1.0 OVERVIEW OF PROPOSED PROJECT PROPONENT DESCRIPTION

PROJECT PROPONENT

The Ministry of Transportation and Infrastructure plans transportation networks, provides transportation services and infrastructure, develops and implements transportation policies, and administers many related acts, regulations and federal-provincial funding programs, including the Building Canada Fund. The Ministry strives to build and maintain a safe and reliable multi-modal transportation system and provide affordable, efficient and accessible transportation options for all British Columbians. The Ministry's priorities include improving vital rural and urban infrastructure, investing in public transit, cycling infrastructure and other green modes of transportation, reducing transportation-related greenhouse gas emissions and strengthening the economy through the movement of people and goods.

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An environmental assessment team has developed this Application for an EAC under the BC *Environmental Assessment Act.*The technical information within this Application was prepared with the input of discipline leads with expertise in relevant areas, as summarized in **Table 1-1**.

Table 1-1 Environmental Assessment Discipline Leads

Application Section Number	Responsible Team Member and Qualifications	Area of Technical Expertise
2.0	John Villamere, MEng., PEng Anna Wright, BA Jemma Scoble, MASc	Environmental Assessment Communications and Public Consultation Aboriginal Consultation
3.0	Brandie Roberts, MSc	Assessment Methodology
4.1	Matt Gellis, PEng	River Hydraulics and Morphology
4.2	Ted Lewis, PhD	Surface Water and Sediment Quality
4.3	Cory Bettles, MSc, RPBio, CFP Sarah Thomasen, MSc, RPBio Morgan Edwards, MSc, RPBio	Fish and Fish Habitat
4.4, 4.5	Linda Dupuis, MSc, RPBio	Vegetation, Wildlife
4.6	Jos Beckers, PhD, PGeo	Soil and Groundwater
4.7	Clair Wakefield, MASc, PEng	Noise and Vibration
4.8	Mike Lepage, MSc., ACM, CCM	Air Quality
5.1	Claude Pierce, BA Sylvie Lefebvre, BA, MBA, CMC	Economic Activity
6.1	Roxanne Scott, BSc, MPA	Marine Use
6.2, 6.3	Sylvie Lefebvre, BA, MBA, CMC Claude Pierce, BA	Land Use, Community Cohesion
6.4. 6.5, 6.6	Daryl Harrison, BA, ADP GIS	Visual Quality, Lighting, Shading
7.1	Alice Storey, PhD	Heritage Resources
8.1	Marla Orenstein, MSc	Physical Determinants of Health
8.2	Robin Sydneysmith, PhD	Social Determinants of Health
9.0, 10.0	Brandie Roberts, MSc	Accidents and Malfunctions, Effects of Environment on the Project,
11.0	Province of British Columbia	Summary of Statutory Requirements Under CEAA 2012
12.0	Jemma Scoble, MASc Province of British Columbia	Aboriginal Consultation Aboriginal Interests Assessment
13.0	Anna Wright, BA	Public Consultation
14.0, 15.0	Aidan Ballantyne, MRM, RPBio Marek Holin, BSc	Management, Monitoring, and Follow-Up Plans

1.1 DESCRIPTION OF PROPOSED PROJECT

1.1.1 Project Purpose

BC Ministry of Transportation and Infrastructure (MoTI) is proposing the Project, which includes a new four-lane bridge that meets current seismic and road design standards, and provides a safe and reliable crossing for vehicles, pedestrians and cyclists, network connections in Surrey and New Westminster, and the removal of the existing bridge.

The central location of the existing Pattullo Bridge makes it a vital link across the Fraser River in the regional transportation network for people, goods, and services. The bridge connects King George Boulevard, Scott Road, and indirectly Highway 17 in Surrey with McBride Boulevard, Columbia Street, and Royal Avenue in New Westminster. Opened in 1937, it is one of the oldest bridges in Metro Vancouver and does not comply with modern design standards. The existing Pattullo Bridge would be at risk in the event of a moderate earthquake, ship collision, or high wind event. Its piers are at risk of being undermined by river scour, and many bridge components have surpassed their design service life. Existing facilities, such as sidewalks, barriers, and connections for pedestrians and cyclists, do not provide the same level of protection from traffic as a new facility. **Table 1.1-1** summarizes the key drivers of the Project.

Table 1.1-1 Key Project Drivers

Project Drivers	Description
User safety and sub-optimal design standards	▪ The bridge does not meet current roadway design guidelines for lane widths and curvature. ▪ To mitigate impacts of narrow lanes, centre lanes are closed at night when vehicle collision risks are highest. ▪ The bridge does not meet modern wind load design standards. ▪ The piers are at risk of being undermined by river scour.
Seismic and ship collision vulnerability	▪ The aging bridge does not meet current seismic standards and would be at risk in the event of a moderate earthquake. ▪ The bridge is vulnerable to damage from a potential ship collision with its structural supports. ▪ An assessment of rehabilitation needs revealed that upgrading the bridge to meet modern seismic standards would be technically challenging and cost prohibitive.
Pedestrian/cycling issues	▪ Bridge facilities, such as sidewalks, barriers, and connections for pedestrians and cyclists, do not provide the same level of protection from traffic that a new facility would.
Unreliable travel times	▪ During rush hours, travel demand on the roads leading to the bridge results in queuing and unreliable travel times for the movement of people, goods and services. ▪ Large trucks straddle the lanes, reducing available capacity.

Project Drivers	Description
Community impacts	▪ Current traffic volumes (including truck volumes) and related congestion and neighbourhood traffic infiltration adversely affect the livability of adjacent communities due to air quality, noise and resulting health impacts.
Ongoing maintenance and repairs	▪ Many bridge components have surpassed their useful lifespan and need replacing or major rehabilitation. ▪ An assessment of rehabilitation needs revealed that rehabilitating the existing structure would be financially prohibitive and ineffective in addressing the aforementioned issues.

The Project represents a significant investment in multi-modal transportation mobility improvements and is aligned with several of the Province's key strategic initiatives to make life more affordable, improve services, and create good jobs and a sustainable economy for BC residents. The Project is also an important part of the following long-range regional plans:

- TransLink's *Moving the Economy: A Regional Goods Movement Strategy* (2017)
- Mayors' Council on Regional Transportation's *Regional Transportation Investments: a Vision for Metro Vancouver* (2014)
- TransLink's *Regional Transportation Strategy* (2013)
- Metro Vancouver's *Metro Vancouver 2040 (Regional Growth Strategy)* (2011)

1.1.1.1 Project Goals and Objectives

From the project drivers listed in **Table 1.1-1**, three overarching goals were developed for the Project to guide design development. They are:

- **Provide a structurally sound bridge crossing** to maintain a critical local and regional connection
- **Improve safety for all users** with modern lane widths and road curvature, a centre median and separated pedestrian and cyclist facilities
- **Improve connectivity, reliability and modal choice** while supporting environmental objectives

The Project supports the following objectives:

- Provide a river crossing for all modes that is structurally sound, and meets current standards for withstanding seismic and ship impacts
- Support local and regional land use plans and economic development
- Provide reliable access and predictable travel times for all modes
- Minimize single-occupancy vehicle use and vehicle kilometers travelled

- Move toward the regional goal that, by 2040, half of all trips will be by walking, cycling or transit
- Minimize emissions of greenhouse gases and pollutants
- Minimize impacts to the natural environment
- Support neighbourhood livability by minimizing and mitigating impacts, including during construction

1.1.1.2 Key Project Elements

To address the above objectives, the Project will replace the existing bridge with a new, four-lane bridge. The Project will provide:

- A safer crossing with modern lane widths to accommodate standard passenger and commercial vehicle sizes, separated by a centre median to ensure improved safety for all bridge users
- Pedestrian and cyclist facilities, separated from traffic on both sides of the bridge
- Network connections to New Westminster and Surrey
- Removal of the existing Pattullo bridge structure

The Project will be located just north and upstream of the existing Pattullo bridge and will continue to link the communities of New Westminster and Surrey. This will allow the new bridge to optimize the use of existing road network and travel patterns. Constructing the bridge parallel to the existing bridge will also allow the existing bridge to continue operating until the new bridge is operating. Once the new bridge is open, the existing bridge will be removed.

The new four-lane bridge will be designed in a manner to not preclude a potential future expansion to six lanes. No commitment has been made regarding a potential future expansion to six lanes. Any future option to add lanes will be considered as a separate project and will be subject to a collaborative planning, analytical and consultative process between the Province, TransLink and municipalities. A potential future expansion of the bridge will be subject to the regulatory review/assessment requirements of the time.

1.1.2 Location of Proposed Project

The existing Pattullo Bridge crosses the Fraser River between Surrey and New Westminster at the following UTM Coordinates: Zone 10, 5450718 N and 507751 E (**Figure 1-A-1**).

1.1.2.1 Linking Metro Vancouver Communities

The corridor is a critical link for local travel between the two city centres of New Westminster and Surrey on either side of the Fraser River. Providing direct, multi-modal connections between Regional City Centres is a key component of *Metro Vancouver 2040* and the *Regional Transportation Strategy*.

Surrey is a rapidly expanding city experiencing significant growth in commercial, institutional, large-format retail and industry. The retail growth is centred primarily around a new and growing city centre while much of the industrial growth is related to the port economy. Close to the bridgehead, a new health and technology hub is planned in proximity to Surrey Memorial Hospital. With a growing population of more than 500,000 people, Surrey is recognized as the fastest-growing city on Canada's West Coast. Widespread single and multi-family residential areas are being developed across the city, increasing the need to balance neighbourhood livability with regional transportation.

The City of New Westminster is home to approximately 70,000 residents and is centrally located within Metro Vancouver with excellent rapid transit access. As an established community with traditional single-family homes and recent high density, sustainable transit-oriented developments, the City of New Westminster's key considerations regarding the new bridge are that it supports existing economic activity and facilitates redevelopment while preserving community livability goals. Significant commercial and industrial development happening on both sides of the city (Queensborough and Brunette areas) are creating more demand for better transportation links through and in and out of New Westminster. Ensuring good access to the Royal Columbian Hospital, close to the existing Pattullo Bridge and Highway 1, is also a priority.

1.1.2.2 Pattullo Corridor – Service to Major Gateways

The Pattullo corridor connects provincial and regional routes with municipalities north and south of the Fraser River. The corridor also supports Metro Vancouver's role as one of Canada's Asia Pacific Gateways by linking key Regional Activity Centres with Gateway/International Activity Centres. It provides a direct connection between industrial lands in New Westminster and Surrey.

The existing Pattullo Bridge is identified as a transportation network priority in several strategic plans, including the Gateway Transportation Collaboration Forum's *Greater Vancouver Gateway 2030* report. In combination with Highway 17, it also provides important goods movement and trade linkages between Roberts Bank Terminal, the Fraser River Trade Area and the adjacent communities. Approximately half of the one million heavy trucks that cross the Pattullo bridge each year are transporting goods through the Asia-Pacific Gateway.

1.1.2.3 Asserted Traditional and Treaty Nation Territories

As shown in **Figure 1.A-2**, the Project is entirely or partially located within the asserted traditional territories, and/or Treaty Nation territories of the following Aboriginal Groups.:

- Cowichan Tribes
- Halalt First Nation
- Katzie First Nation
- Kwantlen First Nation
- Kwikwetlem First Nation

- Lake Cowichan First Nation
- Lyackson First Nation
- Musqueam Nation
- Penelakut Tribe
- Semiahmoo First Nation
- Squamish Nation
- Stz'uminus First Nation
- Tsawwassen First Nation
- Tsleil-Waututh Nation

1.1.2.4 Location of the Project Relative to VFPA Jurisdiction

The location of the proposed project, including main Project components relative to Vancouver Fraser Port Authority (VFPA) jurisdiction can be seen on the figures entitled: VFPA Land Use and VFPA Land Use Designations located in **Section 6.2 Land Use**.

Given the date of its construction, the existing Pattullo Bridge does not have a tenure across VFPA lands. Tenure will be required with VFPA for the new bridge structure.

The in-stream Project components, as detailed below in **Section 1.1.4.2.2**, are within VFPA jurisdiction, and the approach spans directly adjacent to the Fraser River in the City of Surrey cross over VFPA property that is currently leased. The relationship between the above Project components, the high water mark, and VFPA jurisdiction and lease boundaries is shown in the conceptual-level design drawings located in **Appendix 18.17 – Reference Concept (SK-RW-043; SK-RW-044)**.

Anticipated access points and potential construction and demolition laydown areas will be dependent on final design requirements but shall not be placed in areas that have major impact on private businesses and VFPA operations.

1.1.3 Project Design

The Project Description provided in this Application delineates a Project Boundary (**Figure 1-A-3**), as defined in the Application Information Requirements (AIR), including a conceptual-level design for key Project infrastructure elements (**Appendix 18.17 Reference Concept**). Preparation for the Environmental Assessment for the Project and associated studies began in 2016. At that time, it was anticipated that the new bridge would be tolled and the Project scope included roadworks in both Surrey and New Westminster.

Following the removal of tolls on Fraser River crossings in September 2017, due diligence by the Province indicated that certain proposed roadworks in Surrey would lead to unacceptable traffic queuing on Highway 17 after opening day. Further analysis is needed to better understand these connections. As a result, the Pattullo Bridge Replacement Project Business Case (Jan 2018) recommended moving forward with reduced roadwork scope in Surrey. Therefore, the revised project scope (Revised Scope) for the Pattullo Bridge Replacement Project that will be procured, does not include Scott Road Extension and Scott Road Exchange in Surrey.

