Surrey Langley SkyTrain:

Environmental Screening Review

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Volume 1 – Technical ESR Sections

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Acknowledgements

Following the transfer of the Surrey Langley SkyTrain Project from TransLink to the Province of BC to facilitate the construction of a full 16-kilometre extension - from King George SkyTrain Station in Surrey to 203 St. in Langley City – in one stage, the consolidated delivery of the Environmental Screening Review (ESR) was required.

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- Katzie First Nation;
- Kwantlen First Nation;
- Matsqui First Nation;
- Musqueam Indian Band (xʷməθkʷəy̓ əm);
- Semiahmoo First Nation; and
- Tsawwassen First Nation.

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Executive Summary

Project Overview

The Surrey Langley SkyTrain Project (SLS or the Project) will extend the Expo Line 16 kilometres from King George SkyTrain Station in the City of Surrey to 203 Street in the City of Langley via an elevated guideway. The permanent footprint of the SLS will be located generally within the existing municipal Right-of-Way (ROW) for Fraser Highway. At 200 Street, upon approach to the terminus station at 203 Street, the alignment transitions from Fraser Highway to Industrial Avenue. The Project alignment spans three municipalities: the City of Surrey, the Township of Langley, and the City of Langley, as shown below.

With the exception of Green Timbers Urban Forest (GTUF) and the Serpentine Valley, the Project alignment is located within an urban context adjacent to existing residential, institutional, commercial and industrial land uses. Key components of the Project include the SkyTrain guideway, stations, control and communication system, propulsion power system (PPS), and SkyTrain vehicles as described in the following table.

Project Component	Component Description
Elevated guideway	Elevated guideway and supporting infrastructure will be situated along Fraser Highway with storage tracks constructed on some segments. Longer than typical spans of guideway will be required at some locations (for example, for crossings at the Serpentine River and at Highway 15).
Stations	The eight stations will have platforms accessible by elevator and escalator from the street level, similar to what currently exists on the Expo Line.
SkyTrain vehicles	The SLS system will be designed to accommodate vehicles that are similar to the various models currently in use on the Expo Line. SkyTrain vehicles will be supplied and operated by TransLink.
Power, control, and communication system	The Project will be powered by electricity supplied by BC Hydro via new dedicated underground distribution lines, with up to 10 PPSs, as well as power and communication ducts along the alignment. PPSs will typically be integrated with the SkyTrain stations; however, up to two PPSs will be standalone. Automatic train control, communication, and security systems will be similar to those on the Expo Line.
Integration: roadways, other transit, pedestrian access/trails	Project systems will integrate fully with existing SkyTrain systems. Transit exchanges to provide connections between bus and SkyTrain will be located at the following stations: 166 Street, 196 Street, and 203 Street. Existing utilities and services will be modified, as needed, to support the Project. Roadway segments will be widened and/or reconfigured, as required, to accommodate guideway columns, stations, and associated parking and access. Site-specific work will also be required to match existing topography and watercourse crossings.

Environmental Screening Review Process

In 2019, both the BC Environmental Assessment Office (BC EAO) and the Impact Assessment Agency of Canada (IAAC) concluded that the SLS was not subject to either a provincial or federal Environmental Assessment process. However, the Project initiated an Environmental Screening Review (ESR) to perform a thorough due diligence assessment of potential impacts on the human and natural environments, permitting requirements, and for information and engagement with First Nations, stakeholders and the public. This Environmental Screening Review (ESR) considers the planning, construction, and operation phases of the Project, and is predicated on robust analysis, fieldwork, engagement, and responsible environmental management.

The objectives of the SLS ESR process are to provide a:

- Clear and transparent mechanism to identify potential Project-related effects on the natural and human environment as well as mitigation strategies;
- Description of specific details regarding the Province's commitment to protecting environmental and socio-economic values as related to the Project; and
- Summary of feedback from First Nations, stakeholder and public engagement.

The scope of the ESR is based on a detailed Terms of Reference (TOR), which considered feedback from First Nations, stakeholders, and the public. The ESR assesses potential effects of the Project's construction and operation on environmental values (termed "screening elements" (SEs)) and identifies appropriate mitigation measures and next steps for environmental management. ESR results were informed by baseline assessments of the Project corridor; review of relevant environmental regulations and policies; reviews of similar transportation projects; professional experience; and feedback from interested parties.

First Nations Engagement

Since early 2019, the Project team has been engaging at an in-depth level with First Nations whose Traditional Territories overlap with the Project area. Additionally, the Project team has been informing First Nations whose Traditional Territories are adjacent to the Project area of major milestones and offering engagement opportunities. The Project team has worked to establish and maintain open and transparent working relationships with First Nations to facilitate effective and meaningful engagement throughout the Project planning process and review of the draft ESR. Key interests and input from participating First Nations have informed Project planning initiatives, including the development and refinement of appropriate Project-related mitigations.

Stakeholder and Public Engagement

Stakeholder and public engagement are also critical components of rapid transit planning. The Project team has conducted outreach to diverse stakeholders, including municipal staff, elected officials, community organizations, business associations, institutions, and local interest groups to:

- Foster relationships with key individuals and groups along the Project alignment;
- Raise awareness about the Project and how it will benefit one of B.C.'s fastest-growing regions;
- Gather important feedback to help inform the ESR and refine Project planning; and
- Promote engagement opportunities to maximize participation in the Project's development.

To date, the Project team has held three rounds of public engagement: spring 2019, fall 2019, and spring 2022. Engagement results indicate widespread and consistent support for the SLS project and concurrence that the ESR process is sufficiently thorough. Key interests are in how the Project may affect environmental and human receptors, and how the Project intends to avoid or mitigate potential effects. These include interests in the protection of trees, wildlife, and fish habitat; noise; and minimizing effects on environmentally sensitive areas. The Project team will continue to engage with stakeholders and the public throughout the duration of the Project.

Project Assessment and Key Findings

The ESR summarizes potential Project-related interactions with each SE during construction and operation activities and how those interactions could affect the SE. The ESR describes the mechanism to assess each identified interaction, including how anticipated changes could affect the SE. The table below outlines the review indicators used to identify effects for each SE, summarizes the potential Project-related effects, and recommends appropriate mitigation measures.

Key Findings for Potential Project-related Effects and Recommended Mitigation

<table>
<tr><th>Screening Element</th><th>ESR Review Indicators</th><th>Assessment of Potential Effects</th><th>Summary of Recommended Mitigation</th></tr>
<tr><td>Air Quality and Greenhouse Gases (GHG)</td><td>Estimated change in emissions of concentrations of criteria air contaminants (CACs) relative to baseline
Estimated change in emissions of GHGs relative to baseline</td><td>Construction-related emissions of CAC and GHG are expected to be temporary, reversible, and offset by air quality improvements within 3 years of Project operation
Project operation is expected to reduce emissions of CAC and GHG due primarily to the transportation mode shift from buses and private vehicles (powered by internal combustion engines) to the electrically powered SkyTrain system</td><td>Use best management practices (BMPs) to minimize CAC and GHG emissions during construction, such as:
Use electric-powered equipment, where feasible, or Tier 4 and higher diesel equipment
Conduct regular inspections and maintenance on all equipment and enforce equipment idling restrictions
Integrate high-volume fly ash concrete or other low carbon alternatives, where feasible
Use water for control of dust generation during dry periods
Manage traffic to minimize delays, as possible</td></tr>
<tr><td>Noise and Vibration</td><td>Predicted noise levels at sensitive receptors for daytime, nighttime and day-night levels; and peak one-hour sound level.
Predicted vibration levels at sensitive receptors:
Peak particle velocity in mm per second or vibration decibel (dB)
Root mean square velocity in mm per second or vibration dB
Root mean square acceleration in mm per squared second or in multiples of acceleration due to gravity
Ground-borne noise in A-weighted decibels (dBA)</td><td>Potential noise and vibration levels during Project construction and operation were predicted through detailed modelling and indicate a limited number of affected receptors
Some temporary impacts may occur during construction, particularly in areas that require impact pile driving
A small number of areas along the alignment may experience perceptible increases in noise during SLS operation</td><td>Minimize noise and vibration effects, where feasible, during Project construction in urban and commercial areas by:
Installing piles using drilling or other low vibration techniques
Providing advance notification or limiting noise-generating construction activities to daytime hours
Following a management process to receive and track feedback
Monitoring noise and vibration within identified areas with potential impacts and use temporary noise barriers when necessary
During testing/ commissioning and operation, where Project noise and vibration may be perceptible without further mitigation, conduct monitoring to inform the need for measures (e.g., friction modifiers or noise barriers)</td></tr>
<tr><td>Contaminated Sites</td><td>Historical Schedule 2 activities or known contamination recorded at acquired properties, or where known contamination is present
Contaminated soil and/or groundwater:
Identified during investigations prior to construction
Suspected where potential indicators of contamination are encountered during construction
Remaining following construction</td><td>Forty-seven medium-risk and seventeen high-risk areas of potential environmental concern (APECs) were identified where historical operations may have caused contamination
Potential risks and effects consist of liabilities associated with property acquisition, soil and groundwater management during construction, and future impacts to human and ecological receptors
Potential effects can be reduced by implementing the recommended mitigation measures, but may not be entirely resolved prior to Project construction</td><td>Address potential site contamination prior to and during Project construction by:
Assessing potential environmental liabilities associated with property acquisitions by completing due diligence investigations and developing remediation estimates
Completing Phase II Environmental Site Assessment (ESA) to assess APECs prior to property acquisition
Support appropriate management of excavated materials during Project construction by:
Sampling soil and groundwater within or adjacent to medium-risk and high-risk APECs during advance or early works
Characterizing excavated soil from properties identified as APECs, and from unpaved areas adjacent to roadways
In the absence of pre-characterization, risks to the Project construction schedule due to chance finds of contaminated soil and groundwater may be partially mitigated through the development and implementation of a Contaminated Site Management Plan</td></tr>
<tr><td>Fisheries and Aquatics</td><td>Changes in areal extent (m^2) of instream or riparian habitat related to physical disturbance or changes in flow causing loss, alteration or inaccessibility to fish
Changes in water quality
Changes to fish/egg mortality due to changes in water quality or flows</td><td>The Project is not anticipated to result in permanent or temporary changes to instream fish habitat
The Project is estimated to have a permanent change of 2,253 m^2 and a temporary change of 11,900 m^2 of riparian habitat within legislated stream setback areas</td><td>To prevent introduction of deleterious substances to fish habitat during Project construction, use standard erosion prevention and sediment control practices, spill response plans, and properly implemented BMPs
For instream work areas, isolate work areas from streamflow, and salvage fish and amphibians
Where other mitigation measures cannot prevent Project-related impacts to fish or fish habitat, conduct offsetting (e.g., habitat creation, restoration, or enhancement) to compensate for loss of fish productivity, as required by relevant regulatory agencies</td></tr>
<tr><td>Vegetation and Wildlife Resources</td><td>Changes to:
Potential occurrence and locations of species of management concern (species at risk and invasive species)
Availability of wildlife habitat features
Spatial extent of ecological communities at risk
Habitat availability or suitability for focal species at risk
Spatial extent of forest canopy cover and connectivity
Number of trees within the Project footprint
Risk of injury or mortality to wildlife due to extent, duration, or timing of activities</td><td>Project construction activities could interact with species of management concern, alter the abundance and quality of wildlife habitat, affect areas of high habitat suitability, or could affect the quality of Green Infrastructure Network hubs and corridors
Up to 1,644 trees are located in the Project footprint (temporary and permanent), primarily east of 148 Street. Most of these are street or boulevard trees, of which some will require removal. No trees have been identified for removal in GTUF</td><td>Prior to or during Project construction, conduct:
Clearing outside of the bat roosting and breeding bird seasons
Species at risk salvages
Arborist survey to confirm tree removals (based on final design and construction plans)
Use BMPs during Project operation, including TransLink's standard operating procedures
Use native, culturally important and climate-resilient plantings in landscaping and site restoration
Conduct post-construction monitoring of vegetation plantings and wildlife mortality adjacent to areas of high habitat suitability to confirm the effectiveness of mitigation</td></tr>
</table>

Screening Element	ESR Review Indicators	Assessment of Potential Effects	Summary of Recommended Mitigation
Archaeology and Heritage	• Areas of designated high archaeological potential that may be affected (Areas of Archaeological Interest (AOI)) • Number and description of archaeological and heritage sites with the potential to be altered	• Systematic shovel testing in accessible locations of 17 AOIs and two Management Areas located in or near the Project footprint have identified an archaeological site not previously registered (DhRq-117) • Site DhRq-117 is unlikely to be affected by the Project • 12 previously recorded or designated heritage sites are located within 1 km of the Project area; three sites overlap with the Project footprint but are unlikely to be affected	• Conduct additional AIAs and monitor AOIs that are currently inaccessible • Where feasible, avoid disturbing known archaeological sites. If site avoidance is not feasible, mitigate impacts to identified archaeological sites within the Project footprint through site-specific measures and in accordance with the *Heritage Conservation Act*, provincial guidance and associated permitting • Use the Archaeological Chance Find Management Procedure as per AQP guidance • Where warranted, develop additional measures in discussion with regulators, First Nations, and landowners
Agricultural Land	• Alignment with provincial and municipal agricultural land use designations • Area (m^2) of agriculturally designated land and in agricultural use potentially lost temporarily or permanently due to Project activities • Alteration of land use through effects to infrastructure and changes in sensory conditions (noise, light)	• Project use of Agricultural Land Reserve (ALR) in the Serpentine Valley is primarily limited to existing Fraser Highway ROW • The Project will require temporary and permanent use of non-ALR lands in agricultural use east of the Serpentine Valley	• Refine Project design to minimize additional permanent property acquisition in the ALR • Engage with agricultural operators prior to and during construction to identify potentially affected agricultural infrastructure and help manage potential direct and indirect effects • Develop and implement an agricultural management plan to prevent potential soil quality effects in adjacent lands
Land Use	• Alignment with local and regional government land use policies • Changes to residential, commercial and industrial properties • Change in area and features of parkland	• Project activities will extend onto land that is not within road ROWs and is currently designated and zoned for other uses • Permanent changes to land use due to the Project are estimated at 10.1 ha	• Conform with agreements between TransLink and the municipalities to enable robust planning, and minimize adverse changes in land use while accommodating planned growth • Use design and construction measures to minimize the Project footprint and potential effects to existing land uses, engage with property owners, businesses, and communities, and manage disturbance • Maintain the function of recreational features and potentially affected access during construction, and restore like-for-like functionality of these features when construction is complete
Transportation and Access	Changes in: • Parking and access to properties • Roadway description (e.g., number of lanes, traffic flow characteristics) • Vehicle volume (vehicles/day, vehicles/km travelled) • Passenger vehicle travel time (selected origin/destinations) and reliability • Transit (travel time, ridership) • Pedestrian and cycling routes and access Changes in public access to emergency services (qualitative); routes and travel times for emergency services; and public safety and security.	During construction, impacts could include disruptions to: • Traffic, such as vehicle lane closures, pedestrian and cycling paths, and access to commercial and residential properties • Businesses, including transport of goods and services and access to services • emergency services and access to healthcare hubs • Changes to safety and security around station locations during operation Project operation will mitigate current transportation issues by improving transportation options, capacity and access while supporting planned growth and economic development	• During construction, manage traffic to minimize disruption to all road users and maintain functional access to properties through extensive and ongoing communication and engagement between the Province, project contractors (Project Co), First Nations, and stakeholders (e.g., businesses and residents) • Develop and implement a Traffic Management Plan for Project construction, including specific sub-plans to manage access, public information, incidents, and traffic control that: • Provides public notifications of construction details and impacts well in advance • Minimizes disruption of transportation and access • Sets out a collaborative process to develop site-specific mitigation, such as plans to keep people and goods moving, maintain access to services and keep businesses operating • Use design plans and TransLink-operating procedures to manage safety and security for station operation
Visual Landscape Assessment	Change of views to surrounding communities, residential neighbourhoods, and public areas	• The Project will directly affect views from some residential and public areas • For commercial areas, public and recreational trails, effects are anticipated to be minor to minimal • For select residential areas, proximity of guideway or stations could result adverse visual effects that should be mitigated	• Use careful design measures to help preserve views of the natural landforms and buffer views of structures • Consider additional visual buffering for areas where proximity to residential areas is a factor or where privacy is a primary concern • To integrate the Project into the existing landscape and community, enhance public realms in station design; use visual buffers; incorporate architectural finishes, cultural recognition and landscaping at stations; and preserve views, where possible

Assessment of Remaining Effects Following Mitigation

To avoid or minimize potential effects on the biophysical and human environment, the ESR includes proposed Project and site-specific mitigation measures that meet or exceed industry standards or best management practices (BMPs). Following implementation of Project design and recommended mitigation measures, some adverse effects may remain. The tables below summarize these effects, including characterizing the effects in terms of magnitude, geographical extent, duration, frequency, and reversibility.

Summary of Effects Remaining after Mitigation - Construction

ESR Screening Element	Magnitude	Geographic Extent	Duration	Frequency	Reversibility
Air Quality and GHGs	Low	Low*	Long	Continuous	Reversible
Noise and Vibration	Low	Low	Long	Continuous	Reversible
Contaminated Sites	Low	Low	Medium	Uncommon	Reversible
Fish and Aquatics	Low	Low	Long	Rare	Reversible
Vegetation and Wildlife	Low	Low	Medium	Uncommon	Reversible
Arch and Heritage	Negligible	Low	Short	Rare	Reversible/ Permanent
Agricultural Land	High	Low	Permanent	Continuous	Permanent
Land Use	High	Low	Permanent	Continuous	Permanent
Transportation and Access	Moderate	Low	Short	Common	Reversible
Visual Landscape	N/A	N/A	N/A	N/A	N/A

* Rating for criteria air contaminants. GHGs will be global in geographic extent.

Highest effect

Lowest effect

Summary of Effects Remaining after Mitigation - Operation

ESR Report Section	Magnitude	Geographic Extent	Duration	Frequency	Reversibility
Air Quality and GHGs*	Medium*	Regional/ Global*	Long*	Continuous*	Permanent*
Noise and Vibration	Negligible	N/A	N/A	N/A	N/A
Contaminated Sites	Negligible	N/A	Negligible	Negligible	Negligible
Fish and Aquatics	Negligible	N/A	N/A	N/A	N/A
Vegetation and Wildlife	Negligible	N/A	N/A	N/A	N/A
Arch and Heritage	Negligible	N/A	N/A	N/A	N/A
Agricultural Land	High	Low	Permanent	Continuous	Permanent
Land Use	High	Low	Permanent	Continuous	Permanent
Transportation and Access*	High*	Regional*	Permanent*	Common*	Permanent*
Visual Landscape	Moderate	Low	Permanent	Continuous	Permanent

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Highest effect

Lowest effect

*Light green indicates that overall positive effect is anticipated for these Screening Elements.

Next Steps

Content from the ESR will be incorporated into a framework for Project Co to develop a Construction Environmental Management Plan or CEMP. The CEMP Framework will outline the content of the Project Co's CEMP. In addition to mitigation and performance objectives, the CEMP Framework will describe recommended mitigation that will help meet performance objectives and provide required content for each component plan of the CEMP, including those for erosion and sediment control, noise and vibration and fish and fish habitat.

Tables

Figures

Photos

Addenda

Appendices (Under Separate Cover – Volume 2)

Acronyms and Abbreviations

Abbreviation	Definition
3D Model	three-dimensional model
AAQO	Ambient Air Quality Objective
AEC	Areas of Environmental Concern
AIA	Archaeological Impact Assessment
ALC	Agricultural Land Commission
ALR	Agricultural Land Reserve
AOA	Archaeological Overview Assessment
AOI	Area of Interest
APEC	areas of potential environmental concern
AQP	Appropriately Qualified Professional
AST	above-ground storage tank
BAU	business as usual
B.C.	British Columbia
BC EAO	British Columbia Environmental Assessment Office
BCRTC	British Columbia Rapid Transit Company
BMP	Best Management Practice
BTEX	benzene, ethylbenzene, toluene, and xylene
CAC	criteria air contaminant
CEMP	Construction Environmental Management Plan
CFP	Chance Find Procedure
CH_4	Methane
CL	commercial land
CN	Canadian National Railway
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COSMOS	City of Surrey Mapping Online System
CSOA	contaminated sites overview assessment
CSR	Contaminated Sites Regulation
CSRA	Contaminated Soil Relocation Agreement
DBH	diameter at breast height
DBSS	MOTI Design-build Standard Specification
DFO	Fisheries and Oceans Canada

Abbreviation	Definition
DNA	deoxyribonucleic acid
DW	drinking water
ECCC	Environment and Climate Change Canada
eDNA	environmental DNA
EMA	*Environmental Management Act*
EMF	Electromagnetic field
ENV	B.C. Ministry of Environment and Climate Change Strategy
EPA	United States Environmental Protection Agency
ESA	Environmental Site Assessment
ESC	erosion and sediment control
ESR	Environmental Screening Review
FAA	*Fisheries Act* authorization
FAR	floor area ratio
FCSI	Federal Contaminated Sites Inventory
FOR	B.C. Ministry of Forests (formerly Ministry of Forests, Lands, Natural Resource Operations and Rural Development)
Footprint	The Project’s permanent footprint and temporary workspace
FTA	Federal Transit Administration (United States)
GHG	greenhouse gas
GIN	City of Surrey Green Infrastructure Network
GTUF	Green Timbers Urban Forest
HADD	harmful alteration, disruption, or destruction (of fish habitat)
Hatch	Hatch Limited
HCA	B.C. *Heritage Conservation Act*
Hemmera	Hemmera, an Ausenco Company
HEPH	Heavy extractable petroleum hydrocarbons
HWR	Hazardous Waste Regulation
IAAC	Impact Assessment Agency of Canada
IAPP	B.C. Invasive Alien Plant Program
JPOCSC	Jim Pattison Outpatient Care and Surgery Centre
LED	light-emitting diode
LEPH	Light Extractable Petroleum Hydrocarbons
LSA	local study area
MBCA	federal *Migratory Birds Convention Act, 1994*
MOE	Ministry of the Environment
MOTI	BC. Ministry of Transportation and Infrastructure

Abbreviation	Definition
MOVES	Motor Vehicle Emission Simulator
MUP	multi-use pathway
N_2O	nitrous oxide
NCP	Neighbourhood Concept Plan
NH_3	Ammonia
NO_2	nitrogen dioxide
NOx	Nitrogen oxides
NRDE	non-road diesel engine emission
O_3	Ozone
OCP	Official Community Plan
OMC	Operations and Maintenance Centre
OSPA	Overarching Supportive Policies Agreement
PAH	polycyclic aromatic hydrocarbon
PCOC	potential contaminant of concerns
PFR	Preliminary Field Reconnaissance
PM	particulate matter
POE	pathway of effects
PPS	propulsion power substation
Project	Surrey Langley SkyTrain Project
Project Co	Project Contractor, of which three will be three, responsible for guideway, station or systems contract delivery respectively
Province	Ministry of Transportation and Infrastructure and Transportation Investment Corporation
PRRO	People of the River Referrals Office
RAPR	Riparian Areas Protection Regulation
RCD	Reference Concept Design
RCMP	Royal Canadian Mounted Police
RGS	Regional Growth Strategy
ROW	Right-of-way
RSA	regional study area
RSBC	Revised Statutes of British Columbia
SARA	*Species at Risk Act*
SE	Screening Element
SLS	Surrey Langley SkyTrain Project
SO_2	sulphur dioxide
SPA	Supportive Policies Agreement
SPEA	streamside protection and enhancement area (City of Surrey)

Abbreviation	Definition
TCP	Traffic Control Plan
TI Corp	Transportation Investment Corporation
Three Municipalities	City of Surrey, Township of Langley, and City of Langley
TMP	Traffic Management Plan
TOR	Terms of Reference
VKT	vehicle kilometres travelled
VLA	Visual landscape assessment
VOC	volatile organic compound
VOC-Fuels	VOC related to gasoline and diesel fuel storage and handling
VPH	volatile petroleum hydrocarbon
WSA	*Water Sustainability Act*

Symbols and Units of Measure

Symbol/Unit of Measure	Definition
%	percent
>	more than
°C	degree Celsius
cm	Centimetre
dB	decibel
dBA	A-weighted decibel
H	Hour
Ha	hectare
Hz	hertz
K	Kelvin
Km	kilometre
km/h	kilometres per hour
Kt	kilotonne
kV/m	kilovolts per metre
kWh	kilowatt hour
L_d	daytime noise level
Ldn	day-night average sound level
L_n	nighttime noise level
$L_{eq(1hr)}$	peak one-hour sound level
m	metre
m^3	cubic metres
mg/L	milligram per litre
pH	potential of hydrogen
$\mu g/m^3$	microgram per cubic metre
uS/cm	microsiemens per centimeter
t	Tonne

1 Introduction

The Surrey Langley SkyTrain Project (SLS or the Project) will extend the Expo Line 16 kilometres from King George SkyTrain Station in the City of Surrey to 203 Street in the City of Langley via an elevated guideway. The permanent footprint of the SLS will be located generally within the existing municipal Right-of-Way (ROW) for Fraser Highway. At 200 Street, upon approach to the terminus station at 203 Street, the alignment will be located to the north side of Fraser Highway to Industrial Avenue. The Project alignment spans: the City of Surrey, the Township of Langley, and the City of Langley (the Three Municipalities).

Initial submissions to both the BC Environmental Assessment Office (BC EAO) and the Impact Assessment Agency of Canada (IAAC) in 2019 concluded that the SLS was not subject to either a provincial or federal Environmental Assessment process. After these determinations, the Project initiated an Environmental Screening Review (ESR) to perform a thorough due diligence of potential environmental impacts and permitting requirements, as well as to provide information for First Nations, stakeholder, and public engagement. This Environmental Screening Review (ESR) considers the planning, construction, and operation phases of the Project, and is predicated on robust analysis, fieldwork, engagement, and responsible environmental management.

1.1 Environmental Screening Review Purpose and Objectives

The purpose of the ESR process and associated engagement process is twofold:

- To support the Province's (BC Ministry of Transportation and Infrastructure (MOTI) and BC Transportation Investment Corporation (TI Corp)) commitment to design a project that is informed by First Nations, stakeholders, and public input; and
- To demonstrate the Province's commitment to studying, and appropriately managing, potential environmental effects during the Project's procurement, construction, and operation phases.

The objectives of the ESR are to provide a:

- Clear and transparent mechanism to identify potential Project-related effects on the natural and human environment as well as mitigation strategies;
- Description of specific details regarding the Province's commitment to protecting environmental and socio-economic values as related to the Project; and
- Summary of feedback from First Nations, stakeholders, and public engagement.

1.2 Project Location

Delivery of the SLS Project fulfills a key priority outlined in the 2014 10-Year Vision by the regional Mayors' Council on Regional Transportation. The Project represents a significant investment in transportation improvements, including rapid transit and active transportation, and supports provincial, regional, and municipal growth strategies. It will connect the Three Municipalities and better connect the area south of the Fraser to other areas of Metro Vancouver. As highlighted in **Figure 1-1**, eight new stations will be located at: 140, 152, 160, 166, 184, 190, 196, and 203 Streets. These station locations are in areas identified for transit-oriented development and will connect arterial roadways with existing and future bus, cycling and pedestrian networks to facilitate the growth of complete, connected communities.

The Project will connect Surrey Centre, the emerging second urban core of Metro Vancouver, with the growing communities of Fleetwood, Clayton, Willowbrook, and Langley City Centre. The Project will provide fast, frequent, and convenient new connections to key destinations, including Kwantlen Polytechnic University and Simon Fraser University campuses, Surrey Memorial Hospital, Jim Pattison Outpatient Care and Surgery Centre, Green Timbers Urban Forest, the Surrey Sport and Leisure Complex, Willowbrook Shopping Centre, and Downtown Langley.

Figure 1-1 Surrey Langley SkyTrain Project Location

1.3 Project Need and Context

The SLS is a key priority of the Province as it supports federal, provincial, regional and municipal goals, including transportation, sustainability, and economic development objectives. More specifically, it supports provincial priorities, such as creating affordable housing options, meeting the objectives of CleanBC — the Province's roadmap to achieve climate targets — and supporting mode-shift with active transportation infrastructure.

Metro Vancouver, TransLink, and the Three Municipalities outline their respective visions for future rapid transit[1], as summarized below:

- Metro Vancouver's vision for the region is summarized in the Regional Growth Strategy (RGS), which is currently being updated for 2050, with policies to help accommodate the growing population, connect urban centres, and focus on climate change and equity (Metro Vancouver 2020).
- TransLink's Regional Transportation Strategy for 2050 provides transportation policy for the Metro Vancouver region over the next 30 years (TransLink 2021) and identifies the Project as the highest regional priority.
- The City of Surrey has numerous plans that frame a vision for a thriving, green, inclusive city, with investment in rapid transit identified as a top priority.
- The Willowbrook Regional Centre is identified in the Township of Langley's Official Community Plan (OCP) as a primary focal point for regional-scale commercial and mixed employment activities and to serve as a sub-regional transportation hub (Township of Langley 2013).
- The City of Langley supports the development of transit in the Fraser Highway corridor through transit-oriented land use designations in its OCP (City of Langley 2021).

The Project supports municipal objectives to advance transportation and housing goals to help meet projected population and job growth. By the year 2050, Metro Vancouver expects an additional 1.2 million more residents and 500,000 new jobs. By then, the population of the Three Municipalities, specifically, is projected to increase by 424,000 people and add 150,000 new jobs. As the population in communities south of the Fraser River continues to grow, so does the need for transit. The Project will help to address the following transportation challenges:

- Congestion, increased travel times, and decreased reliability for automobile users, buses, and the goods movement sector;
- Fewer residents south of the Fraser who live or work within walking distance of rapid transit compared to other parts of Metro Vancouver;
- Current transit service that is unable to support growing demand, especially during peak periods;
- Residents who have less access to employment, housing, services, and education opportunities due to a lack of transit options;
- Current active transportation levels (including biking and walking) that are much lower than the target regional mode share of 50% (e.g., in Surrey, the mode share is 18%); and
- Greenhouse gas (GHG) emissions that continue to rise as automobile usage and associated congestion trends upward.

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[1] See **Section 14**: Land Use for additional detail on relevant regional and municipal policies relevant to the Project.

1.4 Project History and Alternatives Considered

In 2009, a process began to assess potential alternatives for rapid transit in the region. TransLink and the Province, along with municipalities and Metro Vancouver, undertook a phased approach to identify and evaluate key findings to inform decision making. A summary and timeline are found in **Figure 1-2** below.

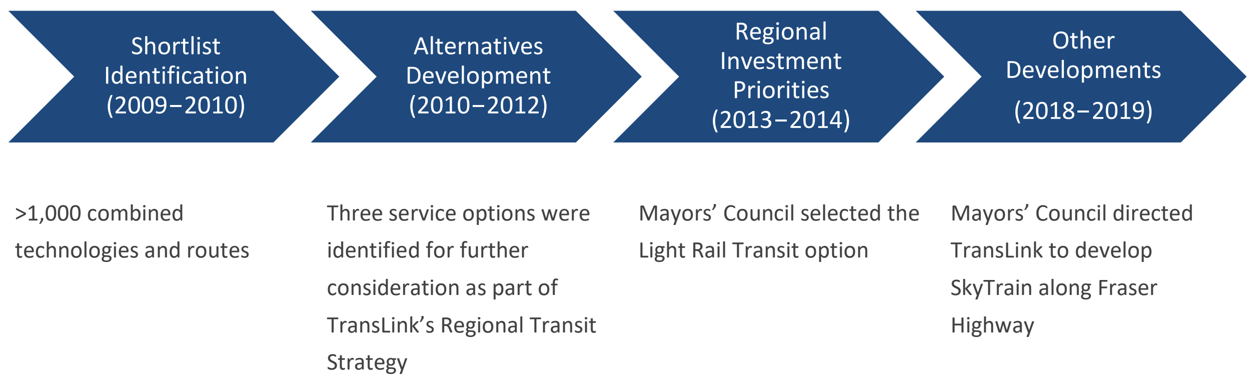

Figure 1-2 Phased Approach and Consideration of Alternatives: 2009 to 2019

In December 2018, following a request from a newly elected mayor and council in the City of Surrey, the Mayors' Council on Regional Transportation directed TransLink to suspend the Surrey-Newton-Guilford Light Rail Transit Project and proceed with planning for a SkyTrain project along Fraser Highway, that would meet the south of Fraser rapid transit priority plan in the Mayors' 10-Year Vision (2014). Given the importance of regional rapid transit expansion in meeting key transportation, housing, and climate objectives, the Province assumed responsibility for Project delivery in October 2020, and committed to deliver the full 16 kilometre SkyTrain extension to the City of Langley. The Province analyzed three alternatives is to determine how best to proceed:

- Business as usual (BAU) – an express version of Route 503, defined as a proposed Fraser Highway RapidBus service;
- Option 1: Consolidated approach – construct the Project in one stage with SkyTrain technology; and
- Option 2: Phased approach – construct the Project in two stages with SkyTrain technology (Stage 1 from King George SkyTrain Station to 166 Street in Fleetwood, Surrey) and Stage 2 from 166 Street in Fleetwood, Surrey to 203 Street in Langley City.

