportunity that brings innovation and efficiencies.	✓✓	✓✓½	✓✓½	✓✓
Corridor service quality and performance are maximized. Project objectives related to reliability, and mobility are achieved, construction impacts on traffic are minimized and the asset performs effectively during construction and post-construction.	✓✓	✓✓	✓✓	✓✓
Cost, schedule certainty and affordability are maintained. Project is delivered on time and on budget within fiscal and cash flow constraints.	✓✓	✓✓½	✓✓½	✓✓

Table 17: Qualitative Assessment Scoring Framework

Scale	Assessment	Description
x	Poor	Model fails to meet basic requirements of the Project.
✓	Low	Minimally meets the Project procurement objectives.
✓✓	Medium	Adequately meets the Project procurement objectives.
✓✓✓	High	Provides a highly efficient and effective delivery solution for the Project based on its procurement objectives.

8.3 RISK ANALYSIS

Risk management is an essential process in project delivery, and this section summarizes those risks that were identified by the Project team as the most strategic in assessing procurement delivery options. A guiding principle of a procurement options assessment is to allocate risks to: (1) the parties that are best able to manage the risk, and (2) to a party that has strong incentives to manage the risk. The procurement model selection is a means of efficiently allocating these risks. The key risk considered for the procurement assessment included risk of schedule delays to ensure alignment with the proposed Crossing project.

8.4 MARKET SOUNDING

Market sounding for the Corridor Improvements was conducted in September 2020. Participants provided valuable feedback that will be considered further in the development of the Corridor Improvements. Feedback included views on suggested technical investigative work, the mitigation of risks in relation to third party (and third-party interfaces), risk allocation between the owner and contractor, traffic management, and geotechnical baselining. There continues to be strong interest in the Corridor Improvements among all market participants interviewed.

Based on the information gathered during the market sounding, the Project team will be incorporating several of the suggestions from the participants into the Project planning, technical works, and procurement documents, including:

- Schedule – Maintaining the anticipated procurement schedule (as would be indicated in RFQ/RFP), was specifically noted as a key area of importance to participants, noting that procurement delays pose resourcing challenges and increased costs.
- Geotechnical – Suggestions that geotechnical conditions should be a shared risk. Early preload recommended if design is far enough advanced to give confidence in placement.

- Traffic Management – interchange interaction with Existing Tunnel / high traffic volumes, especially during the day and during counterflow activities. Night work recognized as most likely. Detours and/or extended hours would allow for better efficiencies and better price for the Province.
- Utilities Relocations – Third party coordination is difficult for contractors and indicated as more challenging in recent years. Early coordination by owner, and utility relocation before contract award where possible would be beneficial.

8.5 RECOMMENDED PROCUREMENT MODEL FOR THE CORRIDOR IMPROVEMENTS

Based on the analysis, a DB procurement model is recommended for the Steveston Highway Interchange Improvement as it was deemed to more efficiently:

- Maximize schedule certainty over the construction period;
- Manage and mitigate key project risks; and
- Maximize competition, providing innovation and efficiencies.

With respect to the Transit and Cycling Improvements, the analysis supports a DBB procurement model, and the level of design development allows for initiation of procurement directly following approval of this Business Case.

PART D – IMPLEMENTATION PLAN AND FUNDING

Part D describes the plan to implement the Project, based on the recommended procurement models and Project schedule, and presents the estimated Project cost and potential funding sources at this phase of the Project life.

9 IMPLEMENTATION PLAN

This section describes the policy and process framework in place to execute the procurement, the resources that have been dedicated, and the governance structure designed to ensure an open, fair, and competitive procurement.

9.1 PROJECT DELIVERY STRUCTURE

The Project will be delivered by the Ministry and TI Corp. TI Corp is wholly owned subsidiary of the BC Transportation Financing Authority (BCTFA), the Provincial owner of the transportation assets, with a mandate to:

- Provide cost effective and flexible delivery for assigned major projects;
- Apply strong and consistent risk management, project and financial processes and control; and
- Be accountable and report out to the BCTFA as the owner of the assigned project.