The Revised Scope of the Project is reduced from the Reference Concept and thus still falls within the current Project Boundary. The effects assessments within this Application are thus conservative as they are based on the Reference Concept. To ensure that potential adverse effects are adequately assessed, the Effects Assessments for each Value Component (VC) and Intermediate Component (IC) in this Application used the larger original scope.

The Project will be delivered as a design-build-finance project; the successful Contractor will be responsible for the final Project design, construction approach, staging, schedule, and partial financing during construction.

The Project includes the following key components:

- A new four-lane replacement bridge that will provide:
    - A safer crossing with modern lane widths to accommodate standard passenger and commercial vehicle sizes, separated by a centre median to ensure improved safety for all bridge users.
    - Pedestrian and cyclist facilities that are separated from traffic on both sides of the bridge.
    - Consistency with current seismic, wind load and ship impact standards.
- Network connections to New Westminster and Surrey.
- Removal of the existing bridge.

The Reference Concept reflects a level of design adequate to identify and address significant constraints, evaluate and minimize risk, and limit the potential impacts of the Project. In this context, the extent and nature of environmental effects described in this Application are those that would be anticipated to occur assuming the Project is developed within the designated Project Boundary. While this level of detail is sufficient to support the environmental assessment of the Project, the design–build-finance nature of the Project allows for contractor design refinements, which may include innovative designs or approaches to construction that improve operational performance, reduce construction costs, or avoid or minimize potential effects on environmental or community values.

Such changes, if any, will be limited to those that do not result in Project-related effects over and above those described in the Application or in construction activities that extend beyond the defined Project Boundary. With these restrictions, the procurement process provides the opportunity for design

improvements during Project delivery while ensuring that the extent and nature of potential Project-related effects presented in this Application are not exceeded. Changes in a certified project may be undertaken subject to consideration by EAO. Under the *Environmental Assessment Act*, substantive variation from the certified Project Description may trigger the requirement for an amendment to the EAC before allowing such works to proceed. The amendment process, which includes an opportunity for stakeholder input, provides a mechanism for considering whether proposed changes in project scope could result in potential adverse effects, and for confirming that any such additional effects can be mitigated.

1.1.4 Phases of the Proposed Project

1.1.4.1 Overview of Project Phases

The scope of the Project will be confirmed during final design and construction planning with the successful design-build-finance Contractor. Construction is anticipated to start in 2019, contingent upon the issuing of an Environmental Assessment Certificate for the Project. Opening of the new bridge is planned in 2023. The existing bridge is anticipated be removed in 2024 after the new bridge is open. The major milestones of the Project schedule are shown in **Table 1.1-2**.

Table 1.1-2 Project Milestones

Project Phase/Stage	Schedule
Environmental Assessment and Procurement	
EA Application and Regulatory Review	2018-2019
Anticipated EA Certification	2019
Procurement	2018-2019
Contract Award	2019
Construction	
Construct new bridge and local road connections	2019-2023
New bridge in service	2023
Remove existing bridge	2024
Operation	
Operations and maintenance	Ongoing from 2023

1.1.4.2 Project Components

The on-site and off-site components of the Project are described below. These components are illustrated according to the Reference Concept in **Appendix 18.17 – Reference Concept**. These figures provide plans, profiles, and sections pertaining to the proposed work, including water depths, navigation clearances, and extent of removal of the existing Pattullo Bridge.

1.1.4.2.1 Project Components in the City of New Westminster

The Project components in the city of New Westminster include:

- Roads to access the new bridge from McBride Boulevard, Royal Avenue, and East Columbia Street
- Roads to access McBride Boulevard, Royal Avenue, and East Columbia Street from the new bridge
- Infrastructure to support roadworks, including retaining walls and overpass structures, as required
- Multi-use paths and sidewalks to provide continuity across the Project area and on the new bridge
- Approach spans to connect roads in New Westminster to the in-stream components of the new bridge, including a direct ramp connections from East Columbia for both southbound and northbound bridge traffic
- Landscaping

1.1.4.2.2 River Crossing Project Components

The Project components on the river crossing include:

- A four-lane, long-span bridge over the main and secondary navigation channels
- Multi-use paths on either side of the main span and approach spans
- Suicide prevention barrier on the outer edge of each multi-use path
- Removal of the existing Pattullo Bridge

1.1.4.2.3 Project Components in the City of Surrey

The Project components in the City of Surrey include:

- Approach spans to connect King George Boulevard to the new bridge
- Roadway tie-ins to King George Boulevard
- Multi-use paths and sidewalks to provide continuity across the Project area and on the new bridge
- Connection between the new bridge and Highway 17
- Reconstruction of Bridge Road to allow two way traffic to access to Old Yale Road
- A grade separation between Old Yale Road and Highway 17
- Landscaping

1.1.4.3 Key Project Activities

Sequencing and construction activities will be established after award of the design-build-finance contract. The Contractor's design and construction activities will conform to all applicable design criteria, technical requirements, and constructability and traffic management requirements. All construction activities at the site will occur within the Project Boundary. The following activities and sequencing of work are anticipated:

- Optimization of proposal design and final design.
- Site preparation and mobilization, including installation of fencing, site offices, clearing, and grubbing, and finalization of subcontracts and other administrative requirements.
- Permitting, including final Navigation Protection Act permit, Fisheries Act permits, BC Provincial permits, permits from Cities of New Westminster and Surrey for traffic pattern changes, rail work permits, and others.
- Relocation of utilities as required.
- Off-site fabrication of structural components.
- Ordering of materials.
- Onshore ground improvements to meet seismic performance requirements for embankments and foundations.
- Roadwork and multi-use trail construction, including excavation, construction of embankments, the road base, and road drainage; and installing/adding street lighting, barriers, pedestrian railings, paving, lane markings, and signage.
- Construction of onshore structures, including overpasses, underpasses, multi-use trail bridges and retaining walls.
- Construction of stormwater collection/treatment facilities.
- Construction of the new bridge:
    - implementing the Marine Stakeholders Communications Plan including tug assist requirements
    - installation of cofferdams including ground improvements and rip rap
    - constructing in-stream and onshore foundations
    - constructing in-stream and onshore pile caps
    - constructing towers
    - constructing piers for approach spans and ramps

- constructing the cable-stayed deck
- constructing approach span and ramp decks
- installing barriers, hand rails, security fencing, suicide prevention barrier, lighting, structural health monitoring, snow and ice management systems
- final paving and lane marking

- Site remediation and landscaping.
- Removal and removal of the existing Pattullo Bridge.

1.1.4.3.1 Site Preparation

Site preparation activities typically include collection of design-related data and work required before actual construction begins. Site preparation typically includes the following:

- Surveying – Defining the extent of area where construction works will take place, and locating site access roads, temporary detours, utilities, property accesses, and sensitive areas.
- Geotechnical investigations – Assessing existing ground conditions within the Project corridor, including confirmation of pile capacities. Locations needing ground improvements will be identified through compaction testing and by collecting soil core samples.
- Clearing and grubbing – Removing existing vegetation where required for highway widening and improvement. Work will take place within the right-of-way and will include the removal of organic material and soils that are unsuitable for construction.
- Temporary drainage structures – Establishing works to maintain existing drainage patterns and manage stormwater runoff within the Project alignment while accommodating temporary access routes and detours.
- Erosion and sediment control measures – Establishing infrastructure to minimize soil erosion and prevent the release of sediments into watercourses during site preparation and other pre-construction activities.
- Staging and laydown areas – Establishing areas for the staging and/or storage of materials and/or heavy equipment such as cranes and construction materials. Wherever possible, staging and laydown areas will be located in previously disturbed areas within the Project Boundary.

1.1.4.3.2 Temporary Works

Temporary works could include the following:

- Establishing temporary roads and detours to provide access to construction areas and isolate public traffic from construction activities. Traffic patterns and property access within the Project Boundary limits will be maintained throughout the Project. A Construction Traffic Management Plan (**Section 14.0 Management Plans**) will be developed to describe the approach to traffic management that will be established during Project construction.

- Temporary lighting to facilitate construction during winter months or night work. Community notifications will be made in advance of installation and use of night-time lighting, if required.
- Temporary barging facilities to assist in the delivery of construction materials and minimize the use of regional and local roads. All temporary barge facilities will be removed when no longer required. It is estimated that, on average, between three and five barge trips per week will be generated by the Project. Most of this barge traffic is assumed to be entering the Project boundary in an upstream direction from the mouth of the Fraser River as opposed to downstream from locations further up the river. This upstream barge traffic could be mainly using the south arm of the river but large barges are also known to use the north arm.
- A temporary bridge to detour Royal Avenue traffic while work is carried out on the Royal Avenue Overpass may be required. This temporary structure would be removed once the work on the Royal Avenue overpass is completed.
- Temporary bridges (trestles) from the north and south shores to the nearest instream construction locations. Temporary trestles would be removed after completion of construction.
- Installation of temporary instream enclosures (cofferdams) that would allow foundation construction activities to be separated from the Fraser River. Cofferdams would be removed once foundation construction is complete.

1.1.4.3.3 Ground Improvements

Ground improvements will be undertaken where necessary to minimize settlement and improve the seismic performance of structures. Ground improvements are potentially required adjacent to the tower foundations and for works in Surrey. The following are two typical ground improvement methods:

- Preload – Preload involves the placement of sand onto the compressible soils to consolidate underlying material in areas intended to support roadbeds and associated infrastructure. Sand used for preload is typically applied in discrete layers to build up the amount of loading required to achieve the desired level of soil compaction in underlying materials. Preload controls settlement in areas of structurally weak soils.
- Densification – For structures in areas underlain by loose sands prone to liquefaction, ground densification treatment may be required. One such technique is vibro-replacement with stone columns. This involves lowering a vibrating probe 20 m to 30 m into the ground using water jets, and backfilling the cavity created by the probe with clear crushed stone while vibrating to densify the ground and crushed stone.

1.1.4.3.4 Roadway and Multi-Use Trail Construction

Construction works will include the realignment of existing roads, construction of new roadways and addition of multi-use pathways (MUPs) in New Westminster and Surrey. General activities to support this construction include:

- Embankment construction – Embankment construction involves the removal of unsuitable material and replacement with fill, or with expanded polystyrene (EPS) if there is a need to minimize weight. Often embankments are retained by walls to minimize footprint. Where walls are not used, the embankment edges will slope from the finished to the existing grade at a ratio of 3:1 (width to height). Slopes are seeded or landscaped in their final configuration. In soft soils, preloads are placed in advance of building the embankment to minimize settlement.
- Road base construction – Typical road base preparation for the at-grade sections of the highway will include the following:
    - excavating unsuitable soils, replacing with suitable material from borrow areas, and compacting the replacement soils
    - establishing a subgrade (the soil surface on which the road will be built) by placing fill on soils that are suitable for construction to achieve the appropriate grade (level) and density (compaction)
    - placing gravel on the subgrade, followed by topping with a base-course consisting of layers of different sized gravels
- Paving and line painting – Typically, asphaltic concrete, a mixture of liquid asphalt and aggregates in a hot mix solution, is used for road surfaces in BC. This mixture is prepared off site and transported to the project where it is applied and rolled to a smooth surface. Asphalt pavement can be produced in a variety of ways to deliver different qualities as required. Road surfaces will have lane markings in accordance with contract requirements. Lane markings include a reflective component that improves visibility for night driving.
- Addition of temporary MUP overpasses at certain designated high risk locations, to separate the movement of pedestrians and cyclists from busy intersection operations.
- Installation of sign bases, signs, and lighting – Construction signs and new directional signs will be required. Excavation and, in some cases, foundation piles may be required to install highway sign foundations, depending on soil conditions and the size of the sign. Sign bases can vary in size; moderate-sized excavations and structurally sound foundations are required for large directional signs that span the width of the road, while minor works are required for smaller signs. Both types of signs will be specified at various locations, as dictated by the MoTI specifications.

1.1.4.3.5 Construction of Overpasses, Underpasses

Grade separations may be required for roads, structures, retaining walls, and embankments, followed by the removal of any existing structures that are no longer required. The construction of grade separation structures consists of ground improvements, installing foundations, constructing concrete pile caps and piers (substructure), erecting girders, constructing concrete deck (superstructure), and removing existing infrastructure. Ground improvement practices that support the construction of structures are as described above. Additional construction work for the development of interchanges and overpasses/underpasses is described below.

- Foundations – New structures in Surrey will require the use of deep, driven/vibrated or drilled pile foundations. Geotechnical conditions in New Westminster are considerably better than in Surrey, and spread-footing foundations may be feasible. Foundation types will be finalized during detailed design.
- Substructure – Reinforced concrete will most likely be used to construct the concrete piers and abutments. Depending on access to the work site, concrete will be placed by means of a chute directly from the truck, a crane and bucket, or a pump truck; alternatively, precast concrete will be used.
- Superstructure – Grade separation superstructures will be constructed with steel girders and/or precast, pre-stressed concrete girders and reinforced concrete deck slabs. One or two cranes are typically used to lift girders into place. After the main superstructure elements (the girders) have been placed, the deck will be installed either with cast-in-place concrete and conventional formwork, or with partial-depth precast deck slabs serving as stay-in-place formwork. After the superstructure is complete, compacted backfill will be placed up to the abutments.
- Removal of existing structures – All decommissioned elements, including concrete piers, precast concrete girders, cast-in-place concrete decks, and concrete parapets or steel railings will be recycled or disposed of at an appropriate facility. The Contractor will provide a removal plan that outlines specific procedures, including any traffic management plans that may be required to support disassembly and removal. Removal activities will be undertaken in compliance with environmental management plans established for specific demolition works and with the terms and conditions of environmental permits and approvals. Project works will be managed to minimize the amount of construction-related waste produced, including demolition waste from removed roadway and structures.