The analysis evaluated several criteria including transportation planning; urban development; social, community and environmental impacts; economic development; financial costs; and deliverability. The analysis concluded that a consolidated approach could deliver the Project for $3.95 billion with an estimated completion date of 2028, which is approximately $550 million less and two years earlier than a phased approach.

In July 2021, the Province secured up to $1.3 billion in funding from the federal government and confirmed its intent to deliver the Project all the way to the City of Langley. In October 2021, the Province proceeded with Business Case planning on the basis that the consolidated approach was optimal for the Project.

A number of advance works were approved to proceed in parallel with Business Case planning to de-risk certain key elements and support the schedule in recognition of the Project's high priority. The advance works include major utility relocation, project investigation and engagement, road widening[2] and property acquisition. The Project's Business Case was approved in July 2022, along with the Project's budget and funding, launching the start of the procurement process.

Additional background information on Project background and planning is available in the Document Library at gov.bc.ca/surreylangleyskytrain.

1.5 Environmental Approval Requirements for the Project

As part of Project planning, TransLink received confirmation from the BC EAO and the federal IAAC that, due to the nature and scope of the physical works, no assessment would be required under the federal *Impact Assessment Act* (SC 2019, c. 28, s. 1)[3] or the BC *Environmental Assessment Act* (SBC 2002, c. 51). While the Project scope remains lower than legislated federal or provincial thresholds for physical works, an amendment to the Reviewable Projects Regulation of the BC *Environmental Assessment Act* in 2020 requires a Notification under Section 5(1)(c) if the construction workforce is anticipated to be 250 or more employees or contractors. Following a public comment period in July 2022, the BC EAO confirmed a regulated assessment was not required and that the Project could proceed to secure individual permit approvals for investigation and construction, as needed[4].

1.6 Environmental Screening Review Process

Although the Project is not subject to a formal environmental assessment process for Project approval, the Province recognizes the importance of advancing the Project in a way that respects and protects natural and human environments. Therefore, the Project initiated robust ESR process to inform Project design and planning so that potential impacts can be avoided, minimized, or mitigated, and that concerns from First Nations, stakeholders, and the public are adequately addressed.

Developing the ESR included comprehensive engagement of First Nations, stakeholders, and the public to scope the ESR, identify potential effects and solicit feedback on mitigation measures. Input obtained through the ESR process will help to guide Project final design, and pre-construction and construction planning.

The scope of the ESR was defined through the development of the ESR Terms of Reference (TOR) (**Appendix A**). The TOR identified aspects of the biophysical and socio-economic environment (called Screening Elements (SEs)) to be reviewed and detailed how the review would be carried out. **Figure 1-3** outlines the ESR process. Input and feedback from First Nations, stakeholders, and the public helped to inform the draft TOR and the development of the ESR. For details, see **Section 4** First Nations Engagement and **Section 5** Stakeholder and Public Engagement. The final TOR is available in the Document Library at https://www2.gov.bc.ca/gov/content/transportation-projects/surrey-langley-skytrain.

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2 Concurrent to the Project planning, the City of Surrey undertook advance works to widen Fraser Highway and facilitate the future SkyTrain guideway. These road improvements, funded in part by the Project, are considered in the ESR report, however the environmental effects of these advance works are outside the scope of the ESR.

3 The decision from the IAAC is available at: https://iaac-aeic.gc.ca/050/evaluations/document/136148

4 The determination from the BC EAO is available here: https://www.projects.eao.gov.bc.ca/api/public/document/63066073bdbfc000227f4fd9/download/PN-005-EAO-Project-Notification_Report-and-Letter%20-%2020220824.pdf

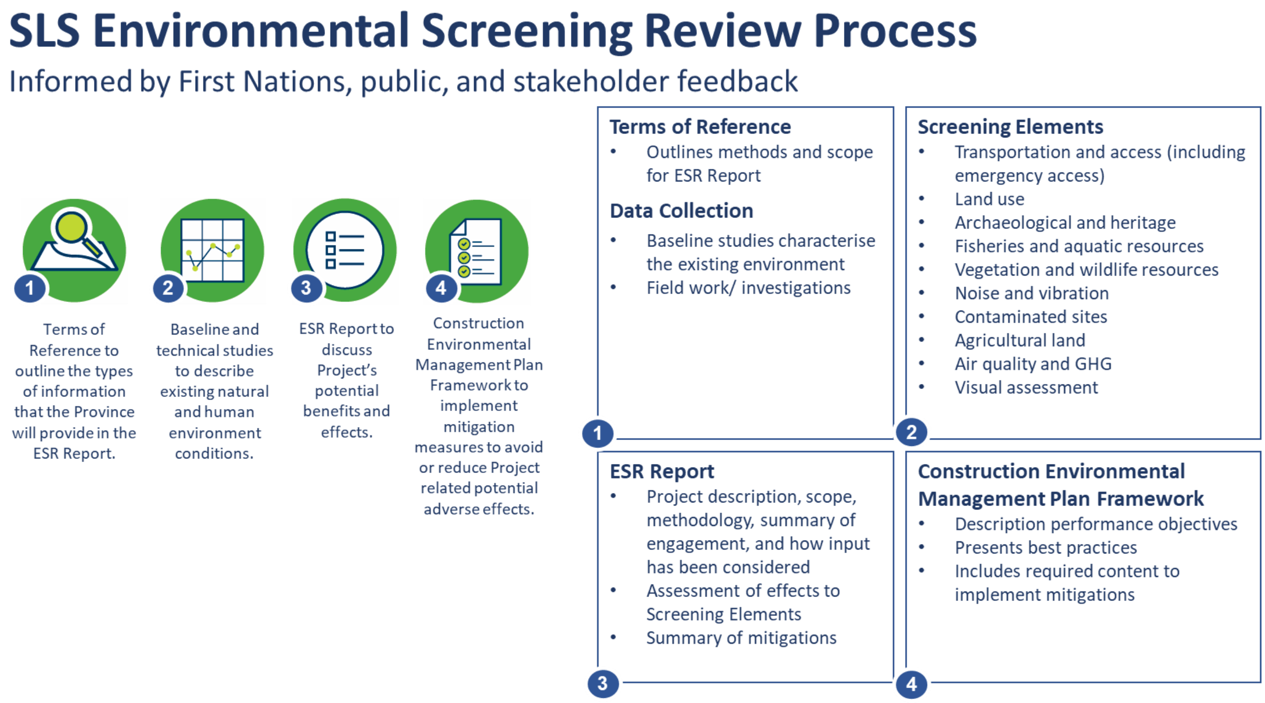

Figure 1-3 Environmental Screening Review Process

2 Project Description

The SLS design is guided by integration with the existing SkyTrain network, TransLink planning documents, and Metro Vancouver's broader regional growth plans for transportation, population, and employment. The Project will provide fast, frequent, convenient, and sustainable rapid transit to increase transit mode share, and help shape land use to support regional and municipal growth.

This ESR assessed the SLS Reference Concept Design (RCD)[5]. The RCD represents the feasibility of one design option for consideration by the Design-Build construction contractors (referred to herein as Project Co). If the final design developed by Project Co differs from the RCD such that additional adverse effects are considered likely, further assessments of impacts will be required prior to construction to confirm that the ESR conclusions remain valid.

2.1 Setting

The SLS alignment will be located primarily within the municipal road ROW for Fraser Highway. Station construction will mostly occur on adjacent private lands, which will require property acquisitions. Minor acquisitions of fee simple properties will be required for guideway approaches to stations as well as for Power Propulsion Substations (PPS).

Much of the alignment is characterized as urban, populated, and developed due to existing residential, commercial, institutional, and other land uses. Between 140 and 148 Streets, the SLS will be in the median of existing municipal right-of-way (ROW) through the Green Timbers Urban Forest (GTUF). Within the Serpentine Valley, the Project is located primarily within the existing municipal ROW for properties located in the Agricultural Land Reserve (ALR) and through a rigorous design process, the Project footprint has been minimized as much as possible.

2.2 Project Components

The principal Project components include the SkyTrain guideway, stations, control and communication system, PPS, including design to accommodate SkyTrain vehicles. The SLS power feed will be supplied by BC Hydro via new dedicated distribution lines. Once constructed, tested, and commissioned, responsibility for operating the Project infrastructure will be assumed by TransLink. Project physical components are summarized in **Table 2-1**.

Table 2-1 Physical Components of the Project

Project Component	Component Description
Elevated guideway	Elevated guideway and supporting infrastructure will be situated primarily along Fraser Highway with storage tracks constructed on some segments. Longer than typical spans of guideway will be required at some locations (for example, for crossings at the Serpentine River and at Highway 15).
Stations	The eight stations will have platforms accessible by elevator and escalator from street level, similar what currently exists on the Expo Line.
SkyTrain vehicles	The SLS system will be designed to accommodate vehicles that are similar to the various models currently in use on the Expo Line. SkyTrain vehicles will be supplied and operated by TransLink.

5 The RCD version April 2022 was used for the ESR assessment of effects.

Project Component	Component Description
Power, control, and communication system	The Project will be powered by electricity supplied by BC Hydro via new dedicated underground distribution lines, with up to 10 PPSs, as well as power and communication ducts along the alignment. PPSs will typically be integrated with the SkyTrain stations; however, up to two PPSs will be standalone. Automatic train control, communication, and security systems will be similar to those on the Expo Line.
Integration: roadways, other transit, pedestrian access/trails	Project systems will integrate fully with existing SkyTrain systems. Transit exchanges to provide connections between bus and SkyTrain will be located at the following stations: 166 Street, 196 Street, and 203 Street. Existing utilities and services will be modified, as needed, to support the Project. Roadway segments will be widened and/or reconfigured, as required, to accommodate guideway columns, stations, and associated parking and access. Site-specific work will also be required to match existing topography and watercourse crossings.

2.2.1 Alignment

The Project alignment is shown in **Figure 2-1**. Between King George SkyTrain Station and 152 Street, the guideway will be centred on the median of Fraser Highway (**Figure 2-2**). In the vicinity of 152 Street, the guideway will transition to an alignment on the north side of Fraser Highway ("north-running") and continue until east of 166 Street (**Figure 2-3**). Through the Serpentine Valley (approximately 170 Street to 180 Street), the alignment will be south-running (**Figure 2-4**). It will then revert to north-running until Highway 10. At 200 Street, the alignment will shift north from Fraser Highway to Industrial Avenue until the terminus at 203 Street. Where the alignment is spatially constrained, crosshead or offset columns may be required (**Figure 2-5**). The temporary (construction phase) and permanent (SLS and roadway infrastructure) footprints are shown in **Appendix B**: Project Description Figures.

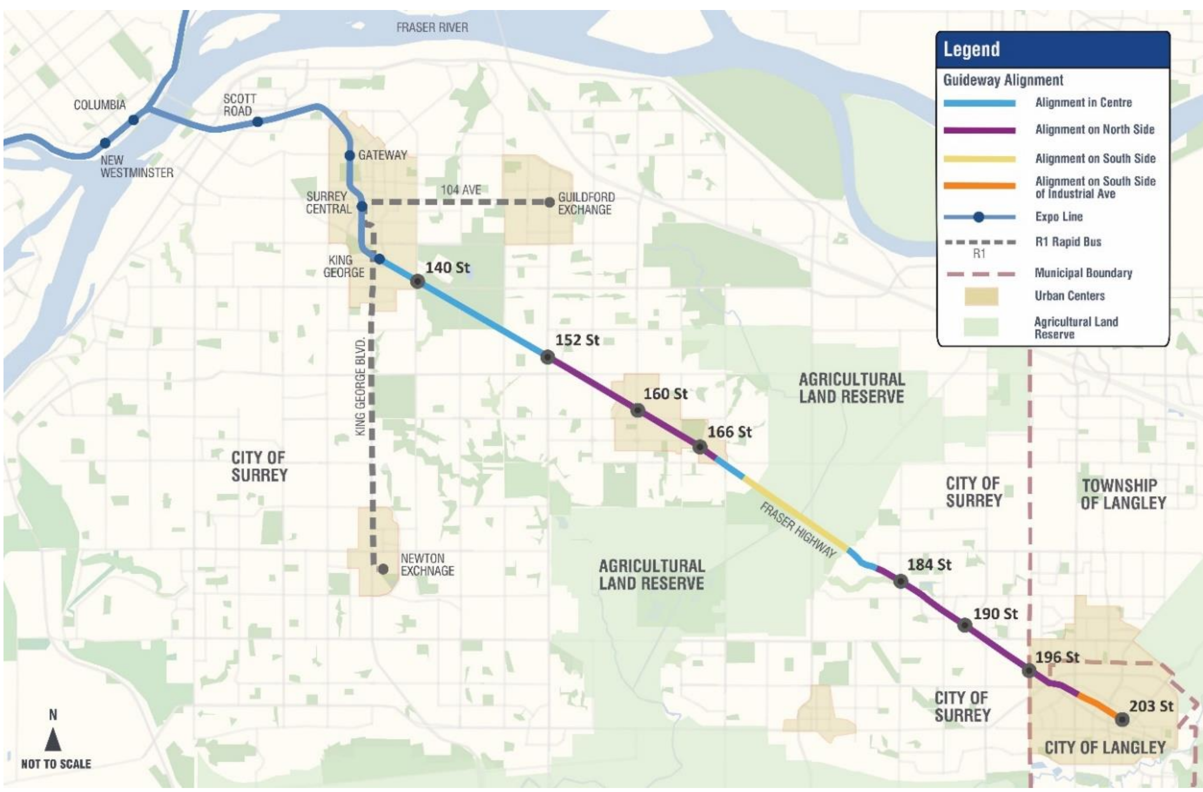

Figure 2-1 Project Overview showing Alignment Types (Median, North, South)

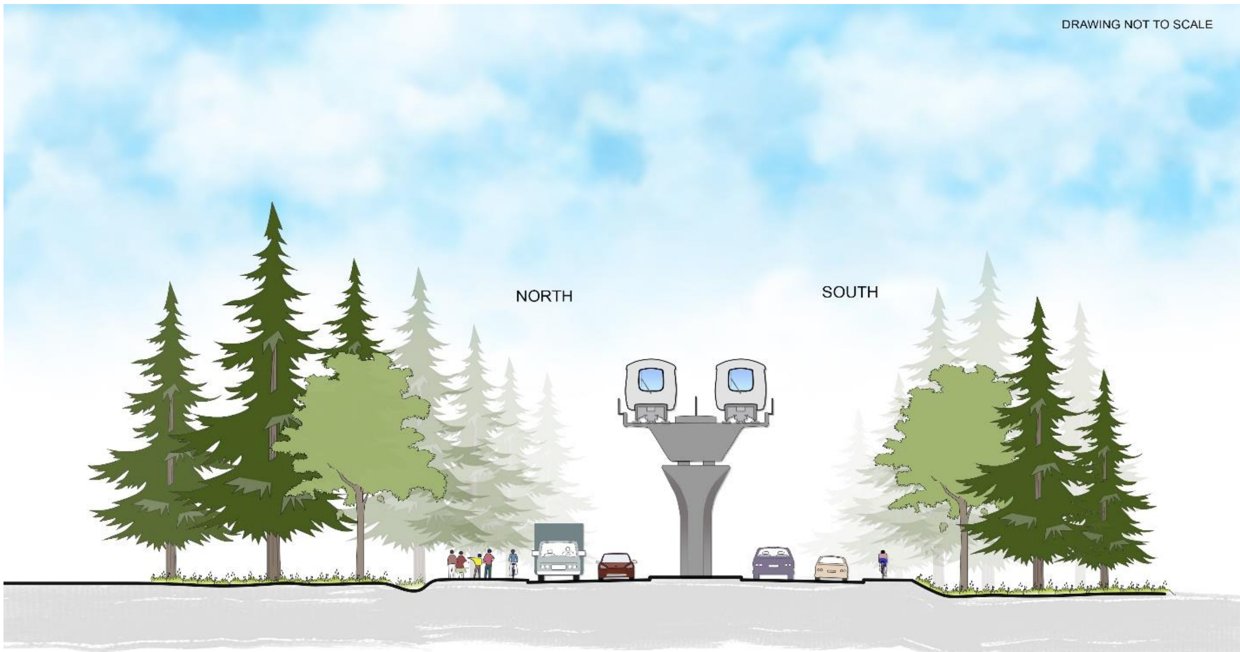

Figure 2-2 Typical Cross-section of Guideway – Median-running

Figure 2-3 Typical Cross-section of Guideway – North-running

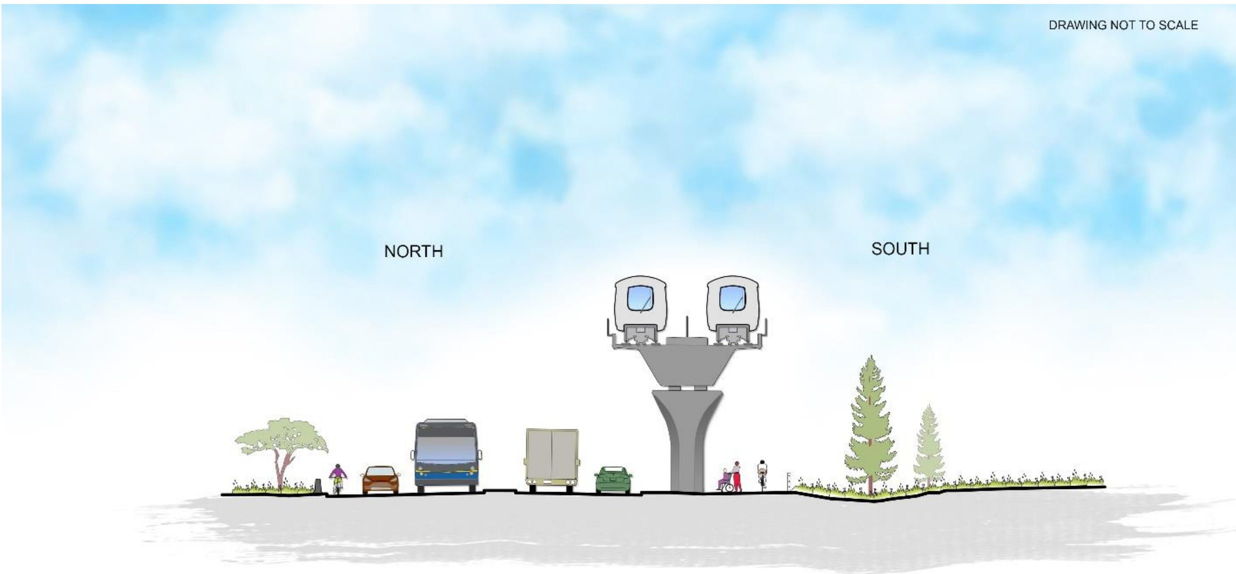

Figure 2-4 Typical Cross-section of Guideway – South-running

Figure 2-5 Example of Offset Column in the Existing SkyTrain System

2.2.2 Elevated Guideway

The entire 16 kilometre SkyTrain extension will be elevated (**Figure 2-1**) with key features that include:

- Alignment generally situated adjacent to Fraser Highway;
- Simple spans of precast box girder segments, typically 39 m in length;
- Typical design clearance of 5.1 m from roadway to the underside of the structure;
- Mountable street and traffic lighting to the guideway structure, if required;
- Storage tracks constructed east of 140 Street Station, west of 166 Street Station and east of 176 Street;
- Limited roadway widening or reconfiguring, as needed;
- Modifications of typical guideway span configurations at certain locations, such as for crossings of the Serpentine River and Highway 15;
- Track type to be direct fixation, continuous-welded rail; and
- Modifications or relocations of existing utilities and services, as needed, to facilitate Project construction and operation.

2.2.3 Stations

The Project includes eight stations located primarily along Fraser Highway at 140 Street, 152 Street, 160 Street, 166 Street, 184 Street, 190 Street, 196 Street, and 203 Street. All stations will be an elevated side-platform design on the north side of Fraser Highway other than 140 Street Station and 203 Street Station. 140 Street Station will be elevated on support columns above Fraser Highway in the median. 203 Street Station will be a centre-platform design. The following criteria were considered in the selection of station locations:

- Analysis and forecasts of current and projected ridership demand, based on planned future employment and population growth;
- Local context, development scale, and community objectives;
- Intermodal connectivity with established bus routes and bus exchanges;
- Avoidance of environmentally sensitive areas;
- Response to municipal land use policies and zoning that encourage higher-density town centres, transit-oriented development, and ridership growth;
- Minimizing constructability issues;
- Access requirements for passenger pick-up and drop-off, HandyDART, maintenance, and emergency response; and
- Minimizing effects on existing properties, GTUF, and ALR areas.

Design of the eight new stations will incorporate the latest TransLink design standards for enhanced capacity, accessibility, and safety (see **Figure 2-6** and **Figure 2-7**). Customers will enter stations at street level and use escalators, elevators, or stairs to reach the elevated platforms. Two of the proposed stations (140 Street and 160 Street) will include an intermediate mezzanine level to facilitate passenger circulation to address specific site constraints.

Design considerations for the new stations include the following:

- Enabling efficient passenger circulation;
- Preventing crime and enhancing public safety through environmental design principles, such as glass walls and open sightlines; and
- Facilitating accessibility through wayfinding elements, high-contrast materials, and other appropriate design features.

Exterior amenities at stations will include an entry forecourt, one or more new bus shelters, and landscaping elements. Each station will be close to bus stops and will provide short-term parking for passenger pick-up and drop-off, as well as parking for assisted ride services, such as HandyDART. Other amenities could include provision for passenger-accessible washrooms. Commercial Retail Units will be located at most stations. Additional public facilities will be provided, including bike parking, parkades or lockers, and customer service centres at select stations.

Figure 2-6 Station Design Concept for Side Platform

Figure 2-7 Station Design Concepts for Centre Platform

2.2.4 SkyTrain Vehicles

As the regional transit authority that operates and maintains the existing SkyTrain network, including SkyTrain vehicles, TransLink oversees the procurement and management of SkyTrain vehicles. SkyTrain vehicle models will be consistent with those in use on the Expo Line (**Figure 2-8**). Configurations will include two to six cars per train, depending on the vehicle model. SkyTrain vehicles are powered by linear induction motors, with power supplied by two electrified rails. Further information on the SkyTrain fleet is available at www.translink.ca.

As with the existing fleet, the vehicles will be serviced at Operations and Maintenance Centres (OMCs). Vehicles will be stored in the same manner as those on the existing SkyTrain system (i.e., at OMCs, and on sidings, pocket tracks, and the main line during non-revenue periods).

Figure 2-8 Example SkyTrain Configuration (Four-car MKIII Train)

2.2.5 Power, Control, and Communications System

The Project's electrical power will be supplied by BC Hydro via new dedicated underground distribution lines, with up to nine PPSs and power and communication ducts positioned along the alignment. Except for standalone PPSs, these elements will be integrated into station footprints (**Figure 2-9**). It is planned that standalone PPSs will be located on municipal ROWs near the 140 Street Station at the intersection of Fraser Highway and 96 Avenue east of the Serpentine River, and near 201 Street. In the design of the system, due consideration was given to levels of electric and magnetic fields (EMFs) produced by trains and the electrified rail that powers them.

For seamless operation of the SkyTrain system, automatic train control and other communication and security systems will integrate with those currently in use on the existing Expo Line. These systems allow the SkyTrain Operations Control Centre to monitor and control vehicles, facilities, and equipment; operate the SkyTrain system in a safe and secure manner; and communicate with customers on trains and in stations.

(Image Source: Google Maps 2019)

Figure 2-9 Example of a Propulsion Power Substation (PPS) Integrated into a SkyTrain Station

2.2.6 Drainage Design

Project infrastructure will affect existing drainage by increasing impervious surfaces in local catchments and requiring some minor changes to drainage infrastructure. Minor incremental changes in impervious surfaces will occur due to an expansion of roadway areas to accommodate the guideway; conversion of existing green space to guideway foundations, stations, PPSs, transit exchanges; and active transportation and pedestrian amenities.

Where the track traverses green space, track drainage will be diverted through swales before discharge to the stormwater system. Station runoff will be controlled via underground vaults to regulate flows to the stormwater system. To meet stormwater flow requirements in the Three Municipalities, flows will be controlled to pre-Project rates at transitions to municipal infrastructure.

2.2.7 Integration with Other Transport Systems and Protocols

The Project will integrate into existing SkyTrain systems, protocols, and networks. TransLink has initiated related projects to expand the capacity of the existing SkyTrain network and support operation of SLS.

Three new transit exchanges will support increased bus service and provide direct bus connections to TransLink's South of Fraser sub-region service area. These exchanges will be located at the 166 Street, 196 Street, and 203 Street Stations.

In general, the capacity of the road network, after any Project-related changes, will remain the same as before construction. To retain existing functionality, the number of on-road vehicle and cycle lanes in each direction will not change.

Pedestrian and cycling facilities along the alignment will operate in a similar manner to pre-construction conditions. Enhancements near stations will improve access and provide passenger waiting areas.

2.3 Project Schedule

Table 2-2 summarizes the Project schedule. Design activities, including engineering and environmental planning support for development of the Project Business Case have been completed. Environmental planning to support permitting and procurement are underway. Detailed design, construction, and testing and commissioning[6] of the Project is expected to take four years, with a target in-service date of 2028.

The Project will not require major maintenance or upgrades for approximately 20 years. SkyTrain has operated continuously for almost 40 years in the region, demonstrating that, with periodic maintenance, the system does not require prolonged downtime and does not result in major degradation of the guideway. As such, there are no plans to decommission the Project, however a 25-year period is considered for operational modeling.

Table 2-2 Preliminary Project Schedule

Key Project Activities	2021	2022	2023	2024	2025	2026	2027	2028
First Nations Engagement (ongoing)								
Stakeholder and Public Engagement (ongoing)								
Environmental Studies and Screening Review (2 years)								
Permitting and Environmental Planning (2 years)								
Engineering Studies and Procurement (3 years)								
Construction, Testing, and Commissioning (4 years)								

2.4 Procurement and Operations

A range of procurement models were assessed for the Project. The objective was to select a procurement model that manages key Project risks, maximizes benefits from the competitive process, allows for innovation and efficiency, complies with procurement policies and standards, provides cost and schedule certainty, and is developed in an environmentally sound manner. The plan for procurement involves multiple contracts consisting of a three-way scope split for guideway and superstructure, systems and

6 Testing and commissioning is anticipated to begin approximately one year prior to the in-service date.

trackwork in Propulsion Power Substation (PPS), and stations. Each scope will be implemented by a project contractor, referred to collectively in the ESR as Project Co. Once constructed, the Project infrastructure will be transferred to TransLink. TransLink's BC Rapid Transit Company (BCRTC) operates and maintains the existing SkyTrain system and will operate and maintain the completed Project.

2.5 Project Activities

The following sections outline the elements of the construction and operations/ maintenance phases of the Project.

2.5.1 Construction

This section describes construction activities typically conducted as part of a SkyTrain project. Typical activities and associated construction equipment types are listed in **Table 2-3**.

Table 2-3 Construction Activities and Typical Equipment for SkyTrain Projects

Construction Activity Type	Equipment Type
Pavement removal	Scrapers, articulated dump trucks, excavators
Concrete demolition	Concrete mechanical (e.g., hoe rams, jackhammers), hydro saws
Road reconstruction (subgrade, base, asphalt baselift, sidewalks, boulevard, curb)	Asphalt pavers, concrete pavers, compactors (double-drum vibratory and pneumatic), bobcats, bulldozers, graders, stripe painters
Utility relocations	Excavators, backhoes, dump trucks, compactors, hydro-vacs, pumps
Construction zone general support	Light plants, traffic management
Construction staging (in yard)	Compressors, pumps, forklifts, cranes, mobile elevating work platforms, power lifts
Drainage diversion and installation	Excavators, water pumps
Construction waste removal	Front-end loaders, articulated dump trucks
Column foundation	Drill rigs, pile drivers (vibratory, hydraulic and impact hammer), concrete trucks, pumper trucks, hydro-vacs
Guideway superstructure installation and erection (both pre-cast and steel)	Erection truss, pre-cast guideway launchers, overhead gantry cranes
Compacting and backfilling	Graders, vibratory tampers
Rail installation	Heaters, portable diesel and light generators, rail saws, welding rigs, track lifting rigs
Systems installation	Hi-rail utility trucks – with cable reels, with crane
Road-side electrical and communications installation, install signals	Cherry-pickers, mobile cranes, rigging equipment
Adjacent property restoration	Small roller, backhoe

2.5.1.1 Construction Staging

Similar to other SkyTrain projects, SLS construction could be sequenced as follows:

1. Site preparation;
2. Utility relocation;
3. Construction of guideway substructure, including piles and columns;
4. Road reconstruction;
5. Pre-cast guideway assembly;
6. Station and transit exchange construction;
7. Track installation;
8. Systems installation; and
9. Testing and commissioning.

The duration of each stage of construction is likely to vary along the alignment, depending on the complexity of the work in each area. Typically, guideway work will be sequenced such that there a relatively short period of construction activity in any one area. Road reconstruction could be required at any point, depending on local staging needs. After the guideway is assembled and once roadwork completed, there will be minimal construction impacts at ground level.

2.5.1.2 Advance Works

Advance works, including fieldwork and environmental site assessment, are underway to allow provide certainty about site conditions, and minimize risks, including logistical and traffic delays. Advance works currently in progress include relocating BC Hydro transmission lines that cross the alignment near 138 Street and 96 Avenue.

Other advance works scheduled to be complete by 2024 include:

- Relocating BC Hydro overhead distribution lines and communications lines that parallel Fraser Highway;
- Conducting contaminated site and archaeological assessments, as required, on select properties where there is identified risk;
- Conducting test piling in the Serpentine Valley to confirm engineering design; and
- Demolishing buildings and other structures related to property acquisition (see Property Acquisition below).

2.5.1.3 Property Acquisition

Some property will be required to accommodate the Project, primarily at station locations and adjacent alignment transition areas. A limited number of properties may be purchased in their entirety, but most property will be obtained through gaining ROWs over small portions of land and temporary easements on others to facilitate construction access. MOTI has an established program to support a fair and transparent process that respects the confidentiality of negotiations with property owners.

2.5.1.4 Utility Works

Utility works will include the location and identification of utilities, relocation of underground and overhead lines, and the protection of utilities *in situ*, where required. Utilities include BC Hydro, FortisBC, and telecommunications. Regional and municipal utilities include sanitary sewer, storm sewer, drainage, and water lines. Utility realignment and regrading may require work beyond the immediate area of the guideway. Specific utility relocations are under consideration as advance work, as described above.

2.5.1.5 Temporary Land Access

Temporary access of land will be required to facilitate construction. These temporary footprint areas are generally located adjacent to the permanent Project Footprint along the Fraser Highway corridor, and where feasible, typically within the municipal ROW. **Appendix B:** Project Description Figures identify temporary footprint areas adjacent to the alignment.

Additional lands will be used on a temporary basis for ancillary facilities, such as outdoor and warehouse storage and potentially, for a casting yard to manufacture and store guideway segments. Project Co will need to acquire the rights for storage and logistics areas, which will generally be in close proximity to the alignment. Project Co will determine the need for a casting yard; typically, these are located farther away from project sites to optimize efficiency with concrete supply and transportation.

2.5.1.6 Traffic Management

Infrastructure work along Fraser Highway will disrupt traffic flow, particularly during utilities, substructure, and roadway work. Temporary detours and new roadworks may be required to facilitate work while maintaining traffic flow. Detailed Traffic Management Plans (TMPs) will be required to address Project-related changes during construction that affect vehicular traffic, public transit, pedestrians, and cyclists. TMPs are discussed in **Section 15** Transportation and Access and will include details on roadway diversions, signage, traffic control, temporary lane closures, temporary access restrictions, and temporary road closures.

2.5.1.7 Roadworks

The Project will widen and reconfigure roadways to accommodate the alignment at site-specific locations while maintaining through traffic. In addition, sidewalks, and bike lanes will be provided or replaced like-for-like along the alignment. The Province will coordinate with the Three Municipalities regarding any planned improvements. Roadworks will include construction and installation of curbs, sidewalks, bike lanes, exchanges and stops, and crosswalk enhancements.

2.5.1.8 Substructure and Columns

Based on the RCD, typical foundations for the guideway will consist of 2.4 m diameter steel pipe piles. Where possible, piles will be drilled to mitigate potential noise and vibration in the surrounding area. Depending on ground conditions, a section of steel liner pipe may need to be installed during the drilling process. Once the piles have been drilled, concrete and rebar will reinforce the foundation. Impact pile driving will be required through the Serpentine Valley in the cities of Surrey and Langley where deep foundations are necessary due to geotechnical conditions.

The column and top structure will then be formed and filled with concrete and rebar. Once the concrete is set, the forms will be removed, and the column will be complete and ready for the erection truss to lay the guideway.

As is typical on the existing SkyTrain system, guideway column design will depend on the specific location. A photograph of the typical guideway column design is shown in **Figure 2-10**.

(Image Source: Google Maps 2022)

Figure 2-10 Typical Guideway Column Design

2.5.1.9 Installation of Elevated Guideway Segments

Typically, guideways are constructed using an erection truss. This machine bridges two columns and, using a series of cables, lifts pre-cast concrete segments into place. The segments are then epoxied together, and cables tensioned through the pieces that form the beam. Once the beam is set onto the columns, the truss is advanced to the next pair of columns to repeat the process.

2.5.1.10 Construction of Stations

Except for foundation works, station construction will typically commence following construction of the guideway. Station construction includes the superstructure, platforms, roof structures, lighting, and systems installation.