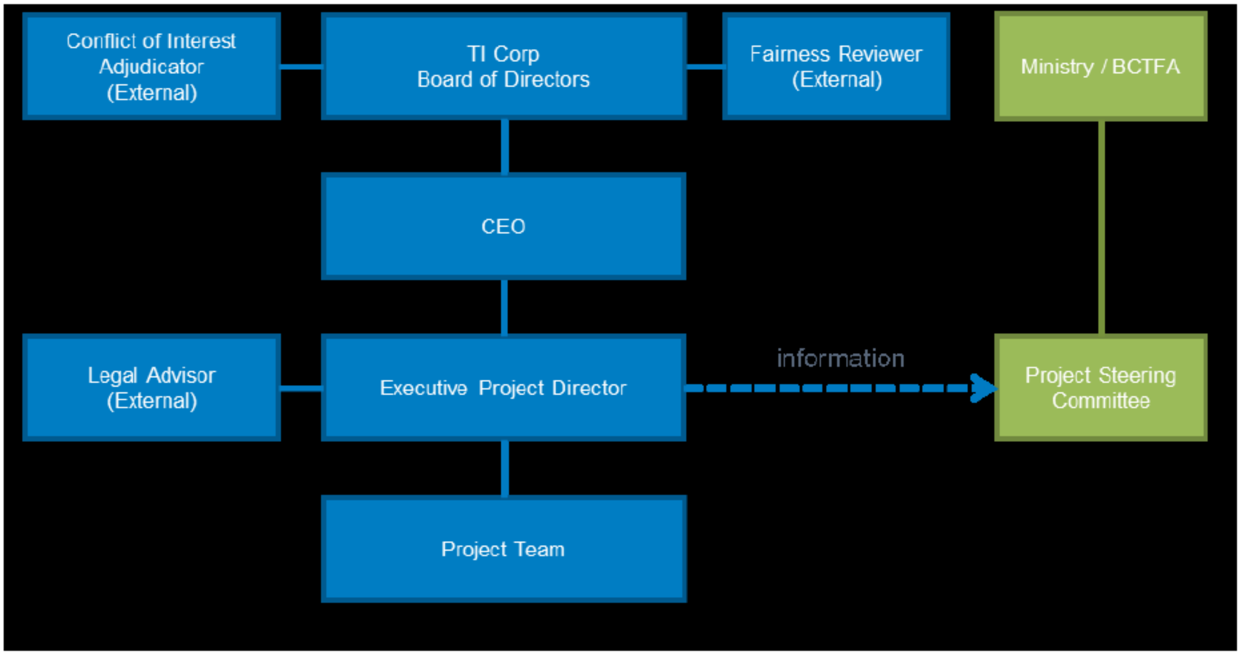
The relationship between BCTFA, the Ministry, and TI Corp is managed through the Master Major Project Delivery Agreement, and delivery directives are issued for TI Corp to deliver specific projects. This delivery directive specifies key project parameters, including budget, completion date and key scope items, which are defined by the Project's Business Case.

9.2 PROJECT GOVERNANCE

9.2.1 Project Governance for Crossing and Steveston Highway Interchange

The Crossing and Steveston Highway Interchange will be delivered by TI Corp as assigned projects from the Ministry and BCTFA, and the TI Corp Board will be accountable for delivery within the approved project parameters for this work. It is envisaged that some Ministry staff will support the work. The Executive Project Director for TI Corp will be responsible for providing regular status reporting to the TI Corp Board and Project Steering Committee. A high-level governance structure for the Crossing and the Steveston Highway Interchange is shown in Figure 17. In addition to the Crossing and Steveston Highway Interchange, key scope items for TI Corp will also include the EA process for Crossing, decommissioning of the Existing Tunnel, and interfacing with BC Hydro for relocation of the existing transmission line in the Existing Tunnel.

Figure 17: Project Governance Structure for Crossing and Steveston Highway Interchange



9.2.2 Project Governance for Transit and Cycling Improvements

The Transit and Cycling Improvements will be delivered directly by Ministry staff, reporting to the Ministry's internal Capital Program Board.

9.3 RECOMMENDED PROCUREMENT PROCESS

9.3.1 The Crossing

Based on the procurement model recommended for the Crossing (ProvDBF) the competitive selection process would follow a traditional two-stage approach including an RFQ followed by a RFP.

9.3.1.1 Request for Qualifications

The RFQ is the first phase of the selection process. RFQ respondents are expected to demonstrate their experience, qualifications, capacity and capability to undertake the Project. They are evaluated on their experience and technical capability in design, construction, project management, quality management, environmental management and communications management. Based on this evaluation, a shortlist of up to three respondents will be invited to participate as proponents in the RFP phase of the selection process.

9.3.1.2 Request for Proposals

The second stage of the procurement process is the RFP. The RFP package includes a detailed description of the Project, a draft contract, proposal submission requirements and details relating to how the proposals will be evaluated. The Project team anticipates implementing an interactive, two-stage RFP evaluation process such that proponents submit a technical proposal, which is evaluated based on the Province's stated performance requirements set out in a draft contract, in advance of their financial proposal. All proponents submitting technical proposals satisfying the RFP requirements will be invited to submit a financial proposal including a fixed price for the proposed solution based on an anticipated EAC issue date. The final executed contract would include the price adjustment mechanism agreed during the RFP stage.