1.1.4.3.6 Construction of New Bridge

The new bridge consists of approach spans and a river crossing. These are described below.

- Approach Spans – Multi-span bridge structures (approach spans) will be provided to bring the roadway from existing at-grade elevations to the elevation required for the river crossing. In addition to the construction practices discussed in previous sections, the following methods could be expected for the construction of the approach spans:
- Embankment construction – Embankments will be constructed to transition from at-grade roads to the roadway on the approach spans. Embankment construction typically requires ground improvements (see **Section 1.1.1.1.3**), placing of fill, installation of retaining walls and paving.
- Foundation construction – Given the soft soils in Surrey, deep foundations, piles for example, will be required. Piles would be either driven or augured to the depth required by the design. In addition, the upper layers of the soils adjacent to the deep foundations in Surrey will need to be densified (see **Section 1.1.1.1.3**) to provide the required seismic resistance.

- Substructure installation – Pile caps and bridge piers (bridge substructure) will be used to transfer load between the bridge deck and the foundations. Bridge substructures are typically constructed using cast-in-place concrete although in some cases steel or precast concrete components might be used.
- Deck construction – The approach span deck will likely consist of a concrete road deck supported by either precast concrete, cast-in-place concrete or steel girders. Girders would be erected using cranes and the concrete deck would typically be precast and/or cast-in-place concrete. A segmental precast concrete deck could also be used and installed with a launching gantry.
- River Crossing – The river crossing will require a long span structure to cross the navigation channel and to allow foundations to be placed such that changes to river hydraulics are minimized. Work for the river crossing will be carried out using temporary trestles and barge mounted equipment. Typical construction methodologies include the following:
    - Foundations – Foundations for the river crossing will be similar in nature to those described above for the approach spans. Ground improvements may be required around each instream foundation to mitigate potential liquefaction and riprap may need to be placed around foundations to control scour. To control underwater noise, piles could either be driven through specially configured sleeves (see Section X) or within dewatered cofferdams, or drilled.
    - Substructures – Pile caps, piers and, in the case of cable stayed bridges, towers will be required to transfer loads from the bridge deck to the foundations. Substructure construction could include placing of cast-in-place concrete and/or installation of precast concrete and fabricated steel elements. A variety of cranes including barge mounted cranes and tower cranes are expected to be required for this construction.
    - Main span – A long span structure will be required to span the navigation protection zone, and to allow instream foundations and substructures to be placed such that changes to the river hydraulics are minimized. Depending on the final length of the main span, viable long span structures include cable stayed bridges and tied arches. Both of these bridge types will require erection of structural steel components using cranes or lifting hoists as well as construction of a a concrete deck consisting of prefabricated and/or cast-in-place concrete.
- Figures showing one possible construction staging scheme for the reference concept are given in **Figures SK-S-520 to SK-S-528**, included in **Appendix 18.17 – Reference Concept**.
- Sequencing and Staging of Bridge Construction – Sequencing and staging of bridge construction will be influenced by the Contractor's construction approach and will be determined in concert with design activities. The Contractor will provide plans for all elements of the Project, including temporary facilities, detours, and staging and laydown areas, which will be finalized through the design submission and review procedures established in the contract. All staging locations will be within the Project Boundary. Some staging areas will be moved over the course of construction as various work activities are completed and traffic is relocated.

1.1.4.3.7 Removal of the Existing Bridge

When the new bridge is open to traffic, the existing Pattullo Bridge will be removed. The existing bridge consists of the following elements:

- Main span – a supported steel through arch with a 137m (450 ft) span
- In-river approach spans – steel deck trusses with spans between 61m (200 ft) and 107m (350 ft)
- Onshore approach spans – concrete spans of 23m (75 ft)
- Main span and in-river approach span foundations – sunken caissons with timber piles used on the Surrey side of the river
- Onshore approach span foundations – piled foundations
- Substructures – hollow concrete

Existing bridge removal will involve the sequential removal of span elements followed by removal of the piers. One possible method for this removal is shown in **Figures SK-S-500 to SK-S-503** included in **Appendix 18.17 – Reference Concept**. Removal will involve the following activities:

- removal of the main span
- removal of the truss spans over the Fraser River
- removal of the approach spans in Surrey
- removal of the approach spans in New Westminster
- removal of in-stream substructures the top of the existing riprap except in areas within the navigation channel where the existing bridge will be removed to EL -14 m (GSC)
- removal of onshore substructures to finished grade separation

Disposal of construction material will be the duty of the Contractor. It is anticipated that this material will either be recycled or disposed according to regulatory requirements.

1.1.4.3.8 Utilities

A number of utilities have been identified by the Project including utilities owned by BC Hydro, British Columbia Transmission Corporation (BCTC), Fortis BC, Kinder Morgan, Shaw Communications Inc., TELUS Communications Company, municipalities, and others are located within the Project limits (Appendix 18.17, Figure SK-U-150). The existing Pattullo Bridge carries several utilities: a Fortis low-pressure compressed natural gas pipeline, telecommunications fibre optic cables for Telus, Shaw, Allstream, and others, and power lines from New Westminster Hydro to the New Westminster Railway Bridge (NWRB) for CN Rail. The Project is working with affected agencies to establish requirements for protection and relocations as required.

Other utilities that cross the Project limits are the Metro Vancouver watermain along Royal Avenue, the Metro Vancouver sewage line along Columbia Street, various New Westminster Hydro lines, BC Hydro distribution lines in Surrey, and water and sewage utilities owned by the Cities of Surrey and New

Westminster. These utilities will either be protected and left in place or relocated in consultation with the respective utility owner.

Detailed utility relocation requirements will be finalized by MoTI. As part of confirming the final design of the Project, the Contractor will work with utility companies to identify and address utility relocations and avoid service disruptions and associated costs during construction.

1.1.4.3.9 Grading and Drainage

The City of New Westminster is situated on a hill that consistently slopes toward the Fraser River. This area is currently serviced by gravity storm sewer systems that discharge directly to the Fraser River. The project area within the City of Surrey generally consist of low-lying areas that are currently drained via flood boxes and pump stations that are located along the edge of the Fraser River. Deck drainage on the existing bridge is managed by catch basins positioned at pier locations, collecting and discharging runoff directly to the Fraser River below the bridge.

The Project will be designed in a manner that ensures no direct discharge of untreated road runoff from the new bridge and approaches into the river or other water courses. Stormwater flowing along the affected roadways will be managed and treated appropriately, and all stormwater runoff from the new bridge will be collected and treated using methods such as biofiltration / mechanical treatment facilities before being released. As such, stormwater drainage infrastructure will not encroach on the air draft of the navigation channel, and dripline effects on the navigation channel will be minimized.

Stormwater management infrastructure will adhere to best practices in BC and will be consistent with the concept of integrated stormwater management. Design and construction of the drainage infrastructure will take into account hydrological requirements and habitat values associated with drainage features. Any use of oil, grit separators will be informed by design criteria/guidelines of the City of Surrey or the City of New Westminster as applicable.

New drainage infrastructure associated with the Project will be developed with reference to the following documents:

- BC Supplement to TAC Geometric Design Guide, Section 1000 (MoTI 2007a)
- BC Supplement to CAN/CSA-S6-14 (MoTI 2007b)
- Culverts and Fish Passage Fact Sheet (MoTI 2013)
- Stormwater Planning: A Guidebook for British Columbia (BC MOE 2002)
- The applicable documented standards of the relevant municipality

1.1.4.3.10 Emergency Vehicle Access

Access for emergency vehicles is an important design consideration. Consultation with the following First Responders from the Cities of Surrey and New Westminster will continue to ensure their needs are addressed as much as possible within the design criteria:

- Surrey RCMP and Surrey Fire Services
- New Westminster Police Department and New Westminster Fire and Rescue Services
- BC Emergency Health Services (BC Ambulance)

1.1.4.3.11 Lighting

Functional street lighting will be provided on roadways to meet the required design standards. In addition, marine and aviation navigation lighting will be installed on the new bridge to meet applicable codes and regulations. A more detailed lighting design will be provided by the Contractor and will meet VFPA energy efficiency requirements.

1.1.4.3.12 Ancillary Construction Activities

The following activities/facilities will also be required in addition to construction of the Project components associated with specific Project phases described in previous sections:

- Staging Areas – Laydown areas will be required during construction for staging equipment and storage/preparation of construction materials. Laydown areas will be used for temporary storage of construction or demolition materials such as gravel and precast concrete sections, and for assembly of culverts, formwork, and reinforcing steel construction. These areas may also be used for site offices, workshops, equipment storage, and other related purposes. The Contractor will confirm the number and location of required staging areas based on the detailed Project design and construction staging plan. When Project construction is complete, any land used for staging and not required for permanent Project infrastructure will be restored to its pre-construction condition. The Contractor will be responsible for obtaining the required permits and approvals for staging areas on lands other than those within the Project Boundary before initiating such works.
- Aggregate and Preload Materials – Aggregate will be required for roadbed construction and the manufacture of concrete for bridge construction. It is assumed that aggregates will be sourced from existing pits and quarries within the region and from any new aggregate quarries developed for the Project. Preload material required to support ground improvement will also be obtained through existing sources and vendors; no Project-specific works will be undertaken to obtain preload materials.
- Concrete and Asphalt Production Facilities – Concrete and asphalt will be required for Project construction. While a number of facilities in or near the corridor are capable of supplying these materials, the final design and construction methodology could possibly include the development of concrete and/or asphalt production facilities within the Project area to help reduce the volume and impacts of construction traffic on local and regional roads, and to expedite the construction schedule.
- Waste Disposal – The Project will be managed to minimize the production of construction-related waste. Construction waste includes demolition waste from removing roadways and structures, and excavated material that cannot be used as fill along the alignment. Costs and other constraints associated with conventional waste disposal encourage contractors to re-use or recycle waste material. For example, a variety of technologies are available for recycling pavement. Concrete rubble can be crushed and re-used for road base and other applications,

and reinforcing bars can be separated and salvaged. Contractors will be able to re-use excavated material for applications such as preloading and filling, either at locations along the alignment or at off-site construction projects. Where disposal of waste is necessary, such activities will be conducted in accordance with the *Environmental Management Act*.

The Project, as currently contemplated, is not expected to involve activities that may require a *Disposal at Sea Permit* pursuant to the Disposal at Sea provisions of the *Environmental Protection Act* 1999, c 33. In the unlikely event that the need for disposal at sea does arise, it will be the Contractor's responsibility to liaise with the Regional Ocean Disposal Advisory Committee and acquire the necessary permit from Environment Canada in accordance with applicable regulatory requirements.

- Construction Site Offices – The requirement for construction site offices and ancillary buildings will be confirmed as part of the completion of the final design of the Project. When Project construction is complete, land used for these purposes and not required for permanent infrastructure will be rehabilitated in a manner consistent with its prior condition.

1.1.5 Marine Structures and Navigation Envelope

1.1.5.1 Marine Structures

The project will comprise the placement of no more than four new piers located within the Fraser River. Demolition of the existing Pattullo Bridge will result in the removal of six piers from the Fraser River. This work is shown for clarity in the Reference Concept drawings located in **Appendix 18.17**.

1.1.5.2 Navigation Envelope Design

1.1.5.2.1 Existing Navigation Channels

There are currently two navigation channels at the site, which is constrained by the New Westminster Rail Bridge (NWRB):

- The main navigation channel, which is designated as a two-directional deep-sea channel
- The secondary channel, which is designated as a domestic channel predominantly for low air draft vessels that do not require an opening of the NWRB swing span

Table 1.1-3 Navigation Openings at Adjacent Bridges

Bridge	Main Channel Openings width x height above HHWL [m]	Secondary Channel Openings width x height above HHWL [m]
New Westminster Rail Bridge[1]	49 wide for downstream transits 51 wide for upstream transits	60 x 6.7
Existing Pattullo Bridge	101 x 45	60 x 25
SkyBridge	310 x 43	60 x 37.8

[1] Height is not relevant for the NWRB main channel because the bridge has a swing opening.

1.1.5.2.2 Navigation Channels During Construction

During construction, one of the following combinations of existing navigation channels will be available at all times. Navigation through the construction area will be based on the requirements of Transport Canada and VFPA. A Marine Stakeholders Communications Plan will be developed with the Marine Stakeholders Group to keep river users informed of construction activities and closures of sections of the existing navigation channels. Tug assist will be provided for vessels transiting the site.