2.5.1.11 Construction of Power Supply

Electrical power supply from the PPSs to the trains will be supplied through new underground duct banks. The SkyTrain system runs off a voltage converted by the PPS. PPS buildings will typically form part of the station infrastructure. Due to spatial constraints at the 140 Street Station and 203 Street Station, the PPS for these stations will be separate from the station structure. . Due to the distance between the stations at 166 Street and 184 Street, plans include a standalone PPS for the Fraser Highway ROW east of the Serpentine River to provide power to that portion of the Project.

2.5.1.12 Management and Disposal of Waste

The Project will generate general construction waste and excavation material. Waste will be managed in accordance with best practices, and Project requirements. Excavated materials that are unsuitable for reuse will be transported off site for disposal at regulated facilities.

2.5.1.13 Testing and Commissioning

Prior to the operation of the SLS, TransLink will conduct a complete and thorough testing and commissioning process to ensure that trains operate safely; trains traverse the guideway as designed; and all associated systems operate as designed. During this testing period, trains will be driven slowly along the alignment in manual mode to ensure that nothing intrudes into the operating envelope. The train will be operated at incrementally higher speeds and under increasing levels of autonomy until it can operate in fully automatic mode at design speeds.

2.5.2 Operation

Average SkyTrain travel speeds on the extension will be similar to those on the existing Expo Line. Trains are expected to run every 6 to 8 minutes during peak hours from King George SkyTrain Station to Langley City Centre for a total run time of approximately 22 minutes. **Table 2-4** summarizes the initial design operating parameters for initiation of SLS revenue service**.** By the year 2050, average weekday ridership is estimated to be 80,000 customers.

Table 2-4 SLS Operating Parameters for Design

Operating Parameter	Design Capacity
Total Fleet	55 cars
Maximum Vehicle Length	5-car train sets; 84.8 metres
Travel Time	22 minutes between King George and Langley City Centre
Average Operational Speed	44 kilometres per hour
Maximum Line Speed	80 kilometres per hour
Power Pick-up	Positive/negative power rail

2.5.2.1 Maintenance

Ongoing maintenance of the extension will occur at regular intervals, and as needed, throughout operation, as is the case for the existing SkyTrain system. Activities include servicing SkyTrain vehicles and tracks and maintaining stations. Maintenance and renewal will include inspections and monitoring, as needed, to manage performance and address safety and environmental conformance. Vehicle maintenance activities typically take place at OMC facilities.

2.5.2.2 Integration with Other Modes of Transportation

Once operational, the Project will replace the bus service along Fraser Highway and is expected to increase transit mode share within the Three Municipalities on account of increased service frequency, improved customer experience, and faster travel times. Stations at 166 Street, 196 Street, and 203 Street will provide bus connections to destinations across TransLink's South of Fraser sub-region service area. Prior to operation, TransLink will adjust local bus routes to better integrate with the SLS and avoid duplication of services.

The Province and the Three Municipalities will collaborate to enhance the customer experience within and outside the stations through design elements intended to realize the following benefits:

- Maintaining and improving (e.g., widening) sidewalks in the vicinity of stations;
- Integrating planted boulevards and pedestrian buffers into station planning;
- Promoting safe and seamless pedestrian access to stations through signage, upgraded intersection crossings, sidewalks, safety barriers, and lighting;
- Designating spaces for passenger pick-up and drop-off, taxis, and ride-hailing;
- Providing amenities, such as shelters and street furniture at stations with connecting bus service; and
- Providing reserved parking areas for service vehicles and access for emergency service vehicles.

At a minimum, bike lanes will be replaced along Fraser Highway to be functionally similar to the existing cycling facilities. In addition, west of 152 Street and between 64 Avenue and 196 Street, cycling facilities will be improved. Bike policy for the extension will be consistent with that for the rest of the SkyTrain system.

3 Project Benefits

It is expected that the Project will help achieve short- and long-term local, regional, and provincial benefits. With the elevated alignment positioned along a dedicated ROW, SkyTrain cars can safely carry large numbers of transit customers and travel at higher speeds, thereby providing more efficient and reliable service. Additional benefits include job and economic growth, improved community health and quality of life, a fast, frequent, and convenient transportation choice for the growing population, and a cleaner, more resilient, and sustainable mode of transportation.

This section provides an overview of the Project's anticipated benefits based on analysis the Province conducted for the Business Case, including transportation, social and community, economic, and environmental benefits. For additional information on the Business Case, please visit the Document Library at www.surreylangleyskytrain.ca.

3.1 Improving Transit Service

The Three Municipalities are facing increased transit overcrowding and congestion in transportation corridors. The SLS will help to mitigate these challenges, as described below.

3.1.1 Increasing Transit Capacity

The greater capacity and higher frequency of SkyTrain will support increased ridership compared to the existing capacity of a RapidBus. The SLS is forecast to have a weekday ridership of approximately 56,000 in 2028 and 80,000 by 2050 (MOTI et al. 2022). In 2050, capacity would be more than five times the capacity of RapidBus (BAU). Of the forecasted trips in 2050, approximately 43% (or 34,400 trips) will be new transit trips by customers who switched from other modes of transportation (predominantly from auto travel).

Although the COVID-19 pandemic negatively affected public transportation ridership, detailed modelling and a sensitivity analysis of pandemic impacts and other uncertainties indicate that ridership recovery supports the investment in the Project.

3.1.2 Lowering Transit Travel Time

The SLS will provide fast, frequent, and reliable rapid transit service that offers significant savings in transit travel times. Typically, once customers board a train on the SkyTrain network, they can quickly and predictably travel around Metro Vancouver. For example, once the SLS is in operation, travel time between the 203 Street Station in the City of Langley and the King George Station in the City of Surrey will be 22 minutes (TransLink 2020).

As traffic congestion along Fraser Highway and surrounding areas continues to grow, bus and automobile travel times will increase. Due to the SkyTrain's grade separation on an elevated guideway, travel times will remain consistent. **Figure 3-1** highlights the travel time savings from the Project to various destinations when compared to BAU.

Figure 3-1 2050 Fleetwood Origin Transit Travel Times BAU and Project (MOTI et al. 2022)

3.1.3 Increasing Transit Reliability

The SLS will also increase transit reliability, enabling transit customers to estimate their travel time more accurately. Currently, they must account for extra time in their commute to ensure a timely arrival due to uncertainties in traffic conditions. Resilience is a factor of reliability for a transportation network. With its dedicated ROW and elevated platform, SkyTrain will be more resilient to many of the conditions that cause disruptions to road users such as:

- Poor weather conditions, including rain or snow that can affect vehicle speeds and road safety7;
- Traffic jams and road closures resulting from collisions; and
- Congestion resulting from high volumes of automobiles on roads.

The reliability of SkyTrain technology is tried and tested with the existing Expo Line. For example, in 2018 SkyTrain arrivals were on schedule 96.5% of the time (Chan 2019). As traffic congestion increases in Metro Vancouver and on-street travel times become more uncertain, the relative reliability of the SLS compared to the bus transit will continue to improve.

[7] The Province in collaboration with TransLink's operating partners, BCRTC and Coast Mountain Bus Company, have provided input to an assessment of climate change and resilience to consider adaptations to Project operations for extreme climate events.

3.1.4 Improving Customer Experience and Comfort

The SLS will improve the transit customer's experience and comfort over existing conditions. At stations, users will wait for the SkyTrain at grade-separated platforms that will provide good weather protection and provide accurate travel times through a Passenger Information Display System. As is the case elsewhere along the system, SkyTrain vehicles will include air conditioning, heating, seating, dedicated areas for individuals with disabilities, and space for bikes and other sustainable modes of transportation. In addition, the SLS will offer safety and security features, such as Transit Police patrol, fare gates, and closed-circuit television cameras.

3.1.5 Improving Safety

As noted above, traffic modelling for the SLS forecasts a reduction in on-road vehicle kilometres travelled (VKT) in Metro Vancouver by 2050, which would be coupled with a mode shift to rapid transit. By reducing automobile travel, rapid transit can increase road safety by reducing congestion and accidents. Residents of transit-oriented communities have much lower per-capita traffic fatality rates than residents of more automobile-dependent sprawling communities (Litman 2021; Stimpson et al. 2014). For example, research has shown that increasing rail service frequency by 10% reduces car and motorcycle use by nearly 3%, which reduces road accidents by 4.6% (Lalive et al. 2013).

3.1.6 Improving Transportation Choice

The SLS will provide access to rail rapid transit to areas that are currently only served by bus. This presents new travel opportunities for cyclists and people with mobility devices, for example, as rail rapid transit may enhance accessibility compared to bus travel.

New SkyTrain stations will be located adjacent to bicycle routes that connect Fraser Highway to other parts of Surrey, Langley and beyond, such as 96 and 88 Avenues, Highway 15, and the Guildford, Newton, Cloverdale, and Willoughby neighbourhoods. In addition to the existing bicycle parkade, lockers, and racks at King George Station, bike parkades at 166 Street and 203 Street Stations will help to grow the number of people turning to rapid transit and active transportation.

3.2 Increasing Sustainable Mode Share

A robust, permanent, and stable network of transit and active transportation infrastructure will enable sustainable transportation choices. The SLS will increase transit ridership and replace a significant number of VKT by private automobile. By improving sustainable transportation options, the SLS will support TransLink's target for the year 2043 of 50% of all trips region-wide to be made by walking, cycling, and transit. With a forecasted average of 64,000 weekday boardings in 2035, the SLS is estimated to replace nearly 24,000 auto trips by 2035 (MOTI et al. 2022). The shift from private automobile to transit could reduce per capita car ownership, lowering transportation costs and combustion engine emissions. This shift is likely to benefit low-income households, in particular.

3.3 Improving Access to Transit

By the year 2050, the Three Municipalities are forecast to grow by more than 424,000 new residents and 150,000 new jobs. Currently, these municipalities are under-served by rapid transit, as there are only four SkyTrain stations in the City of Surrey, and all are along King George Boulevard. The SLS is a critical investment, offering a growing population the ability to travel more affordably and efficiently around the south of Fraser area (TransLink 2021).

The SLS will improve regional access by connecting key areas such as Surrey Metro Centre, Fleetwood Town Centre, and Langley City Centre with rapid transit, providing public transit access to more housing, employment, education, business, community facilities, and services options. Furthermore, the transit network will be better able to accommodate peak demand for major cultural, social, and sporting events, thus further enhancing community accessibility. Through increased accessibility, users will have more opportunities to participate in events and access services in their communities. This is especially important for seniors and individuals with special mobility needs.

3.4 Supporting Economic Development

The SLS will encourage long-term economic growth in the region by supporting higher-density, mixed-use communities near transit, particularly around SkyTrain stations, in accordance with regional and municipal planning objectives for sustainable growth. Increased access to transit will improve access to labour and educational opportunities. In addition, fewer cars on the roads will free up road space for moving goods through the region.

3.4.1 Increased Access to Opportunities

The SLS will improve connectivity and access to employment and educational opportunities across the SkyTrain network. By better connecting residents to jobs and post-secondary institutions, the SLS is anticipated to increase economic competitiveness of the region (TransLink 2020). Improving transit connections between centres of innovation, such as the Surrey campus of Simon Fraser University and the Langley and Surrey campuses of Kwantlen Polytechnic University, will encourage economic growth in the future.

The population of the Three Municipalities is projected to increase by 35% from 2017 to 2035 and by 60% from 2017 to 2050, which is significantly higher growth than the rest of Metro Vancouver (MOTI et al. 2022). Growth forecasts indicate that 58,000 residents will live within 800 m of the new stations by 2035 (TransLink 2020). The SLS will improve access to a wider range of housing options, including rental housing, while providing access to jobs, education, and other opportunities.

3.4.2 Supporting Job Creation

The Project is predicted to generate approximately 12,000 direct and 12,000 indirect equivalent employment opportunities (Full Time Equivalents)(MOTI et al. 2022), stimulating the local economy, and supporting provincial and federal economic objectives in the post-COVID-19 period.

3.4.3 Improving Goods Movement Efficiency

By removing automobile trips from Fraser Highway and connecting road networks, the Project seeks to improve the efficient movement of goods by:

- Reducing truck travel time and resources spent in traffic due to lowered traffic congestion (annual truck-time savings are projected to be over 3.7 million minutes in 2035 and over 6.3 million minutes in 2050); and
- Promoting the efficient use of existing road assets and realizing cost savings by delaying investments in future road expansion.

3.4.4 Supporting Urban Economies

Urban economies benefit when businesses and people locate themselves near one another or gather in cities and industrial clusters. People in urban communities can more easily access jobs that better match their skills, and they are more easily able to share knowledge face to face. In addition, urban agglomeration creates demands for more business, entertainment, and cultural opportunities, which in turn benefit more people. Congestion is a challenge in communities and can make urban interactions too costly or time-consuming to pursue. When people forego these benefits, net costs and other effects from congestion rise significantly. Numerous urban economic development benefits are associated with encouraging densification of businesses and residential areas around the SLS alignment. This focused densification is expected to lead to economic efficiencies such as:

- Clustering business enterprises and economic activities, increasing access between firms;
- Improving access to suppliers and customers;
- Improving availability to a larger pool of labour resources; and
- Increasing overall economic productivity and activity levels (Dachis 2013).

Furthermore, it is expected that workers currently living and working in urban areas around the SLS alignment will benefit from enhanced access to services and improved productivity. For example, reduced commute times and costs may enable workers in the labour force to access more varied employment opportunities.

3.5 Increasing Health Benefits

The SLS will provide numerous health benefits for transit users by supporting physical activity, improving air quality, and providing better access to health services.

3.5.1 Supporting Physical Activity

The SLS will spur higher-density land use of areas around new SkyTrain stations where new commercial and residential complexes will emerge in response to increased demand for housing and services in the region. Amenities in complete communities (i.e., walkable, mixed use, and transit-oriented) will be close enough to encourage walking as the primary choice over alternate modes of transportation. Research indicates that people living in more walkable areas are two to three times more likely to walk to complete home-based trips, and are half as likely to be overweight, compared to those living in less walkable areas (Devlin et al. 2009; Frank et al. 2009). Increasing walkability stimulates socialization, and provides residents with a stronger sense of community, thereby improving mental health and community resiliency. In addition, transit systems, like SkyTrain, when combined with transit-oriented communities, often improve pedestrian and cycling conditions, which leads to increased fitness and better health outcomes in the population. On average, public transit users walk approximately three times more than people who rely on automobile transportation, almost achieving the 22 daily minutes of recommended moderate physical activity for health purposes (Besser and Dannenberg 2005).

3.5.2 Improving Air Quality and Lowering Greenhouse Gases

Long-term exposure to air pollutants can increase the likelihood of cardiovascular and respiratory disease, cancer, and harmful birth outcomes. Various criteria air contaminants (CACs), such as carbon monoxide (CO), nitrous oxides, sulphur oxides, volatile organic compounds (VOCs), and particulate matter (PM) are produced by on-road vehicles, particularly vehicles powered by combustion engines. During the operation phase, the Project’s electric technology is predicted to benefit air quality in the region through reduced emissions from:

- Mode shift from private combustion engine powered vehicles to rapid transit;
- Lower amounts of congestion-related idling of on-road vehicles; and
- Displacement of diesel buses and their associated emissions.

3.5.3 Increasing Access to Health and Recreational Services

The SLS will improve access to health services and social and recreational activities, which could collectively contribute to better health and well-being of residents in neighbouring communities. The SLS will increase access to health care facilities, such as medical clinics, Surrey Memorial Hospital, Langley Memorial Hospital and the Jim Pattison Outpatient Care and Surgery Centre (JPOCSC). Access to recreational and community infrastructure, such as parks, community centres, and recreational facilities, including the Fleetwood and Langley City Community Centres and the Surrey Sports and Leisure Complex will also improve.

3.6 Providing Environmental Benefits

BC’s transportation sector is a major contributor to air pollution and is responsible for 37% of BC’s GHG emissions (MOTI et al. 2022). The SLS will provide a clean and resilient mode of transportation with numerous environmental benefits, and will replace auto trips with transit trips, thereby reducing road congestion and VKT.

Environmental benefits include:

- Reduced air pollutants and GHG emissions;
- Reduced water pollutants;
- Reduced congestion-related idling;
- Deferral of future roadway expansion due to capacity issues;
- Increased opportunities for active transportation; and
- Increased opportunities for integrated development.

Although an initial increase in GHGs is predicted to result from proposed construction activities, a significant reduction in annual Project-related GHG levels is predicted by the year 2035 (for estimates of reductions, see **Section 7** Air Quality and Greenhouse Gases). The forecasted reduction in total GHG emissions (as measured in CO_2 equivalents) in 25 years of Project operation is 98 kilotonnes (kt). By decreasing exposure to air pollutants, the SLS will lower the risk of associated health conditions in neighbouring communities.

The Project's construction activities are expected to generate approximately 15 kt of direct GHG emissions (as expressed in CO_2 equivalents) during construction. Emissions will become carbon neutral because of GHG savings approximately 3 years after the SLS opens. Furthermore, the SLS promotes higher-density mixed-use land development, which creates opportunities for residents to live closer to where they work, shop, or study. Clean operation of an electrically powered SkyTrain system and improved mode share will also trigger shifts from on-road vehicle usage, helping to reduce the amount of contaminants from road run-off entering adjacent watercourses.

3.7 Encouraging Higher-Density, Mixed-Use Communities

Working in collaboration with the Three Municipalities throughout the Project's design and development process, the Province expects SLS to be a significant catalyst in achieving transit- oriented development in a number of areas along the Project alignment. The Project is a key component in strengthening transportation demand management objectives and promoting affordable housing supply (MOTI et al. 2022).

3.7.1 Creating Walkable Higher-density Communities

Metro Vancouver encourages higher-density development along rapid transit corridors through its RGS (Metro Vancouver 2022). As demonstrated elsewhere in Metro Vancouver, the SkyTrain's speed, frequency, reliability, and permanency encourage developers to maximize the amount of residential, commercial and leisure space, for example, around SkyTrain stations, which supports urban densification.

The SLS will facilitate greater density and concentrations of people and jobs, which supports land use planning and rezoning objectives. Thoughtful redevelopment, shaped and supported by other municipal policies, can enable transit-oriented communities around SkyTrain stations. Development in these transit hubs provides a reliable source of transit ridership within a compact, mixed-use environment. In this way, development around the stations will support the aims of Metro Vancouver's RGS, TransLink's Transport 2050 Regional Transportation Strategy (TransLink 2022), and municipal transportation plans and OCPs.

3.7.2 Creating Opportunities for Affordable Housing

As has been noted for the Broadway Subway Project (Government of BC 2019b), households in areas well served by rapid transit generally spend less on transportation costs. Rapid transit is an important means to provide more transportation options that are affordable and sustainable. By improving the viability of development near SkyTrain stations, new opportunities to develop market and below-market rental housing can be created. One can expect some land value uplift as the benefits of nearby rapid transit and transit-oriented development make the area more attractive. The Province's Overarching Supportive Policies Agreement (OSPA) (Government of BC 2022) and TransLink's Supportive Policies Agreements (SPA)s with the Three Municipalities outline processes to encourage a net new supply of affordable housing (MOTI et al. 2022).

4 First Nations Engagement

4.1 Introduction

The Province places high value on early and frequent engagement with First Nations, including seeking their input on ESR-related materials, and providing opportunities to participate in field studies. The Province will continue to work with participating First Nations throughout the duration of the Project.

Initial engagement (beginning in early 2019) for the King George Station to 166 Street stage of the Project was led by TransLink. Since August 2021, following the decision to assume delivery of the Project, the Province has led engagement activities.

The following section describes the First Nations engagement from January 16, 2019 to December 31, 2022, as well as future plans. This summary:

- Describes the Province's principles and guidelines related to First Nations engagement and consultation;
- Identifies potentially affected First Nations;
- Summarizes ESR-related engagement activities;
- Describes participating First Nations' key interests and feedback along with the Project team's responses; and
- Discusses how input from participating First Nations on the draft ESR influenced the ESR and will inform environmental management, including the development of proposed mitigation measures to minimize or eliminate potential effects during Project construction and operation.

4.2 Principles and Guidelines for First Nations Engagement and Consultation

The Province is committed to the meaningful and effective involvement of participating First Nations in the planning and delivery of the Project. The Province recognizes the importance and relevance of the rights and interests of First Nations in Project development and related decision-making processes. This stems from the recognition that First Nations have the right to practice and protect their unique cultures, identities, traditions, and customs and that certain sites, places, landscapes, traditional practices, and beliefs can have deep cultural and spiritual significance for First Nations.

The principles and guidelines that have informed the Project's approach to engagement and consultation with First Nations on the Project and the ESR are as follows:

- Establishing effective and respectful working relationships from the outset;
- Ensuring meaningful engagement throughout the ESR process;
- Providing timely Project and ESR-related information to First Nations;
- Providing meaningful opportunities for input to ESR-related documents and involvement in ESR-related fieldwork;
- Obtaining feedback from First Nations regarding the ESR process; and
- Identifying and addressing interests and input raised by participating First Nations, including updates to the ESR.

4.3 Identification of Potentially Affected First Nations

The Province's contacts for First Nation Consultation Areas were utilized to identify First Nations potentially affected by the Project. The Project team has been consulting at an in-depth level with the following First Nations who have identified interests potentially affected by the Project:

- Katzie First Nation;
- Kwantlen First Nation;
- Matsqui First Nation;
- Musqueam Indian Band[8];
- Semiahmoo First Nation;
- Tsawwassen First Nation;
- Seabird Island Band;
- PRRO - Shxw'owhámél;
- PRRO - Skawahlook First Nation; and
- PRRO - Soowahlie First Nation.

For the purposes of this summary, the above First Nations are the participating First Nations.

4.4 Approach to Engagement Activities

A multi-year, phased approach to First Nations engagement guides the work of the Project. To date, it has included:

- Phase 1 – Project Introductions – completed;
- Phase 2 – Overview of Design and ESR Process – completed; and
- Phase 3 – Input into ESR and CEMP Framework - completed.

Engagement methods for the exchange of information and related comments and input includes letters, email updates, teleconferences, in-person and virtual meetings, and opportunities for involvement in field studies.

The COVID-19 pandemic affected the operations and capacity of many participating First Nations. As a result, the Project adapted its engagement methods to meet First Nations' modified needs, priorities, and operational capabilities. Examples include:

- Holding virtual meetings since March 2020 via video conferences, including initiating meetings with new First Nations' referrals staff to provide information on the Project's background and current activities;
- Accommodating First Nations staff working at home offices by couriering hard copies of materials, where requested;
- Incorporating feedback from participating First Nations in the development and implementation of additional safety protocols for field studies;
- Offering opportunities to participate in fieldwork, either in person or virtually; and
- Modifying review timelines for ESR-related materials to accommodate capacity constraints.

[8] Musqueam initially participated in an in-depth review of the ESR for Stage 1 (to Fleetwood) but has indicated that engagement will be more limited for the full Project extent and will defer to more closely affected Nations. The Project team will continue to share project updates and to engage Musqueam on any material changes in scope or design.

Phase 1 to 3 engagement activities are described below

Phase 1 – Project Introduction (January 2019 to March 2019):

- Introductory letters and follow-up correspondence via email and phone;
- Meetings with participating First Nations;
- Correspondence included preliminary information on the proposed alignment, Project design concepts, schedule, and estimated costs and opportunities; and
- Discussion topics included the engagement process, initial First Nations interests, and action items.

Phase 2 – Overview of Design and Environmental Screening Review Process (April 2019 to May 2019):

- Project update meetings; and
- Discussion regarding Project scope, draft ESR and TOR.

Phase 3 – Input into ESR and CEMP Framework (June 2019 to December 2022):

- Invited participating First Nations to:
    - participate in environmental and archaeological field studies (see **Section 4.4**);
    - review ESR baseline reports, the Archaeological Overview Assessment (AOA), Interim Archaeological Impact Assessments (AIAs)[9], and other ESR-related documents;
- Meeting topics included the above-noted reports, and Project and design updates; and
- Requests for information on Indigenous Knowledge[10] and Traditional Land Use[11] related to the Project area.

In addition to this type of direct engagement, First Nations will continue to have opportunities to provide input through various federal and provincial permit referrals.

4.4.1 Meetings with First Nations

Since early 2019, the Project team held regular in-person and videoconference meetings with participating First Nations based on their identified interest and availability to discuss the Project, ESR, archaeology, and key areas of interest. In August 2021, the Province began holding monthly meetings (virtually) with participating First Nations to ensure relevant updates and opportunities are shared in a timely manner.

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9 On behalf of Stó:lō, Stó:lō Research and Resource Management was provided drafts of the Project's AOA and AIA for review and invited to participate in archaeological field work.

10 Indigenous knowledge is defined as… a body of knowledge built up by a group of people through generations of living in close contact with nature. [Indigenous Knowledge] is cumulative and dynamic. It builds upon the historic experiences of a people and adapts to social, economic, environmental, spiritual and political change" (Government of Canada (2015, 2016).

11 Traditional land use "*refers to how the use of lands and resources may be affected throughout the proposed project's lifecycle (pre-construction, construction, operation, decommissioning, and abandonment). This includes uses by Aboriginal peoples that are actively being carried out at the time of the evaluation and uses that are likely to occur in a reasonably foreseeable future provided that they have continuity with traditional practices, traditions or customs…"* (Government of Canada (2015).

4.4.2 First Nations Fieldwork Participation

Table 4-1 summarizes First Nations' participation in Project fieldwork between 2019 and 2022. All participating First Nations were invited to join field programs, both on-site and virtually since the onset of COVID-19 in March 2020. First Nations technicians have provided valuable input during environmental and archaeological field studies, and opportunities to participate in field programs will continue as the Project progresses.

Table 4-1 First Nations Participation in Project Fieldwork, 2019 to 2022

Field Program	Date	First Nations
Terrestrial Field Program	June 2019	• Kwantlen First Nation • Matsqui First Nation
Aquatics Field Program	July 2019	• Kwantlen First Nation • Matsqui First Nation
Archaeological Preliminary Field Reconnaissance (PFR) (part of the AOA)[1]	July 2019	• Katzie First Nation • Kwantlen First Nation • Semiahmoo First Nation
Archaeological monitoring of geotechnical drilling	July – August 2019 May 2020	• Katzie First Nation • Matsqui First Nation • Musqueam Indian Band • Kwantlen First Nation • Semiahmoo First Nation
AIA fieldwork (King George Station to 166 Street)	August 2020	• Katzie First Nation • Kwantlen First Nation • Matsqui First Nation • Musqueam Indian Band • Semiahmoo First Nation • Tsawwassen First Nation
Archaeological monitoring of utility locates (Fraser Highway around 96 Avenue)	December 2020	• Katzie First Nation • Kwantlen First Nation • Matsqui First Nation • Musqueam Indian Band • Semiahmoo First Nation
Archaeological monitoring of geotechnical drilling	August – September 2021	• Kwantlen First Nation • Musqueam Indian Band
AIA fieldwork (Part 1 – 166 Street to Langley City)	December 2021	• Katzie First Nation • Kwantlen First Nation • Musqueam Indian Band
AIA of geotechnical test pile work area	June 2022	• Katzie First Nation • Kwantlen First Nation
AIA fieldwork (near Highway 15 and Fraser Highway intersection)	October 2022	• Semiahmoo First Nation • Matsqui First Nation
AIA fieldwork (Part 2 between 168 Street and 203 Street)	November 2022	• Katzie First Nation • Musqueam Indian Band

Note:

1. Musqueam Indian Band did not participate due to capacity constraints.

4.5 First Nations Reponses to Project Engagement

In addition to in-depth involvement of participating First Nations, the Project engaged and received input from other First Nations, as summarized below.

The Project team sent introductory information and then regular updates to the following First Nations and groups:

- Kwikwetlem First Nation;
- Seabird Island Band;
- Shxw’ow’hamel First Nation; and
- Stó:lō Tribal Council.

Feedback from the above-listed First Nations is summarized as follows:

- Kwikwetlem First Nation initially confirmed that the Project is not in the Nation’s Territory; since Summer 2021, upon their request, Kwikwetlem First Nation has been provided updates on major milestones;
- In August 2022, Seabird Island Band requested greater involvement. Discussions are ongoing regarding the scheduling of regular meetings, and other opportunities that are of interest;
- Through a phone call and email in May 2019, PRRO deferred content reviews to First Nations located closer to the Project site, with the exception of archaeology activities and reporting where Stó:lō Research and Resource Management remains engaged;
- In 2019, Stó:lō Tribal Council initially inquired about Project opportunities (the Project responded accordingly) and then followed up in summer 2021 requesting that Project information be sent to PRRO; and
- Up to December 31, 2022, no responses have been received from Shxw’ow’hamel First Nation.

Through to June 2021, the Project also sent introductory correspondence and notification-level updates to the following First Nations located on Vancouver Island:

- Cowichan Tribes;
- Halalt First Nation;
- Lake Cowichan First Nation;
- Lyackson First Nation;
- Penelakut Tribe; and
- Stz’uminus First Nation.

As of December 31, 2022, no feedback or responses were received from these six First Nations.

4.6 Project and ESR-related First Nations’ Interests

To date, participating First Nations have expressed interest in both general Project activities as well as ESR-related components, including meaningful engagement, participation in fieldwork and Project opportunities, protection of heritage and archaeological sites, environmental protection, Indigenous Knowledge and Traditional Land Use information. A full summary of the identified interests and the Project team’s responses are summarized in **Addendum 4-1**.

4.7 First Nations Input to ESR Reporting

The ESR process serves as a means to gather input from participating First Nations on potential Project-related environmental effects and mitigation. A summary of input that has helped to inform the ESR scope of assessment is found below. The Project team will continue to incorporate additional input received by participating First Nations, where applicable.

4.7.1 Input to Draft ESR Terms of Reference

Three participating First Nations provided feedback on the draft TOR for the ESR (dated May 22, 2019) and two responded by indicating that had no comments to provide. The comments and input were reviewed, acknowledged, and integrated into the final ESR TOR as well as Project plans and design, as appropriate. Details on how the Project team considered and addressed the comments are included as part of **Addendum 4-1** . The ESR TOR was updated to reflect the fact that the Province assumed the role of Project delivery agent, and that the ESR encompasses the full 16-kilometre scope.

4.7.2 Input to Draft Environmental Baseline Reports

Four participating First Nations commented on the following baseline reports: Agricultural Land; Air Quality and Greenhouse Gases; Fisheries and Aquatics; Contaminated Sites; Noise; Terrestrial; and Vibration. How their input has influenced the scope of these reports is summarized, together with input on the ESR report, in **Table 4-2**. Also, participating First Nations and Stó:lō Resource and Research Management provided comments on the draft AOA, which was incorporated into **Section 12** Archaeology and Heritage.

4.7.3 Input to Draft ESR

Feedback was received on all technical sections of the ESR and participating First Nations and Stó:lō Resource and Research Management provided comments on draft Interim AIA reporting, which has been integrated into **Section 12** Archaeology and Heritage. **Table 4-2** summarizes the input that has influenced the ESR scope as well as the identification of potential Project-related effects, and, finally, how the Project incorporated the input into the ESR.