Throughout the procurement process, a Fairness Reviewer would be retained to monitor the selection process and provide a written report at the conclusion.

9.3.2 Steveston Highway Interchange

Based on the DB procurement model recommended for the Steveston Highway Interchange improvement the competitive selection process would follow the traditional two-stage approach of an RFQ followed by a RFP as discussed in the previous sections.

Throughout the procurement process, a Fairness Reviewer would be retained to monitor the selection process and provide a written report at the conclusion.

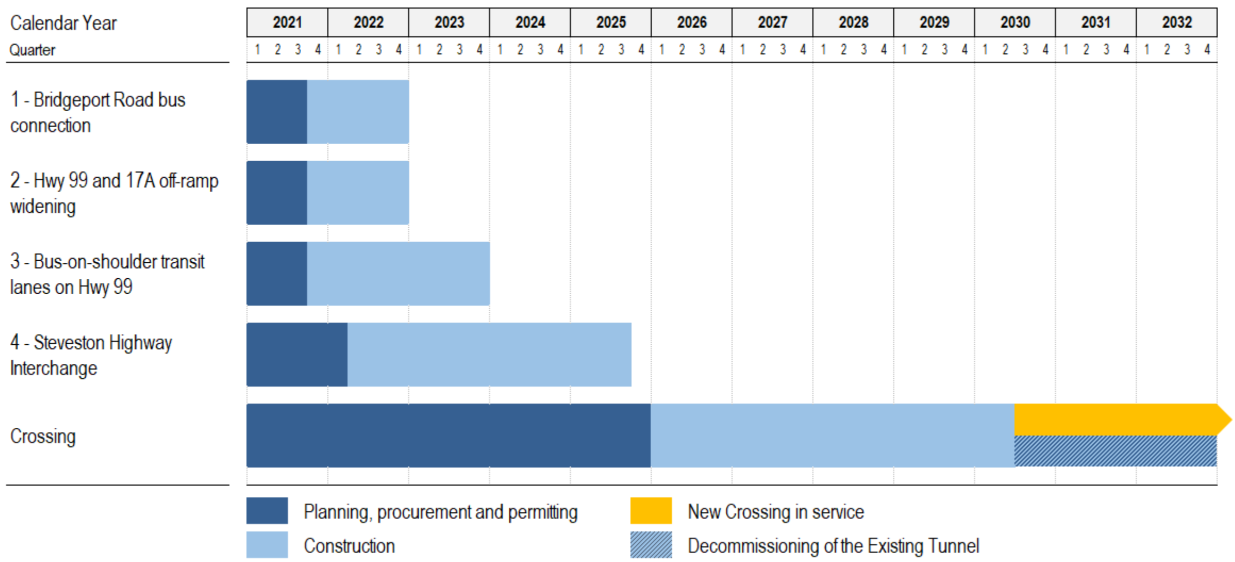
9.3.3 Transit and Cycling Improvements

The procurement process for the DBB model recommended for the Transit and Cycling Improvements would result in a tender process in which the owner would engage a design team to develop a detailed design (working drawings) for the improvements and once the working drawings are complete, a tender call for construction pricing would be issued. The lowest qualified price would be selected, and an industry standard fixed-price construction contract would be used.

9.4 PROJECT SCHEDULE

Figure 18 illustrates the anticipated procurement and design and construction period for the Project. This schedule assumes Treasury Board approval to proceed is received by Q2 2021.

Figure 18: Project Delivery Schedule



Highlights of the schedule relating to the Corridor Improvements are:

- For the Transit and Cycling Improvement projects (improvements #1, 2 and 3), it is anticipated that contractor mobilization will begin Fall 2021 and construction will continue through Spring 2023. Each project schedule will need to be maintained to avoid conflict between the contractors and their respective traffic management plans.
- For the Steveston Highway Interchange replacement, it is anticipated that contractor mobilization will begin in Spring 2022 and construction will continue through 2025.
- The provincial EAC amendment for the Transit and Cycling improvements and the Steveston Highway Interchange is anticipated to be completed in Fall 2021. Permitting is anticipated to be complete Winter 2021 following receipt of the amended EAC.
- A delay of 6 months in the construction start date could affect the available construction seasons and, as a result, the estimated completion dates reflected above may be affected by more than 6 months.

With respect to the Crossing:

- RFQ issuance is planned for early 2023 with a proponent shortlist expected by Spring 2023.
- The RFP is planned for issuance in Spring 2023, with a preferred proponent expected to be selected and a contract awarded by Summer 2024.