Table 1.1-4 Navigation Channel Availability During Construction

Navigation Channel Configuration During Construction	Main Channel, Upstream Direction through NWRB	Main Channel, Downstream Direction at NWRB	Secondary Channel
A	Open	Open	Open
B	Open	Open	Closed
C	Open	Closed	Open
D	Closed	Open	Open

1.1.5.2.3 Proposed Navigation Protection Zone for New Bridge

Based on discussions with personnel from VFPA and Transport Canada–Navigable Waters Protection Program (TC-NWPP) and with vessel operators, a Navigation Protection Zone (NPZ) has been proposed. The NPZ represents the area in the river where no permanent construction will be permitted. This includes but is not limited to both piers and the bridge deck. The NPZ includes both horizontal and vertical boundaries, and is shown in **Figure SK-C-509 and Figure SK-C-529** in **Appendix 18.17 – Reference Concept** and summarized below:

- Width: 275m.
- Air Draft: stepped from 25 m, to 41.92 m, to 48.66 m (above GSC) across the NPZ. This is inclusive of a 2.0 m overhead clearance safety allowance.
- Water Draft: stepped from -10 m, to -14.34 m (below GSC) across the NPZ to ensure current and future navigational requirements are maintained.

Additional to the Navigation Protection Zone, an Administrative Safety Zone (ASZ) has been proposed to the Surrey side of the NPZ. It does not preclude the building of permanent infrastructure, but indicates that additional review considering navigation implications would be required before construction.

1.1.5.2.4 Navigation Lighting

Marine and aerial navigational lighting, signage, and other navigation aids will be designed to satisfy the requirements of Transport Canada and the VFPA. Flood lighting, if required, would be designed for the pylons to increase their visibility for navigation purposes. Lighting will meet VFPA energy efficiency requirements.

1.1.5.2.5 Vessel Impact Risk Assessment

The proposed new bridge will be designed such that the risk of vessel collision-induced structural collapse has a probability of less than or equal to 1% in 100 years. This is equivalent to a significant vessel collision event with a return period of 10,000 years. Design loads will be calculated in accordance with CSA-S6-14 and the AASHTO Guide Specification. Two types of vessel impact scenarios will be considered: impact to bridge piers, and impact to the bridge superstructure.

Because key components of this risk assessment must be based on the final pier locations and configuration details, final assessment of ship impact risks will be undertaken during detailed design and after award of a Design-Build contract. The assessment of vessel collision risk will consider:

- Vessel characteristics, including weight and dimensions, and the present and future frequency of transits
- Vessel velocity and direction, including during tides, floods, and seasonal variations such as freshet
- Water depth and river bathymetry, including local and general scour depths
- Vessel operation considerations, including loss of steerage, breakaway from moorage, and errors in navigation
- Pier locations, orientation, and dimensions

Ship impact risk assessment will be carried out in accordance with the *Canadian Highway Bridge Design Code* CSA-*S6-14* (S6-14) as amended by British Columbia *Bridge Standards and Procedures Manual* (TranBC 2016). S6-14 also allows the *AASHTO Guide Specification and Commentary for Vessel Collision Design of Highway Bridges* (AASHTO 2009) to be used. Several jurisdictions in the USA and Europe have undertaken extensive research with regard to ship impact risk assessment; the resulting design guidelines from this research are also valuable resources. **Section 9.0 Accidents and Malfunctions** provides additional information related to the assessment of risks associated with ship impact.

1.1.5.2.6 Dredging/Underwater Excavation

Removal of buried portions of instream piers of the existing bridge to comply with VFPA and Transport Canada requirements will necessitate localized underwater excavation to remove river bed sediments at one existing pier location. No other dredging of the river bed is anticipated as part of the proposed Project.

1.1.6 Land and Marine Use

Land use in areas of New Westminster and Surrey adjacent to the Project is predominantly light and heavy industrial, retail, commercial, and residential; further details on land ownership, zoning, and tenures and maps are provided in **Section 6.2 – Land Use**. The new bridge will span the Fraser River, which is used for commercial, recreational, and Aboriginal fishing, port activities, and other commercial and recreational marine purposes.

The Project intersects VFPA Land Use Plan Planning Area 5, which extends from approximately 3 km southwest of the Alex Fraser Bridge on the South Arm of the Fraser River, and 1 km west of the Queensborough Bridge on the North Arm of the Fraser River, east to the Port Mann Bridge. VFPA Planning Area 5 hosts much of the port activity on the Fraser River. VFPA land use designations around the Project include:

- Port Terminal – Fraser Surrey Dock lands
- Commercial – a small area of riverfront at River Market at Westminster Quay
- Industrial – most of the remaining Surrey riverfront and small parts of the New Westminster riverfront
- Recreation – the foreshore adjacent to Brownsville Bar Park in Surrey and a section of the Fraser River waterway near Sapperton Landing Park in New Westminster
- Conservation – the foreshore area adjacent to Tannery Park and a small area at the mouth of the Brunette River

The NWRB is located between the alignment of the existing Pattullo Bridge and that of the replacement Project. While operated by CN Rail, the bridge is used by CN Rail, CP Rail, Burlington Northern Santa Fe Rail, and Southern Railway of British Columbia. In addition, Amtrak and the Rocky Mountaineer operate along rail rights-of-ways that that run through Surrey and Westminster to the NWRB.

1.1.6.1 Property Ownership and Management

Property around the Pattullo Bridge within Surrey and Westminster is owned by federal, provincial, or local governments, or are privately held. The submerged land in the location of the Pattullo crossing, both existing and proposed, is under VFPA (Federal) jurisdiction.

Vancouver Fraser Port Authority (VFPA) also has jurisdiction over navigation in the Fraser River and some property along the foreshore. The Municipalities of Surrey and New Westminster have jurisdiction over other property on their respective sides of the bridge.

1.1.7 History of the Proposed Project

Several studies have been undertaken since 2006 to review and validate the economic, social, and environmental need for a long-term crossing solution. The Mayors' Council, Metro Vancouver, TransLink, and the Province have long recognized the need for investment in a replacement of the existing Pattullo Bridge. The need for a new bridge is driven by current deficiencies with the seismic resiliency, existing bridge geometry, structure condition, pedestrian and cyclist facilities, reliability, and community livability.

1.1.7.1 Strategic Review: 2012-2014

Between 2012 and 2014, TransLink, the City of Surrey, the City of New Westminster, and the Province led the Pattullo Bridge Strategic Review Process, which explored more than 25 alternatives to rehabilitate or replace the existing Pattullo Bridge; these included alternative routes, number of bridge lanes, and community connections. The Strategic Review process examined and assessed these options through broad consultation and technical review.

Based on technical analysis and public and stakeholder consultation, the Strategic Review partners narrowed the list of options to six, all of which involved a multi-modal transportation connection. Two viable options were then identified: a new four-lane bridge and a new six-lane bridge, both at the existing crossing location. When evaluated against a set of technical, environmental and economic objectives, the four-lane option scored better than the six-lane option in terms of providing a cost-effective solution,

supporting the regional goal of moving people out of cars, and reducing emissions, whereas the six-lane option scored better in terms of transportation reliability and supporting economic development.

1.1.7.2 Mayor's Council Vision: 2014

In early 2014, the Mayors' Council established a Subcommittee on Transportation Investment to define its vision for the region, establish spending priorities, and recommend new funding mechanisms capable of supporting those priorities.

In June 2014, the Mayors' Council released its "Regional Transportation Investments: a Vision for Metro Vancouver," which recommended the preferred replacement as a new four-lane bridge, designed in a manner so as not to preclude potential expansion to six lanes in the future.

1.1.7.3 Community Connections

Since 2014, MoTI, TransLink, and the Cities of Surrey and New Westminster have worked collaboratively to examine options for network connection to the new bridge. The recommended scope of connections included in the Project was determined based on a technical due diligence review of options initiated by MoTI, and a strategic options analysis, which considered benefits, costs and other qualitative factors.

1.1.7.4 Project-related Studies

The following studies have been identified as relevant to the project:

- Geotechnical Investigations for Skytrain Phase II – Surrey Guideway Sta. 23+707 to 24+656, December 20, 1986, Thurber Consultants Ltd.

  This report documents the results of a geotechnical investigation for the section of Skytrain elevated guideway in Surrey. The investigation program consisted of 15 Becker tests and 3 sampled mud rotary drill holes. For the Skytrain Phase II project, geotechnical foundation recommendations are provided.

- Skytrain Phase III Whalley Extension June 20, 1990. Thurber Consultants Ltd.

  This letter report documents the results of additional drilling investigation for the Skytrain Pahe III Whalley extension project. Drilling was conducted at 33 locations along the Skytrain extension and consisted of solid stem auger holes and dynamic cone penetration tests. Copies of 4 CPT logs, obtained in 1985 are provided

- Pattullo Bridge Seismic Retrofit and Rehabilitation Project, New Westminster and Surrey, BC – Factual Report for Geotechnical Onshore Investigation, Seismic Retrofit and Rehab – Marine Earth Geoscience – Final Report – February 20, 2015

  This report presents the results of the 2014 geotechnical site investigation and laboratory testing program conducted for the existing Pattullo Bridge seismic retrofit and rehabilitation project. The report provides factual data. The site investigation program consisted of two multi-channel analyses of surface waves (MASW), five Seismic Core Penetration Tests (SCPTs), and two bore holes, one (BH 14-01) to a depth of 81 m and one shallow hole (BH 14-02]). Soil samples were obtained for soil characterization purposes.

- Pattullo Bridge Seismic Retrofit and Rehabilitation Project, New Westminster and Surrey, BC – Geotechnical Characterization Report – Marine Earth Geoscience – February 27, 2015

  Applicable to the seismic retrofit and rehabilitation project for the existing Pattullo Bridge, this document provides a description of the site conditions, soil parameters, seismic design considerations, and geotechnical design and construction considerations.

- Phase A Geotechnical Site Investigation Report – Rev A – July 6, 2016, Draft – Golder Associates Ltd.

  This report documents the results of a geotechnical investigation carried out between April 7 and April 29, 2016, along the Reference Concept corridor between New Westminster and Surrey. The report provides subsurface data on the depth to competent glacial soils or bedrock. Three boreholes (BH16-01 to BH 16-03) were sampled, and two seismic cone penetration tests (SCPT 16-02 and SCPT 16-03) were conducted. Selected samples were tested for classification and characterization of the subsurface strata.

- Phase A Preliminary Geotechnical Engineering Input – March 17, 2017, Draft – Golder Associates Ltd.

  This report includes high-level development of soil and bedrock stratigraphic interpretations, soil liquefaction assessment, and pile capacity estimates based on Phase A site-specific investigation results. The report also provides geotechnical commentary on the Reference Concept planned interchanges and secondary road connection structures, where compressible and seismically vulnerable ground conditions are expected to require special treatment methods such as precasting, ground improvement, and the use of lightweight fill materials to facilitate embankment and wall construction.

- Phase B Geotechnical Site Investigation Report-Marine Report – Factual Geotechnical Data Report – November 2017

  This report documents the results of a geotechnical investigation carried out between June and July 2017 along the Reference Concept corridor between New Westminster and Surrey in the Fraser River. The report provides subsurface data on the depth to competent glacial soils or bedrock. Three boreholes (BH17-01 to BH 17-03) were sampled, and three seismic cone penetration tests (SCPT 17-01 to SCPT 17-03) were conducted. Selected samples were tested for classification and characterization of the subsurface strata.

- Phase C Geotechnical Site Investigation Report – On Land – New Westminster and Surrey – Golder Associates Ltd.

  This report will document the results of a geotechnical investigation carried out between November 2017 and December 2017.

- Test Pile Geotechnical Data Report – Pattullo Bridge – Golder Associates Ltd. (not yet received; test pile project not complete)

  This report documents the results of the test pile work, providing information on the pile capacity of a 914 mm diameter steel pipe pile driven to till. Vibration and noise measurements are provided.

1.1.8 Traffic

The Project involves changes to the Pattullo Bridge corridor and related road, cycling, and pedestrian networks that influence the movement of people and goods, as represented by changes in future traffic demands, traffic flows, origins and destinations, and travel mode choice. To help understand the effects on existing motorized traffic and the anticipated changes to the bridge corridor and road connections, TransLink commissioned a Traffic Modelling Analysis Report which studied traffic demands and travel patterns from the present, to the opening of the new bridge in 2023, to longer-term time horizons (**Appendix 18.1 Traffic Analysis Report**).

1.1.8.1 Historical and Existing Conditions

Traffic demands and patterns in the area surrounding the existing Pattullo Bridge have changed substantially since its opening in 1937, particularly within the past ten years (2008 – 2017) due to significant population growth on both sides of the Fraser River, and completion of several major transportation infrastructure projects which had a significant impact on regional traffic demands and patterns. These projects include the completion of the 10-lane Port Mann Bridge and associated improvements along the Highway 1 corridor, the completion of the South Fraser Perimeter Road (Highway 17), the expansion of the transit system including an extension of the Millennium Line (the Evergreen Line extension), the Pattullo Bridge Rehabilitation Project during the summer of 2016, and the removal of user tolls from the Port Mann Bridge and Golden Ears Bridge beginning on September 1, 2017.

As a result of these events, it is more difficult to observe a typical traffic trend in the vicinity of the Pattullo Bridge corridor. At the time of writing this report, traffic on the existing Pattullo Bridge and surrounding areas are still adapting (i.e. changing) to the removal of user tolls from all Fraser River crossings effective September 1, 2017. Traffic volumes on the existing Pattullo Bridge and adjacent corridors are noticeably trending downwards, as motorists return back to the untolled Port Mann Bridge. The impact of toll removal, in the general context of historical traffic volumes and trends, is described below.