Table 4-2 First Nations Input into ESR Scope, Potential Effects, and Project Responses

First Nation Input	Integrated into ESR
First Nations Engagement	

• Sought clarity on the use of the term "Indigenous Peoples" instead of "First Nations"
• Requested revision to the level of engagement
• Requested inclusion on specific language rather than referencing a "traditional name"
	• ESR updates to Section 4 First Nations engagement included:
	  • "Indigenous Peoples" changed to "First Nations"
	  • level of engagement being sought based on the change to the Project's full scope
	  • reference to specific language for traditional place names

Air Quality and Greenhouse Gases	
• Sought clarity for sources of forecasted increases in PM and sulphur dioxide (SO_2) emissions	• Clarified sources of CACs and GHGs and Project construction effects in the context of regional emissions
Noise and Vibration	
• Requested consideration of noise and vibration impacts on wildlife for Project construction and operation, particularly in the Green Timbers Urban Forest (GTUF) and aquatic areas	• Considered potential Project effects of noise and vibration on wildlife and fish, including those in GTUF, in **Section 10** Fisheries and Aquatics and **Section 11** Vegetation and Wildlife Resources
Contaminated Sites	

• Commented on the buffer used to assess larger properties and properties with offset alignments
• Commented on potential interactions between clearing and grubbing and contaminated sites
• Requested quality control measures related to contaminated soil removal, disposal, and further investigation; and confirmation that new material is contaminant free
	• ESR updates to **Section 9** Contaminated Sites included:
	  • clarified the buffer used for property review
	  • added a quality assurance protocol to require waste manifests and manage imported material and contaminated media in accordance with the BC Contaminated Sites Regulation (CSR)

First Nation Input	Integrated into ESR
Fisheries and Aquatics	

• Sought clarification that all watercourses were assessed by an appropriately qualified professional (AQP)
• Sought clarity for the inclusion of provincially or federally *Species at Risk Act* (SARA) listed fish
• Requested the inclusion of detailed list of sources and inclusion of B.C. *Wildlife Act*
• Inquired about updates to the description of applicable legislation, classification, and Project field reconnaissance of Class C watercourses
• Suggested adding more water quality parameters (e.g., pH, dissolved oxygen, temperature) in the assessment
• Sought clarity that General Wildlife Permits are required to conduct fish salvage works
• Sought clarity on distance from Streamside Protection and Enhancement Area setback
• Sought updates to construction mitigation including addition of Class C watercourses; use of construction environmental monitors; and inclusion of amphibian salvage
• Requested offsetting details to address riparian habitat loss
• Requested further consideration to aquatic-related Best Management Practices
• Sought clarity on operational practices for spill management
	• ESR updates included:
	  • indication that an AQP visited each watercourse
	  • inclusion of provincial guidance relevant to fish and fish habitat protection and at-risk species
	  • cross-references to Section 11 Vegetation and Wildlife Resources for information on BC Wildlife Act and wildlife salvage
	  • inclusion of setbacks for Class C watercourses.
	  • clarification of requirement to follow the conditions outlined in the regulatory approvals
	  • inclusion of pH, DO and conductivity as parameters mostly likely to be affected by the Project
	  • clarification of mitigation in environmentally sensitive areas such as visual and physical barriers (e.g., snow fencing), use of biodegradable hydraulic fluid, and considering wildlife features in fish habitat restoration
	  • a statement of conformance which requires environmental monitoring by an AQP in environmentally sensitive areas
	  • inclusion of references used in the baseline reports
	  • confirmation with regulators on Project design and if offsetting is required consultation with First Nations will occur
	  • cross-reference to **Section 18** Environmental Management during Operations for spill management during operations

Vegetation and Wildlife	

• Emphasized protection of critical habitat and identifying species at risk (e.g., little brown myotis)
• Requested additional analysis to include changes in species composition
• Sought consideration of habitat for nesting migratory birds during land clearing
• Recommended design elements for SkyTrain stations to mitigate risks of bird strikes
• Sought inclusion of wildlife species in habitat offsetting
• Sought clarity for inclusion of at-risk insect species
• Requested clarity regarding wildlife survey methods- including for raptors
	• **Section 11** Vegetation and Wildlife Resources updates include:
	  • clarification of protections for nesting birds under the Migratory Birds Convention Act, 1994 (SBC 1994, s. 22), (e.g., pre-clearing surveys conducted by AQPs) and for at-risk species and provincial BMPs for raptors
	  • recommended design elements for Project infrastructure to mitigate risk of bird strikes
	  • commitment to considering wildlife species in fish habitat restoration
	  • reference to amphibian BMPs (Government of BC 2004) to inform mitigation
	  • clarification of noxious weed control practices

First Nation Input	Integrated into ESR

• Emphasized the treatment, removal, and disposal methods for preventing the spread of noxious weeds
• Requested addition of potentially occurring at-risk plant species and rare ecological communities
• Expressed concern over the protection of culturally important plants
• Sought consideration of opportunities to plant offsetting trees in correct provenance and to best meet wildlife habitat conservation objectives
• Expressed interest in certain trees removed during construction
	• input regarding seasonal plant species traditionally collected, cultivated, or traded for and by First Nations
	  • at-risk plant species and rare ecological communities in **Table 11-4**
	  • additional details regarding field survey methods
	  • removal of species names of culturally important plants
	  • mitigation update to add a notification to First Nations in advance of specific trees being removed

Archaeology and Heritage	

Scope of Assessment
• Requested the completion of relevant First Nation Heritage Management permits
• Requested appropriate treatment for identified archaeological and heritage resources (as approved by First Nations), including input for archaeological assessment methods, mitigation, and management options
• Requested the opportunity to participate in archaeological monitoring of the Project geotechnical program as well as AOA preliminary field reconnaissance and AIA fieldwork
Project Effects
• Requested that the potential for Project-related impacts to archaeological and heritage sites be considered even if an area is deemed as 'low potential' for the presence of archaeological materials
	Scope of Assessment
	• Relevant First Nations permits were obtained and kept current for archaeological activities for the ESR process
	• Input was sought from participating First Nations during:
	  • development of the Chance Find Procedure
	  • planning and implementation of archaeological studies, fieldwork, and monitoring
	  • following identification of an archaeological site found during AIA fieldwork
	  • archaeological and heritage mitigation and management options
	• Participating First Nations were invited to join preliminary field reconnaissance (PFR), AIA fieldwork and monitoring of geotechnical and utility location programs
	Project Effects
	• Input of participating First Nations was considered in addition to following provincial guidance in identifying archaeological areas of interest (AOI)s and conducting AIAs
	• Other input received by participating First Nations (including Traditional Land Use information) has been reflected directly in the AOA, interim AIA reports, and in **Section 4** First Nations Engagement

Agricultural Land	
• Sought clarity on impacts of noise levels to non-humans within the ALR • Requested assessment of cumulative effects regarding alteration to agricultural land use and statement of the significance of stated effects	• ESR updated to indicate noise generated by PPS would not exceed ambient levels • ESR updated to evaluate effects to agricultural land after mitigation as characterized by magnitude, duration, reversibility, geographic extent, and frequency

<table>
<tr><th>First Nation Input</th><th>Integrated into ESR</th></tr>
<tr><td colspan="2">Land Use</td></tr>
<tr><td>Sought clarity on the responsibility for consultation for disposition of Crown land
Requested text to reflect the importance of First Nations rights and Traditional Land Use and Indigenous Knowledge within the ESR
Requested update to Ministry references to current name</td><td>Section 4 First Nations Engagement of the ESR has been updated to:
clarify the responsibility of the Crown with respect to the disposition of Crown Land
summarize Traditional Land Use information received
ESR updated to reflect renaming of FOR</td></tr>
<tr><td colspan="2">Transportation and Access</td></tr>
<tr><td>Sought consideration of environmental timing windows and timing of tree clearing in traffic management planning for construction</td><td>The ESR includes environmental considerations e.g., timing windows and timing of tree clearing</td></tr>
<tr><td colspan="2">Visual Landscape</td></tr>
<tr><td>Requested inclusion of Indigenous cultural recognition and art at SkyTrain stations and substations, noted as part of visual mitigation subsection</td><td>The ESR, including Section 16 Visual Landscape Assessment, has been updated with recommendations for cultural recognition such as Indigenous art for Project infrastructure</td></tr>
<tr><td colspan="2">Environmental Management during Construction</td></tr>
<tr><td>Requested Table 17-1 be updated to reflect additional interactions with air quality and GHGs
Requested Table 17-2 with key considerations for the CEMP</td><td>Table 17-1 interactions updated for those between operating and/or fueling heavy equipment during construction with air quality and GHGs
Table 17-2 updated to reflect additional Project activity interactions with key considerations for the CEMP</td></tr>
<tr><td colspan="2">Environmental Management during Operation</td></tr>
<tr><td>Requested consideration of monitoring during Project operation to assess bird strikes and determine if adaptive management or preventative measures are needed
Requested assurance that Project-related utilities and services are kept secure</td><td>Section 11 Vegetation and Wildlife Resources of the ESR updated with recommendations for station design to prevent bird strikes and post-construction effectiveness monitoring
ESR mitigation updated to include details on security personnel and station security</td></tr>
<tr><td colspan="2">General</td></tr>
<tr><td>Requested clarification of testing and commissioning timeframe</td><td>Section 2.3 of Project Description updated to add the one-year timeframe for testing and commissioning</td></tr>
</table>

4.7.4 Traditional Land Use Information

Through ongoing engagement, participating First Nations have provided information on Traditional Land Use in and around the general vicinity of the proposed Project area as well as the potential impacts to First Nations rights and interests. Traditional Land Use information received from potentially affected participating First Nations was considered to help enhance the Project and facilitate the development of mitigation measures to reduce or avoid potential adverse impacts. The information was gathered through the activities described above as well as through:

- First Nations' review of the Project's draft reporting for the AOA, AIA, and ESR; and
- A Nation-specific Traditional Land Use Study[12].

Spatial boundaries for Traditional Land Use included a regional area defined for the general vicinity of the Project (1.5 km) and a local study area boundary. A buffer of 200 m on each side of the Project centreline was used to define the local study area for Traditional Land Use information, similar to that used for the vegetation and wildlife SE and archaeology and heritage SE.

The archival, ethnohistorical, and archaeological information the Project received provides numerous examples of the rich cultural heritage of Traditional Land Use of the region by First Nations. Based on information received to date, most Traditional Land Use activities and features in the general vicinity of the Project do not overlap with the Project study area.

Given that the Project will be located where much of the existing road corridor is surrounded by relatively dense and urbanized commercial, residential, and other development, potential impacts to current Traditional Land Use are expected to be minimal. The following subsections summarize the Traditional Land Use information received, as gathered through archival and ethnohistorical sources[13].

4.7.4.1 Aquatic Resources, Fishing, and Water

Fishing and aquatic resource harvesting are a fundamental component of First Nations culture and identity. Specific waterbodies in the region, including the Nicomekl, Salmon, and Fraser rivers, have been identified as being important to the participating First Nations, and fishing sites were located along these watercourses. In the Project study area, the Serpentine River is located in the Traditional Territory of participating First Nations, and this river and an associated trail provided access to fishing and trapping resources as far south as Mud Bay. Fish species, including sturgeon, salmon, eulachon, and steelhead, were and continue to be used for food and ceremonial purposes. Migrating salmon were historically harvested from canoes with harpoons, dip nets, and gaffes or captured in basket traps, and continue to be harvested from vessels.

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12 The majority of the specific Traditional Land Use information included in this section is from Kwantlen First Nation's: *Kwantlen Land Use and Occupation in the Vicinity of Proposed Surrey Langley SkyTrain Project, 2020*

13 The Project team was informed that, due to historical constraints, a limited amount of Traditional Land Use information is available for the Project area, and additional Traditional Use sites, that were not identified in the information reviewed, may potentially exist along the Project corridor. Where information of Traditional Land Use is identified, the Project team will discuss potential mitigation with affected First Nations.

4.7.4.2 Vegetation Resources and Plant Harvesting

Along with fishing and harvesting aquatic resources, Traditional Land Use activities included participating in seasonal rounds of plant harvesting, which in addition to nutrition, provided materials for domestic use (e.g., basketry) and plants for medicinal or ceremonial purposes. In the regional area, seasonal plant species of traditional importance to First Nations include: wapato, camas, bracken fern, fresh shoots, hazelnuts, native apple species, and a number of *Vaccinium* and other native berry species

4.7.4.3 Wildlife, Hunting and Trapping

Hunting and trapping wildlife continue to enrich the nutritional, spiritual, cultural, and domestic aspects of First Nations culture. Archival sources in the region reveal that First Nations hunted elk and beaver. Former hunting and habitation sites have been identified northwest and more than 1.5 km from the Project alignment.

4.7.4.4 Cultural Continuity

Prior and ongoing cultural association with the regional and local study areas is evident in much of the Traditional Use information provided. For example, a traditional trail connects an ancestral fishing ground and former habitation site, located northwest and more than 1.5 km from the Project alignment to a berry harvesting site southwest of the Project area. The trail is assumed to be subsequently used as part of the Old Yale Wagon Road. In addition, trail and canoe routes have been identified that link the Fraser River at Barnston Island to Mud Bay via the Serpentine River.

Further, traditional place names for key natural features speak to prior and ongoing association by First Nations. For example, hən̓q̓əmin̓əm̓, the Nicomekl River translates to *neqэmeqэl*, which means "Snokomish Stream" or "when the tide comes in" and a portage trail that once followed this river is called *sce:l'xʷeyəm*.

4.7.4.5 Heritage and Archaeology

Prior and ongoing association of First Nations use of the regional and local study area is also evident in the archaeological record, as indicated through the discovery of stone tools and flakes, along with ethnohistorical accounts and non-Project specific information provided by participating First Nations. Information pertaining to moderate to high archaeological potential in the proposed Project area has been considered by Kleanza in their identified areas of archaeological interest, which have been or will be investigated as part of the AIA. See **Section 12** Archaeology and Heritage for more information.

4.8 Upcoming Engagement

Participating First Nations will continue to be meaningfully consulted and engaged on the Project, including participation in ongoing fieldwork activities, Project permitting, continued discussion of areas of interest including those related to environment and archaeology, and Project opportunities.

Addendum 4-1 Project and ESR-related First Nations Interests

Topic	First Nations Comment	Project Team Response
Meaningful engagement	• Engagement should be on a government-to-government basis • Desire for meaningful engagement and to achieve consensus on decision-making throughout all phases of the Project, including discussions around consultation, procurement, and construction • Desire to be included in SLS Project planning and to understand how First Nations feedback will be used in Project decision-making • Desire for adherence to the Truth and Reconciliation Commission of Canada's principles and Calls to Action	Meaningful engagement and consultation are important to the Project team. The Project team appreciates the input provided by First Nations as part of the ESR process. Participating First Nations reviewed the draft ESR TOR, the foundational planning document for the Project's ESR. The Project team integrated and addressed comments from participating First Nations into the final TOR, where applicable. The Project team sought input and meaningfully addressed and integrated input from participating First Nations during their review of the baseline reports and ESR report. Input that influenced the scope of the assessments and identification of Project-related effects to date has been included in the First Nations Engagement summary, in addition to being sent directly to First Nations who have provided input. The Project team will continue to maintain open and transparent lines of communication while working collaboratively with participating First Nations to identify interests and suitable mitigation and resolve concerns. The Project team will continue to consider all comments and take input into account in Project decision-making, planning, and execution, while acknowledging the importance of the Province's passing of the *Declaration on the Rights of Indigenous Peoples Act* (SBC 2019, c. 44) and the ongoing implementation of the Truth and Reconciliation Commission's Calls to Action (Truth and Reconciliation Commission of Canada 2015; Government of BC 2019a).
Participation in fieldwork, and Project opportunities	• Participation in fieldwork opportunities • Interest in reviewing available information and participation in monitoring, including contaminated site investigations	Participating First Nations have been and continue to be provided opportunities to participate in archaeological and environmental fieldwork. First Nations offered valuable input and field participation during the AOA, PFR, AIA fieldwork, and monitoring of geotechnical drilling and utility locate investigations (reviewing for both ground composition and potential existing contamination in the Project area).
Protection of heritage and archaeological sites	• Highlighted numerous villages, trails, and extensive use within Surrey and Langley over countless generations for which there may be physical evidence • During all stages of construction, heritage and archaeology methods will need to include monitors on site and an agreed-upon procedure for recognizing and conserving archaeology and artifacts that may be discovered	Archaeological methods have been described in archaeology permit applications provided to First Nations, in permits required by First Nations, in tailgate meetings in advance of the AIA fieldwork and as part of draft Interim AIA reporting. The Project team has provided opportunities for involvement in archaeological fieldwork by participating First Nations where Project activities overlap with archaeological areas of interest (AOI)s. The Archaeological Chance Find Procedure developed for Project activities that involve ground disturbance was provided to participating First Nations, for review. The Project team sought and received Traditional Land Use information from participating First Nations. Information was reviewed and integrated into the ESR, where applicable, see **Section 4.7**.

Topic	First Nations Comment	Project Team Response
Environmental protection	• Identify species at risk habitat and create management plans alongside First Nations for offsetting, mitigation, habitat enhancement, and habitat restoration • Interests in fish and fish habitat (e.g., mitigation to prevent ground and instream disturbances for water crossings; site controls during construction; restoration of disturbed habitat and habitat offsetting) • Importance of good water quality, including construction water quality planning • Interest in methods for discovery and assessment of contaminated materials found during construction, and appropriate disposal • Interest in details for spill response • Concern with vegetation and tree removal within the GTUF because of the value it provides to wildlife species and people • Control and elimination of invasive plants • Impact of environmental conditions on Project design • Participation in environmental monitoring and discussions on and opportunities for restoration work	The Project team will continue to engage with First Nations regarding their interests in ESR-related activities, such as environmental monitoring and habitat enhancement planning and fieldwork, as the Project is advanced. Measures for management of species at risk and invasive plants are included in draft copies of the TOR, ESR, and CEMP Framework that were provided to participating First Nations. In response to interests in fish and habitat conservation: • The ESR TOR includes changes to water quality as a Review Indicator for assessing potential effects to the fisheries and aquatics SE. • Water quality has been integrated as a performance objective in the CEMP Framework. First Nations input has been considered throughout the ESR process, including for construction-related issues and mitigation. A key tool for environmental protection during Project construction will be the CEMP. As noted above, a detailed CEMP Framework is an important component of the ESR process and includes required content for the CEMP. The CEMP Framework includes: • Mitigation and minimum requirements related to contaminated site and excavated materials management • Provisions for a detailed Spill and Emergency Response Plan, including environmental performance objectives and measures during construction to avoid or mitigate Project-related environmental effects • A list of required sub-plans, which includes a Vegetation and Wildlife Management Plan
Traditional Land Use / Indigenous Knowledge	• Highlighted numerous villages, trails, and extensive use within Surrey and Langley over countless generations • Incorporate Indigenous Traditional Knowledge wherever possible • Consideration of culturally important plants	Indigenous Knowledge and Traditional Land Use information provided by First Nations has been considered in Project baselines and the ESR report. Inclusion of Indigenous Knowledge and Traditional Use information in Project reporting considers the applicable confidentiality associated with the provided information. Traditional Land Use information is summarized in **Section 4.7.**

5 Stakeholder and Public Engagement

5.1 Introduction

Since the Project's inception in early 2019, the Project team — both under TransLink and the Province of BC — has undertaken a robust level of public and stakeholder engagement to help inform key elements, such as Project design and the scope of the ESR. The following is a summary of engagement that occurred between April 2019 and June 2022, which helped to contextualize this ESR. For more information on stakeholder and public engagement, please see the Surrey Langley SkyTrain Project website.

5.2 Stakeholder Engagement

Engagement is a key component of rapid transit planning, and as such, the SLS Project team initiated early outreach to diverse stakeholders representing community organizations, business associations, institutions, interest groups, and elected representatives in Surrey and Langley to:

- Raise awareness about the Project, including the need for rapid transit to help meet future population and employment growth in the region as well as the Project's development process (i.e., planning and design, procurement, construction, and testing phases before in-service operation begins);
- Solicit feedback to help inform and/or refine Project planning, including the ESR;
- Foster positive relations with individuals and groups near the Project alignment; and
- Promote engagement opportunities to maximize participation in and feedback on the Project.

Through one-on-one or small group conversations and meetings, stakeholder engagement has elicited comments, including, but not limited to:

- Requests for data sharing (i.e., ESR baseline reporting);
- Concerns about habitat fragmentation in Green Timber Urban Forest; and
- Questions about indirect impacts of the Project on the Surrey Nature Centre.

Engagement will continue throughout the lifecycle of the Project, including the procurement and construction phases, to ensure stakeholders remain apprised of developments and potential impacts, and will have the opportunity to comment accordingly.

5.3 Public Engagement

The Project team has conducted several rounds of public engagement, which confirms that support for the Project is high throughout Metro Vancouver, particularly in the Three Municipalities (City of Surrey, City of Langley, and Township of Langley). Rounds of public engagement took place in Spring 2019, Fall 2019, and Spring 2022, as described below.

5.3.1 April 4-26, 2019

Between April 4 and 26, 2019, the Project team conducted a first round of public engagement to gather feedback on priorities, opportunities, considerations, and the level of support for SLS. To ensure broad access to information and to maximize public participation, the three-week engagement period included:

- A robust print, radio, digital, and in-transit multilingual marketing campaign;
- Online opportunities, including a feedback form in English and Punjabi;
- In-person opportunities, including four open houses in Surrey and Langley with feedback forms in English and Punjabi as well as street team promotions at major transit hubs in Surrey and Langley; and
- Outreach to diverse communities, including attendance at Surrey's Party for the Planet and Vaisakhi Parade, and a presence at local gurdwaras.

Public interest resulted in record-level participation with more than 21,000 completed feedback form responses and more than 1,000 attendees at the open houses.

5.3.1.1 Results

Results indicated widespread support for improved transit in Surrey and Langley, generally, and for the proposed SLS, specifically. In the Three Municipalities, an average of 85% of respondents supported the proposed Project:

- Surrey – 82%;
- City of Langley – 90%;
- Township of Langley – 92%; and
- Rest of Metro Vancouver – 84%.

Respondents noted that the most important considerations for rapid transit south of the Fraser are predictable transit travel times, efficient use of public money, a comfortable and safe transit experience, and increased transportation options.

A market research survey was commissioned to complement the feedback form and obtain statistically representative data. Findings of the survey were consistent with the public engagement feedback results.

5.3.1.2 Environmental Findings from the Spring 2019 Engagement

Respondents expressed concern about the Project's potential effects during construction and operation on nearby residences and businesses, including:

- Traffic during construction;
- Access to businesses during construction;
- Displacement of existing residences and businesses;
- Air pollution;
- Noise and vibration from construction and operations; and
- Visual effects because of the elevated guideway.

Additionally, the need to preserve green spaces and wildlife habitats during construction and operation was highlighted as a key priority.

5.3.2 November 1–17, 2019

A second round of public engagement was held between November 1 and 17, 2019, during which members of the public provided feedback on the:

- Proposed SkyTrain alignment and station locations;
- Access to SkyTrain and its integration with other modes of transportation, such as walking, cycling, buses, and private vehicles; and
- Draft TOR for the ESR.

Similar to the previous round of engagement, there was significant interest in the Project with:

- 2,000 attendees at the five in-person open houses in Surrey and Langley;
- 8,000+ completed feedback form responses; and
- 5,000 participants in a live Telephone Town Hall with the Project Director.

5.3.2.1 Results

General feedback obtained in the public engagement showed:

- Broad support for the SkyTrain extension, particularly construction of the full 16-km alignment in one stage;
- Agreement that identified factors were sufficiently thorough in helping to determine placement of the guideway; and
- Features, such as shelter and lighting; wayfinding maps and signage; bus connections and pedestrian walkways; and pickup/drop-off and park-and-ride spaces, are important considerations for new stations and the surrounding areas.

Once again, a market research survey was commissioned to obtain statistically representative responses. Findings were consistent with the public engagement results and confirmed that the level of support for the Project remained high at 77%.

5.3.2.2 Environmental Findings from the Fall 2019 Public Engagement

Some respondents highlighted impacts of the Project on the surrounding area as a key area of interest and concern, particularly effects on public green spaces, wildlife habitat, and tree removal during construction. Other respondents recommended the sustainable disposal of construction waste, and yet others were interested in the Project’s carbon footprint during the operation phase. Lastly, some respondents suggested that SkyTrain infrastructure should be resilient against both seismic activity, and natural events that could potentially obstruct the guideway.

The fall 2019 public engagement feedback form asked if respondents thought the proposed ESR process was sufficiently thorough, including the following proposed SEs:

- Air Quality and Greenhouse Gases;
- Agricultural Land;
- Archaeology and Heritage;
- Contaminated Sites;
- Fisheries and Aquatics;
- Land Use;

- Noise and Vibration;
- Transportation and Access; and
- Vegetation and Wildlife.

An overwhelming majority (93%) of respondents and open house attendees indicated that they believed the ESR process is sufficiently thorough. A follow up question invited respondents to provide further comment related to the ESR process. **Table 5-1** outlines key topics of interest.

Table 5-1 Topics of Interest from Fall 2019 Engagement

Topic	Description
Proposed reviews	Some respondents highlighted proposed SEs of particular interest, including noise and vibration, and vegetation and wildlife.
Additional reviews	Some respondents suggested additional topic areas, including quality of life in surrounding neighbourhoods as well as impacts on housing affordability, and cleanliness around stations. Others noted that the SkyTrain should help facilitate a strong sense of place through urban design considerations. They suggested reviews of: • Safety and security on and around the SkyTrain • Visual impacts (e.g., obstructing views, casting shadows) • Community health • Light pollution
Green Timbers Urban Forest (GTUF)	Respondents expressed concern about the effects of SkyTrain construction and operation on GTUF, including tree removal, and the effects of noise, light, and vibration on wildlife habitat.
Indigenous consultation	Respondents were keen to know if Indigenous communities are being consulted on the ESR process.
Potential Project delays	Many respondents expressed concern about potential delays to the Project schedule due to the ESR process – they want the SLS built as quickly as possible.
Impacts on decision-making	Respondents suggested that the results of the ESR should inform decision-making in a meaningful way, notably to minimize impacts on all the proposed SEs. Some respondents were interested in whether the ESR would have a meaningful effect on decision-making.
Environmental benefits of SkyTrain	Respondents noted that the environmental benefits that stem from Project operation should qualify as part of the ESR. For example, SkyTrain enables more people to choose transit over personal vehicle use, which: • Lowers emissions • Improves air quality • Reduces congestion • Reduces the need to widen roadways
Insufficient information or lack of expertise to provide feedback	Some respondents expressed a need for more information about the ESR process (e.g., how it would be undertaken, and how the results would be used.) before they could provide informed feedback. Other respondents cited their lack of expertise to provide informed feedback.

5.3.3 May 9–June 9, 2022

This round of public engagement, held between May 9 and June 9, 2022, provided a fulsome update on the full 16-kilometre Project, including:

- Project background, objectives, and benefits;
- Scope and schedule;
- Alignment and stations;
- Advance works before construction;
- Environmental Screening Review; and
- Engagement with Indigenous groups, stakeholders and the public.

The public engagement, promoted through a variety of channels including a media release, social media, and promotional street teams at transit hubs in Surrey and Langley, included an online feedback form and two in-person open houses in Surrey and Langley. The feedback form focused on elements of the Project, including the ESR.

5.3.3.1 Environmental Findings from the Spring 2022 Public Engagement

Respondents were asked if there are any specific environmental mitigations that should be considered. While 72% of respondents said no, 28% indicated a specific mitigation. The public also provided feedback on preferences for tree replacements as follows:

- 47% preferred local/native plant species;
- 34% preferred climate-resilient plant species; and
- 18% preferred that all plantings be aesthetically-pleasing.

The following list summarizes feedback related to the environment and is followed by **Table 5-2**, which provides additional feedback about the Project, categorized by stage.

- **Climate and Environment**
  - Preserve green space, trees, and agricultural land;
  - Reduce environmental effects in design and construction practices;
  - Design the Project to include flood mitigation, appropriate drainage, heat, etc.;
  - Consider potential vehicle congestion around new SkyTrain stations;
  - Incorporate habitat conservation in all phases (i.e., planning, design, and construction) as well as consider opportunities to rehabilitate existing habitats; and
  - Consider embodied carbon during design and construction.
- **Construction**
  - Use environmentally responsible materials and construction practices;
  - Use as little concrete as possible;
  - Consider environmental management of contamination, runoff, and improper disposal of construction materials; and
  - Create a parking and traffic management strategy.

Respondents outlined the following suggestions, concerns, and questions related to climate and environment:

- **Suggestions**
    - Consider climate change effects, such as drainage, flood mitigation, and solar intensity during Project design and construction;
    - Incorporate both positive and negative effects of the Project in the ESR;
    - Design the entire Project to be as green and as environmentally friendly as possible, including the stations;
    - Limit the number of trees that need to be removed; and
    - Design stations and all development along the corridor to reduce bird strikes and minimize the impact on wildlife and natural habitats.
- **Concerns**
    - Effects on wildlife, farms, wetlands, and other habitats, and how to mitigate;
    - Impacts on Green Timbers Urban Forest and the loss of trees to build the Project; and
    - Impacts on the environment and sensitive ecosystems.
- **Questions**
    - Mitigations to prevent birds from flying into SkyTrain station windows;
    - Timing of the ESR; and
    - How the Project will minimize construction effects on air quality.

Table 5-2 Mitigation Feedback from Spring 2022 Engagement

Mitigation Topic	Suggested Mitigation
Planning and Design	
Environmentally friendly project including the stations	Respondents noted that they would like to see: • stations include green spaces and solar panels, covered walkways, rainwater collection, and living walls and plants • community garden plots for open spaces along the SkyTrain alignment • the Project completed as soon as possible to maximize environmental benefits Some respondents are concerned that the Project will have poor aesthetics with dead space that will be a magnet for graffiti.
Flood mitigation, appropriate drainage, heat, etc.	Respondents suggested: • ways to improve rainwater management (e.g., green roofs and drought-tolerant plants) • that station design should mitigate solar intensity on hot days • assessments of flood risk (City of Langley is built on a flood plain) • minimal paving to limit flooding Project greenspaces and softscapes should be used to attenuate stormflows.
Project effects on wildlife, farms, wetlands, and other habitats and potential mitigations	Respondents agree that protecting agricultural and environmentally sensitive areas is important and that: • ALR land is an incredibly important resource for the sustainability of our region and requires due consideration • the route through the 176 Street corridor and its vital farm and wetlands/floodplain spaces needs assessment • sensitive ecosystems and species at risk of disruption should be identified • any wildlife that is uprooted should be safely and respectfully relocated • overpasses and underpasses, and habitat for wildlife movements along the alignment should be incorporated to minimize habitat fragmentation

Mitigation Topic	Suggested Mitigation
Conservation of natural habitat and species rehabilitation	Respondents noted the importance of habitat conservation and rehabilitation for species such as migratory birds, mammals, and amphibians throughout project phases. Respondents indicated that: • continued wetland use along Fraser Highway should be prioritized for frogs and other semi-aquatic life • native vegetation should be incorporated into the design • marshland around Fraser Highway and Highway 15 should be created to compensate for loss of area filled in last year • fallow fields west of Highway 15 could be used to create a new pond/marsh area
Limit tree removal	Respondents would like the Project to relocate and/ or replace trees (vs. simply cutting them down): • the priority for selection of replacement trees is for them to be local/native and climate-resilient rather than aesthetically-pleasing • no more old-growth trees should be cut down
Impacts on Green Timbers Urban Forest and tree loss	Some respondents noted: • it is unfortunate that SkyTrain will not be underground between 140th and 148th to minimize above-ground construction and permanent structures • it would make more sense to route the alignment down 104 Ave to 152 Street and 152 Street to Fraser Highway
Limit bird strikes	To minimize bird strikes and associated mortality: • install glass walls along the SkyTrain tracks to stop birds from flying into the trains; • add closely-spaced dots on station windows • reduce unnecessary light that can disorient birds, especially during spring and fall migration (including participating in the Lights Out program and turning off as many lights as possible during bird migration)
Noise mitigation	Respondents: • would like to know more about noise mitigation during and after construction • hope that noise won’t negatively impact or push out homeowners • suggest that more trees and vegetation is planted for privacy and sound buffers
Parking and traffic management	Respondents would like to see: • increased space for cyclists and cycling facilities to decrease car trips • additional busses to connect Langley, Surrey, Vancouver, Abbotsford, and Chilliwack • reduced numbers of cars on Fraser Highway, and healthy transportation options, such as cycling and walking • lower speed limits as the population and communities grow, to help protect urban wildlife
Indigenous consultation	Respondents noted the importance of consulting Indigenous people and groups: • the Project should be used as an opportunity to engage on environmental management for species at risk, species of concern to First Nations, and invasive species
Timing of the Environmental Screening Review	Respondents would like to have: • seen the environmental assessment occur at the start of project planning to allow for changes • the assessment completed quickly without wasting years on studies and then cancelling the project. Focus on the least amount of environmental impact as possible Respondents think that the ESR should not be politicized.

Mitigation Topic	Suggested Mitigation
Incorporate both positive and negative effects of the Project in the ESR	Respondents noted that: • the Project will reduce the number of cars on the road, encourage compact density, and increase ties to natural areas • the Project benefits and people-based savings offset the environmental harm • concern around the lack of formal government environmental assessment requirements • the importance of considering adverse effects of not improving and prioritizing transit • local art should be integrated into the stations
Construction	
Environmental impacts in design and construction	Respondents suggested possibilities to reduce the Project's environmental effects, such as: • building the Project underground to lessen surface disruptions • installing solar panels on all transit infrastructure
Environmentally responsible materials and construction practices	Respondents suggested that: • sustainable materials should be used and for the Project to contract construction companies that care about what they do • LEED and ENVISION design principles should be employed • embodied carbon should be factored in, and more attention should be given on how to best mitigate and offset emissions, e.g., consider greener concrete, its life cycle and GHGs • creation of green spaces, urban tree planting, biofiltration etc. could be used to help offset carbon • trees and greenery should not be replaced with concrete
Climate change effects and mitigation during Project design and construction	Implement strategies to reduce Urban Heat Island Effect, such as green rooves, increased tree cover, and solar cells on SkyTrain stations Respondents would like to know how much CO_2: • sequestration will be lost by removing vegetation and replacing trees with smaller ones • is released by the Project, including all diesel construction equipment, concrete production, and worker transport
Concerns about contamination, runoff, and chemicals	Respondents highlighted: • contamination of salmon spawning waterways • the importance of protecting nearby creeks from runoff • rodenticides should be banned around the Project site to protect owls and raptors
Operations	
Concerns about crime, storage, and connectivity around stations	Respondents asked: • how will the Project manage property crime around transit hubs? • will stations provide safe storage of self-powered transportation, such as bikes? • will bus routes/ connections to new SkyTrain stations improve?
Affordable housing around stations	Respondents would like to see considerations for "greener" or low GHG affordable (car-free) housing near/at SkyTrain stations.
Improvement to air quality	Respondents noted that the Project will help drivers mitigate the high cost of gas and reduce air pollution once in operation. Respondents asked how will transit operations and maintenance practices (e.g., vehicles) will affect air quality.

5.4 How Stakeholder and Public Feedback has Informed the ESR

The ESR has incorporated stakeholder and public feedback, as outlined in **Table 5-3**, which summarizes revisions by SE.