- The provincial environmental assessment is anticipated to be completed in 2024. Permitting is anticipated to be complete within one year following receipt of the EAC.
- Based on the current schedule, it is anticipated that construction works will begin in 2026, with the design of the Crossing continuing following the award and opening scheduled by Q2 2030.
- Decommissioning of the Existing Tunnel will occur between 2030 and 2032.

9.5 ENVIRONMENTAL ASSESSMENT AND PERMITTING

9.5.1 Corridor Improvements

As noted in Section 6.3, the Corridor Improvements will require an amendment to the EAC for the GMTR Project (EAC#T17-01), and the Crossing will require a full EA and a new EAC.

The Project Team has shared the intention to move forward with the Corridor Improvements with Indigenous groups, Metro Vancouver, TransLink, area municipalities and the public. The specific improvements were selected with input from Metro Vancouver, TransLink, Delta, Richmond and TFN (as part of the Metro Vancouver Mayors' Task Force). Additional engagement with these groups and other key stakeholders is anticipated through the EAC amendment process. It is anticipated that some of the conditions attached to the GMTR EAC will apply to the Corridor Improvements.

In addition to the amendment of the existing EAC, the Corridor Improvements will require approvals from the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD), and the Agricultural Land Commission. In anticipation of the Indigenous consultation requirements of FLNRORD permits, the Project team has initiated consultation with identified Indigenous groups and is working with FLNRORD to ensure a coordinated consultation approach.

Archaeology assessments will be required for the Corridor Improvements and the Crossing. The Project team has prepared a public tender for a Consulting Archaeologist to join the Project team and lead a coordinate approach to meeting the archaeological requirements for both phases of the Project.

9.5.2 New Fraser River Crossing

With respect to the Crossing, an environmental assessment will be conducted by the EAO under the BC *Environmental Assessment Act, 2018*. Beyond the construction of the new ITT, the scope of the EA will include the construction and decommissioning of a casting basin facility, the removal of the Existing Tunnel and decommissioning of the approaches and portal areas for the Existing Tunnel. Following the EA, the Crossing requires a number of permits in order to proceed from other federal and provincial agencies including DFO, Transport Canada, FLNRORD, and the Agricultural Land Commission. These permits will detail requirements related to the design and construction phase of the Project. In the event the Project requires lands under management of the VFPA, activities on such federal lands may require a Project and Environmental Review under Section 82 of the federal *Impact Assessment Act, 2019*.

9.6 INDIGENOUS GROUPS ENGAGEMENT

The Project team has been engaging with the identified Indigenous groups since February of 2019. This engagement included seeking input on the Project principles, goals, and objectives, Indigenous participation in the options analysis, and detailed discussions of the short-listed crossing options. In addition, to address Indigenous groups' concerns and interests related to fish, fish habitats, and their ability to fish, the Project team hosted two Fisheries workshops to identify opportunities for additional environmental assessments and investigation that are broader in scope than the Environmental Assessment and targeted to Indigenous interests. The Project team has since collaborated with the Indigenous groups to develop five advanced environmental studies (Eulachon, Sturgeon, Salmonids, Migratory birds, and habitat mapping) with input from all identified Indigenous groups and has partnered with selected Indigenous groups to deliver the work. The Project team has reached capacity funding agreements with nine of the twelve identified Indigenous groups and has regularly occurring meetings regarding the Project.

The Project team has engaged with identified Indigenous groups specifically regarding the Corridor Improvement projects since August 2020. This engagement has been delivered separate from the larger Crossing project because of the scope or impacts and schedule being different in scale and level of impact. The Project team will continue to engage with Indigenous groups on the Corridor Improvement projects through consultation on the EAC amendment.

The Project team has developed a detailed Indigenous engagement plan for the Crossing project. The plan will implement the Indigenous engagement requirements included in the new EA process while also meeting the Ministry's duty to consult. Key elements of the plan include consensus building activities and actions, identifying impacts and developing mitigations or accommodations early in the engagement process, and identifying economic development and partnership opportunities early in the project development phase. The Project team will seek to reach Project Agreements with all the identified Indigenous groups which will provide enhanced certainty of the Project through a lengthy construction phase.

TFN has expressed a preference for a bridge solution over a new ITT, citing concerns with greater environmental impacts to the Fraser River and fish habitats among other general concerns. In response to TFN's concerns the Ministry has sought to focus discussions with TFN on potential long-term improvements to the River environment and fish habitat through habitat offsetting and improvement initiatives. The Ministry will continue to work closely with TFN through the EA process.