Annual Average Daily Traffic (AADT) – the Bridge AADT was observed to increase from 2013 to 2015 (from an AADT of approximately 70,000 vehicles per day to 78,000 vehicles per day). In 2017, the AADT appears to have returned to 2013 AADT levels of 70,000 vehicles per day, although it should be noted that the 2017 AADT considered 9 months of data when the Port Mann Bridge was tolled, and 3 months of data after the tolls were removed. As a result, the AADT in 2018 is expected to continue to trend downwards, as motorists continue to revert to the untolled Port Mann Bridge for the full year.

Monthly Average Daily Traffic (MADT) – Typically, fall season traffic is assumed to represent "baseline" traffic patterns. The peak of observed monthly bridge traffic was recorded in September 2015, at approximately 80,000 vehicles per day. Comparatively, the MADT observed in September 2017, after removal of the Port Mann Bridge tolls, was 61,000 vehicles per day, or approximately 30% lower than the recorded peak.

Fall Peak Period Traffic – Traffic volumes on the existing Pattullo Bridge during the peak periods have also noticeably decreased after the removal of tolls on the Port Mann Bridge. Although traffic volumes were observed to be lower throughout the day, the decrease is especially evident in the southbound PM peak direction, where peak period volumes decreased from approximately 3,200 vehicles per hour (observed in Fall 2015) to just under 3,000 vehicles per hour (observed in Fall 2017).

Truck Traffic – Similarly, a noticeable reduction in heavy truck volumes was also observed in 2017. The removal of tolls since September 2017 is expected to reverse the 15% increase in trucks which was caused by the diversion of trucks to avoid tolls on the Port Mann Bridge.

1.1.8.2 Traffic Forecast

To understand the anticipated changes in traffic demand to the bridge corridor and connections, a specialized analysis was conducted to assess traffic demand at both the regional level and within the local areas in the immediate vicinity of the project. The demand analysis was largely based on TransLink's Regional Transportation Model (RTM) using the EMME software. To assess the traffic changes for the new bridge, two scenarios were investigated: a "No Build Scenario" and a "Build Scenario".

1.1.8.2.1 No Build Scenario – Rehabilitated Three Lane Pattullo Bridge

To assess the changes associated with the new bridge, a base case scenario is required. Due to technical and safety considerations associated with the existing Pattullo Bridge, it would be costly and technically challenging to rehabilitate the existing bridge to accommodate four modern-width traffic lanes. The No Build scenario, therefore, involves the structural seismic retrofit and rehabilitation of the existing bridge while reducing the existing four lane configuration to three lanes with modern lane widths. The three lane configuration would be operated with a reversible center lane, which would provide an additional lane in the peak direction of travel during the peak periods. The existing sub-standard on-ramp from Columbia St to the bridge would be permanently closed as well. No further changes to the road connections in Surrey or New Westminster are included in this scenario.

1.1.8.2.2 Build Scenario – The Project

The Build scenario (Project) includes a new, four-lane bridge that meets current seismic and road design standards, and provides a safe and reliable crossing for vehicles, pedestrians and cyclists, network connections in Surrey and New Westminster and the removal of the existing bridge.

The Build scenario includes the following connections on each side of the river:

- In New Westminster, a new off-ramp to eastbound East Columbia Street will be provided along with other geometric and roadway realignments to connect to the new bridge. The existing westbound East Columbia Street loop on-ramp will also be replaced for improved geometry. In addition to the road connection changes, there will be improved pedestrian and cycling facilities along the project corridors.
- In Surrey, the new bridge will connect directly into King George Boulevard. A new direct southbound ramp from the bridge will be provided to connect to westbound Highway 17. The existing at-grade signalized intersection at Highway 17 / Old Yale Road will be replaced with a grade separated crossing. Cycling and pedestrian improvements are included beyond those on the new bridge. In addition, within the Reference Concept, the Scott Road Extension and Scott Road Exchange are included in the environmental assessment (note that these elements have been removed in the revised scope as per the business case).

1.1.8.3 Traffic Analysis

The traffic analysis compared changes of key traffic parameters between the No Build Scenario and the Build Scenario for the AM, Midday, and PM peak hours. The parameters analyzed include vehicle-kilometres travelled (VKT), vehicle-hours travelled (VHT), traffic demand and capacity at the bridge and connecting roads, as well as origin-destination (OD) travel times. Key findings of the analysis for both opening day (2023) and 2030 operations are as follows:

- In a regional context – with a spatial scope stretching from Lions Bay in the west and Hope in the east – the VKT and VHT parameters are not anticipated to have a noticeable difference between the No Build and the Build Scenarios.
- An increase in traffic demand on the bridge is anticipated during the peak periods, with the increase primarily attributed to the extra traffic capacity in the off-peak direction available on a 4-lane bridge versus a 3-lane bridge. On the bridge approaches, traffic demand increase on East Columbia Street and Highway 17 are also anticipated due to improved bridge direct accesses in the Build Scenario.
- Estimated travel times for the Build Scenario were generally less than the No Build Scenario for all time periods, with the exception of the AM northbound and PM southbound periods due to increased traffic demands using a 4-lane bridge. However, increases in those two periods were generally less than five minutes, which is generally within the range of travel time deviations from day to day. Generally, the improved road connections to and from Highway 17 and East Columbia Street is expected to have a positive travel time impact.
- Between the 3-lane No Build and 4-lane Build Scenarios, the expected increase in AADT across the Pattullo Bridge is anticipated to be approximately 16,000 vehicles per day.

1.1.8.4 General Traffic Movement

The new bridge will provide important improvements for everyone using the bridge, including people who are driving, cycling or walking. The Project will improve connections to regional road networks and cycling and walking paths on either side of the bridge. In New Westminster, the new bridge will continue to connect directly to McBride Boulevard and new direct ramps will connect the bridge to East Columbia Street. In Surrey, the new bridge will continue to connect directly to King George Boulevard, and a new off ramp will connect the bridge to westbound Highway 17. These new connections will reduce the reliance on local residential streets to access the new bridge.

1.1.8.5 Goods Movement

Replacement of the existing Pattullo Bridge is identified as a road network priority in a number of strategic plans, including the Greater Vancouver Gateway 2030 report by the Gateway Transportation Collaboration Forum, and the Regional Goods Movement Strategy for Metro Vancouver (RGMS) by TransLink. In combination with Highway 17, the bridge also provides important goods movement and trade linkages between the Roberts Bank Terminal, the Fraser River Trade Area and the adjacent communities.

The replacement bridge's wider lanes and direct connection to Highway 17 – a key link to VFPA lands in Surrey (e.g. Fraser-Surrey Docks) - are anticipated to facilitate goods movement north and south of the Fraser River. The grade separation of Old Yale Road and Highway 17 to replace the existing signal on the Highway is also expected to improve travel reliability along Highway 17. A project-specific Traffic Management Plan will be developed to outline how road users, including truck traffic and traffic generated by the project work, will be accommodated safely and reliably during construction.

Upgrading Bridge Road from its existing one-way eastbound configuration to a two-way road is also anticipated to improve truck and goods movement connectivity for the south of Fraser industrial lands that were previously separated by the Highway 17 corridor. Local access and egress into and out of the VFPA managed lands in the surrounding area is expected to remain largely the same, although the grade separation of Old Yale Road at Highway 17 will likely result in some trucks having to use the Tannery Road interchange to access Highway 17 instead.

1.1.8.6 VFPA Managed Lands

Truck access and egress to/from the Fraser-Surrey Docks (FSD) industrial area is not anticipated to be impacted significantly, as traffic movements at the two primary accesses at Highway 17 / Tannery Road and Highway 17 / Elevator Road will not change. In addition, the upgrade of Bridge Road from its existing one-way eastbound configuration to a two-way road is expected to restore the local goods movement connectivity between FSD and the industrial lands north of Highway 17 along Musqueam Drive and 116 Avenue. Similar to today, trucks can continue to access FSD via Old Yale Road and Timberland Road, although the grade separation of Old Yale Road at Highway 17 will likely result in some trucks having to use the Tannery Road interchange to access Highway 17 instead. Overall, local access and egress into and out of the VFPA managed lands in the surrounding areas is expected to remain the same.

The Project is not expected to have an impact on the physical or operational characteristics of the rail network, including rail operations to and from FSD and along the New Westminster Rail Bridge. In rare instances where railway operations may be temporarily disrupted to enable special construction activities, such events will be coordinated and communicated with railway companies and other key stakeholders in advance.

1.1.8.7 Sensitivity Analysis

A high-level sensitivity analysis was also conducted to explore traffic variations on the Pattullo Bridge corridor due to changes to connections to the Surrey approach road network. The analysis indicated that a reduced Surrey road network connecting to the new bridge (i.e. deferring the construction of the King George Boulevard and Scott Road interchange, as well as the connection at Highway 17 / Scott Road Extension as per the Revised Scope) indicates a negligible difference in traffic demand across the bridge in the peak directions of travel.

1.1.9 Project Costs and Benefits

The Pattullo Bridge Replacement Project Business Case (January 2018) (https://engage.gov.bc.ca/pattullobridge/) establishes the need for investing in a replacement bridge. The business case cost/benefit analysis presented in this section is based on the implementation of the Revised Scope (without Scott Road Extension and Scott Road Exchange in Surrey). However, the environmental assessment is based on the Reference Concept (referred to as Full Scope in the business case) and calculations below of expenditures, employment and tax revenues during construction were therefore calculated using the capital cost of the Reference Concept. This section summarizes the costs and benefits discerned from these analyses.

1.1.9.1 Project Costs

A capital cost estimate of approximately $1.377 billion including financing and property acquisition costs, has been developed for the Revised Scope of the Project. Given that the Project is the replacement of an existing bridge, no significant increases in net new ongoing operating and maintenance costs are anticipated.

Most of the capital construction costs are associated with structural elements, including the new bridge, ramps, roadworks, and removal of the existing bridge. The major cost items are summarized below.

- Bridge structure – foundations, substructure, deck
- Bridge ramps – foundations, substructure, deck
- Roadways – site preparation, excavation and fill, paving, barriers, drainage
- Utilities
- Systems and signage – ITS systems, signage, lighting, traffic controls
- Traffic management during construction
- Environmental management and mitigation
- Geotechnical assessment

- Property – acquisition, licences to construct
- Community relations
- Project management and engineering
- Removal of existing bridge

A Contractor will be selected through a competitive Design-Build-Finance procurement process that encourages innovative design solutions.

1.1.9.2 Project Economic, Social and Community Benefits

As a key link in the local and regional transportation system, the Project has been developed to address the current structural, operational, and community livability challenges of the existing bridge and connections.

1.1.9.2.1 Project Expenditures and Employment During Construction

Economic benefits would accrue to the Province of BC, the rest of Canada and other countries because of Project related construction expenditures. The estimates of employment, household income, GDP and tax revenues are based on the estimated capital cost of the Reference Concept and results derived from a custom run of the BC Stats Input-Output model (See Section 5.1.1.4.4 Technical Boundaries for an explanation of some of the limitations of the model). Based on model results, approximately 80% of Project expenditures would be on direct purchases of goods and services produced in BC (including labour and profits), approximately 10% on imports from other provinces, which would support employment in the rest of Canada outside BC, and 10% internationally on imported goods and services.

Based on results from the BC Stats Input-Output model, Project construction is expected to generate 8,200 person-years (PYs) of employment in British Columbia, an average of 1,370 PYs per year based on five years of design and construction and one year to demolish the existing bridge. These include 3,935 PYs of direct employment, 3,460 PYs of indirect employment and 805 PYs of induced employment. The input/output model results provide a holistic view of the Project's economic impacts by industry, but cannot be relied upon to identify specific employment opportunities for specific occupations.

The BC Stats Input-Output model defines a full-time-equivalent person-year of employment as 1,750 hours per year, or 50 weeks at 35 hours per week, which differs from the average number of hours worked for each worker in each type of affected industry. As a result, the 8,200 PYs of employment translate to 7,550 workers for the 6 years of the Project, including:

- 3,260 construction industry workers directly employed by the Project in BC, an average of 545 direct workers per year who would likely be based in Metro Vancouver
- 3,400 workers indirectly employed through suppliers of goods and services, or an annual average of 570 workers, of whom an estimated 68% would be based in Metro Vancouver and 32% in the rest of BC

- 880 workers, or an average of 145 jobs per year through induced effects from direct and indirect worker spending on goods and services, of whom an estimated 58% would be based in Metro Vancouver and 42% in the rest of BC

Project employment will benefit workers by providing more employment choices, and income earned will spur general economic activity. These benefits among others are detailed in **Appendix 18.11 – Social and Economic Statistical Data**.

Construction industry workers directly employed as a result of the Project would include construction labour, trades, professional and other related staff. Based on expected employment effects derived from the input/output model, the top five direct supplier industries include:

- architectural, engineering, and related services
- cement and concrete product manufacturing
- architectural and structural metals manufacturing
- management, scientific, and technical consulting services
- building material and supplies wholesaler-distributors

Annual household income from BC due to employment related to Project expenditures is expected to average about $100 million, or a total of approximately $600 million over six years. The estimated increase in Gross Domestic Product (GDP) in BC is around $815 million. Approximately 80% of the provincial GDP, employment, and household income benefits from Project construction and existing bridge removal are expected to remain in Metro Vancouver, with the balance, or about 20%, flowing to the rest of BC. With 20% of Project capital expenditures occurring outside BC (10% in the Rest of Canada and 10% outside Canada), the Project would also support employment in other Canadian provinces and in other countries.