Table 5-3 Changes to the ESR Based on Stakeholder and Public Feedback

Screening Element	Changes to the ESR Based on Respondent Feedback
Air Quality & GHGs	The ESR was clarified to describe: • Project effects of GHG's on climate change; global warming as a descriptor for methane; extended emission trends over the last 12 years; and GHG emission details of passenger vehicles • differing GHG estimates; local government and regional policies and GHG targets; location of CAC emission reductions; and updated mitigations • sources of CACs and GHGs from construction materials with high carbon footprints
Noise and Vibration	The ESR was revised to consider: • effects and mitigations on wildlife and people during construction, particularly in GTUF • updates to the major and minor ratings within the Project Interactions table • potential mitigations for nighttime construction in GTUF, if required, with the City of Surrey • operational impacts and mitigations relating to GTUF and the Surrey Nature Centre as well as the efficacy of proposed mitigation measures to meet future densities along the Project alignment and around SkyTrain stations
Contaminated Sites	The ESR was updated to: • incorporate requirements for water discharged from contaminated sites (e.g., Metro Vancouver Waste Discharge permit) • revise the recommended risk classification of a site
Fisheries and Aquatics	The ESR was updated with: • revised stream classification definitions to align with recent provincial and federal regulatory changes • consistent stream names throughout report sections • broadened language from 'impacts of freshet' to 'storm events' as it relates to smaller streams (e.g., Tributary to Lay Creek and Lay Creek) • discussion of effects related to fish passage and overwintering due to road widening and culvert upgrades • revised habitat balance areas
Vegetation and Wildlife	The ESR was updated to: • clarify the term 'presence' as it relates to Pacific water shrew (*Sorex bendirii*) and environmental DNA (eDNA) detection • clarify how trees in the Project area are categorized • clarify the protection of critical habitat and methods to identify species at risk • reflect mitigations regarding adaptive management, including planning for inadvertent discovery of a species at risk (e.g., Oregon forestsnail [*Allogona townsendiana*]) • include additional detail for mitigations re: potential Project interactions with bats • include mitigation to account for the lag in the growth of replacement trees and various changes to adjacent mature trees • include explicit considerations of moisture regime, aspect, and climate change re: landscaping and revegetation • add requirements for pre-construction surveys for bird nesting and other wildlife, where appropriate

Screening Element	Changes to the ESR Based on Respondent Feedback
Archaeology and Heritage	The ESR has been updated with additional detail on key findings of the Project's AOA and AIA.
Land Use	The ESR now includes: • details of approved area plans, added details about the City of Surrey's OCP • information on the City of Surrey's Sensitive Ecosystem Map features, e.g., Streamside Protection Areas and Green Infrastructure Network (GIN) Development Permit Areas and Class "B" watercourses
Transportation and Access	The ESR has been updated to integrate relevant aspects of the Three Municipalities' traffic management technical inputs to the Project's TMP
Visual Landscape	Visual landscape was added as an SE. This new section assesses potential effects of permanent infrastructure from representative viewpoints of residences, civic and institutional locations and public spaces.
Environmental Management During Construction	The ESR Incorporates provincial and federal environmental permitting directives in the Project's restoration requirements.
Environmental Management During Operation	In response to feedback on the ESR, as well as updated procedures for other SkyTrain projects currently in operation, new technologies to mitigate impacts during operations, and systems to address extreme climate are under consideration and will be integrated into designs, as appropriate.

5.5 Future Engagement

The Project team will continue to engage with stakeholders and the public throughout the lifecycle of the Project to keep them apprised of Project developments, including public engagement opportunities.

6 Scope and Methods

This section of the ESR describes the methods that were used to assess potential Project-related effects on the biophysical and human environments for Project components and activities. This section also highlights the approach to each SE, which enabled the Project team to complete the following steps in the assessment:

- Identify environmental and social aspects for inclusion in the ESR;
- Define the scope of assessment;
- Determine the methods for assessment of baseline conditions;
- Describe existing conditions;
- Identify Project interactions and assess any potential effects;
- Identify mitigation measures to avoid or limit potential effects; and
- Provide conclusions regarding the overall effects of the Project.

6.1 Selection of Screening Elements

Each SE assessment focused on aspects of the biophysical and social environment that may be affected by the Project. Selection of SEs considered:

- Relevant environmental policies, regulations, or guidelines;
- Potential for construction and operation-related effects (based on the RCD);
- Potential effects that have been assessed for similar projects (e.g., Evergreen Line, Canada Line, Broadway Subway Project); and
- Interests, issues, and input identified by First Nations, regulatory agencies, stakeholders, and the public.

First Nations and public review of the draft TOR (see **Section 4** First Nations Engagement and **Section 5** Stakeholder and Public Engagement) generated feedback on candidate SEs. The final TOR reflected feedback from members of participating First Nations, stakeholders, and the public. Based on this feedback, the TOR (**Appendix A**) was updated to include the following SEs:

- Air Quality and Greenhouse Gases (GHG);
- Noise and Vibration;
- Contaminated Sites;
- Fisheries and Aquatics;
- Vegetation and Wildlife Resources;
- Archaeological and Heritage;
- Agricultural Land;
- Land Use;
- Transportation and Access; and
- Visual Landscape.

6.2 Scoping of Screening Element Assessment

This section of the ESR outlines the methods used to scope the assessment of potential effects on each SE. **Section 7** through **Section 16** provide additional detail related to specific considerations for individual SE scoping.

6.2.1 Regulatory and Policy Setting

Section 7 through **Section 16** provide reviews of relevant regulatory requirements, policy, and guidelines for interactions with and relevance for each SE. Federal and provincial regulatory requirements as well as policy direction are listed. Regional and municipal legislation, policy and guidelines are provided to provide context for consistency and equivalency. Each SE has different legislated requirements, which are detailed within their respective section.

6.2.2 Influence of Engagement on the Assessment

Section 4 First Nations Engagement and **Section 5** Stakeholder and Public Engagement of the ESR describe the engagement with First Nations, stakeholders, and the public. In accordance with the ESR TOR, feedback that has influenced the scope of the assessment and identification of effects has been included. These sections address Project engagement that has been underway since 2019.

6.2.3 Identification of Potential Effects and Review Indicators

The identification of potential effects and associated Review Indicators are described in the ESR TOR, which was provided to First Nations, stakeholders, and the public for review before finalization in May 2021. Review Indicators are criteria for qualitative and quantitative measures of change from baseline conditions and that result from the Project, which represent potential change to the SEs. For each SE, potential Project-related effects that are of interest or concern to regulators, First Nations, stakeholders, and the public, are measured using Review Indicators that represent the types of changes that could occur relative to current conditions.

The scope of the ESR Review Indicators was confirmed through First Nations, stakeholder, and public engagement; these are summarized in **Table 6-1**.

Table 6-1 Potential Project Effects and Review Indicators

Screening Element	Potential Project Effect	Review Indicators
Biophysical Environment Biophysical Environment		
Air Quality and Greenhouse Gases (GHG)	Change in concentrations of air contaminants	• Estimated change in emissions of concentrations of air contaminants relative to baseline.
	Change in GHG emissions	• Estimated change in emissions of GHGs relative to baseline.
Noise and Vibration	Change in noise levels	• Predicted noise levels at sensitive receptors: • daytime noise level • nighttime sound level • day-night sound level • peak one-hour sound level
	Change in vibration levels	• Predicted vibration levels at sensitive receptors: • peak particle velocity, expressed in millimetres per second or vibration decibel • root mean square velocity, expressed in millimetres per second or vibration decibel • root mean square acceleration, expressed in millimetres per squared second or in multiples of acceleration due to gravity • ground-borne noise, expressed in A-weighted decibels

Screening Element	Potential Project Effect	Review Indicators
Contaminated Sites	Environmental liabilities associated with the acquisition of potentially contaminated properties	• Historical Schedule 2 activities potentially occurred at acquired properties, or known contamination is present.
	Soil and groundwater management during construction	• Contaminated soil and/or groundwater identified during investigations prior to construction. • Contaminated soil and/or groundwater suspected where odours, staining, sheen, debris, or other potential indicators of contamination are encountered during construction.
	Exposure risk to human health or ecological receptors following construction	• Contaminated soil, groundwater and/or soil vapour remaining following construction.
Fisheries and Aquatics	Changes in fish habitat	• Change in habitat structure: areal extent (m^2) of instream and riparian habitat altered due to physical disturbance. • Loss of habitat: areal extent (m^2) of instream and riparian habitat destroyed due to physical disturbance. • Change in access to habitat: areal extent (m^2) of instream and riparian habitat made inaccessible to fish due to physical disturbance or changes in flow. • Change in water quality: changes in total suspended solids, turbidity, pH, dissolved oxygen, and conductivity.
	Changes in fish mortality/health	• Changes to fish/egg mortality: predicted numbers of fish/eggs due to direct physical disturbance, changes in water quality, or changes in flows.
Vegetation and Wildlife Resources	Effects on species or habitats of management concern	• Change to potential occurrence of species at risk (plants and animals). • Change to potential occurrence and locations of invasive species (plants and animals). • Spatial extent of provincially listed ecological communities at risk and wetted areas. • Change in habitat availability or suitability for focal species at risk. • Change in the availability of wildlife habitat features.
	Effects on wildlife habitat or ecological communities	
	Effects on connectivity of vegetated areas	• Change in spatial extent of urban forest canopy cover. • Change in spatial extent of GIN elements and potential for changes to connectivity. • Change in number of trees within the Project alignment, including boulevard trees and/or protected trees.
	Wildlife injury or mortality risks	• Potential for injury or mortality risk to wildlife due to extent, duration, or timing of activities during construction and operation.

Screening Element	Potential Project Effect	Review Indicators
Human Environment		
Archaeology and Heritage	Disturbance or destruction of archaeological resources, including sites and areas of archaeological potential (known and unknown)	• Areas of designated high archaeological potential may be affected. • Number and description of archaeological sites with the potential to be altered.
	Disturbance or destruction of heritage resources, including buildings, landscapes, or locations of heritage value (known and unknown)	• Number and description of heritage sites with the potential to be altered.
Agricultural Land	Lack of consistency with agricultural land use regulations and policy	• Alignment with provincial and municipal agricultural land use designations.
	Loss of agriculturally designated land (permanent and temporary) and land in agricultural use	• Area (m^2) of agriculturally designated land and in agricultural use lost due to Project activities.
	Alteration of agriculturally designated land	• Alteration of land through effects to infrastructure and changes in sensory conditions (noise, light).
Land Use	Inconsistency with land use regulations and policies	• Alignment with local and regional government land use policies.
	Effects to commercial and residential land uses	• Residential and commercial properties affected by the Project and anticipated changes.
	Effects to industrial land use	• Industrial properties affected by the Project and anticipated changes.
	Effects to conservation and recreation land	• Area of parkland affected. • Parkland features affected.
Transportation and Access	Change in transportation and access from baseline during construction and operation	• Change in parking and access to properties. • Change in roadway description (e.g., number of lanes, traffic flow characteristics). • Change in vehicle (cars, trucks, buses) volume (vehicles/day, vehicles/km travelled). • Change in passenger vehicle travel time (selected origin/destinations) and reliability. • Change in transit (travel time, ridership). • Change in pedestrian and cycling routes and access.
	Change in public safety and security	• Change in public access to emergency services (qualitative). • Change in emergency medical services, fire rescue, and police response routes (qualitative) and travel times. • Potential change in public safety and security.
Visual Landscape Assessment	Change from existing view conditions	• Change in views to surrounding communities, residential neighbourhoods, and public areas.

The potential effects that remain after mitigation has been applied to each SE, based on changes in their characteristics. These effects are characterized in terms of magnitude, extent, duration, frequency, and reversibility, as relevant to each SE. These effect characteristics are defined in **Section 6.6**.

6.2.4 Spatial and Temporal Boundaries

The SE assessments presented in **Section 7** through **Section 16** incorporate spatial and temporal boundaries, as described below.

6.2.4.1 Spatial Boundaries

Spatial boundaries encompass areas with potential for Project-related effects. The TOR outlined proposed spatial boundaries for each SE (**Table 6-2**), and the spatial boundary of this ESR is the full scope of the Project (i.e., from the existing King George SkyTrain Station in Surrey to 203 Street in the City of Langley). Feedback from First Nations, stakeholders, and the public did not result in any changes to spatial boundaries.

Table 6-2 Screening Elements and Spatial Boundaries

<table>
<tr><th>Screening Element</th><th>Designated Spatial Boundaries</th><th>Rationale for Designated Boundaries</th></tr>
<tr><td colspan="3">Biophysical Environment</td></tr>
<tr><td rowspan="3">Air Quality and Greenhouse Gases (GHG)</td><td>Local study area (LSA): City of Surrey, Township of Langley, and City of Langley municipal boundaries</td><td>The Project is located within the City of Surrey, Township of Langley, and City of Langley. During construction, the Project may affect local air quality.</td></tr>
<tr><td>Regional study area (RSA): Metro Vancouver regional district boundaries</td><td>Indirect effects on air quality may occur within Metro Vancouver. In addition, the RSA represents the regulatory boundary for air quality management.</td></tr>
<tr><td>Provincial and national jurisdictional boundaries</td><td>GHG emissions have a global effect that cannot easily be measured on a local or regional scale.</td></tr>
<tr><td rowspan="2">Noise and Vibration</td><td>Noise: 150 m of proposed Project centreline and the first two rows of buildings adjacent to the alignment</td><td>Noise emissions during construction and operation may affect sensitive receptors. Buffered area includes the first two rows of buildings along most of the alignment and represents the area of potential effects due to Project construction and operation.</td></tr>
<tr><td>Vibration: 50 m of proposed Project centreline and the first row of buildings adjacent to the alignment.</td><td>Vibration from construction equipment and activities may affect sensitive receptors. Buffered area includes the first row of buildings along most of the alignment and represents the area in which Project-related vibration effects may occur.</td></tr>
<tr><td>Contaminated Sites</td><td>100 m of proposed Project centerline.</td><td>Buffered distance is sufficient to capture current and former offsite operations that could have caused contamination within the Project footprint, potentially impacting soil, groundwater and/or soil vapour.</td></tr>
<tr><td>Fisheries and Aquatics</td><td>30 m of the Project footprint up to 50 m upstream and up to 300 m downstream of locations where the Project footprint intersects instream or riparian habitats</td><td>Construction and operation may affect freshwater fisheries and aquatic resources.</td></tr>
<tr><td>Vegetation and Wildlife Resources</td><td>Vegetation: 10 m buffer around the Project footprint.</td><td>Construction may affect vegetated areas and wildlife and their habitat within these buffered distances.
The Project may affect species at risk and their habitat.
The Project may provide avenues for the spread of invasive species within the Project corridor.</td></tr>
</table>

Screening Element	Designated Spatial Boundaries	Rationale for Designated Boundaries
Human Environment		
Archaeology and Heritage	1 km of proposed Project centreline for AOA	Buffered distances considered adequate for archaeological overview and impact assessments. Ground disturbance during Project construction that could adversely affect archaeological and heritage resources will be contained within Project footprint.
	200 m of proposed Project centerline for AIA where Project construction could disturb archaeological and heritage resources.	
Agricultural Land	200 m buffer on each side of the Project centreline from the existing King George SkyTrain Station to 100 m beyond the City of Langley terminus at 203 Street.	Buffered distance reasonably comprises the review area in which parcels in agricultural use may be directly or indirectly affected by Project construction and operation activities.
Land Use	200 m buffer on either side of the centreline of SkyTrain alignment and stations.	Existing land uses encompass diverse types of residential, commercial, park, and recreational land use.
Transportation and Access	City of Surrey, Township of Langley and City of Langley communities, properties adjacent to the Project, and travel routes within 200 m of the Project centerline.	Construction activities are expected to change existing traffic flows (vehicular, cycling, and pedestrian) and parking and access to adjacent properties. Operation activities will change existing traffic patterns, access to properties and parking around new SkyTrain stations.
Visual Landscape	Study Location: area of study in a 300 m radius from the Project centreline.	Project guideway and SkyTrain stations will change views from residences and areas used for recreation.
	Viewpoint: selected street-level photographs.	

6.2.4.2 Temporal Boundaries

Temporal boundaries provide the timeframe within which potential effects are assessed in relation to Project phases. Temporal boundaries are based on the timing and duration of Project activities (i.e., during construction and operation) that may interact with a SE. Based on the current Project schedule, the temporal boundaries for the assessment are as follows:

- Planning phase: 2020 to 2024;
- Construction and commissioning phase: 2024 to 2028; and
- Operation (including maintenance) of Project – 2028 onward.

6.3 Baseline Conditions

The description of existing or baseline conditions is based on data collected from desktop reviews and, where applicable, field programs within the relevant spatial boundaries (see **Table 6-2**). Where information is available, pre-Project conditions are described to provide context for SE assessment. The overview of baseline conditions includes geographical and biophysical features, land use, and the built/developed environment, as relevant to the topic. Key findings contained in the technical reports are summarized in the ESR.

6.4 Project Interactions

The assessment evaluates the potential Project interactions between each SE and identified Project activities, as outlined in **Table 6-3**. The interactions identified are based on the RCD and typical construction equipment and methods used on other SkyTrain projects in Metro Vancouver.

Table 6-3 Potential Interactions Between Screening Elements, Project Activities and Works

Project Activities and Physical Works	Air Quality and Greenhouse Gases (GHG)	Noise and Vibration	Contaminated Sites	Fisheries and Aquatics	Vegetation and Wildlife Resources	Archaeology and Heritage	Agricultural Land	Land Use	Transportation and Access	Visual Landscape [1]
Construction										
Clearing and grubbing	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
Property acquisition, including demolition of inert building materials	✓	✓	✓	-	✓	o	✓	✓	o	-
Relocation of overhead BC Hydro transmission lines	✓	✓	-	-	-	o	✓	✓	✓	-
Utility installation/relocation	✓	✓	✓	o	o	✓	✓	✓	✓	-
Use of temporary laydown areas	-	o	-	o	o	✓	✓	✓	o	-
Access and traffic management	o	o	-	-	o	-	✓	✓	✓	-
Roadwork widening (select locations)	✓	✓	o	o	o	✓	✓	✓	✓	-
Drainage realignment (select locations)	✓	✓	o	✓	o	✓	✓	✓	o	-
Installation of SkyTrain guideway foundations[1]	✓	✓	✓	o	✓	✓	✓	✓	✓	✓
Installation of overhead SkyTrain guideway[1]	✓	✓	-	-	✓	-	o	✓	✓	✓
Stations (foundations, structure, lighting, access, service connections, security)[1]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Power propulsion substations[1]	✓	✓	✓	-	✓	✓	o	✓	✓	✓
Management of non-contaminated excavated material, including excavation	✓	✓	-	o	✓	✓	o	✓	o	-
Management of contaminated or hazardous materials	✓	✓	✓	o	✓	✓	o	o	o	-
Testing, commissioning, and start-up	o	o	-	-	-	-	o	o	-	-
Operation										
Operation of the Project	✓	✓	o	o	✓	-	✓	✓	-	✓
Maintenance of the Project	✓	o	-	-	o	-	o	-	o	✓

Notes:

– **No Interaction:** Interaction between a Project component and the SE is unlikely.

o **Minor Interaction:** Effects may result from an interaction, but standard measures to avoid or minimize the effects are available and understood to be effective, and any residual effects would be reduced to negligible. Interaction is not discussed further.

✓ **Interaction:** Interaction occurs and likely requires additional mitigation; carried forward and discussed in subsequent sections.

1. Visual landscape only covers presence of completed Project infrastructure, not construction effects

Where interactions may result in potential effects, they are carried forward to the assessments in **Section 7** through **Section 16**. These interactions are then further refined to focus on the specific potential effect(s) within each SE, and a description of the mechanism of interaction for each Project activity or physical work is provided. Pathways or next steps to address effects are described for both construction and operation, as applicable. Effects remaining after the application of these mitigation measures are discussed in **Section 6.6**.

6.5 Mitigation Measures

Where potential Project-related effects are anticipated, mitigation measures are identified to reduce or avoid potential impacts. These mitigation measures are based on industry-standard Best Management Practices (BMPs) and specific to each SE. Mitigation is categorized according to the stage of Project development. For each SE, the relevant stages to implement mitigation measures are during design (denoted as “D”), construction (denoted as “C”), and operation (denoted as “O”). A high-level description of each proposed mitigation measure is provided within each SE section; these identified measures are carried forward and discussed as requirements within **Section 17** Environmental Management during Construction. Specific requirements for mitigation measures will be outlined in the CEMP Framework[14], which will be:

- Linked to performance objectives;
- Addressed in the Project Co’s CEMP and will be applicable to the construction means and methods employed; and
- Implemented in accordance with Project and regulatory requirements to avoid or limit potential effects to the SEs.

For environmental management planning, performance objectives will be identified to evaluate the effectiveness of mitigation measures in managing potential effects and, where relevant, recommend monitoring or management requirements. High-level objectives for construction implementation are described in **Section 17** Environmental Management during Construction.

6.6 Discussion of Review Results

Section 7 through **Section 16** include reviews of potential Project-related effects to individual SEs that remain after implementing mitigation measures. Criteria to assess these remaining effects help to characterize effects qualitatively and relative to baseline conditions, where relevant. The following generalized definitions serve as a guide to establish the specific effect characteristics for each SE:

- **Magnitude**: Refers to the amount of change to the existing condition of an SE, considering factors such as the uniqueness of the effect and the change relative to natural or background variation. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance), and high (exceedance of criteria or threshold).
- Geographic Extent: Refers to the geographic area over which an effect will occur.
  The geographic extent of effects may be none, negligible (footprint/site), low (within the local study area), regional, or greater than regional.

[14] Note that the CEMP Framework is a standalone document to be developed following completion of the ESR.

- Duration: Refers to the length of time for an SE to return to its existing condition.
  The duration of an effect may be short-term (i.e., within the construction phase), medium-term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (irreversible) (i.e., extending past the life of the Project).
- Frequency: Refers to the number of times that an effect might occur. The frequency of an effect may be rare, uncommon, common, or continuous.
- Reversibility: Refers to the degree to which existing conditions can be regained after the factors causing the effect are removed. Effects can be reversible, partially reversible, or permanent.

Where feasible, these characteristics are described quantitatively in each SE section. When residual effects cannot be characterized quantitatively, the effects are characterized qualitatively.

6.7 Conclusion

Each SE section includes a summary of the conclusions, including findings, mitigation measures, and recommended monitoring. Identified effects will be assessed to determine whether additional mitigation will be required after the application of identified measures and industry standard BMPs.

7 Air Quality and Greenhouse Gases

7.1 Introduction

Air quality refers to the degree to which the atmosphere is free from contaminants and substances at concentrations that could measurably affect human health, wildlife, and vegetation. Air quality also refers to aesthetic qualities, such as visibility. The contaminants most relevant to the Project include CACs and greenhouse gases (GHGs). CACs refer to a group of commonly found air contaminants, including carbon monoxide (CO), PM, nitrogen dioxide (NO_2), sulphur dioxide (SO_2), VOCs, ammonia (NH_3), and ozone (O_3), for which Ambient Air Quality Objectives (AAQOs) have been established. GHGs are a group of gases with concentrations that build up in the atmosphere and contribute incrementally to climate change. The most prevalent GHGs associated with the Project are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

This air quality and GHG assessment for the SLS describes baseline conditions in the Project study area specific to this SE, and reviews potential interactions, effects, and proposed mitigation measures. Potential effects on air quality and GHGs were reviewed based on the information requirements identified in the TOR (**Appendix A**) for the Project.

7.1.1 Project Features Relevant to Air Quality and GHG

Key features of the Project Description (**Section 2**) relevant to the air quality and GHG SE include those that are intrinsic to the SkyTrain system and SLS design as well as its overall purpose. The SLS extends the Expo Line along Fraser Highway from King George SkyTrain Station in the City of Surrey to 203 Street in the City of Langley. The SLS will provide a fast, frequent, convenient, and electrically powered transit option to replace internal combustion engine-powered modes of transportation by increasing transit mode share within the Three Municipalities. TransLink will adjust local bus routes to better integrate with the Project and avoid duplication of services, such as the existing bus service along Fraser Highway.

During construction, the use of fossil-fuelled vehicles and equipment may be required, resulting in direct air emissions along the alignment. It is anticipated that much of guideway construction will be conducted sequentially, as has been the case for other SkyTrain projects, thus limiting the duration of construction emissions in any one area of the Project alignment. Project construction will require the production of cement and steel, which may be associated with indirect air emissions.

By displacing buses and personal vehicles from the road network, the Project is expected to reduce air emissions, and benefit both local and regional air quality during operation. The SLS will run off electricity supplied by BC Hydro via new dedicated underground distribution lines, with up to 9 PPSs as well as power and communication ducts along the alignment and will not be a direct source of air emissions.

7.1.2 Selection as a Screening Element

Air quality (i.e., CACs) and GHGs were selected as a SE because of their:

- Potential to change due to Project construction activities;
- Potential to trigger regulatory requirements; and
- Importance to First Nations, stakeholders, and the public.

Short-term air quality effects may occur during Project construction due to direct air emissions from equipment and indirect air emissions (e.g., production of cement and steel for use in Project structures). During operation, the Project is expected to reduce air emissions in the region by providing an alternative to the use of vehicles and buses powered by internal combustion engines. During Project operation, the main sources of air emissions will be from maintenance equipment and a small proportion of the electricity required to run the SkyTrain[15].

The selection of indicators for review of air quality and GHGs is based on the information requirements in the TOR and a review of the potential effects. Review indicators are summarized in **Table 7-1.**

Table 7-1 Selection of Review Indicators

Potential Effect	Review Indicator(s)	Rationale for Selection
Change in concentrations of CACs	Estimated change in emissions of CACs relative to baseline	This indicator considers Project-related effects on human and wildlife health, vegetation, and aesthetic qualities, particularly along main traffic corridors where exposure to CACs is at an elevated level and associated with adverse health effects.
Change in emissions of GHGs	Estimated change in emissions of GHGs relative to baseline	This indicator considers the Project's potential incremental contributions to climate change.

7.1.3 Spatial and Temporal Boundaries

This section presents the spatial and temporal boundaries identified for the Project study area.

7.1.3.1 Spatial Boundaries

Given the nature of air quality management in the region, and the widespread effects of GHG emissions on climate change, two study areas informed this assessment on air quality and GHG: a Local Study Area (LSA), and a Regional Study Area (RSA). The Project's LSA is represented by the City of Surrey, Township of Langley, and the City of Langley municipal boundaries in which the Project is located. The regional district boundaries of Metro Vancouver were used to represent the RSA, which is the regulatory boundary for air quality management and where there may be indirect effects to air quality. **Figure C7-1** (**Appendix C**: Air Quality and Greenhouse Gases Figures) shows the spatial boundaries for this SE.

7.1.3.2 Temporal Boundaries

Temporal boundaries are the Project phases that were considered in the assessment. It includes the Project works and activities that are reasonably expected to potentially affect air quality and GHG emission levels. The following temporal boundaries were considered in this assessment:

- Planning Phase: 2020 to 2024;
- Anticipated construction and commissioning phase: 2024 to 2028; and
- Operation phase (including maintenance) of Project: 2028 and beyond; while there is no planned decommissioning of the Project, for modeling purposes, a timeframe of 25 years of operation was selected for certain SEs, such as air quality.

[15] BC Hydro generates and/or purchases a small proportion of thermal energy, chiefly to supplement the power mix in winter (Our clean system (bchydro.com))

For the purpose of the assessment, the estimated duration of Project construction, including testing and commissioning, is 4 years and 5 months. Project-related effects on air quality and GHG emissions for the operations phase were considered for 2028 (opening day), 2035, and 2050[16].

7.1.4 Regulatory and Policy Context

Federal and provincial legislation that may apply to the Project is summarized in **Table 7-2**, and key bylaws, policies, and guidelines are summarized in **Table 7-3**.

Metro Vancouver has delegated authority under the BC *Environmental Management Act* (EMA) to manage and regulate air quality within the region. Metro Vancouver regulates the discharge of air contaminants through the Greater Vancouver Regional District Air Quality Management Bylaw. This bylaw prohibits the discharge of air contaminants while conducting an industry, trade, or business without a permit or approval. Discharges conducted strictly in accordance with other emission regulations and bylaws (e.g., non-road diesel engines, see below), however, are not subject to permitting under the Greater Vancouver Regional District Air Quality Management Bylaw.

Through provisions of Bylaw No. 1082, Metro Vancouver regulates the discharge of air emissions from non-road diesel engines (NRDEs) through the Greater Vancouver Regional District NRDE Emission Regulation Bylaw. This bylaw provides registration and labelling requirements for the operation of NRDEs. This bylaw also restricts where one may operate older engines that follow less stringent emission standards.

In addition to the listed regulations and policies, Project Co will be required to follow the Design-Build Standard Specifications for Highway Construction (Government of BC 2019c), including Section 165 Protection of the Environment.

Table 7-2 Key Legislation

Legislation	Responsible Agency	Relevant Aspects of Legislation	Applicability to the Project
Provincial			
Environmental Management Act, SBC 2003, c. 53 (EMA)	Ministry of Environment and Climate Change Strategy (ENV)	The EMA delegates authority to Metro Vancouver to regulate air quality in the region.	The Project will affect air quality in the region.
Climate Change Accountability Act (CCAA 2018)	ENV	The Act has updated the Province's GHG emission reduction targets, reporting and forecasting procedures.	The Project is part of the BC strategy to meet the reduction targets.

16 This air quality and GHG assessment is conducted based on supporting traffic modelling conducted by McElhanney. Traffic modelling was conducted for 2017, 2035, and 2050 as these represent the years for which traffic modelling inputs (e.g., land use, population, etc.) were available. Therefore, Project-related effects for the operations phase were considered for these years. Potential effects in 2028 were estimated based on a linear interpolation between 2017 and 2035.

Table 7-3 Key Bylaws, Policies and Guidelines

Bylaws, Policies and Guidelines	Responsible Agency	Relevant Aspects of Bylaws, Policies and Guidelines	Applicability to the Project
Provincial			
CleanBC Climate Strategy	ENV	Provides strategic actions for BC to reduce its GHG emissions to help meet the challenge of climate change, while driving economic growth.	The Project plays a part in the Province's strategies to achieve its reduction targets for GHG emissions.
Regional			
Air Quality Management Bylaw No. 1082, 2008	Metro Vancouver	Prohibits, regulates, and otherwise controls and prevents the discharge of air contaminants.	The Project may cause discharge of air contaminants.
Non-Road Diesel Engine Emission Regulation Bylaw No. 1329, 2021	Metro Vancouver	Regulates the use of non-road diesel engines and reduces harmful emissions. Tier 2, 3 and 4 diesel engines must be registered.	Project construction and operation will require the use of non-road diesel engines.
Mayors' Council 2018	Mayors' Council and TransLink	Provides actions to meet GHG emissions reduction target for the region's transportation.	The Project plays a part in TransLink's target of 80% reduction in GHG emissions by 2050, which aligns with federal and provincial targets.
Ambient Air Quality Objectives (2020)	Metro Vancouver	Establishes air quality objectives to guide air quality management decisions in Metro Vancouver.	The Project may affect air quality in the Metro Vancouver region.
Clean Air Plan (2021)	Metro Vancouver	Outlines actions to reduce air contaminant and GHG emissions in Metro Vancouver to improve air quality, protect human health, and support the commitment for a carbon neutral region by 2050.	The Project is integral to the Plan and the region's long-term goals to manage air quality and GHG emissions.
Metro 2050 Regional Growth Strategy (RGS) (2022)	Metro Vancouver	Provides the regional land use framework for planning, including aspects related to transportation and air quality.	The Project is part of the regional strategy to encourage transportation infrastructure that reduces energy consumption and GHG emissions and improves air quality.
Climate 2050: Strategic Framework (2018)	Metro Vancouver	Provides the strategic framework for Metro Vancouver's climate policies and actions.	The Project is part of the regional strategy to shift vehicular transportation to non-vehicular modes of transit and become carbon neutral by 2050.
Municipal			
Community Climate Action Strategy (2013a)	City of Surrey	Provides guidance for the community to reduce vulnerability to climate change impacts.	The Project is part of the City's strategy (currently being updated in response to the City's Climate Emergency Declaration and adoption of a 2050 net-zero GHG target in the OCP).

Bylaws, Policies and Guidelines	Responsible Agency	Relevant Aspects of Bylaws, Policies and Guidelines	Applicability to the Project
Community Energy and Emissions Plan (2013b)	City of Surrey	Outlines the City of Surrey's GHG reduction targets and provides guidance for the community to reduce energy consumption and GHG emissions.	The Project is part of the City's Plan (currently being updated in response to the City's Climate Emergency Declaration and OCP targets for GHGs)
Climate Action Strategy (2021)	Township of Langley	Outlines the Township's targets and actions to address climate change, in response to the Council's Climate Emergency declaration, and prepare for a sustainable future.	The Project aligns with the Township's action on advocating for public transit expansion.
Sustainability Framework (2010)	City of Langley	Expresses the City's commitment to sustainability, affirms community goals, and defines a structure that aligns the City's policies, plans, and actions toward a common direction.	The Project aligns with the City's goal to have attractive and convenient transportation choices that move people efficiently both within the City and to and from other Lower Mainland communities.