9.7 PROJECT STAKEHOLDER AND PUBLIC COMMUNICATIONS / CONSULTATION

A communications and public engagement plan will be developed for the Project. The plan intends to address the need to ensure that the identified Indigenous groups, local governments, stakeholders and members of the public are advised of the planning process. In addition, the plan will allow for the provision of appropriate information and venues to allow the public to provide meaningful input to the design process as appropriate.

9.8 PERFORMANCE MEASUREMENT

Performance measurement is the process by which completed projects are measured to determine whether the Project's intendent objectives and expected benefits have been realized. The Project team has developed an evaluation framework (Table 18) that includes tailored performance measures based on data currently collected by the Ministry and TransLink and representative of the Project goals. A detailed Performance Measurement Plan will be developed through the delivery phase of the Project.

Table 18: Performance Measures for the Project

Project Goal	Performance Measure	Method of Measurement
Affordability and delivery	Deliver Project within approved Budget.	Comparison of actual to approved budget.
	Deliver Project within approved Schedule.	Comparison of substantial and final completion to approved schedule.
Support sustainability of Fraser River communities	Reduce travel times through the Corridor in the peak and non-peak directions.	Travel time studies.
	Improve traffic safety performance.	Analysis of Ministry's Collision Information System.
	No loss of land within the Agricultural Land Reserve.	Calculation of takes and additions to Agricultural Land Reserve.
Facilitate increased share of sustainable modes of transport	Improve speed and reliability of transit travel times through the Corridor.	Evaluation of transit travel speed and reliability on key bus routes.
	Create fixed link for active transportation across the Fraser River on the Corridor.	Achievement of design criteria.
Enhance regional goods movement and commerce	Reduce annual duration of unplanned closures on the Crossing.	Data collection through Transportation Management Centre of BC.
	Maintain the navigational channel of the Fraser River.	Achievement of design criteria.
	Improve vertical clearances at the Crossing and allow for movement of dangerous goods along the Corridor.	Achievement of design criteria.
Support a healthy environment	Construct project in accordance with regulatory requirements.	Logged environmental incidents by regulatory agency during construction phase.
	Enhance environment for fish, wildlife, birds and marine mammals.	Achievement of offsetting requirements in accordance with the EAC and regulatory requirements.

10 FUNDING

10.1 POTENTIAL SOURCES OF FUNDS

The Government of Canada is working closely with provinces, municipalities and Indigenous groups in recognition of the unique needs of each community to build infrastructure that will improve the quality of life for all Canadians. The Province values its longstanding partnership with the federal government in funding public infrastructure.

The Province has engaged with the Government of Canada and has consistently indicated that the Project is one of BC's top infrastructure priorities. The Project represents a unique opportunity for the Government of Canada to participate in a project of national significance that contributes to Canada's trade competitiveness, Metro Vancouver's regional growth, economic opportunities for Indigenous communities, and the growth of transit and active transportation.

To date, no partnership funding has been secured with the Government of Canada, and the Project is being funded solely by the Province. Discussions with the Government of Canada on funding opportunities are expected to continue until Q2 2021.

10.2 PROJECT CASH FLOWS

The total Project cost estimates estimated to be $4.3 billion. The estimated cash flow by fiscal year is outline in Table 19. Further details on the costs for the Crossing and Corridor Improvements are provided in Appendix H and Appendix I, respectively.

Table 19: Total Project Cash Flow Summary

Cost category [1]	2021-2022	2022-2023	2023-2024	2024-2025	2025-2026	2026-2027	2027-2028	2028-2029	2029-2030	2030-2031	2031-2032	Total
Contractor's construction costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Owner's costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
IDC, bid development and SPV costs (Contractor)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Contingency / Risks	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Subtotal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Provincial IDC	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Crossing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**4,147.9**
Contractor's construction costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Owner's costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Contingency / Risks	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Subtotal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Provincial IDC	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Steveston Hwy Interchange	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**87.5**
Contractor's construction costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Owner's costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Contingency / Risks	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Subtotal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Provincial IDC	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Transit and Cycling Improvements	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**49.4**
Total Corridor Improvements	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**136.9**
TOTAL PROJECT COST	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	**4,284.8**

[1] Figures in $ million, nominal basis, 2021 as base year. Fiscal year ends in March.

PART E – RECOMMENDATION

This Business Case demonstrates the need for the Project to address the congestion, reliability and safety challenges associated with the Existing Tunnel; and support active transportation and economic development in the region.

This Business Case recommends proceeding with the Project at an estimated total cost of $4.3 billion using the recommended procurement models for the Crossing and Corridor Improvements.