1.1.9.2.2 Tax Revenues During Construction

Tax revenues from construction- and removal-related activities are expected to be around $210 million, including $105 million in Federal taxes, $90 million in Provincial taxes, and $15 million in local government taxes paid within BC. These calculations are based on the Reference Concept.

The estimated tax revenues by major type of tax include approximately:

- 60% in personal income taxes generated through direct, indirect, and induced employment
- 10% in corporate income taxes
- 30% in taxes on products and factors of production net of subsidies

Additional detail on tax revenues and other benefits described in this section are provided in **Appendix 18.11 Social and Economic Statistical Data**.

1.1.9.2.3 Alignment with Regional and Community Plans

The Project aligns with provincial, regional, and community plans by replacing a critical bridge crossing with a structurally sound and safer crossing in the same corridor. Improved connections on both sides of the bridge are aligned with community plans and will facilitate easier access for goods movers, drivers, pedestrians, cyclists, and transit users.

1.1.9.2.4 Community Connectivity

The Build scenario will improve pedestrian and cyclist connections within the community and to transit. Improved and protected multi-use paths on the bridge will better connect the communities of Surrey and New Westminster for pedestrians and cyclists, including BC Parkway users.

1.1.9.2.5 Collision Cost Savings During Operations

As compared to the No Build scenario, the Build scenario (Revised Scope) is expected to result in about $42 million in collision cost savings for travellers over a 30-year operating horizon (as reported in the business case). The anticipated savings are primarily due to the improved road geometry on the bridge and key connections.

1.1.9.2.6 Regional Travel Time Savings During Operations

The Build scenario (Revised Scope) will improve traffic connections, and thus travel time for users, particularly on the direct ramps to and from East Columbia Street and the direct off-ramp to Highway 17. As compared the No Build scenario, the resulting regional travel time savings reported in the business case are estimated to be about $87 million over a 30-year operating horizon.

1.1.9.2.7 Vehicle Operating Savings During Operations

Vehicle operating cost savings result from travelling shorter distances and less idling while in congested traffic. Comparing the Revised Scope to the No Build scenario, vehicle operating savings for users are estimated to be $34 million over a 30-year operating horizon (as reported in the business case).

1.1.9.2.8 Improved Seismic Resiliency (Bridge)

In terms of safety and societal benefits, the replacement bridge (Revised Scope) would improve seismic resiliency and better survive a major seismic event compared to the No Build scenario. The seismic benefits were quantified by determining the annual value of reduced risk. Over a 30-year operating horizon, the Build scenario is expected to provide $188 million in seismic benefits with a new bridge that meets modern seismic guidelines (as reported in the business case). The No Build scenario assumes that a retrofit could not increase the seismic resistance beyond a 1-in-100-year return period earthquake because of the extremely challenging technical and financial resources that would be required.

1.1.9.2.9 Regional and Local Connectivity

The Project (Revised Scope) will provide new direct connections between the bridge and the regional road network, thus improving connectivity between major activity centres and corridors. These direct connections will improve the efficiency of goods movement in the corridor, help people get to their

destinations, and reduce use of the local street network to access the bridge during high congestion times. Improvements to the local road network will include grade-separating Old Yale Road from Highway 17, and improving the Bridge Road connection.

1.1.9.2.10 Goods Movement Benefits

The Build scenario (Revised Scope) is expected to provide economic benefits related to changes in truck travel times and the operating costs of logistics and shipping companies. Reductions in congestion delays will drive reductions in operating costs and help facilitate and/or expand economic activity through increased competitiveness and market access. As compared to the No Build scenario, the goods movement industry is expected to benefit by about $76 million over a 30-year operating horizon (as reported in the business case).

1.1.9.2.11 Employment During Operations

No significant increase in net new jobs is anticipated during the operations phase of the Project because it replaces an existing bridge that requires ongoing operating and maintenance effort.

1.1.9.3 Environmental

The Project aims to improve connectivity, reliability and modal choice while supporting environmental objectives. Enhanced Active transport options such as separated pedestrian and cyclist facilities will provide new opportunities to selecting alternate, less fuel intensive modes of transport such as walking, cycling or transit.

1.1.9.4 Health Benefits

The Project includes a new, four-lane bridge that meets current seismic and road design standards, and provides a safe and reliable crossing for vehicles, pedestrians and cyclists. As such the Project is associated with a number of health benefits:

- Lower collision rates as compared to the No Build scenario
- Improved seismic resilience that meets current design and safety standards
- Improved accessibility and connectivity to services, activity centres, and corridors
- Safer and more accessible Fraser River crossing for pedestrians and cyclists on both sides of the bridge, allowing for more active transport

1.1.9.5 Heritage

The Project has required the completion of studies to identify historic heritage and archeological resources associated with the area. These studies will help guide efforts to acknowledge the history of the area and design mitigation and management measures to ensure these tangible and intangible resources are protected.

1.1.9.6 Cost /Benefit Analysis

Proect benefits considered in the business case include:

- Quantified user benefits – Travel time reliability, vehicle operating cost savings, and seismic risk reduction
- Unquantified user benefits – Benefits to cyclists and pedestrians, regional network connectivity, and reliable access
- Economic development benefits – Impact on development potential and goods movement
- Social and community benefits and considerations – Alignment with community and regional plans, and community connectivity

The business case provides the benefits and costs for the Project in comparison with a Base Case, (referred to in this Application as the "No Build" scenario) as previously described and repeated below. Due to the reduction in scope recommended in the Business Case, a conservative approach in reporting the benefits and costs has been taken in this Application. To avoid overestimation of benefits and costs, the benefits and costs reported here are associated with the Revised Scope. To ensure that potential adverse effects are adequately measured, the Effects Assessments for each VC and IC in this Application uses Reference Concept.

The No Build scenario is a theoretical plan to rehabilitate the existing bridge to maintain its serviceability in the absence of a new bridge. The existing structure would be reconfigured for three, rather than four, lanes of traffic to meet modern technical and safety standards; considering the required lane widths and pier foundation constraints, the rehabilitated bridge would not be able to accommodate a four-lane configuration.

The No Build scenario would include a structural seismic retrofit and general bridge upgrading. The centre lane would be a counter-flow lane where traffic changes direction depending on demand for the peak traffic flow periods. The theoretical retrofit program would include strengthening the structural elements such as piers and the superstructure, soil densification at bridge foundations, additional scour and marine vessel impact protection, and a full deck rehabilitation.

The Business Case recommended a new four-lane bridge with new on-and off-ramps to East Columbia St, a new direct southbound off-ramp from the bridge to connect to westbound Highway 17, and grade separation of the Highway 17 and Old Yale Road intersection (Revised Scope).

The methodology for cost comparison was based on economic benefit-cost analysis principles, with the present value (PV) of Project benefits and costs being estimated in accordance with provincial guidelines. For the purposes of evaluation, a 35-year analysis period was assumed, covering the years between 2017 to 2051, to allow for a calculation of Traffic Disruption During Construction. Benefits are assumed to begin in 2023 when the new bridge opens; therefore, the annual user benefits from 2023 to 2051 were discounted back to the current year (2017) using a discount rate of 6%.

With the Project (Revised Scope) costs estimated at $1.377 billion in as-spent dollars, including interest during construction, the present value of net Project costs, incremental to the No Build scenario, is approximately $260 million. The net present value of the Project benefits, incremental to the No Build scenario, is estimated to be $523 million (Error! Reference source not found.).

Table 1.1-5 Incremental Present Value of Project (Revised Scope) Benefits and Costs

	Present Value (2017$M)
Total Net Benefits	523
Total Net Costs	260
Benefit/Cost Ratio	2.01

Note: The Pattullo Bridge Replacement Project Business Case provides more detail on the Present Value of Project Benefits and Costs for several options including the Revised Scope option and the Reference Concept. (https://engage.gov.bc.ca/pattullobridge/)

1.2 APPLICABLE AUTHORIZATIONS

This section of the Application identifies all licences, permits, and/or approvals that may apply to the Project, some of which may be required after the EAC has been issued but before construction can commence (**Table 1.2-1**). The Proponent does not intend to request concurrent permitting under the *Environmental Assessment Act, SBC 2002, Chapter* 43 pursuant to the *Concurrent Approval Regulation (BC Reg. 371/2002)*.

Table 1.2-1 Potential Provincial, Federal, and Municipal Permits, Approvals, and Authorizations

Name of Authorization	Statute and Authorizing Agency	Description of Need for Authorization
Provincial		
Environmental Assessment Certificate	*Environmental Assessment Act,* SBC 2002, Chapter 43; EAO.	Required because the proposed Project is considered to be a reviewable Project pursuant to the BCEAA Reviewable Projects Regulation (BC. Reg. 370/2002).
Approval	*Dyke Maintenance Act*; Ministry of Environment, Dyke Inspector.	Required if the proposed Project entails temporary and/or permanent disturbance to, or modification of, the Fraser River dike system. Concurrence from the local diking authority would also be required.
Soil Relocation Agreement (SRA)	*Environmental Management Act*, SBC 2003, c. 53; Contaminated Sites Regulation, BC. Reg 375/96; Ministry of Environment.	Soils disturbed by construction that contain contaminants in concentrations that exceed applicable CSR standards would be subject to restrictions on reuse or relocation. A SRA may be required if contaminated soils are to be moved to locations other than approved landfills.

Name of Authorization	Statute and Authorizing Agency	Description of Need for Authorization
Heritage Investigation Permit	*Heritage Conservation Act*, RSBC 1996, c. 187, s. 14; Ministry of Forests, Lands and Natural Resource Operations (FLNRORD), Archaeology Branch.	Required for Archaeological Impact Assessment during the EA phase.
Site Alteration Permit	*Heritage Conservation Act*, RSBC 1996, c. 187, s. 12; FLNRORD, Archaeology Branch.	Required if the proposed Project disturbs confirmed archaeological site(s) or values.
License of Occupation	*Land Act*, RSBC 1996, c. 245; FLNRORD.	Required where construction will involve occupation of Crown Land.
Easement or Right-of-way	*Land Act*, RSBC 1996, c. 245; FLNRORD.	Required where the proposed Project will entail acquisition of additional right-of-way on Crown Land.
s. 11 Approval	*Water Sustainability Act,* SBC 2014, c. 15; Water Sustainability Regulation, BC. Reg. 36/2016, Part 2; FLNRORD.	Required because construction is anticipated to cause “changes in and about a stream” as defined in the Act. Approval is expected to be required for changes affecting the Fraser River and other watercourses (i.e., tributaries to Fraser River).
Notification	*Water Sustainability Act,* SBC 2014, c. 15; Water Sustainability Regulation, BC. Reg. 36/2016, Part 3; FLNRORD.	Submission of a Notification(s) (rather than obtaining an Approval(s) as per row above) is expected to be required for some works affecting smaller watercourses (such as roadside ditches) in the proposed Project area.
s. 10 Approval	*Water Sustainability Act,* SBC 2014, c. 15; FLNRORD.	May be required for short-term water withdrawal from the Fraser River to support construction of the new bridge or demolition of the existing bridge.
Permit	*Wildlife Act,* RSBC 1996, c. 488; FLNRORD.	Required for salvage and relocation of wildlife potentially affected by construction (to enable sampling for wildlife presence during the EA phase and/or to remove potentially affected wildlife from harm’s way during construction).
Permit	*Wildlife Act,* RSBC 1996, c. 488, FLNRORD.	May be required to remove or relocate an eagle, peregrine falcon, gyrfalcon, osprey, or heron nest, even when the nest is not in active use.

Name of Authorization	Statute and Authorizing Agency	Description of Need for Authorization
Permit	*Wildlife Act,* RSBC 1996, c. 488; FLNRORD.	Required if construction entails hunting, trapping, or killing nuisance animals (e.g., to complete demolition of the existing bridge).
Federal		
Category D Project Review Permit	*Canada Marine Act*, SC 1998, c. 10; VFPA Planning and Development Department (VFPA is an authority that is enabled by the *Canada Marine Act*).	An over-arching Project Review Permit will be required because the proposed Project will affect lands or waters located within VFPA jurisdiction as well as property managed by VFPA.
Category B Project Review Permits	*Canada Marine Act*, SC 1998, c. 10; VFPA Planning and Development Department.	May be required for investigation and assessment activities (e.g., archaeological impact assessment, geotechnical assessment) on lands or waters located within VFPA jurisdiction.
Building Permit	*Canada Marine Act*, SC 1998, c. 10; VFPA Planning and Development Department (VFPA is an authority that is enabled by the *Canada Marine Act*).	May be required to erect temporary buildings and/or structures on VFPA property (e.g., as may be necessary for construction). Exceptions include certain in-water works such as mooring dolphins, pilings.
Commercial Lease	*Canada Marine Act*, SC 1998, c. 10; VFPA Real Estate Department.	A commercial tenure agreement between TransLink and VFPA will be required for the new bridge and possibly also for undertaking temporary staging/construction works on lands or waters within VFPA jurisdiction.
s. 6(1) Approval	*Navigation Protection Act*, SC 2014; Transport Canada's Navigation Protection Program.	Required because construction and operation of the new bridge, as well as demolition of the existing bridge, will cause permanent, and likely also temporary, obstruction of navigation in the Fraser River, which is on the Act's List of Scheduled Waters.
s. 35(2)(b) Authorization	*Fisheries Act*, RSC. 1985, c. F-14; DFO.	Would be required in the possible event that the proposed Project cannot avoid or mitigate "serious harm to fish" as defined in the Act. A request for DFO review of the proposed Project will be submitted once suitably detailed information on potential effects on fish and fish habitat become known, after which DFO will determine whether or not an authorization is required.