7.1.4.1 Ambient Air Quality Objectives

Air quality is evaluated based on concentrations of air contaminants in outdoor or ambient air. Metro Vancouver establishes Ambient Air Quality Objectives (AAQOs) to assess and provide context for air quality monitoring data and guide decisions for environmental assessments (Metro Vancouver 2022). The current AAQOs for CACs relevant to the Project are shown in **Table 7-4**. There are no AAQOs in Metro Vancouver for volatile organic compounds (VOCs) or ammonia (NH_3).

Table 7-4 Metro Vancouver AAQOs (Metro Vancouver 2020)

Contaminant	Averaging Period	AAQO ($\mu g/m^3$)[1]
Carbon monoxide (CO)	1 hour	14,900
	8 hour[2]	5,700
Particulate matter (PM_{10})	24 hour[2]	50
	Annual	20
Particulate matter ($PM_{2.5}$)	24 hour[2]	25
	Annual	8[3]
Nitrogen Dioxide (NO_2)	1 hour	113[4]
	Annual	32
Sulphur dioxide (SO_2)	1 hour	183
	Annual	13
Ozone (O_3)	1 hour	161
	8 hour[5]	122

Notes:

1. $\mu g/m^3$ = microgram per cubic metre.
2. Based on a rolling average.
3. There is also a long-term aspirational target of 6 $\mu g/m^3$ for $PM_{2.5}$.
4. Based on the annual 98th percentile of the daily 1-hour maximum concentration of NO_2, averaged over three consecutive years.
5. Based on the annual 4th highest daily 8-hour maximum concentration of O_3, averaged over three consecutive years.

7.1.4.2 Greenhouse Gas Emissions Targets

The Province updated its GHG reduction targets through legislation in the *Climate Change Accountability Act* (2018) which replaced the 2007 *Greenhouse Gas Reduction Targets Act*. The new targets for GHG emissions include a reduction of 40% below 2007 levels by 2030, 60% by 2040, and 80% by 2050. The CleanBC Plan (Government of BC 2018a) identifies actions to help achieve this target, including working with key partners to increase the share of personal and commuting trips by sustainable modes of transportation, such as public transit. The CleanBC Plan supports the Pan-Canadian Framework on Clean Growth and Climate Change to enable economic growth and to provide strategies to reduce GHG emissions.

Table 7-3 identifies regional and municipal policies that relevant to the Project's role in reducing GHG emissions. In the absence of ambient concentration or emissions criteria for GHG emissions, Metro Vancouver has established regional goals to reduce GHG emissions, with the aim of becoming carbon neutral by 2050 and 45% below 2010 levels by 2030. In its Clean Air Plan (Metro Vancouver 2021), and re-iterated in its Climate 2050 Strategic Framework (Metro Vancouver 2019), the regional strategy to reduce GHG emissions due to transportation includes plans to expand active transportation networks. The Three Municipalities consider the Project as a key element in their strategies and plans to support provincial and regional goals and targets to reduce GHG emissions.

7.2 Baseline Conditions

The baseline review of existing conditions included the full scope of the SLS Project, located in portions of the Three Municipalities, all within Metro Vancouver.

7.2.1 Methods

Information reviewed to characterize baseline conditions for air quality and GHGs is included in the following publicly available sources:

- Metro Vancouver Emission Inventory and Forecast (Sidi, S., Metro Vancouver, pers. comm., March 2022);
- National Inventory Report (ECCC 2021a); and
- Metro Vancouver air quality monitoring data, as reported to the National Air Pollution Surveillance Program (ECCC 2022).

7.2.2 Results

Existing 2015 emission estimates completed by Metro Vancouver for the LSA and RSA are summarized in **Table 7-5**.

Currently, mobile sources represent a large contributor to emissions of many CACs and GHGs in the LSA and RSA. Mobile emissions in the LSA represent 5% of total emissions for NH_3, up to 91% for CO, and 64% of total GHG emissions[17]. Over the next two decades, increasingly stringent vehicle emission standards and electrification of the vehicle fleet are expected to be countered by a projected growth in population and number of passenger vehicles, half of which are sport utility vehicles and light trucks with higher

[17] Municipality estimates of mobile GHG emissions versus total may differ due to differences in GHG inventory methodology from Metro Vancouver.

fuel consumption rates. In addition, industrial sector emissions are anticipated to increase over the coming years, as well as marine activity and general building heating. When all sectors are considered, emissions are forecast to increase without efforts to reduce vehicle use, except for CO and nitrogen oxides (NO_X), which are predicted to decrease while GHGs emissions are forecasted to hold steady. This reflects the overall contribution of each sector to total emissions, as they differ by contaminant. Overall, emission reductions for the mobile sector are projected to more than offset emission increases related to population and industrial expansion for the key mobile contaminants (i.e., CO and NO_X), whereas other contaminants will only be partially offset.

Total emissions of CACs in the LSA represent 16% to 42% of total emissions in the Metro Vancouver region, with the exception of SO_2. Local emissions of SO_2 represent only 5% of total regional emissions, given the lack of large industrial emitters in the LSA. For GHGs, emissions in the LSA represents 22% of total regional emissions.

Table 7-5 Existing 2015 CAC and GHG Emissions in the LSA and RSA

Source	CAC Emissions (t)							GHG Emissions (kt)			
	CO	PM_{10}	$PM_{2.5}$	NO_X	SO_2	VOC	NH_3	CO_2	CH_4	N_2O	CO_2e[1]
Total Emissions in the LSA											
Industrial	30	127	71	33	2	234	1	80.5	0.001	0.001	80.8
Area	4,241	1,312	850	940	30	8,088	1,906	914	4.5	0.1	1,058
Mobile	41,853	287	271	6,130	29	3,235	102	2,030	0.2	0.07	2,058
Total	**46,124**	**1,726**	**1,192**	**7,103**	**61**	**11,557**	**2,008**	**3,025**	**4.8**	**0.2**	**3,196**
Total Emissions in RSA											
Industrial	2,863	1,293	607	5,704	699	2,374	86	2,520	0.7	0.02	2,545
Area	11,367	4,045	2,448	4,524	238	30,085	4,342	4,038	19.2	0.2	4,585
Mobile	152,941	1,302	1,227	33,510	404	12,751	358	7,517	0.8	0.3	7,624
Total	**167,171**	**6,640**	**4,282**	**43,738**	**1,341**	**45,210**	**4,785**	**14,074**	**20.8**	**0.5**	**14,754**

Source: Sidi, S., Metro Vancouver, pers. comm., March 2022

Note:

1. CO_2e = carbon dioxide equivalent; t = tonnes; kt = kilotonnes

Overall, ambient air quality in the RSA and the LSA is generally good, with infrequent exceedances of the AAQOs. Air quality in the LSA is characterized by recent (2018 to 2020) data from monitoring stations in North Delta, Surrey East, and Langley Central (ECCC 2022) where exceedances of the AAQOs were reported for 24-hour coarse PM (PM_{10}) and fine PM ($PM_{2.5}$). These AAQOs were exceeded in the LSA less than 5% of the time (i.e., less than 18 days per year), mostly due to summer wildfires during 2018 and 2020. PM concentrations remained below the AAQO in 2019 when there was minimal wildfire activity influencing the region. Wildfire activity also results in the transport of other products of combustion, such as NO_X and VOCs, into the RSA and LSA. When these combustion products are combined with hot and stagnant weather conditions, elevated levels of O_3 result. The recent data indicates that ambient O_3 concentrations in the LSA exceeded the 1-hour AAQO at one of the three monitoring stations (Langley Central) less than 0.1% of the time (i.e., less than 8 hours) in 2018. The 8-hour AAQO was not exceeded in the LSA during this time.

In summary, the key contaminants of concern in the LSA are PM and O_3, formed by the reaction of NO_X and VOCs in the atmosphere. In recent years, the largest contributor to high ambient concentrations and infrequent exceedances of the AAQOs is wildfire activity. These trends are also attributable to the RSA.

7.3 Project Interactions

Potential interactions between air quality and GHGs, and the Project's proposed activities and physical works, are outlined in **Table 7-6**. A detailed list of construction equipment, which may have emissions leading to interactions, along with fuel type, power rating, number of units, and total estimated hours of operation, is provided in **Addendum 7-1** . This list has been compiled based on typical equipment that has been used on previous SkyTrain projects in the RSA.

Project interactions due to adjacent intensification of land use that is expedited or created with the introduction of SLS is not part of the scope of this Project assessment, due to uncertainties of the timing and level of adjacent redevelopments. However, Project operation is expected to further reduce emissions by facilitating transit-oriented development and encouraging active modes of transportation. Future transit-orientated development should result in the creation of higher density mixed use neighbourhoods adjacent to high-capacity rapid transit, promoting active transportation like walking and cycling. These communities will have lower carbon footprints per household and more energy efficient residential and commercial buildings. Through the SLS SPA, TransLink and the Three Municipalities are working together to ensure these results are achieved.

Table 7-6 Potential Project Interactions with Air Quality and Greenhouse Gases and Potential Effects

Project Activities and Works	Change in CACs	Change in GHGs
Construction		
Clearing and grubbing	o	✓
Property acquisition (including demolition of inert building materials)	✓	✓
Relocation of overhead BC Hydro transmission lines	✓	✓
Utility installation/relocation	✓	✓
Use of temporary laydown areas	-	-
Access and traffic management	o	o
Road widening (select locations)	✓	✓
Culvert extension and drainage realignment (select locations)	✓	✓
Installation of SkyTrain guideway foundations	✓	✓
Installation of overhead SkyTrain guideway	✓	✓
Stations (foundations, structure, lighting, access, service connections, security),	✓	✓
PPS	✓	✓
Management of non-contaminated excavated material	✓	-
Management of contaminated or hazardous materials	✓	-
Testing, commissioning, and start-up	o	o

Project Activities and Works	Change in CACs	Change in GHGs
Operation		
Project Operation	✓ Effect is positive. Project is expected to displace CAC emissions from vehicle traffic and diesel buses.	✓ Effect is positive. Project is expected to displace GHG emissions from vehicle traffic and diesel buses. Electricity generation will result in indirect GHG emissions.
Project Maintenance	✓	✓

Notes:

Interaction Rating:

– **No interaction:** where interaction between a Project component and SE is not likely.

○ **Minor interaction:** where impacts may result from an interaction, but standard measures to avoid or minimize the impact are available and well understood to be effective, and any residual effects would be reduced to negligible. Interaction is not discussed further.

✓ **Interaction:** where an interaction occurs and likely requires additional mitigation. Carried forward and discussed in subsequent sections.

Traffic management during construction may involve detours, lane closures, and lane narrowing, which leads to traffic delays. Vehicle engines may idle more frequently and travel at slower speeds, which increases associated CAC and GHG emissions. Such increases are excluded from this assessment as detailed information on traffic management are not yet available but are expected to be minor compared to baseline and to emissions from construction and maintenance equipment.

Material handling, clearing, and grubbing will result in combustion emissions from use of equipment as well as fugitive dust emissions during Project construction. Dust emissions are not detailed in this assessment as full information on modes and quantities of material to be handled are not available. In addition, large stockpiles or areas of exposed ground are not expected for this Project. Fugitive dust emissions from these activities are expected to be largely mitigated with proactive management (see **Section 7.5**). Furthermore, dust emissions associated with these activities tend to be of larger particle size fractions, which settle quickly and do not contribute significantly to airborne PM_{10} and $PM_{2.5}$. Combustion emissions are carried forward and discussed in **Section 7.4.**

7.4 Potential Effects

Potential Project-related effects associated with air quality and GHGs are listed below and discussed in **Sections 7.4.1** and **7.4.2** for construction and operation, respectively.

7.4.1 Project Construction

During construction, changes in CAC and GHG emissions may be caused by construction equipment, production of cement, and production of steel.

7.4.1.1 Methods

The Project design is currently at the RCD phase; therefore, a detailed inventory of equipment types, sizes, and activity hours is not yet available, however the Project team provided a best estimate of typical equipment and activity hours for each equipment type from previous SkyTrain projects (see **Addendum 7-1**).

Emissions of CACs and GHGs associated with the use of construction equipment were estimated using the United States Environmental Protection Agency (EPA) Motor Vehicle Emission Simulator (MOVES). The MOVES model calculates emission factors for non-road equipment, in units of grams of pollutant per horsepower-hour, and emission factors for on-road vehicles (e.g., haul trucks), in units of grams of pollutant per km[18]. Emission factors for non-road equipment were multiplied by the number, horsepower, and activity hours, as well as default EPA load factors, to estimate potential CAC and GHG emissions from Project construction. For on-road vehicles, emission factors were multiplied by the total distance travelled, which were estimated based on the activity hours, assuming average vehicle speeds of 50 km/h.

The use of concrete for construction of the guideway and stations will require the production of cement, which indirectly results in emissions of GHGs. Based on the RCD, the Project team estimated that approximately 144,700 cubic metres (m^3) (or 347,280 t) of concrete would be required for construction of the guideway and stations. GHG emissions from production of cement in concrete was estimated using an emission factor of 0.533 t CO_2/t cement (ECCC 2021a), assuming an average cement content of 11% by mass (NRMCA 2012).

Construction of the foundation, elevated guideway structure, and running rail will require the use of steel, and is associated with indirect emissions of GHGs. The amount of GHG emissions associated with steel production varies widely depending on methods, but typically results from production of coke, sinter, iron and refining of steel. Based on the Project's RCD, approximately 31,117 t of steel is estimated as necessary for construction of foundations, elevated guideway superstructure, and running rail. GHG emissions were estimated assuming an emission intensity of 1.1 t CO_2e/t steel (Canadian Energy and Emissions Data Centre 2022), which reflects the average 2019 emission intensity for the steel manufacturing sector in Canada.

7.4.1.2 Results

Total estimated emissions associated with Project construction are summarized in **Table 7-7,** assuming an estimated duration of Project construction of 4 years and 5 months (including testing and commissioning). During Project construction, increases in average annual CAC emissions are estimated to range from 0.002% to 0.14% of total LSA emissions, depending on the contaminant. CAC emissions during Project construction are therefore minor relative to existing conditions. Effects on ambient concentrations are expected to be well managed using best practices, no different from other similar construction activities in the region, remaining below relevant AAQOs. Any air quality effects will remain below acceptable thresholds and will be localized to the LSA; air quality in the RSA will not be affected by Project construction emissions.

For GHG emissions, average annual Project construction emissions are estimated to represent an increase of 0.50% of total LSA emissions. GHG emissions during Project construction are therefore minor relative to existing conditions, and not expected to contribute to climate change to any appreciable extent.

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18 MOVES does not provide emission factors for N_2O for Project-scale modelling used for this assessment. For purposes of estimating GHG emissions in CO_2e, emission factors for N_2O and were scaled based on the estimated CO_2 emissions, using information contained in Environment and Climate Change Canada's National Inventory Report ECCC (2021a).

Table 7-7 Summary of CAC and GHG Emission Estimates from Project Construction

Source	CAC Emissions (t)							GHG Emissions (kt CO_2e)
	CO	PM_{10}	$PM_{2.5}$	NO_X	SO_2	VOC	NH_3	
Construction equipment	104.1	2.3	1.6	43.3	0.07	4.2	0.2	15.3
Production of cement	-	-	-	-	-	-	-	20.4
Production of steel	-	-	-	-	-	-	-	34.2
Total emissions	**104.1**	**2.3**	**1.6**	**43.3**	**0.07**	**4.2**	**0.2**	**69.9**
Average annual emissions	23.6	0.5	0.4	9.8	0.02	0.9	0.05	15.8
% of 2015 emissions in LSA	*0.05*	*0.03*	*0.03*	*0.14*	*0.03*	*0.008*	*0.002*	*0.50*
% of 2015 emissions in RSA	***0.01***	***0.008***	***0.009***	***0.02***	***0.001***	***0.002***	***0.0009***	***0.11***

Note:

- CAC emissions from these sources are not applicable to the Project.

7.4.2 Project Operation

During operation, changes in CACs and GHG emissions are expected to be caused by displaced emissions from vehicles, emissions from maintenance activities and indirect emissions from generation of electricity.

7.4.2.1 Methods

Project operations are expected to displace CAC and GHG emissions from vehicle traffic by providing an alternative for private vehicles, resulting in a positive effect of the Project. Some changes to the bus network are also expected to reduce redundant service along Fraser Highway and provide better bus connections to the new stations at 166 Street, 196 Street, and 203 Street.

<u>Traffic Modelling</u>

To fully consider how the Project may affect the region's transportation, the Project engaged McElhanney to conduct regional traffic modelling. The model outputs provided by McElhanney (McElhanney, pers. comm., February 2022) includes total vehicle numbers and average vehicle speeds in the regional road network. Three traffic modelling scenarios were developed to assess potential Project-related effects on vehicle traffic: 2028 (opening day), 2035 (short-term outlook), and 2050 (long-term outlook). For each traffic modelling scenario, outputs were provided for "without Project" and "with Project". The difference between the two sets of outputs represents the displacement of vehicle traffic due to Project operation.

<u>Vehicle Emissions Modelling</u>

Emissions of CACs and GHGs in the LSA were estimated using the US EPA MOVES model. The annual VKT and distribution of vehicle speed from the traffic modelling (McElhanney, pers. comm., February 2022) were used as input to MOVES, along with network information obtained from Metro Vancouver per its emission inventory and forecast (Ries, F., pers. comm., July to August 2019). Since Metro Vancouver has not forecasted beyond 2035, network information for 2050 was based on the 2035 forecasts, with incorporation of targets in the BC *Zero-Emission Vehicles Act*, which states that 10% of all new light-duty cars and trucks will be zero-emission by 2025, and 100% by 2040. TransLink plans to replace its current fleet of diesel and natural gas buses with zero-emission battery electric vehicles. However, the schedule for electrification of the fleet is yet to be defined and, therefore, was not incorporated in the emission estimates.

Indirect GHG emissions associated with charging of electric vehicles were incorporated based on energy consumption estimates from the US EPA MOVES model. An average charging efficiency of 85.7% was assumed (Sears et al. 2014) along with a GHG emission intensity of 19.7 t of carbon dioxide equivalent (CO_2e) per gigawatt hour for electricity consumption in B.C. (ECCC 2021a).

Emissions from Maintenance Equipment

Emissions of CACs and GHGs associated with the use of equipment for the maintenance of SLS (see **Addendum 7-1**) were estimated using US EPA MOVES in the same manner as construction equipment. Information on equipment types, horsepower ratings, and activity hours were provided by BC Rapid Transit Company (BCRTC), the TransLink subsidiary that maintains and operates the Expo and Millennium Lines.

Indirect Emissions from Generation of Electricity

The generation of electricity required for Project operation will result in indirect GHG emissions for the small portion of electricity generated from non-renewable sources (BC Hydro 2021). The Project will be powered by electricity supplied by BC Hydro via new dedicated underground distribution lines, with up to nine (9) PPS along the alignment. Based on the propulsion power load analysis for the RCD, the Project will require 530 kWh of electricity per train trip. The number of train trips was provided by the Province and will gradually increase from 2028 (opening day) to 2050 to meet ridership and system demands. The electricity requirement and associated GHG emissions will likewise increase gradually during this time. Assuming implementation of the CleanBC climate strategy, whereby the Province is committed to producing or acquiring 100% of its energy requirements from renewable sources by 2030, indirect Project emissions of GHGs would be less than those estimated and presented herein (see **Section 7.4.2.2**).

7.4.2.2 Results

Traffic Modelling

Predictions of annual VKT by vehicle category for the three scenarios, based on regional traffic modelling conducted by McElhanney, are summarized in **Table 7-8** and **Table 7-9**. By 2035, traffic is projected to increase by almost 9% in the LSA and over 20% by 2050. For all three scenarios, the Project is expected to displace approximately 1% of annual VKT in the LSA, primarily from the removal of private vehicles. In addition, the Project is expected to help alleviate vehicle traffic congestion in the region due to predicted significant increases in future traffic volumes.

Table 7-8 VKTs by On-road Vehicles With and Without the Project in the LSA

Scenario	Annual VKT (million km)				
	Cars	Light Trucks	Heavy Trucks	Buses	All Vehicles
2028					
Without Project	5,124	150	217	19.0	5,511
With Project	5,070	151	217	17.6	5,456
Net change due to SLS	*-54*	*0.1*	*0.1*	*-1.3*	*-55*
% change due to SLS	***-1.0***	***0.08***	***0.03***	***-6.9***	***-1.0***
2035					
Without Project	5,569	163	244	19.0	5,995
With Project	5,508	163	244	17.6	5,932
Net change due to SLS	*-61*	*0.2*	*0.1*	*-1.3*	*-62*
% change due to SLS	***-1.1***	***0.10***	***0.04***	***-6.9***	***-1.0***
2050					
Without Project	6,311	179	275	21.7	6,787
With Project	6,234	179	275	20.3	6,709
Net change due to SLS	*-77*	*0.2*	*0.2*	*-1.4*	*-78*
% change due to SLS	***-1.2***	***0.11***	***0.06***	***-6.6***	***-1.1***

Vehicle Emissions Modelling

Table 7-9 summarizes the estimated CAC and GHG emissions from vehicle traffic in the LSA. As discussed in **Section 7.2.2**, vehicle emissions of CACs and GHGs are projected to decrease significantly over the next three decades primarily as a result of improved vehicle standards and a change in the vehicle fleet. Future electrification of the bus fleet will further reduce vehicular GHG emissions in the LSA[19].

With the Project, vehicle CAC emissions are projected to decrease by 0.2% (CO and VOCs) to 1.3% (NO_X) in 2028. Project vehicle GHG emissions are expected to decrease by 0.5% in 2028. Percent emission reductions will be higher in 2035, up to 1.2% for CACs and 0.9% for GHGs. Due to the high proportion of the vehicle fleet that will be zero-emission by 2050, emission reductions may be less for some contaminants, including GHGs.

[19] GHG emissions associated with the bus fleet accounts for approximately 2% of total vehicular GHG emissions.

Table 7-9 Summary of CAC and GHG Emission Estimates from Vehicle Traffic in the LSA

Scenario	CAC Emissions (t)							GHG Emissions (kt CO_2e)	
	CO	PM_{10}	$PM_{2.5}$	NO_X	SO_2	VOC	NH_3		
2028									
Without Project	10,155	239		51.2	1,213	14.7	774	63.4	1,021
With Project	10,133	236		50.7	1,198	14.7	773	63.2	1,016
% change due to Project	***-0.2***	***-1.0***		***-1.1***	***-1.3***	***-0.3***	***-0.2***	***-0.3***	***-0.5***
2035									
Without Project	5,895	251		43.8	764	11.1	494	51.6	824
With Project	5,846	248	611	43.4	759	11.0	492	51.1	816
% change due to Project	***-0.8***	***-1.2***		***-1.0***	***-0.7***	***-0.9***	***-0.3***	***-1.0***	***-0.9***
2050									
Without Project	1,647	284		41.6	697	3.1	211	14.0	419
With Project	1,636	280		41.0	697	3.1	210	13.9	415
% change due to Project	***-0.7***	***-1.5***		***-1.3***	***-0.9***	***-0.6***	***-0.4***	***-0.7***	***-0.8***

Summary of Emissions Estimates

Annual estimated emissions associated with Project operation are summarized in **Table 7-10**. For all contaminants and all scenarios, the removed emissions associated with the displacement of vehicle traffic more than offsets the emissions associated with Project maintenance and electricity generation requirements. In 2028, net Project operation CAC emissions are estimated to correspond to a decrease in overall LSA emissions of 0.009% to 0.21%. By 2050, however, the avoided emissions will correspond to a smaller decrease in overall LSA emissions of 0.004% to 0.13%, due to the high proportion of vehicle fleet that is expected to be zero-emission by this time.

Net Project operation CAC emissions in the RSA were not estimated; however, the majority of anticipated vehicle displacement (both private vehicles and buses) for the Project is expected to occur in the LSA. Thus, the absolute change in emissions in the RSA is expected to be slightly larger (i.e., slightly greater net reduction) than those predicted for the LSA. Given that total existing emissions in the RSA are considerably higher than the LSA, the percentage emission reduction in the RSA associated with Project operation is expected to be minor.

Net Project operation GHG emissions are estimated to correspond to a 0.08% to 0.21% decrease in overall LSA emissions, depending on the year. Similar to CAC emissions, the avoided GHG emissions will be less in 2050 as compared to 2028 and 2035, due to the high proportion of the vehicle fleet that is expected to be zero-emission by this time. Although the percent reductions in GHG emissions are not very large on a municipal scale and regional scale, the Project represents a key part of municipal, regional, and provincial strategies and contributes to GHG emission reduction targets.

Table 7-10 Annual Estimated CAC and GHG Emissions from Project Operation

Source	CAC Emissions (t)							GHG Emissions (kt CO_2e)
	CO	PM_{10}	$PM_{2.5}$	NO_X	SO_2	VOC	NH_3	
2028								
Net emissions from vehicle traffic	-22.2	-2.4	-0.6	-15.3	-0.05	-1.7	-0.2	-5.4
Maintenance equipment	1.1	0.04	0.03	0.09	0.004	0.03	0.02	0.3
Electricity generation[1]	-	-	-	-	-	-	-	0.2
Total	-21.2	-2.4	-0.5	-15.2	-0.05	-1.6	-0.2	-5.0
% of 2015 emissions in LSA	***-0.05***	***-0.08***	***-0.03***	***-0.21***	***-0.08***	***-0.014***	***-0.009***	***-0.15***
2035								
Net emissions from vehicle traffic	-48.0	-3.0	-0.4	-5.5	-0.10	-1.7	-0.5	-7.5
Maintenance equipment	0.9	0.06	0.03	0.07	0.005	0.04	0.02	0.3
Electricity generation[1]	-	-	-	-	-	-	-	0.6
Total	-47.2	-3.0	-0.4	-5.4	-0.10	-1.6	-0.5	-6.6
% of 2015 emissions in LSA	***-0.10***	***-0.09***	***-0.02***	***-0.08***	***-0.16***	***-0.014***	***-0.03***	***-0.21***
2050								
Net emissions from vehicle traffic	-11.3	-4.2	-0.6	-6.4	-0.02	-0.8	-0.10	-3.4
Maintenance equipment	1.2	0.06	0.03	0.06	0.005	0.08	0.02	0.3
Electricity generation[1]	-	-	-	-	-	-	-	0.6
Total	-10.1	-4.1	-0.5	-6.3	-0.02	-0.7	-0.07	-2.4
% of 2015 emissions in LSA	***-0.02***	***-0.13***	***-0.03***	***-0.09***	***-0.03***	***-0.006***	***-0.004***	***-0.08***

Note:
1. The indirect GHG emissions from electricity generation presented do not include the increase in renewable energy based on the CleanBC climate strategy. GHG emissions may be less (i.e., greater reduction) than those shown**.** Electricity emissions factor in partial operation in 2028.

7.5 Mitigation Measures

Mitigation measures that may be employed to avoid or reduce potential effects from the Project activities are listed below and included in the Air Quality and Dust Control Management Plan. The mitigation measures, the effect(s) they address, and the Project phase in which they will be implemented are summarized in **Table 7-11**. Mitigation is categorized according to the stage of Project development: Design (denoted as "D"), Construction (denoted as "C"), and Operation (denoted as "O").

Content from this section will be incorporated into the Project's CEMP Framework (see the TOR for additional description of this document). As its name implies, the CEMP Framework document will provide detailed guidance for the content of the Project Co's CEMP. In addition to mitigation and performance objectives, the CEMP Framework will describe best practices to help meet the performance objectives, required content for each sub-plan and details on roles and responsibilities for Project Co's key team members.

7.5.1 Design Mitigation

Mitigation M7.D-1 RCD Optimization

The performance objective of this mitigation measure is to avoid or reduce unnecessary effects on air quality and GHGs through careful planning and optimized design. Many potential inefficiencies can be avoided by taking an anticipatory approach to Project design.

The Project team has incorporated the following design measures into the RCD:

- Entire Project system will run on electricity that is primarily generated from renewable sources; and
- Placement of guideway foundations, stations, and other infrastructure was designed to minimize transportation and access effects.

7.5.2 Construction Mitigation

The following mitigations are recommended for inclusion in an Air Quality and Dust Control Plan, as part of the CEMP.

Mitigation M7.C- 1 Use Electric-Powered Equipment

It is recommended to consider, where feasible, use of electric-powered equipment versus fossil fuelled equipment for Project construction, based on required power specifications, availability, and suitability. Substitution of electric-powered equipment for equivalent non-road fossil-fuelled equipment minimizes direct CAC and GHG emissions.

Mitigation M7.C-2 Conduct Regular Inspections and Maintenance

All non-road equipment for construction should be inspected and maintained according to manufacturer recommendations. Properly maintained combustion engines will minimize fuel consumption, and consequently, minimize Project-related CAC and GHG emissions.

Mitigation M7.C-3 Use Tier 4 or Higher Equipment

The Project should prioritize the use of Tier 4 emission standard, or higher, diesel-fuelled non-road equipment used for construction, where feasible, based on required power specifications, availability, and suitability. In accordance with Metro Vancouver's NRDE Emission Regulation Bylaw, any equipment with lower emission standards will be subject to registration fees and labelling requirements by 2024.

Mitigation M7.C-4 Use Ultra-low Sulphur Diesel

Ultra-low sulphur diesel should be used for all diesel-fuelled, non-road equipment. The use of ultra-low sulphur diesel will minimize the emissions of SO_2 from diesel fuel combustion.

Mitigation M7.C-5 Implement Anti-Idling Policy

In accordance with Metro Vancouver's NRDE Emission Regulation Bylaw, a written anti-idling policy should be developed to minimize idling of all non-road Project construction equipment. The intent of the policy is to place idling limits on different types of vehicles with exceptions for testing, servicing, or safety. The implementation and enforcement of idling restrictions will minimize unnecessary CAC and GHG emissions during construction.

Mitigation M7.C-6 Consider Use of Alternative Concrete Mixes

The Project should evaluate the use of alternative concrete mixes that have lower carbon or GHG footprints than conventional concrete, where appropriate and in consideration of product specifications and structural engineering requirements. The production of cement for use in concrete is associated with indirect GHG emissions. While, on average, conventional concrete contains 11% cement by mass, fly ash may be used to replace up to 30% of the total cementitious material. The use of high-volume fly ash concrete can, therefore, reduce the need for cement production and reduce indirect GHG emissions. Other alternatives, such as low carbon concrete, should also be considered.

Mitigation M7.C-7 Dust Management

Due to the proximity of the Project to busy roadways and urban areas, management of fugitive dust will be required for construction activities where soil is exposed or particulates may be generated (e.g., demolition) as well as during dry periods. A variety of strategies are available to manage fugitive dust during construction, including:

- Street sweeping of transitions to asphalt;
- Covering/wetting of stockpiles;
- Enclosure of dust-generating operations; and
- Application of water to unpaved surfaces, where appropriate.

Mitigation M7.C-8 Minimize Traffic Delays

To minimize increases in CAC and GHG emissions due to congestion-related idling of vehicle traffic during construction-induced delays, detours, and land closures, traffic delays caused by detours, lane closures, and lane narrowing should be minimized. Mitigation options will be detailed in a dedicated Traffic Management Plan (TMP). Recommended measures for the TMP include advance notice to the public, re-routing, and implementing activities one lane at a time, where possible. Additional detail on this mitigation is provided in **Section 16** Transportation and Access.

7.5.3 Operation Mitigation

Mitigation M7.O-1 Use Electric Powered Equipment

BCRTC (TransLink's operator of SkyTrain) and its contractors have transitioned to all electric or battery-powered equipment for station cleaning. TransLink will strive for continual improvement in its operating procedures and equipment procurement, including the electrification of other maintenance equipment where feasible, based on required power specifications, availability, and suitability.

7.5.4 Summary of Proposed Mitigation

Table 7-11 summarizes proposed mitigations specific to each Project phase (design, construction, and operation).

Table 7-11 Summary of Potential Project-related Effects and Mitigation Measures for Air Quality and GHG Emissions

Potential Effect	Mitigation Number	Mitigation Measure	Project Phase	Environmental Management
Change in concentrations of CACs Change in emissions of GHGs	M7.D-1	RCD optimization	Design	Design Criteria
	M7.C-1	Use electric-powered equipment	Construction	CEMP – Air Quality and Dust Control Management Plan
	M7.C-2	Conduct regular inspections and maintenance		
	M7.C-3	Use Tier 4 or higher equipment		
	M7.C-4	Use ultra-low sulphur diesel		
	M7.C-5	Implement anti-idling policy		
	M7.C-8	Minimize traffic delays		
	M7.O-1	Use electric powered equipment	Operation	TransLink Procedures
Change in emissions of GHGs	M7.C-6	Consider use of alternative concrete mixes	Construction	CEMP – Air Quality and Dust Control Management Plan
Change in concentrations of CACs	M7.C-7	Dust management	Construction	

7.6 Discussion

During construction, the Project may result in emissions of CACs from the use of construction equipment and activities such as material handling, clearing, and grubbing. Emissions will be minor, ranging from 0.002% to 0.14% of baseline emissions in the LSA. The magnitude of air quality effects during construction will therefore be low, remaining below relevant AAQOs with the implementation of BMPs. Air quality effects will be short-term and reversible after the construction period and will be localized to the LSA.

Project construction may result in direct emissions of GHGs from the use of construction equipment as well as indirect emissions of GHGs associated with the production of concrete and steel. The magnitude of GHG emissions will be low, representing only 0.5% of total GHG emissions in the LSA. Given the nature of GHG emissions and its persistence in the atmosphere, effects will be greater than regional and long-term.