Name of Authorization	Statute and Authorizing Agency	Description of Need for Authorization
Licence	*Fisheries Act*, RSC 1985, c. F-14; General (Fisheries) Regulation; DFO.	Anticipated to be required for fish collection during environmental assessment; also may be required for salvage and relocation of fish during construction (to remove and relocate fish from in-stream work sites); may also be required to sample fish for the purpose of monitoring the effectiveness of offsetting habitat, as may be required by a DFO authorization (see row above).
Permit	*Species at Risk Act,* SC 2002, c. 29; Environment and Climate Change Canada (Canadian Wildlife Service).	Required in the event the proposed Project entails salvage and relocation of SARA listed species during construction (to remove such species from harm's way).
Obstruction Clearance	*Aeronautics Act,* RSC 1985*, c. A-2;* Canadian Aviation Regulations (*SOR/96-433);* Transport Canada.	Required to allow temporary aeronautics obstruction (e.g., as may relate to use of a crane for bridge pylon construction).
Land Use Notification	*Civil Air Navigation Services Commercialization Act, SC 1996, c. 20;* NAV CANADA.	Required because construction will take place near an airport or near air navigation infrastructure.
Other		
Regional Permits (various)	Various bylaws; Metro Vancouver.	Various permits may be required for works within Metro Vancouver jurisdiction or affecting Metro Vancouver infrastructure.
Municipal Permits (various)	Various bylaws; New Westminster and Surrey.	Various permits may be required for works within municipal jurisdiction or affecting municipal infrastructure.

1.3 ALTERNATIVES TO THE PROPOSED PROJECT

As previously outlined in the History of the Project, efforts to identify a solution for the existing Pattullo Bridge have been underway since 2006. Between 2012 and 2014, TransLink, along with its partners, undertook a comprehensive joint technical Strategic Review to develop and evaluate options to rehabilitate or replace the Pattullo Bridge. More than 25 alternatives were explored over a number of years through technical study and stakeholder discussions. The Strategic Review Process was co-sponsored by TransLink, the City of New Westminster, and the City of Surrey, with participation from the MoTI and Metro Vancouver. A set of nine objectives was established, and the public and stakeholders provided input through an extensive public consultation process (TransLink 2013).

The alternatives included rehabilitation of the existing bridge and replacement (with either a new bridge or tunnel) at three alternative locations (**Figure 1-A-4**)—the existing crossing location; a Surrey-Coquitlam crossing; and a crossing at Tree Island in Richmond-Burnaby—along with various lane configurations.

The following options were examined at the existing alignment:

- Remove and do not replace the existing bridge
- Remove the existing bridge and replace it with a pedestrian and cycling bridge
- Rehabilitate the existing structure to create a two-lane, three-lane, or four-lane bridge
- Replace the existing bridge with a new four-lane, five-lane, six-lane, or eight-lane bridge
- Replace the existing bridge with a four-lane tunnel

Removal of the existing bridge without a replacement link was not deemed acceptable, and options involving a tunnel were rejected on the grounds of capital cost. Alternative crossing locations at either Surrey, Coquitlam or Richmond-Burnaby were not deemed to adequately support local and regional land use plans because they did not provide a direct multi-modal connection between Surrey and New Westminster town centres. As a result, these locations were not considered further.

Two viable options were identified: a new four-lane bridge and a new six-lane bridge, both at the existing crossing location. When evaluated against a set of technical, environmental and economic objectives, the four-lane option scored better than the six-lane option in terms of providing a cost-effective solution, supporting the regional goal of moving people out of cars, and reducing emissions, whereas the six-lane option scored better in terms of transportation reliability and supporting economic development.

1.3.1 Assessment of Alternatives to the Proposed Project

The analysis undertaken as part of the Strategic Review Process to identify a preferred option to replace the Pattullo Bridge is summarized in the *Pattullo Bridge Replacement Project Business Case* and the Strategic Options Analysis (SOA) report available via the links below:

- https://engage.gov.bc.ca/app/uploads/sites/331/2018/05/Business-Case.pdf
- https://engage.gov.bc.ca/app/uploads/sites/331/2018/02/Strategic-Options-Analysis.pdf

The SOA report provides an overview of the studies carried out between 2013 and 2017 and includes a review of the potential replacement options, the decision criteria applied to evaluate the options as project planning evolved, and the preferred option carried forward for analysis in the business case for the Project.

The SOA was carried out in a manner consistent with provincial capital planning policy and requirements, including British Columbia's Capital Asset Management Framework (CAMF) and the MOTI guidelines for transportation infrastructure planning. Accordingly, options were identified and evaluated so as to ensure that public interest objectives are appropriately considered and the recommended option is supported by quantitative and qualitative analysis.

A multiple account evaluation (MAE) was used to evaluate service delivery options in accordance with MOTI's guidelines for business cases for transportation projects. An MAE process provides for the evaluation of both quantitative and qualitative factors across options with respect to five different parameters: customer service, financial, economic development, environmental and social and community. Each account is represented by one or more metrics which represent the important implications of each option and demonstrate the trade-offs involved in selecting one option in relation to the others. The MAE analysis undertaken for the Project is presented in the SOA report.

Project goals and objectives informed the development of criteria used in evaluating strategic options for the Project. These criteria and their linkages to Project goals and objectives are summarized in Table 1.2-2.

Table 1.2-2 Project Goals, Objectives, and Evaluation Criteria of the SOA report.

Goals	Project Objectives	Evaluation Criteria
Provide a structurally sound bridge crossing to maintain a critical local and regional connection.	Provide a river crossing for all modes that is structurally sound and meets current standards for withstanding seismic and ship impacts.	Travel Time Savings Vehicle Operating Savings Travel Time Reliability Collision Cost Savings Improved Seismic Resiliency
	Support local and regional land use plans and economic development.	Regional Network Connectivity (completeness of connectivity between major activity centres and corridors, all vehicles, trucks) Improved Local Access (access to and from the local road network) Future Development Potential (commercial and residential; industrial with good access and proximity to regional routes) Goods Movement Impact
Improve safety for all users with modern lane widths, road curvature, centre median and separated pedestrian and cyclist facilities.	Provide reliable access and predictable travel times for all modes.	Reliable Access (redundancy in connections; minimize bridge closures)
	Minimize single-occupancy vehicle use and vehicle kilometers travelled.	Community connectivity of transit, pedestrians and cyclists
Improve connectivity, reliability and modal choice while supporting environmental objectives.	Move toward the regional goal that by 2040, half of all trips will be by walking, cycling or transit.	Vehicle Kilometers Travelled
	Minimize emissions of greenhouse gases and pollutants.	Regional GHG Emissions

Goals	Project Objectives	Evaluation Criteria
	Minimize impacts to the natural environment.	On-Land Environmental Effects (at-risk wildlife and habitat; native vegetation) On-land Environmental Effects (archaeological and heritage resources) In-River Environmental Effects (Fraser River hydrology and morphology; fish and fish habitat)
	Support neighbourhood livability by minimizing and mitigating impacts, including during construction.	Alignment with Regional Plan Alignment with Community Plans Residences impacted Business impacted Residence takings (partial/full) Business takings (partial/full)

Based on technical analysis and public and stakeholder consultation, the Strategic Review partners narrowed the list of options to six, all of which involved a multi-modal transportation connection. The removal of the bridge without a replacement link was not deemed acceptable, and options involving a tunnel were rejected on the grounds of capital cost. The alternative crossing locations at Surrey-Coquitlam or Tree Island did not adequately support local and regional land use plans, because they did not provide a direct multi-modal connection between Surrey and New Westminster town centres, and so were not considered further.

The six shortlisted options were: (1) a three-lane rehabilitated bridge at the current location; (2) a four-lane rehabilitated bridge at the current location; (3) a four-lane replacement bridge at the current location; (4) a five-lane replacement bridge at the current location; (5) a six-lane replacement bridge at the current location; and (6) a new four-lane bridge between Surrey and Coquitlam combined with a rehabilitated three-lane Pattullo Bridge.

These options were evaluated against Project objectives based on technical and financial considerations by the co-sponsors in the Strategic Review Process, and two viable options were identified at the existing crossing location: a new four-lane bridge, and a new six-lane bridge.

In early 2014, the Metro Vancouver Mayors' Council on Regional Transportation (the Mayors' Council) established a Subcommittee on Transportation Investment to define its vision, establish spending priorities, and recommend new funding mechanisms capable of supporting those priorities. The work of the Subcommittee considered established regional and community plans, including Metro Vancouver's Regional Growth Strategy and TransLink's Regional Transportation Strategy, and in the case of the Pattullo Bridge replacement, considered the results of the Pattullo Bridge Strategic Review process.

In June 2014, the Mayors' Council confirmed the region's preferred solution to replace the existing structure in its *Vision for Regional Transportation for Metro Vancouver*. The Mayors' Council determined that the replacement bridge should be a new, four-lane bridge, designed in a manner to not preclude potential future expansion to six lanes.

In February 2018, MoTI announced that the new four-lane bridge will provide important improvements for everyone using the bridge, including people who are driving, cycling or walking, as well as communities on either side of the bridge:

- A safer crossing for all bridge users with modern, wider lanes, separated by a centre median barrier
- Dedicated walking and cycling lanes, separated from traffic by a median on both sides of the bridge
- Better connections to, from and near the bridge

The new bridge will improve safety and reliability for drivers, cyclists and walkers, as well as goods movement. It will be designed to meet modern seismic, structural, and roadway design standards.

The new bridge will be located just north and upstream of the existing bridge and will optimize the use of the existing road network and travel patterns. Constructing the bridge next to the existing bridge will allow the existing bridge to continue operating until the new one is open. Once the new bridge is open, the existing bridge will be removed.

The project will also improve connections to regional road networks and cycling and walking paths on either side of the bridge. In Surrey, the bridge will continue to connect directly to King George Boulevard, and a new off ramp will connect the bridge to westbound Highway 17.

In New Westminster, the bridge will continue to connect directly to McBride Boulevard and new direct ramps will connect the bridge to East Columbia Street. These new connections will reduce the reliance on local residential streets to access the bridge.

1.3.2 Alternative Means of Undertaking the Proposed Project

Several different project configurations were considered before arriving at the concept presented in this Application. These alternative configurations are described below in terms of bridge alternatives, including bridge alignments and lanes, road geometries, bridge types, and pier locations. The new four lane bridge concept connecting into the existing road network as presented in the Application is a result of the technical development and engagement process.

1.3.2.1 Road Geometry

Several road configurations were considered to connect the new bridge into the existing road networks in New Westminster and Surrey. Separating local traffic from regional traffic helps improve connectivity and reliability of the bridge, which is an important Project objective. Such separation helps maintain the integrity of the community environments at the Project site. In this regard, direct connections between the new bridge and East Columbia Street as well as between the southbound direction of the new bridge and Highway 17 are key road connections in the Project. Given the proximity of East Columbia Street to the

Fraser River and the topography of the river front in New Westminster, the roadway geometry required for the ramp connections between the new bridge and East Columbia Street introduce a constraint to the bridge configuration and location of bridge support piers.

1.3.2.2 Pier Locations

Three configurations for pier locations were developed and reviewed. Relative to the Fraser River navigation channels, these options for pier placement included:

- Option 1 - two piers north of the secondary navigation channel, a pier between the primary and secondary navigation channels. and a pier on the river bank in Surrey.
- Option 2 - a pier north of the secondary navigation channel, a pier between the primary and secondary navigation channels, a pier on the south edge of the primary navigation channel, and a pier on the river bank in Surrey.
- Option 3 – two piers to the north of and two piers to the south of the secondary navigation channel.

Option 3 was chosen as the reference concept since it provides a clear span over the navigation channel to protect marine navigation. Options 1 and 2 resulted in greater impacts to navigation of the river and also, had shown the potential for extensive downstream scour.

1.3.2.3 Bridge Types

Bridge types considered included suspension bridges, cable stayed bridges, arch bridges and girder bridges. These options were reduced to cable stayed bridges based on the following rationale:

- Weak soils south of the river make the anchorage required for a suspension bridge impractical and potentially infeasible;
- Typical girder structures are limited to shorter spans that would not meet the span lengths required for the Project, given the navigation considerations;
- Arch bridges are feasible at the site and could be used to provide spans of greater than 350 metres; however, arch structures have historically been more expensive than cable stayed bridges.

A cable stayed bridge could be used to minimize instream works in a cost-effective way and as such was selected as the reference concept presented in this Application.