An Air Quality and Dust Control Management Plan will be developed, outlining mitigation measures that will be employed to reduce effects on air quality and GHG emissions during Project construction. To evaluate the effectiveness of mitigation measures, visual monitoring should be conducted throughout the construction period. A complaint management process is recommended whereby any air quality related complaints will be investigated in a timely manner. Additional mitigation measures and monitoring will be considered, where necessary.

During the operation phase, the Project will displace private vehicles and diesel buses on the road network, thereby reducing emissions of CACs and GHGs. The reduction in vehicle emissions is expected to more than offset emissions from maintenance equipment and electricity consumption, representing a net benefit to air quality and GHGs. Effects on air quality will last for the life of the Project, and will predominantly occur in the LSA, although some benefit to air quality is also expected in the RSA. Given the nature of GHG emissions and its persistence in the atmosphere, these Project benefits will be regional and long-term.

7.7 Conclusion

Existing air quality in the LSA and RSA is generally good. Currently, transportation sector mobile sources, such as vehicles powered by internal combustion engines, are a large contributor to emissions of many CACs and GHGs in the Metro Vancouver region. Mobile emissions in the LSA represent up to 91% of total CAC emissions and 64% of total GHG emissions. Over the next two decades, the emissions contribution due to mobile sources is projected to decrease due to lower emissions standards and the gradual transition to electric vehicles. However, decreases in mobile source emissions are expected to be countered by increases in emissions from other sectors (e.g., industrial). As a result, total emissions of CACs and GHGs in both the LSA and RSA, are forecast to hold steady or increase. Two exceptions exist with CO and NO_X, which are predicted to continue decreasing due to the prevalence of these emissions from mobile sources.

During construction, the Project will release emissions of CACs and GHGs from the operation of gas- and diesel-powered construction vehicles and equipment. In addition, indirect GHG emissions will result from cement production for use in the concrete required to build the guideway, PPS and stations, and from steel production for use in foundations, guideway superstructure and running rail. Project construction is estimated to result in CAC emissions ranging from 0.07 t for SO_2 to 104 t for CO. These emissions represent 0.002% to 0.14% of total existing emissions in the LSA on an annual basis. GHG emissions associated with Project construction are estimated to be 69.9 kt CO_2e, or 0.5% of total existing emissions in the LSA on an annual basis. The overall effects on air quality resulting from Project construction emissions are predicted to be minor. Furthermore, Project construction emissions are expected to be short-term, occurring over an estimated duration of 4 years and 5 months. Effects on air quality will be reversible after construction is complete.

During operation, the Project is expected to reduce emissions of CACs and GHGs through mode shift from use of vehicles powered by internal combustion engines to electrically powered SkyTrain. However, emissions related to maintenance equipment and non-renewable electricity generation will slightly reduce the overall benefits. With the exception of PM and NO_X, the overall emissions reduction associated with Project operation is expected to be greatest in 2035, before the vehicle fleet is predominantly electrified as a result of the *Zero-Emission Vehicles Act*. CAC and GHG emissions in the LSA will be reduced by up to 0.21% through the assessed operation phase until 2050.

The net emissions benefit associated with Project operation aligns with Metro Vancouver's Clean Air Plan as well as the Province's CleanBC Plan, contributing to regional and provincial GHG emission targets. The Project also represents a key element in climate action strategies for the Three Municipalities. Furthermore, Project operation is expected to further benefit air quality and reduce GHGs by facilitating transit-oriented development, creating higher density mixed use neighbourhoods adjacent to high-capacity rapid transit. These communities will have lower carbon footprints per household and more energy-efficient residential and commercial buildings. Through supportive policy agreements, TransLink and the Three Municipalities are working together to achieve these results.

Table 7-12 Summary of Potential Effects Remaining After Mitigation for Air Quality and Greenhouse Gases – Construction

Potential Effect	Criterion	Rating	Rationale for Rating
Change in concentrations of CACs	Magnitude	Low	Emissions will be minor relative to existing conditions and effects well managed using best practices.
	Geographic Extent	Low	Effects will be localized to the LSA.
	Duration	Medium-term	Effects will last for the duration of Project construction.
	Frequency	Continuous	Emissions will occur when equipment is in use, expected up to 10 hours per day.
	Reversibility	Reversible	Effects are fully reversible after completion of construction.
Change in emissions of GHGs	Magnitude	Negligible-Low	Emissions will be minor relative to existing conditions.
	Geographic Extent	Greater than regional	Effects of GHG emissions are global in nature.
	Duration	Very long-term	GHGs can persist for hundreds of years in the atmosphere.
	Frequency	Continuous	Emissions will occur when equipment is in use, expected up to 10 hours per day.
	Reversibility	Partially reversible	GHGs can persist for hundreds of years in the atmosphere.

Notes:

1. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance, and high (exceedance of criteria or threshold). Generally, magnitude is measured in terms of the proportion of the SE affected within the assessment area (for biophysical SE), or the degree within the interaction area relative to the range of natural or historic (in the case of human environment SE) variation.
2. The duration of an effect may be short-term (i.e., within the construction phase), medium term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (permanent) (i.e., extending past the life of the Project).

Table 7-13 Summary of Potential Effects Remaining After Mitigation for Air Quality and Greenhouse Gases – Operation

Potential Effect	Criterion	Rating	Rationale for Rating
Change in concentrations of CACs	Magnitude	Low	Effect is positive. The Project is expected to result in a net decrease in CAC emissions by displacing vehicle traffic.
	Geographic Extent	Regional	Effect is positive. The Project will reduce CAC emissions across the regional road network.
	Duration	Long-term	Effect is positive. The effect will last the duration of Project operation.
	Frequency	Continuous	Effect is positive. The effect will be continuous when SkyTrain is in operation.
	Reversibility	Reversible	The effect is positive so reversibility not desirable.
Change in emissions of GHGs	Magnitude	Low	Effect is positive. The Project is expected to result in a net decrease in GHG emissions by displacing vehicle traffic.
	Geographic Extent	Greater than regional	Effect is positive. Effects of GHG emission reductions are global in nature.
	Duration	Long-term	Effect is positive. The effect will last the duration of Project operation.
	Frequency	Continuous	Effect is positive. The effect will be continuous when SkyTrain is in operation.
	Reversibility	Reversible	The effect is positive so reversibility not desirable.

Notes:

1. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance, and high (exceedance of criteria or threshold). Generally, magnitude is measured in terms of the proportion of the SE affected within the assessment area (for biophysical SE), or the degree within the interaction area relative to the range of natural or historic (in the case of human environment SE) variation.
2. The duration of an effect may be short-term (i.e., within the construction phase), medium term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (permanent) (i.e., extending past the life of the Project).

Addendum 7-1 Equipment Lists

Table A7-1A Construction Nonroad Equipment

Operation	Equipment	Fuel	Power Rating (hp)	Load Factor	Total Unit-Hours of Operation
Guideway					
Asphalt removal	Asphalt saw	Gasoline	20	0.78	7,796
Concrete removal	Asphalt saw	Diesel	20	0.78	7,796
Asphalt removal	Hoe-ram	Diesel	144	0.59	11,880
Asphalt milling	Milling machine	Diesel	750	0.43	400
Excavation - foundations, demolition, grading	Excavator	Diesel	160	0.59	22,224
Caisson foundations - augered	Drill rig - vibratory	Diesel	1050	0.43	3,803
Caisson foundations - steel pipe piles	Drill rig - hammer	Diesel	500	0.43	423
Caisson foundations - pipe assembly	Welder	Diesel	20	0.21	4,730
Steel placement - foundations, columns, beams, miscellaneous	Crane	Diesel	320	0.43	10,740
Concrete placement - foundations, columns, beams, slabs	Concrete pump truck [boom type]	Diesel	320	0.43	5,064
Concrete placement - pre-cast yard	Concrete pump truck [line type]	Diesel	320	0.43	2,240
Concrete finishing - slabs	Concrete power trowel	Gasoline	10	0.49	320
Concrete formwork placement and removal	Crane	Diesel	320	0.43	8,656
Install precast beam	Gantry truss	Diesel	100	0.43	12,000
Install precast beam	Post tensioning hydraulic pump	Gasoline	20	0.69	3,688
Assemble steel special structure	Compressor for pneumatic impact wrench	Diesel	20	0.43	186
Install steel special structure	Crane	Diesel	320	0.43	186
Install precast beam special structure	Crane	Diesel	320	0.43	80

Operation	Equipment	Fuel	Power Rating (hp)	Load Factor	Total Unit-Hours of Operation
Additional items for Trackwork					
Rail Installation	Heaters	Propane	66	0.68	17,280
Systems Installation	Hi-Rail Utility Truck - Cable Reel	Diesel	270	0.21	2,560
Rail Installation	Compressor for pneumatic impact wrench	Diesel	20	0.43	9,600
Rail Installation	Portable Diesel Generator	Diesel	40	0.43	30,400
Rail Installation	Portable Light Generator	Diesel	30	0.43	2,400
Rail Installation	Rail welder	Diesel	350	0.21	1,720
Rail laying, moving most materials on guideway	Hi-Rail Pettibone	Diesel	163	0.21	5,120
Lifting rail	Crane	Diesel	320	0.43	408
Install precast walkway	Hi rail excavator/pettibone	Diesel	163	0.21	800
Install power rail	Hi-Rail Pick Up Truck	Diesel	200	0.21	1,032
Install LIM	Hi-Rail Pick Up Truck	Diesel	200	0.21	1,376
Additional items for Stations					
Escalator installation	Crane	Diesel	320	0.43	1,184
Station roofing, glazing etc installation	Crane	Diesel	100	0.43	2,560
Station roofing, glazing etc installation	Man lift	Diesel	100	0.21	3,840
Additional items for Utility Relocation and Roadwork					
Excavation - subgrade, trenches	Excavator	Diesel	160	0.59	4,800
2nd Excavator for backfill and pipe activities	Excavator	Diesel	135	0.59	4,800
Compaction - granular, asphalt	Compactors (Double Drum Vibro + Pneumatic)	Diesel	157	0.59	4,800
Compaction - trenches	Backhoe with plate compactor	Diesel	144	0.21	5,280
Asphalt placement	Asphalt Paver	Diesel	173	0.59	5,280
Excavation - expose existing utilities	Hydrovac Truck	Diesel	320	0.43	4,800
Additional items for Miscellaneous					
Construction Staging Yard	Compressor	Diesel	21	0.43	4,480
Construction Staging Yard	Forklift	Diesel	55	0.59	8,320
Construction Zone General Support	Light Plants	Diesel	5	0.43	18,240
Construction Staging Yard, stations, and associated work	Sky Jack	Diesel	55	0.21	3,840
Construction Zone General Support	Crane	Diesel	320	0.43	9,616
Segment lift	Rubber tired gantry crane [100t]	Diesel	320	0.43	1,120

Table A7-1B Construction Onroad Vehicles

Operation	Equipment	Fuel	Total Unit-Hours of Operation	Total VKT
Asphalt disposal	Dump truck	Diesel	2,160	108,000
Excavation - foundations, demolition, grading	Dump Truck	Diesel	16,053	802,629
Caisson foundations - pipe delivery	Tractor trailer	Diesel	4,730	236,500
Steel delivery - reinforcement, miscellaneous	Tractor trailer	Diesel	7,290	364,500
Concrete delivery - foundations, columns, beams, slabs	Concrete truck	Diesel	51,033	2,551,633
Deliver precast beam segments	Low bed tractor trailer	Diesel	11,104	555,200
Deliver steel special structures	Low bed tractor trailer	Diesel	186	9,280
Deliver precast beam special structures	Tractor trailer	Diesel	80	4,000
Deliver rail	Low bed tractor trailer	Diesel	424	21,200
Deliver LIM, power rail, misc to guideway	Boom truck	Diesel	2,880	144,000
Escalator delivery	Tractor trailer	Diesel	592	29,600
Granular delivery	Dump truck	Diesel	9,600	480,000
Compaction - water delivery and spraying	Water Truck	Diesel	480	24,000
Asphalt delivery	Dump truck	Diesel	9,600	480,000
Construction Zone General Support	Pickup Trucks F150, F350 etc	Gasoline	33,280	1,664,000
Construction Zone General Support	Low bed tractor trailer	Diesel	12,544	627,200

Table A7-1C Maintenance Nonroad Equipment

Equipment	Fuel	Power Rating (hp)	Load Factor	Number of Units	Annual Hours of Operation
Speeder	Diesel	20	0.21	2	1460
Grinder	Diesel	30	0.21	1	416

Table A7-1D Maintenance Onroad Equipment

Equipment	Fuel	Number of Units		Annual Hours of Operation		Total VKT	
		Elevated Track	Stations	Elevated Track	Stations	Elevated Track	Stations
NRV - Plant/Electronics/Power/Guideway	Gasoline	7	14	1095	1095	383,250	766,500
NRV - Operations	Gasoline	1	1	730	730	36,500	36,500

8 Noise and Vibration

8.1 Introduction

For the purposes of this assessment, noise is defined as unwanted sound in the environment and is the energy added to the air in the form of acoustical waves. Negative impacts of noise include public concern and can interference with sleep, concentration, communication, overall human health, and quality of life.

Noise is measured in decibels (dB), and for environmental noise assessments, the A-weighted decibel (dBA) is used to represent the relative loudness perceived by the human ear, which is less sensitive to low audio frequencies (less than 1,000 Hertz (Hz)) than other species. A more detailed description of noise and associated terminology is provided in **Addendum 8-1**.

Vibration is an oscillatory motion that is described in terms of its displacement, velocity, and acceleration. Displacement is the distance that vibration at a point on the floor moves away from its static position; velocity represents the instantaneous speed of the vibration's movement across a floor; and acceleration is the rate of change of the velocity. Ground-borne vibration is typically described using velocity or acceleration, measured in vibration decibels (VdB). Vibration waves propagate through the ground and into nearby buildings where it can be detectable by humans, causing irritation, stress, and discomfort. At sufficiently high levels, ground-borne vibration can cause minor cosmetic damage to buildings. In addition, vibrating building components can radiate sound, which is referred to as ground-borne noise. A more detailed description of vibration and associated terminology is provided in **Addendum 8-1**.

The review of potential effects of noise and vibration was conducted based on the information requirements identified in the ESR TOR (**Appendix A:** Terms of Reference). Construction will follow a staged approach, generally consisting of utility relocations, site preparation and roadwork, guideway, and structure construction, then trackwork and systems electrical work. This assessment focuses on potential effects of noise and vibration on human receptors[20]. The results of this assessment consider mitigation measures recommended by TransLink's SkyTrain Noise Study reporting (SLR 2018, 2019, 2020, 2021) .and will help to inform Project plans.

8.1.1 Project Features Relevant to Noise and Vibration

Key features of the Project Description (**Section 2**) relevant to the noise and vibration SE include those that are intrinsic to the SkyTrain system as well as the SLS design, such as the alignment and elevated components. The SLS will generally follow the existing ROW on Fraser Highway from King George SkyTrain Station in the City of Surrey to 203 Street in the City of Langley. Much of the alignment is flanked by residential and commercial receptors, which may be affected by Project-related noise and vibration.

Baseline noise levels in the Project study area are heavily influenced by road traffic along Fraser Highway. As an elevated system that does not interact with ground-level transportation, the SLS offers a cost-effective, high-quality rapid transit option to increase transit mode share in the Three Municipalities. The Project is expected to encourage mode shift from private vehicles to transit, and thereby displace road traffic from Fraser Highway as well as other roads in the road network, thereby reducing noise generated by road traffic.

[20] Potential for sensory disturbance such as noise and vibration on wildlife and recommended mitigation is discussed qualitatively in **Section 11** Vegetation and Wildlife Resources.

The SkyTrain system consists of electric passenger cars with steel wheels that run along grade-separated tracks with steel rails. The wheel-rail interaction represents the predominant source of noise and vibration during operation. Components of wheel-rail interaction include rolling contact, impact, and curve squeal.

Rolling contact refers to the continuous noise and vibration as wheels run over the rails. Rolling noise and vibration is largely influenced by the roughness of the wheel and rail, and the speed at which wheels travel over the rail. The SkyTrain system utilizes a linear induction system, using magnetic fields to enable propulsion and braking. This linear induction system results in lower wheel roughness than conventional systems and thereby minimizes noise and vibration levels generated by the wheel-rail interaction. The Project design entails a nominal top speed of 80 km/h, and an average speed of 44 km/h. As trains approach and leave each station, noise and vibration levels are reduced due to these lower speeds.

Impact refers to the noise and vibration that is generated when wheels encounter a rail discontinuity, such as rail joints and switches. The Project design relies on continuously welded rail, minimizing the presence of joints between rail segments, and minimizing locations of increased noise and vibration due to impact. Where switches are required, the Project design uses a swing-nose design, which incorporates moving parts to eliminate the gap in the rail and minimize discontinuity and associated impact noise and vibration, as compared to conventional fixed switches.

Curve squeal refers to the phenomenon of loud high-frequency noise at tight radius curves, which is generated by friction caused by lateral slip between the wheel and rail, and flange noise caused by the strike of the wheel flange against the inner side of the rail. The Project design includes a relatively straight alignment that has no tight radius curves that could generate curve squeal. The SkyTrain also uses steering wheelsets to minimize the potential of lateral slip. Rail squeal may result at the identified pocket track locations where trains move on and off the mainline.

Other aspects of the Project design relevant to the noise and vibration SE include the elevated alignment, which reduces ground-borne vibration, and the frequency of SkyTrain service (i.e., headway), which influences the frequency of noise and vibration events experienced by individuals at potentially affected receptors.

Much of Project guideway construction is anticipated to be conducted sequentially, as has been the case on other SkyTrain projects. Sequential construction limits the duration of construction activities in any one area of the alignment. Typically, most notable noise and vibration effects from construction activities from the proximity of heavy equipment operation and pile installation to sensitive receptors. Pile installations will likely be conducted using drilling, as possible, to limit effects during construction. Where it is not feasible for a drilled installation, piles would be installed using a combination of vibratory and impact driving.

8.1.2 Selection as a Screening Element

Noise and vibration were selected as a SE because of the potential for the Project to result in additional noise and contribute to sleep disturbance or other human health impacts as well. This could lead to public grievances. First Nations, stakeholders, and the public identified noise as a potential concern during multiple rounds of public engagement conducted for the Project.

During Project construction, the operation of heavy equipment could result in undue exposure to noise sensitive receptors. During the operation of SkyTrain, ambient noise in the community may increase due to train movements and additional human activity around SkyTrain stations; however, overall reductions in community noise may also occur if fewer vehicles are operating within the Project corridor.

This report focuses on the effects of noise and vibration at sensitive receptors - locations with potentially heightened sensitivity or exposure. Sensitive receptor locations include residences; institutions, such as schools, daycares, and senior care facilities; and places of worship that value tranquility. An assessment of facilities housing highly sensitive equipment, such as health care facilities, was also completed.

Review Indicators for noise and vibration were identified based on the information requirements in the ESR TOR and a review of potential effects. They are summarized in **Table 8-1**.

Table 8-1 Selection of Review Indicators

Potential Effect	Review Indicators	Rationale for Selection
Change in noise levels	Predicted noise levels at sensitive receptor locations. Specific metrics include: • Daytime sound level • Nighttime sound level • Day-night sound level • Peak one-hour sound level	This indicator considers potential effects of Project-related noise on public sentiment and human health.
Change in vibration levels	Predicted vibration levels at sensitive receptor locations. Specific metrics include: • Peak particle velocity, expressed in millimetres per second or vibration decibel • Root mean square (RMS) velocity, expressed in millimetres per second or vibration decibel • Ground-borne noise, expressed in dBA	This indicator considers potential effects of Project-related vibration on public sentiment, building damage, and interference with sensitive equipment.

8.1.3 Spatial and Temporal Boundaries

Details about the evaluation's spatial and temporal boundaries, which encompass the noise and vibration scope, are found below.

8.1.3.1 Spatial Boundaries

The study area for the noise and vibration SE, as illustrated in **Figure D8-1** (**Appendix D**: Noise and Vibration Figures), comprised all areas within 150 m of the Project's centreline - from the existing King George SkyTrain Station in the City of Surrey to the future terminus station at 203 Street in the City of Langley. This spatial boundary represents the area where potential effects may be experienced by sensitive receptors during the Project's construction and operation phases, based on results of previous SkyTrain studies (Hatch 2010, SLR 2018).

8.1.3.2 Temporal Boundaries

The temporal boundaries for the noise and vibration assessment comprise the construction and operation phases, including the proposed timing of Project works and activities, which may affect existing noise and vibration levels.

This assessment considers the following temporal boundaries:

- Planning Phase: 2020 to 2024;
- Construction and commissioning phase: 2024 to 2028; and
- Operation (including maintenance) of Project: 2028 and beyond.

8.1.4 Regulatory and Policy Context

The environmental noise that results from public infrastructure projects in BC is regulated by municipal governments under provisions of the *Municipal Act* (Revised Statutes of British Columbia (RSBC) 1996, c. 323). Key legislation for noise and vibration are summarized in **Table 8-2**. The Province will work with the Three Municipalities to define requirements for construction.

Key bylaws, policies and guidelines that helped to inform the noise and vibration assessment are summarized in **Table 8-3.** In the absence of relevant policies and guidelines in BC and Canada[21], guidance was drawn from other jurisdictions. In addition to the listed regulations and policies, Project Co will be required to follow the Design-Build Standard Specifications for Highway Construction (Government of BC 2019c), including Section 165 Protection of the Environment.

Table 8-2 Key Legislation

Legislation	Responsible Agency	Relevant Aspects of the Legislation	Applicability to the Project
Provincial			
Municipal Act, RSBC 1996, c. 323	Province of BC	Delegates regulation of environmental noise from public infrastructure projects to municipal governments in BC.	The Project will generate noise during construction and operation.

21 The BC Ministry of Transportation and Infrastructure has a noise policy; however the policy is specific to assessing and mitigating noise impacts from new and upgraded numbered highways. The policy takes a "dual-threshold" approach whereby a project is assessed not only by the incremental change in noise levels relative to baseline conditions, but also by the absolute levels of noise, and implies projects should improve upon baseline conditions when there is excessive noise. This approach is not meaningful for a transit project such as SLS that does not directly alter existing noise sources.

Table 8-3 Key Bylaws, Policies and Guidelines

Bylaws, Policies and Guidelines	Responsible Agency	Relevant Aspects of Bylaws, Policies and Guidelines	Applicability to the Project
International			
Code of Practice for Noise and Vibration Control on Construction and Open Sites	British Standards Institute	Provides BMPs for vibration control at construction sites.	Project construction will generate noise and vibration in proximity of sensitive receptors.
Transportation and Construction Vibration Guidance Manual (2013)	California Department of Transportation	Highlights guidance and criteria to assess vibration effects from transportation projects.	Project construction will generate vibration in proximity of sensitive receptors.
Transit Noise and Vibration Impact Assessment Manual (2018)	United States Federal Transit Administration	Describes procedures and criteria to predict and assess noise and vibration effects from public transportation projects, including rapid rail transit.	The Project is rapid rail and will generate noise and vibration in proximity of sensitive receptors.
Municipal[1]			
Noise Control Bylaw, 1982, No. 7044	City of Surrey	Prohibits the making of noise that can disturb the quiet, peace, rest, enjoyment, comfort, or convenience of the neighbourhood. Construction hours are limited to the period from 7:00 a.m. to 10:00 p.m., Monday through Saturday	Project construction will generate noise.
Noise Bylaw, 2008, No. 2628	City of Langley	Prohibits the making of noise that can disturb the quiet, peace, rest, enjoyment, comfort, or convenience of the neighbourhood. Construction hours are limited to weekday periods from 7:00 a.m. to 7:00 p.m., and 7:00 a.m. to 5:00 p.m. on Saturday.	Project construction will generate noise.
Community Standards Bylaw, 2019, No. 5448	Township of Langley	Prohibits the making of noise that can disturb the quiet, peace, rest, enjoyment, comfort, or convenience of the neighbourhood. Identifies specific noise criteria applicable to the normal course of business. Construction hours are limited to weekday periods from 7:00 a.m. to 8:00 p.m., except statutory holidays and 9:00 a.m. to 5:00 p.m. on Saturday. Noise thresholds may apply during operation.	Project construction will generate noise.

8.1.4.1 Project Construction Noise Criteria

For Project construction, the noise assessment follows guidance from the United States Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (FTA 2018), including:

- Procedures to predict and assess noise and vibration effects from public transit projects, including rapid rail, light rail, commuter rail, and automated guideways; and
- General construction noise assessment criteria, as shown in **Table 8-4**.

The general assessment criteria for construction noise represent guidance thresholds for impact assessment purposes and do not necessarily represent acceptable thresholds that need to be developed on a project-specific basis. There are separate criteria for daytime noise levels (L_d, referring to 7:00 am to 10:00 pm) and nighttime noise levels (L_n, referring to 10:00 pm to 7:00 am). These criteria are categorized by land use (residential, commercial, and industrial) to account for existing noise levels at identified receptor locations and human activities that may be affected by construction noise. Commercial land uses include office buildings, retail stores, restaurants, recreation facilities, and personal care facilities (e.g., hair salons). Industrial land uses include warehouses, manufacturing operations, and automotive body shops (refer to **Section 14** Land Use).

Table 8-4 General FTA Noise Assessment Criteria for Project Construction

Land Use	Daytime Criteria, L_d (dBA)	Nighttime Criteria, L_n (dBA)
Residential	80	70
Commercial	85	85
Industrial	**90**	**90**

Note: L_d – daytime sound level; L_n – nighttime sound level

Source: FTA 2018.

8.1.4.2 Project Construction Vibration Criteria

The Project's vibration assessment for construction follows British Standard 5228-2: 2009, which provides a code of practice for vibration control at construction sites. Peak Particle Velocity (PPV) is typically used to measure the effects of a project's vibration, based on the more common concerns over potential building damage, and therefore represents the standard parameter for assessment.

The threshold of perception typically ranges from a PPV of 103 VdB in the most sensitive situations to a PPV of 110 VdB in most residential environments. Above these levels, vibration may cause concern or result in possible building damage. **Table 8-5** summarizes vibration criteria, based on human disturbance and cosmetic damage thresholds to buildings.

Table 8-5 General Vibration Criteria for Project Construction Phase

PPV Vibration Criteria (VdB)[1,2]	Effect
Human Response Criteria	
103 to 110	Threshold of vibration perception.
120	Vibration is distinctly perceptible and may cause public concern but can be mitigated with prior warning and explanation.
140	Vibration likely to be intolerable for prolonged period.
Building Damage Criteria	
136	Potential cosmetic damage to historic and some old buildings.
138	Potential cosmetic damage to older residential structures.
142	**Potential cosmetic damage to newer residential structures and commercial / industrial buildings.**

Source: British Standards Institute 2009, CalTrans 2013

Notes: **1.**Referenced to PPV of 1×10^{-6} millimetres per second.

2.Criteria are applicable to continuous/intermittent vibration sources.

Some equipment, activities, and processes may be sensitive to vibration at levels below those perceptible to humans, such as equipment used in hospitals, scientific laboratories, and micro-electronics manufacturing. For activities that occur near these equipment types, vibration criteria depend on the facility and type of equipment in use. There are no standards that provide objective criteria to assess potential ground-borne noise effects associated with construction. Ground-borne noise criteria have been developed by the FTA primarily for railway applications but may be used to screen potential construction effects (British Standards Institute 2009).

8.1.4.3 Project Operation Noise and Vibration Criteria

The noise and vibration assessment for Project operation follows guidelines in the FTA Manual (FTA 2018), which identify transit noise and vibration criteria for different land use categories, as shown in **Table 8-6**.

Table 8-6 Noise and Vibration Criteria for Project Operation

Land Use Category	Land Use Type	Description	Noise Criteria	RMS Vibration Criteria (VdB)[1]	Ground-borne Noise Criteria (dBA)
-	High Sensitivity	Includes buildings where vibration levels, even below the threshold of impacts to human beings, would interfere with operations (e.g., facilities with vibration-sensitive equipment).	Not applicable	See Note 2	See Note 3
1	Special Use	Includes special use facilities where quiet is essential to its intended purpose, such as concert halls, television and recording studios, and theatres.	See **Figure 8-1**	94 to 100	25 to 35
2	Residential	Includes all residential buildings and other buildings where people normally sleep, such as hotels and hospitals.	See **Figure 8-1**	100	35
3	Institutional	Includes all institutional land uses with potential for interference with Project activities (e.g., schools, churches, and medical clinics).	**See Figure 8-2**	103	40

Source: FTA 2018

Notes:

1. Referenced to RMS velocity of 1×10^{-6} millimetres per second.
2. Vibration criteria depend on facility and type of equipment.
3. Vibration-sensitive equipment is generally not sensitive to ground-borne noise and can be evaluated against criteria for Categories 2 or 3.

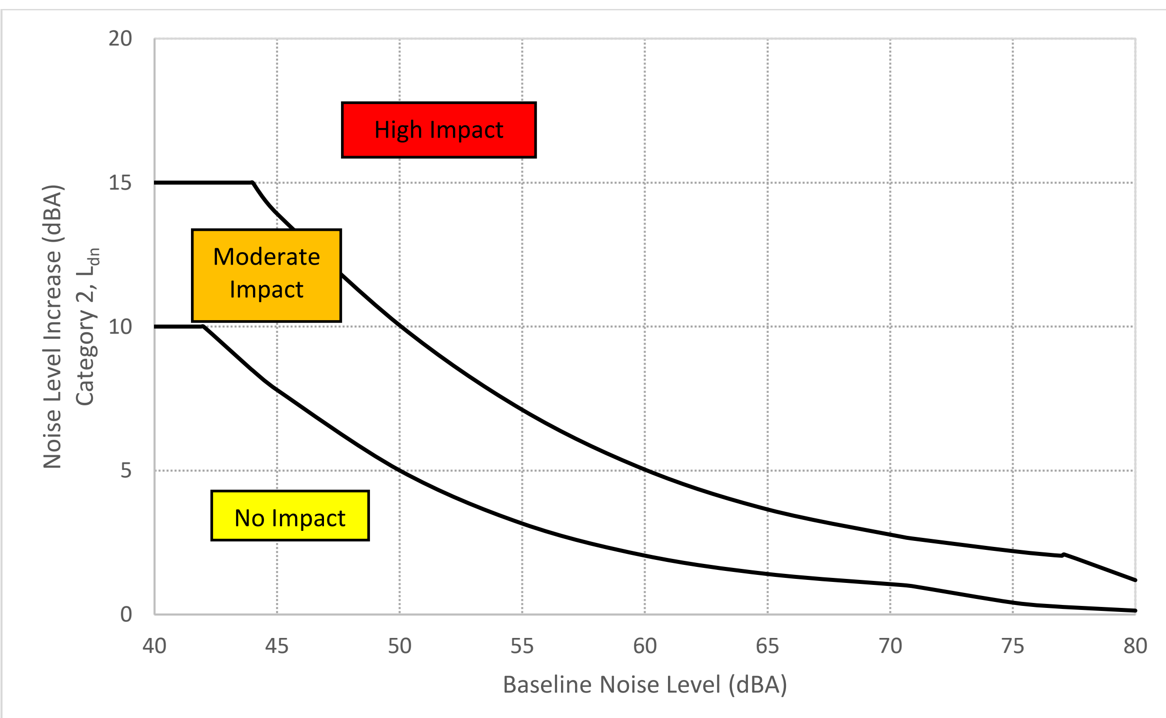
No special-use buildings (Category 1) have been identified within the study area. One High-Sensitivity receptor location was identified at the JPOCSC. A number of residential (Category 2) and institutional (Category 3) receptors are located within the study area, as further discussed in **Section 8.2**.

The FTA noise criteria for residential (Category 2) and institutional (Category 3) land uses are illustrated in **Figure 8-1** and **Figure 8-2**, respectively. These criteria were developed based on research on human response to noise identified as “community noise” and represent a reasonable balance between community benefit and project costs. The criteria, defined using two lines, specify a comparison of increases in noise levels against baseline levels, and are applicable to projects with changes to existing noise sources and not those that add new noise sources. Below the lower line, a project is considered to have no impact. Above the upper line, a project is considered to have high impact. Between the two lines, a project is considered to have moderate impact.

As per the FTA Manual (FTA 2018), the noise metric to evaluate residential (Category 2) receptors is the day-night sound level (L_{dn}), whereby nighttime noise (between 10:00 p.m. and 7:00 a.m.) is increased by 10 dB to account for a community's increased nighttime sensitivity to noise. The peak one-hour sound level ($L_{eq(1hr)}$) is used for institutional (Category 3) receptors where nighttime sensitivity is not a factor. This noise metric represents the loudest hour of Project activity when other community activities are taking place at the noise-sensitive location.