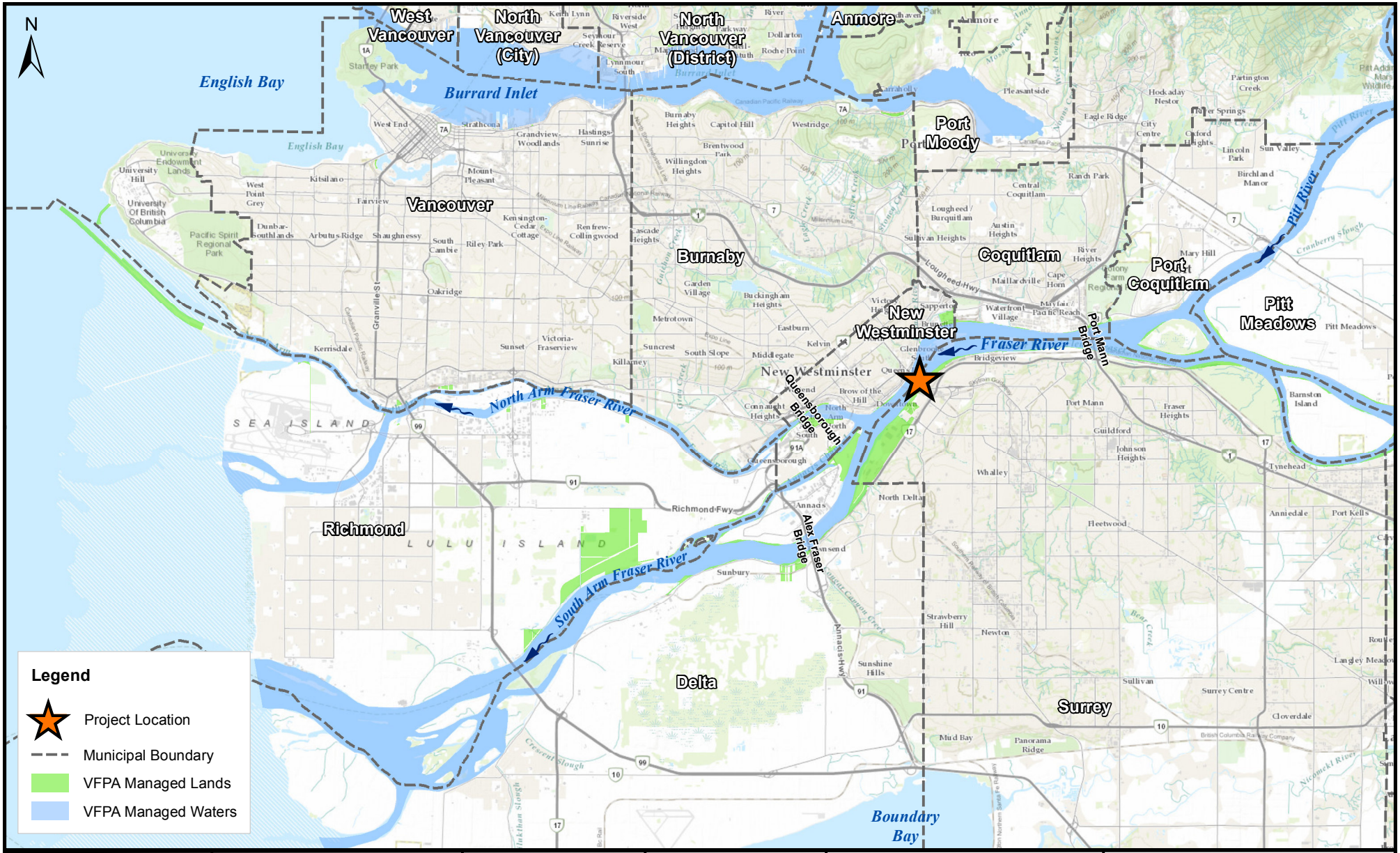
1.4 REFERENCES

TransLink. 2013. TransLink, City of Surrey, City of New Westminster and MoTI, "Pattullo Bridge Review Consultation June 2013: Consultation Summary Report," September 2013.

ATTACHMENTS

Attachment 1-A

Figures



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DESIGNED	___	REFERENCE DRAWING	
DRAWN	AS 18 - 05 - 24	NO.	DESCRIPTION
CHECKED	___		
APPROVAL	___		

BRITISH COLUMBIA Ministry of Transportation and Infrastructure

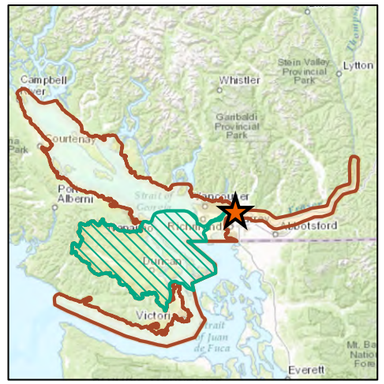
Hatfield CONSULTANTS

Proposed Pattullo Bridge Replacement Project

Location Map

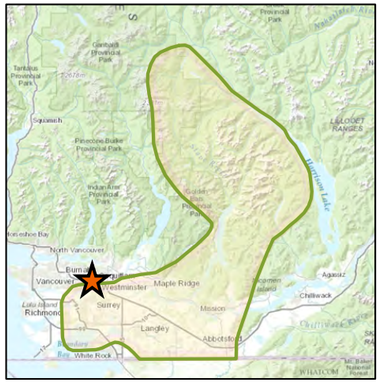
Contract No. 0906-14/SC001110CA

SCALE	FIGURE NO.	REV NO.
1:175,000 (0 1 2 Km)	1-A-1	6

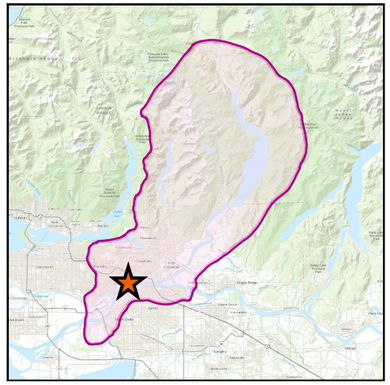


Hul'qumi'num Treaty Group (Marine) Asserted Traditional Territory (red) and Hul'qumi'num Treaty Group (Core) Asserted Traditional Territory (green)

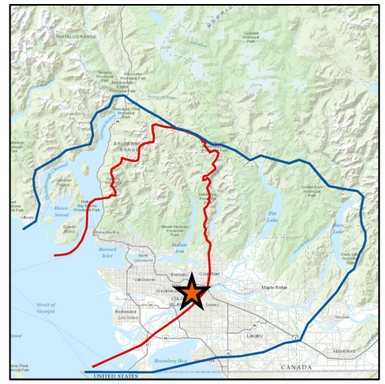
Katzie First Nation Asserted Traditional Territory



Kwantlen First Nation Asserted Traditional Territory

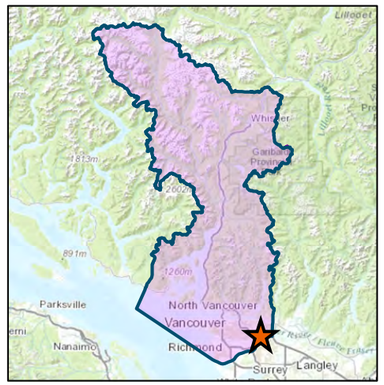


Kwikwetlem First Nation Asserted Traditional Territory

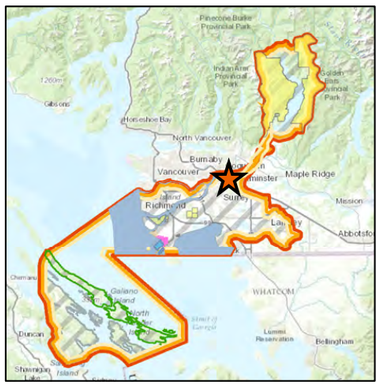


Musqueam Statement of Intent Boundary (red) Musqueam Consultation, Accommodation, Resources Access (CARA) Boundary (blue)

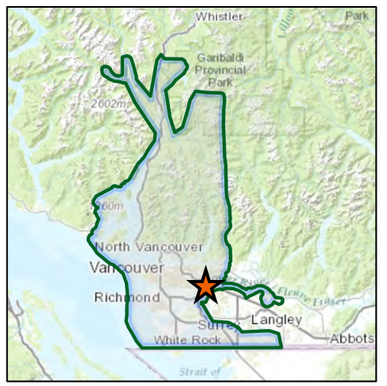
Semiahmoo First Nation Asserted Traditional Territory



Squamish Nation Asserted Traditional Territory



Tsawwassen First Nation Traditional Territory



Tsleil-Waututh Nation Consultation Area

Stó:lō Asserted Traditional Territory (Protective Writ)

Legend

Project Location

W:\TRANS7593-NVA_MXD\Report_Maps

DESIGNED		REFERENCE DRAWING			**Proposed Pattullo Bridge Replacement Project**	**Contract No. 0906-14/SC001110CA**
DRAWN	18-07-23	NO.	DESCRIPTION			
CHECKED					**ASSERTED TRADITIONAL TERRITORIES AND TREATY NATION TERRITORIES**	DO NOT SCALE / FIGURE NO. 1-A-2 / REV NO. 7
APPROVAL						

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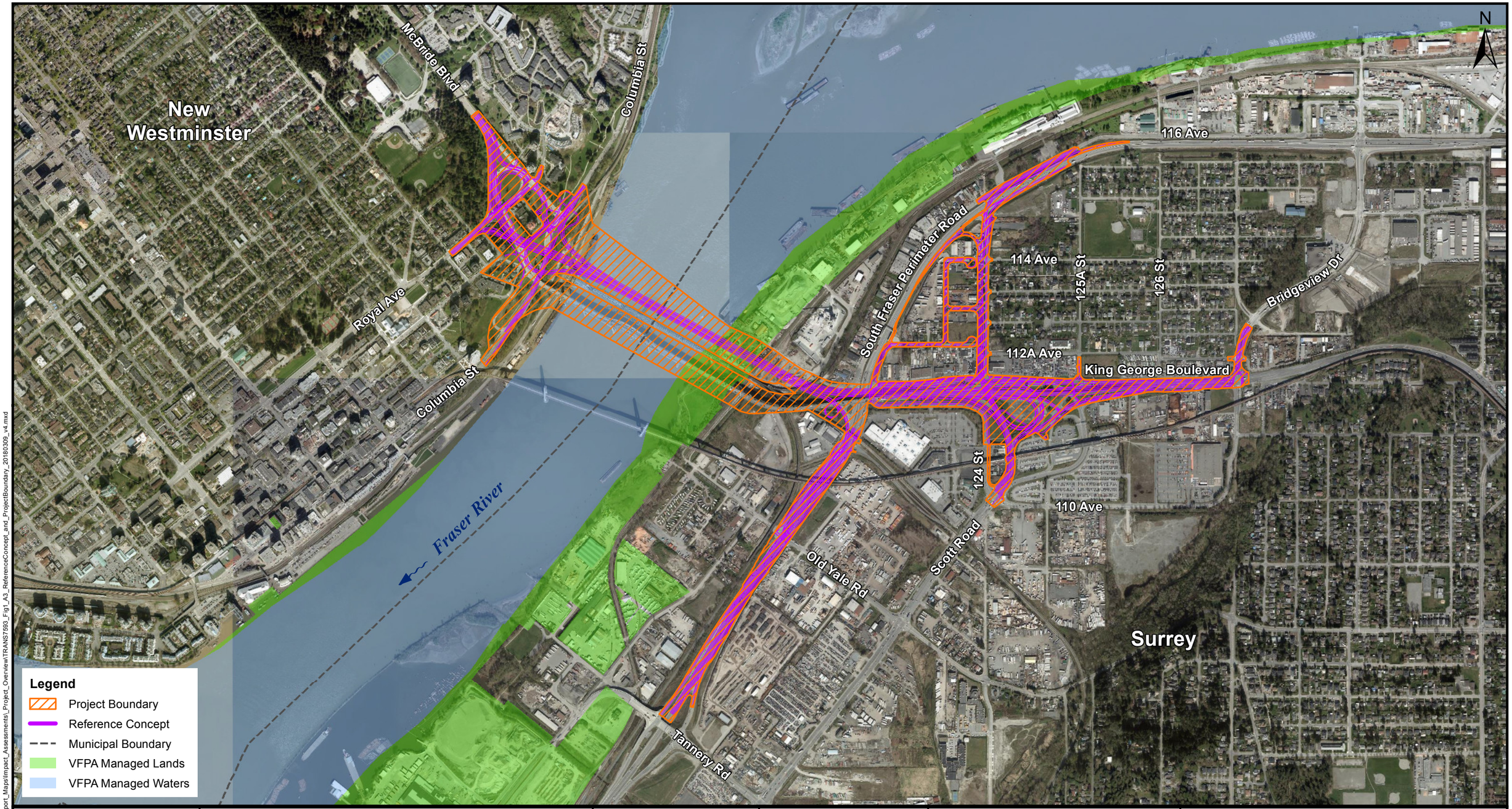

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DESIGNED	___	___	
DRAWN	AS	18 - 03 - 09	
CHECKED	___	___	
APPROVAL	___	___	

REFERENCE DRAWING

NO.	DESCRIPTION
1	Reference Concept, Parsons 2018.

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Proposed Pattullo Bridge Replacement Project

Reference Concept and Project Boundary

Contract No. 0906-14/SC001110CA

SCALE 1:12,000
0 50 100 200 300 m

FIGURE NO. **1-A-3**

REV NO. **4**

Figure 1-A-4 Alternative Locations Considered for Pattullo Bridge Replacement