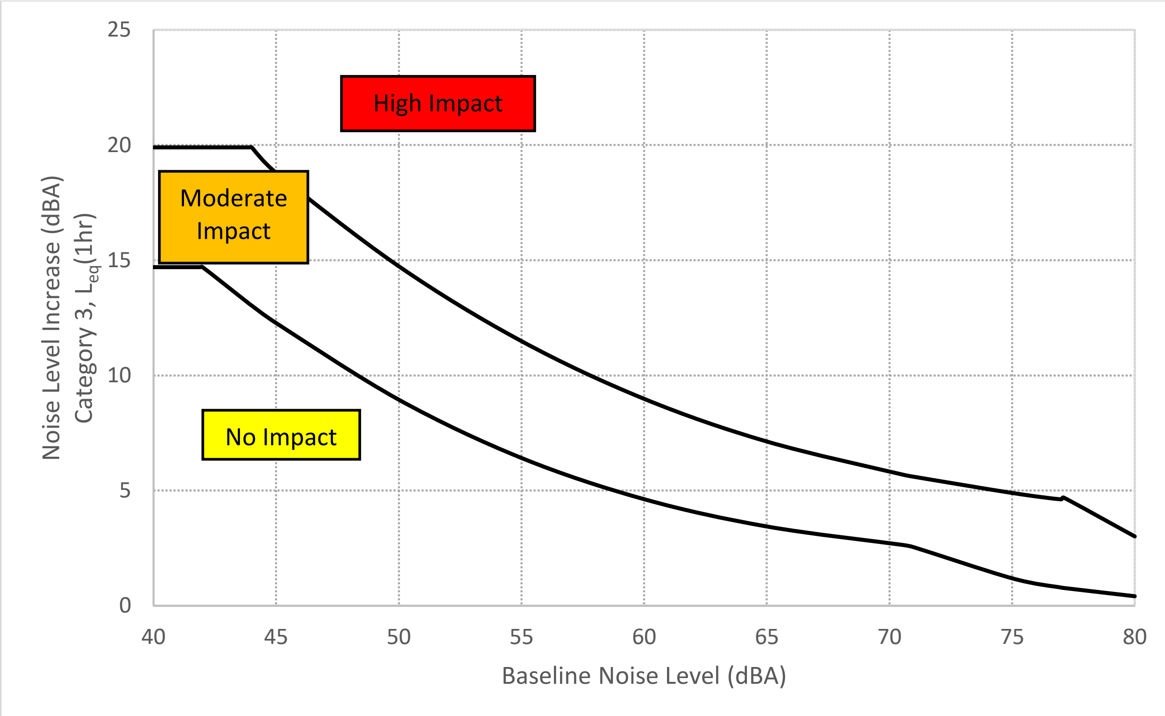
Unlike during Project construction, commercial and industrial land uses are usually not considered interactions during Project operation. Consistent with standard industry practice, these land uses are not considered noise-sensitive, and activities taking place in these buildings are generally compatible with the associated noise levels produced in public transit projects (FTA 2018). The Project will consider noise concerns for these land uses on a case-by-case basis as the Project progresses.

The FTA vibration criteria presented in **Table 8-6**, expressed as the RMS velocity, were developed to assess potential impacts to public sentiment. It is extremely rare for at-grade or elevated types of public transit projects to cause substantial or even minor cosmetic building damage. Similarly, the FTA criteria for ground-borne noise were developed based on potential disturbance to activities occurring at the various land uses.



Source: FTA 2018

Figure 8-1 FTA Noise Criteria for Operation Phase Category 2 (Residential)



Source: FTA 2018

Figure 8-2 FTA Noise Criteria for Project Operation for Category 3 (Institutional)

8.2 Baseline Conditions

Land use within the noise and vibration study area is mostly residential, commercial, or mixed use, except within the GTUF and the Serpentine Valley.

8.2.1 Methods

Hemmera conducted the following desktop and field-based baseline studies to inform the ESR:

- Desktop review of applicable legislation and policy on noise and vibration;
- Desktop review of previous noise baseline work and on-line databases; and
- Site surveys of existing levels of noise and vibration and associated analysis.

8.2.1.1 Desktop Review

The following documents helped to characterize baseline conditions for noise and vibration:

- South of Fraser Rapid Transit Desktop Review and Baseline Noise Report (Stantec 2016);
- Surrey-Newton-Guildford Light Rail Transit Noise Technical Data Report (Stantec 2018b);
- Surrey Newton-Guildford Light Rail Transit Vibration Technical Data Report (Stantec 2018c); and
- Site Survey for Magnetic Resonance Imaging (MRI) Installation at the JPOCSC (ETS-Lindgren 2017).

The locations of potentially sensitive receptors were identified through Google Maps and aerial imagery.

8.2.1.2 Field Assessment

Noise and vibration field monitoring along the Project's alignment at six representative receptor locations helped to support the desktop review, as summarized in **Table 8-7** and illustrated in **Figure D8-1** (**Appendix D**: Noise and Vibration Figures). Baseline noise monitoring took place over approximately 24 hours on a weekday using a Larson Davis Model 831 sound level metre. Baseline vibration monitoring occurred over an approximately 1-hour period on a weekday using an Instantel Minimate Plus vibration monitor.

Table 8-7 Baseline Noise and Vibration Monitoring Locations

Site ID	Location	Land Use	Date of Monitoring
M1	JPOCSC	Institutional / Residential/ Park	July 3–4, 2019
M2	Vacant lot on Fraser Highway near 149 Street	Residential	July 9–10, 2019
M3	Street boulevard at Fraser Highway and 162 Steet	Residential / Commercial	July 31–August 1, 2019
M4	Hope Community Church	Institutional / Residential	July 29–30, 2019
M5	Brookside Lodge Care Community	Institutional / Commercial	July 4–5, 2019
M6	Vacant lot on Industrial Avenue near 201A Street	Commercial / Industrial	July 11, 30–31, 2019

8.2.2 Results

Based on aerial imagery, approximately half the Project's alignment is flanked on either side by residential (Category 2) sensitive receptors. A total of 11 institutional (Category 3) sensitive receptors for the SE study area were identified through a search of Google Maps and verified during the fieldwork. These receptors are listed in **Addendum 8-2**. Baseline noise and vibration monitoring results from the six representative receptor locations are summarized in **Table 8-8** and indicate that noise levels in the study area are characteristic of a busy urban transportation corridor.

Noise is dominated by vehicle traffic along Fraser Highway, which parallels much of the Project's alignment. Noise levels were lower along the busiest sections of Fraser Highway (e.g., Fraser Highway and 162 Street, monitoring location M3) and at lighted intersections (e.g., Fraser Highway and 196 Street, monitoring location M5) where traffic congestion tends to result in slower vehicle speeds. The highest noise levels were measured along less busy, straight sections where vehicles can travel at higher speeds (e.g., Fraser Highway near 149 Street, location M2). Baseline noise levels provide context for Project-related effects (see **Figure 8-1** and **Figure 8-2**).

Overall, baseline vibration levels in the study area are low. Ground-borne vibration levels remained below the threshold of perception at five of the six locations during the baseline vibration monitoring program. Measured levels exceeded the threshold of perception at one location (M5) upon two instances when heavy trucks passed the vibration monitor at free flow speeds.

Table 8-8 Baseline Noise and Vibration Monitoring Results

Site ID	Monitoring Location	Measured Sound Level (dBA)				Measured Vibration Level (VdB)	
		$L_{eq(1hr)}$	L_d	L_n	L_{dn}	PPV[1]	RMS[1,2]
M1	JPOCSC	71.1	68.3	64.2	71.5	<102	<90
M2	Vacant lot on Fraser Highway near 149 Street	72.6	66.5	66.4	72.8	<102	<90
M3	Street boulevard at Fraser Highway and 162 Street	66.2	64.4	60.3	67.5	<102	<90
M4	Hope Community Church	66.7	64.5	60.8	68.0	<102	<90
M5	Brookside Lodge Care Community	64.1	62.5	58.0	65.4	124	112
M6	**Vacant lot on Industrial Avenue near 201A Street**	**64.5**	**60.2**	**54.9**	**62.6**	**<102**	**<90**

Notes: $L_{eq(1hr)}$ – peak one-hour noise level; L_d – daytime noise level; L_n – nighttime noise level; L_{dn} – day-night noise level including 10 dB penalty for nighttime noise

1. Referenced to vibration velocity of 1×10^{-6} millimetres per second.
2. Estimated based on a default ratio for peak to RMS amplitude of four.

In 2017, a structural vibration survey was conducted at the JPOCSC, which provides information on baseline vibration levels at this receptor (ETS-Lindgren 2017). Measured vibration levels at the JPOCSC remained below thresholds for sensitive equipment operated onsite. The measured levels were primarily attributed to onsite mechanical equipment, although potential effects from offsite sources were also included.

8.3 Project Interactions

Table 8-9 outlines potential interactions between the noise and vibration SE and proposed Project activities and physical works.

Table 8-9 Project Interactions and Potential Noise and Vibration Effects

Project Activities and Works	Change in Noise Levels	Change in Vibration Levels
Construction		
Clearing and grubbing	✓	✓
Property acquisition (including demolition of inert building materials)	✓	✓
Relocation of overhead BC Hydro transmission lines	✓	✓
Utility installation/relocation	✓	✓
Use of temporary laydown areas	o	o
Access and traffic management	o	o
Road widening (select locations)	✓	✓
Culvert extension and drainage realignment (select locations)	✓	✓
Installation of SkyTrain guideway foundations	✓	✓

Project Activities and Works	Change in Noise Levels	Change in Vibration Levels
Installation of overhead SkyTrain guideway	✓	✓
Stations (e.g., foundations, structure installation)	✓	✓
PPS	o	o
Management of non-contaminated excavated material	o	o
Management of contaminated or hazardous materials	o	o
Testing, commissioning, and start-up	o	o
Operation		
Operation of the Project	✓	✓
Maintenance of the Project[22]	o	o

Notes:

Interaction Rating:

– **No interaction:** where interaction between a Project component and SE is not likely.

o **Minor interaction:** where impacts may result from an interaction, but standard mitigation measures are understood to be effective, and remaining effects would be reduced to negligible. Interaction is not discussed further.

✓ **Interaction:** where an interaction occurs and likely requires additional mitigation. Carried forward and discussed in subsequent sections.

8.4 Potential Effects

The potential effects of Project interactions with the noise and vibration SE are addressed in the following sub-sections for both construction and operation.

8.4.1 Noise Effects due to Construction

Construction activities (e.g., clearing, grubbing, earthworks) and operation of construction equipment (e.g., excavators and other heavy equipment) are expected to generate noise that could affect nearby receptors. The guideway will likely be constructed sequentially, which will limit the duration of effects in any one area of the Project alignment.

8.4.1.1 Methods

The Project's RCD and a comparison of similar infrastructure projects was used to identify typical equipment, types, sizes, and construction activities (**Addendum 8-3**). Octave-band sound level data for individual sound levels for each type of equipment were obtained from British Standard 5228:1-2009 or from Noise and Vibration Resources (Noise and Vibration Resources 2022). Sound pressure levels have been combined for the various Project activities and are summarized in **Table 8-10**. The inventory excludes vehicles delivering materials to and from the Project site, as those trucks will emit noise on the regional road network, generally, rather than at the Project site.

22 An annual guideway maintenance plan is in place for the SkyTrain system including regular rail and switch grinding activities to fix deformities and restore the profile of the rail. Such activities may generate localized noise and vibration effects. As rail deformities develop over time, generally on the order of months, grinding activities (and associated noise and vibration) occurring in the vicinity of any given receptor will be infrequent. Grinding activities involve the operation of rail grinders along the guideway at speeds of up to 10 km/h and thus any noise and vibration effects will be transitory. Overall, noise and vibration effects from maintenance of the Project are expected to represent a small contribution to overall noise and vibration levels and will be minor relative to operation of the SkyTrain.

Table 8-10 Estimated Construction Equipment Sound Levels

Project Activity	Noise Dominant Equipment	Combined Sound Pressure Level[1] (dBA)
Pre-cast yard	Concrete pump truck, gantry crane	81
Property demolition	Excavator, dump truck	86
Guideway structure with impact pile driving[2]	Hoe-ram, dump truck, asphalt saw, impact hammer	107
Guideway structure with drilled pile installation[2]	Hoe-ram, dump truck, asphalt saw, vibratory drill rig	93
Trackwork	Boom truck, hi-rail Pettibone	85
Stations	Hoe-ram, dump truck, asphalt saw	93
Utility relocations	Hoe-ram, dump truck, asphalt saw	92
Road work	Hoe-ram, asphalt saw, milling machine	92

Notes:

1. All sound pressure levels represent steady-state levels upon concurrent operation of all equipment at a reference distance of 10 m.
2. Vibratory drill rigs will be used for pile driving where practical, but impact hammers may be required at certain locations such as the Serpentine Valley and between 200 St to 203 St in Langley.

The activities listed in **Table 8-10** are expected to occur at any given location along the Project alignment at different times, which means that potential noise effects are not expected to be cumulative. For example, utility relocations will generally occur as advance works, prior to construction of the guideway structure, and stations and will be followed by trackwork. To characterize expected noise during Project construction activities, noise modelling took place for two of the activity groupings with the highest equipment sound levels identified in **Table 8-10**. This modelling approach enabled the development and assessment of worst-case effect scenarios associated with construction of the SkyTrain guideway and stations. Noise effects associated with other Project activities (e.g., demolition, trackwork, utility relocations, and roadwork) are expected to be similar or less than the worst-case effects modelled for drilled pile installation during guideway and station construction.

Noise modelling relied on the CadnaA sound propagation software. All construction equipment was assumed to operate simultaneously on a daily basis for the estimated durations (up to 10 hours per day, see **Addendum 8-3**), during daytime hours only. Guideway construction equipment was modelled as a number of point sources located around the edges of a 300 m by 10 m area, representing the construction zone of one span. Station construction equipment was modelled as a number of point sources located around the edges of a 90 m by 25 m area, representing the expected footprint for a number of stations, including the 184 Street and 190 Street Stations. The 184 Street and 190 Street Stations were selected as the focus of station construction noise modelling due to the proximity of receptors, although other stations will have a similar footprint and similar proximate receptors.

8.4.1.2 Results

The identified setback distances within which the FTA daytime noise (L_d) assessment criteria (i.e., 80 dBA residential, 85 dBA commercial, 90 dBA industrial) may be exceeded for Project construction are outlined in **Table 8-11**. These setback distances are estimated without additional mitigation in place.

Since construction is not expected to occur during nighttime hours, with the potential exception of a small section near the GTUF[23] where there are no residential or commercial receptors, the nighttime noise criteria are not applicable.

Table 8-11 Setback Distances to Project Construction Daytime Noise Assessment Criteria without Mitigation

Project Activity	Residential	Commercial	Industrial
Guideway structure with impact pile driving[1]	58 m	34 m	20 m
Guideway structure with drilled pile installation[1]	16 m	9 m	5 m
Stations	**18 m**	**10 m**	**5 m**

Note:

1. Setback distances for construction of guideway structure are provided for both impact pile driving / drilled pile installation.

Based on the identified setback distances, without mitigation in place, exceedance of the L_d threshold is predicted at a number of residential and commercial receptors during construction. These predictions are based on a conservative modelling approach. It is recognized that the model over-estimates noise levels based on several assumptions, including 1) simultaneous operation of all specified equipment for up to 10 hours per day; 2) worst-case meteorological conditions (e.g., downwind, temperature inversions), 3) no attenuation from buildings or other structures.

However, given the nature of the planned construction activities and their proximity to receptors, exceedances of the L_d noise threshold are expected in certain areas of the Project and mitigation and monitoring will be necessary (see **Section 8.5**).

8.4.2 Vibration Effects Due to Construction

Project construction activities, including the operation of construction equipment, are expected to generate vibration that could affect nearby receptors. A description of assessment methods and results follow.

8.4.2.1 Methods

The CalTrans (2013) and FTA (2018) manuals provide typical vibration source levels for different kinds of construction equipment. These vibration source levels represent typical levels at pre-specified reference distances from equipment, which can then be adjusted to reflect the actual distance between Project construction and nearby receptors[24].

23 This is part of the proposed RCD and would be part of negotiated municipal access with the City of Surrey.

24 Calculation of vibration source levels is based on the following propagation equation:
$PPV_{equip} = PPV_{ref} \times (D_{ref} / D)^n$
British Standard 5228-2: 2009 provides a default value of 1.5 for the exponent "n". As per more recent guidance from CalTrans (CalTrans 2013), the exponent "n" is a function of soil type classification. For silt and clay sediments in the area, a value of 1.3 is suggested and adopted for this assessment.

8.4.2.2 Results

The setback distances within which the various vibration criteria may be exceeded are summarized in **Table 8-12.** These setback distances are estimated without additional mitigation in place.

Table 8-12 Setback Distances to Project Construction Vibration Criteria without Mitigation

Equipment/ Activity	Setback Distance (m)						
	Potential Public Concern	Potential Intolerance	Potential Cosmetic Damage, Historic Buildings	Potential Cosmetic Damage, Older Residential Buildings	Potential Cosmetic Damage, Modern Residential, Commercial, Industrial Buildings	Potential Ground-borne Noise Effects, Residential	Potential Ground-borne Noise Effects, Institutional
Excavator	26	4.6	6.5	5.4	3.8	17	11
Hoe-ram	31	5.2	7.4	6.2	4.4	19	12
Impact piling	66	11.2	16	13	9.4	42	27
Caisson drilling	14	2.4	3.5	2.9	2.0	9.1	5.8
Bulldozer	14	2.4	3.5	2.9	2.0	9.1	5.8
Loaded trucks (e.g., dumptrucks)	13	2.2	3.1	2.6	1.8	8.0	5.1

Based on the typical vibration source levels from CalTrans (2013) and FTA (2008), the greatest vibration effects are associated with impact pile driving, followed by breaking asphalt or concrete using hoe-rams. It is anticipated that impact pile driving will be limited to areas of the Project where drilled installation of piles is not feasible. Activity around buildings located within the identified setback distances that could generate concern from the public, may experience distinctly perceptible vibration effects. As such, advance notice should be provided to owners of all buildings adjacent to Fraser Highway regarding where upcoming construction activities could generate perceptible vibration effects, based on modelling of the detailed design. No registered historic buildings are located within the identified setback distances, and therefore no cosmetic damage to historic buildings is expected. Several commercial buildings and one residential auxiliary building have been identified for potential cosmetic damage, and mitigation measures and monitoring should be undertaken during construction near these buildings (see **Section 8.5**), if modelling of detailed design indicates potential for vibration effects.

Analysis of potential effects on sensitive equipment at the JPOCSC during construction is underway, and the Project is working with Fraser Health to avoid disruptions to the operation of this equipment.

8.4.3 Noise Effects due to Operation

Project operation could affect nearby receptors, primarily due to noise generated by the interaction of SkyTrain vehicle wheels along the rails. Once fully operational, it is assumed that the choice to use SkyTrain as a means of transportation will result in a reduction of private vehicles and buses on Fraser Highway and the surrounding road network. This is based on regional traffic modelling (McElhanney, pers. comm., February 2022) and assumes that the reduction in road traffic noise will partially offset the noise from SkyTrain operations.

8.4.3.1 Methods

To fully anticipate the effects of the Project's operation within the context of the region's transportation system, the CadnaA noise propagation model was used to evaluate the day-night noise level (L_{dn}) and peak one-hour noise level ($L_{eq(1hr)}$) in three scenarios:

- Base Case: existing noise levels based on vehicle traffic conditions in 2017;
- BAU Case: forecasted baseline noise levels based on projected vehicle traffic conditions in 2050; and
- Project Case: BAU Case plus the Project, based on forecasted train volumes in 2050.

The difference between the BAU Case and the Project Case provides the change in noise levels associated with Project operation. Change in day-night noise levels (L_{dn}) are used to evaluate potential effects on residential (Category 2) receptors relative to FTA criteria, as illustrated in **Figure 8-1**. Change in peak one-hour noise levels ($L_{eq(1hr)}$) are used to evaluate potential effects on institutional (Category 3) receptors relative to FTA criteria, as per **Figure 8-2**. Project-related noise effects were evaluated based on forecasted 2050 conditions which are expected to represent worst-case effects in the foreseeable future. Train volume is expected to increase over time to accommodate anticipated ridership, resulting in higher overall noise levels toward 2050. In addition, road traffic is expected to increase over time, resulting in higher baseline noise levels for which there is less "tolerance" for additional Project noise.

The noise algorithm for road traffic in CadnaA is based on traffic type (i.e., cars versus trucks), volume, speed, and road surface type. Traffic data for the three scenarios were obtained from regional traffic modelling by McElhanney (McElhanney, pers. comm., February 2022). Parameters were then adjusted to obtain Base Case noise levels most similar to measured noise levels during baseline monitoring, as shown in **Table 8-8**. The calibrated Base Case noise model was then used to initialize the BAU Case and Project Case noise models.

The noise algorithm does not account for differences between fuel types nor the effects of a shift toward electric vehicles. However, at typical travel speeds along Fraser Highway, vehicle engine noise is expected to contribute only minimally when compared to noise associated with tire-road interaction and wind passage. Therefore, while electric vehicles may be associated with less engine noise, and potentially less offset associated with the Project Case, differences are expected to be negligible and well below any model uncertainties.

SkyTrain noise levels for the Project Case were estimated using the equation for automated guideway transit from the FTA Manual (**Equation 1**)[25], which calculates noise levels at 15 m from the source, based on the average number of cars per train, average train speed, average number of trains per unit time, and other factors (FTA 2018). It is recognized that the capacity, weight, and design speed of the SkyTrain system resembles a hybrid of rapid transit systems and automated guideway systems in the FTA Manual. However, the equation for automated guideway is considered most representative and thus adopted for this assessment due to the differences in technology between heavy rail rapid transit systems

[25] **Equation 1**

$L_{eq} = SEL_{ref} + 10 \log(N_{cars}) + 20 \log (S/50) + 10 \log(V) + Adj_{track}$

where: L_{eq} = equivalent noise level over period of interest at distance of 50 feet from guideway;

SEL_{ref} = reference noise level at distance of 50 feet from guideway, 80 dBA;

N_{cars} = average number of cars per train;

S = average speed of train;

V = average number of trains over period of interest; and

Adj_{track} = adjustment of 5 dBA for locations with 300 feet of special trackwork (e.g., crossovers, pocket tracks) in the United States and the light rail system used for SkyTrain. Most importantly, based on noise monitoring conducted near the Expo and Millennium Lines (Hatch 2010), (SLR 2018)), SkyTrain noise levels are expected to be similar to the FTA referenced noise levels for automated guideway transit.

Noise levels for peak hour and overall daytime and nighttime periods were estimated based on the SkyTrain volumes shown in **Table 8-13**, which were calculated based on the projected headways in the RCD, assuming five cars per train[26]. In addition, train speeds were estimated for individual segments of the guideway, assuming a maximum speed of 80 km/h, average speeds of 44 km/h and a nominal acceleration and deceleration rate of 1 metre per square second near stations.

Table 8-13 Projected SLS Volumes

Time Period	Inbound Trains	Outbound Trains
Daytime (7:00 a.m. to 10:00 p.m.)	111	111
Nighttime (10:00 p.m. to 7:00 a.m.)	44	44
Peak hour	**13**	**13**

8.4.3.2 Results

Noise effects for the Project's operation phase were estimated by considering the change in noise levels between the Project Case and the BAU Case and comparing this to the criteria in **Table 8-6, Figure 8-1,** and **Figure 8-2**. Moderate impacts, based on FTA criteria, were predicted at several existing Category 2 (residential) receptors, as outlined in **Figure D8-2** and **Figure D8-3** (**Appendix D**: Noise and Vibration Figures). No impacts, based on FTA criteria, were predicted at any existing Category 3 (institutional) receptors. **Table 8-14** summarizes the day-night noise levels (L_{dn}) without mitigation at the affected receptors.

Table 8-14 Predicted Noise Levels Due to Project Operation without Mitigation

Station Range	Location	BAU Case L_{dn} (dBA)	Project Case L_{dn} without Mitigation (dBA)	Predicted Increase due to Project (dBA)[1]
100+280 to 100+320	13700 block Fraser Highway	63.4	65.1	1.7
100+580 to 100+710	13900 block Fraser Highway	65.5 to 68.9	67.6 to 70.0	1.1 to 2.1
104+060 to 104+090	15300 block Fraser Highway	59.5	61.8	2.3
107+320 to 107+340	16700 block Fraser Highway	63.2	65.1	1.9
111+350 to 111+490	18400 block Fraser Highway	64.1	67.2	3.1
111+520 to 111+590	18500 block Fraser Highway	61.3	64.5	3.2
112+970 to 113+010	19000 block Fraser Highway	57.1 to 57.2	62.4 to 62.8	5.3 to 5.6
115+540 to 115+600	20100 block Industrial Avenue	62.6	66.7	4.1
115+780 to 115+860	**20200 block Industrial Avenue**	**62.6**	**65.2**	**2.6**

Note:

1. Predicted noise levels are presented for locations with potential moderate impacts based on FTA criteria.

26 While the SkyTrain currently uses 4-car trains, the Project design is to allow 5-car trains to maximize future capacity. The mix of 4-car versus 5-car trains is uncertain. As this assessment is intended to inform Project design, the use of 5-car trains is assumed.

8.4.4 Vibration Effects due to Operation

Similar to anticipated noise effects during operation, the vibration from SkyTrain vehicle wheels moving along the rails could affect nearby receptors at a limited number of locations. They are expected to be very minimal since vibration from elevated systems tend to be lower than at-grade systems for two reasons:

- Elevated guideways require vibration to travel extra distance before it reaches the ground; and
- The elevated structure itself provides some vibration-damping measures.

8.4.4.1 Methods

The FTA Manual details reference vibration curves for rapid transit systems, such as the SLS (FTA 2018). The reference vibration curve for rapid transit systems was then adjusted to reflect Project-specific conditions, as outlined in **Addendum 8-4**. Separated into categories, the adjustments in each category are not intended to be cumulative, except for ground-borne propagation effects, and only the greatest applicable adjustment is applied. Ground-borne noise levels were then estimated based on the estimated vibration levels, in accordance with the FTA Manual[27] (FTA 2018).

8.4.4.2 Results

Setback distances within which the FTA vibration and ground-borne noise criteria for Category 2 (residential) and Category 3 (institutional) receptors may be exceeded are summarized in **Table 8-15**. As indicated in **Figure D8-4.0** to **4.2, in Appendix D**: Noise and Vibration Figures, a small number of residences located near the crossover west of 140 Street and the crossover east of the 184 Street Station, are within these indicated setback distances and may experience vibration effects. While not designated institutional, a commercial business located in the 18500 block of Fraser Highway offers classes to the public and is within the indicated setback distances. As such, this business may experience vibration when classes are in session. Mitigation and monitoring are recommended to avoid or reduce potential effects (see **Section 8.5**) if final design is similar to the RCD at this location.

Table 8-15 Setback Distances to Project Operation Vibration Criteria

Distance from Special Trackwork[1]	Setback Distance for Vibration (m)		Setback Distance for Ground-Borne Noise (m)	
	Category 2 (residential)	Category 3 (institutional)	Category 2 (residential)	Category 3 (institutional)
Greater than 61 m	5	3	<1	<1
30 to 61 m	13	8	<1	<1
Less than 30 m	**25**	**18**	**<1**	**3**

Note:

1. Special trackwork refers to joints and crossovers where the discontinuity can result in higher vibration levels compared to regular track (refer to **Addendum 8-4**).

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27 Calculation of ground-borne noise is as follows:
Ground-borne noise = RMS velocity – Conversion factor
where: ground-borne noise is expressed in dBA;
RMV velocity is expressed in VdB, referenced at 1×10^{-6} millimetres per second; and
Conversion factor = 78 dB for low frequency sources including SkyTrain (i.e., peak frequency of ground vibration is < 30 Hz).

8.5 Mitigation Measures

Mitigation measures to avoid or reduce potential effects from Project-generated noise and vibration during construction and operation are listed below. The mitigation measures, the effect(s) they address, the relevant Project phase, and details of implementation, as directed in a relevant environmental management plan, are summarized in **Table 8-16**. Mitigation is categorized according to the stage of Project development: Design (denoted as "D"), Construction (denoted as "C"), and Operation (denoted as "O").

Content from this section will be incorporated into the CEMP Framework (see the TOR for additional description of this document). As its name implies, the Project's CEMP Framework document will provide detailed guidance for the content of the Project Co's CEMP. In addition to mitigation and performance objectives, the CEMP Framework will describe best practices to help meet the performance objectives and required content for each sub-plan. The CEMP Framework will also include details on roles and responsibilities for the Project Co's key team members.

8.5.1 Design Mitigation

Measures incorporated into the Project's RCD will provide significant noise and vibration mitigation. Mitigation measures incorporated into the RCD are M8.D-1 through to M8.D-5. Further information is available in TransLink's SkyTrain Noise Study reporting (SLR 2019, 2020, 2021). These mitigation measures have been factored into the evaluation of noise and vibration effects. The remaining mitigation measures were determined based on the results of the evaluation and will be dependent on predicted noise and vibration levels, relative to detailed design as well as monitoring at designated receptors.

Mitigation M8.D-1 Elevated Track

Due to the height of the elevated guideway, noise exposure at many low-rise buildings below the guideway structure (i.e., at one and two-storey receptors) will be partially mitigated. This is because they are shielded by the guideway structure itself. Measurements along the Millennium Line suggest that noise exposure below the guideway structure may be about 3 to 4 dB lower than noise exposure at the same level as the guideway (Hatch 2010). The elevated structure also reduces potential vibration effects by approximately 10 VdB relative to at-grade systems (see **Addendum 8-4**).

Mitigation M8.D-2 Linear Induction System

Wheel and rail roughness are key factors that affect noise and vibration. SkyTrain relies on linear induction systems for traction, using magnetic fields to enable acceleration and braking, which generally results in lower wheel roughness than regular braking systems that use friction. In addition, due to the linear induction system and automatic train control, emergency stops are unlikely to result in wheels locking up and skidding, which would form flat spots on wheels. Therefore, the use of linear induction systems provides some mitigation against potential issues with wheel roughness. Noise generated by gear shifting at lower speeds is expected to have a minor effect on overall noise levels.

Mitigation M8.D-3 Harder Rail Steel

The use of harder rail steel reduces the potential for corrugation to develop, thereby reducing noise emissions by as much as 5 dB when compared to softer steel (SLR 2020). Relatively soft steel (260 to 310 Brinell hardness) is in use on the existing Expo Line. The rail used for the Evergreen extension is harder, approximately 350 Brinell hardness. Rail steel of 350 to 370 Brinell hardness will be specified for the SLS.

Mitigation M8.D-4 High Resilience Rail Fasteners

Highly resilient fasteners will be used to fasten train rails to the guideway deck surface as they are a track support system to reduce force and fatigue on components, in the absence of ballast, to increase durability and life of the rail installation. High-resilience fasteners will also help to minimize vibration transmission to the guideway structure, thereby reducing ground-borne vibration effects by approximately 5 VdB (see **Addendum 8-4**).

Mitigation M8.D-5 Welded Rail

Continuously welded rail minimizes joints between segments of rail and reduces noise generated by wheel strike on rail joints. Welded tracks also reduce vibration levels compared to jointed tracks. The typical noise and vibration reduction for welded tracks is 5 dB (FTA 2018). This measure will be specified for the SLS.

Mitigation M8.D-6 Noise Barriers

To reduce predicted noise increases that fall within the moderate threshold level (see **Figure D8-2** and **Figure D8-3, Appendix D**: Noise and Vibration Figures), mitigation measures are recommended along sections of the guideway where these conditions are identified in detailed design. The most common mitigation measure on the existing SkyTrain system is the installation of parapet or centreline noise barriers, which can reduce noise in the order of 5 dB to 10 dB (SLR 2020). However, barriers work by blocking the line of "sight" between the source and the receptor (see **Figure 8-3**). As such, barriers are only generally effective for receptors at the same level, or below, the guideway.

Figure 8-3 Effect of Noise Barriers

Mitigation M8.D-7 Rail Dampers

Rail dampers are recommended to reduce predicted noise increases that fall within the moderate threshold level where there are receptors above the guideway for which noise barriers may not be effective. Rail dampers are tuned mass-spring systems that can be attached to the rails in between the normal rail fasteners. Trials on the existing SkyTrain system suggest rail dampers can reduce noise by up to 6 dB, particularly along track sections where trains are operating at a speed of 60 km/h or more (SLR 2021).

Mitigation M8.D-8 Station Acoustics

As elsewhere on the SkyTrain system, maximum noise thresholds will be specified for station systems to minimize noise in adjacent communities. For example, public address systems should be configured to produce different sound levels at different times of the day, such that announcements will be no higher than baseline noise levels and will be inaudible outside the stations. With such acoustic design in place, no additional mitigation measures are anticipated.

8.5.2 Construction Mitigation

Mitigation M8.C-1 Pile Driving Mitigation and Alternatives

The most notable effects of noise and vibration during construction stem from foundation work, such as impact pile driving and hammering. Where feasible, foundations will be cast *in situ* using casings to be advanced using rotary drilling or other low-vibration equipment, which will have much lower noise and vibration impacts compared to traditional impact pile driving.

Where alternatives to impact driving are not feasible, other mitigation measures should be employed, such as the use of acoustic shrouds, predrilling to reduce the amount of impact driving, and the use of pile cushioning[28] or dollies placed between the head of the pile and the pile driver to increase the period of time over which the energy from the driver is imparted to the pile.

Mitigation M8.C-2 Advance Notification

High dB construction work (e.g., hoe ramming) requires advance notice to inform the public and explain the need. Notification of noisy activities, particularly if night work is required, is recommended for receptors within a 2-block radius, up to two weeks beforehand.

Mitigation M8.C-3 Complaint Management

A public query management process will be established to receive and track feedback during construction and provide timely responses. It is recommended that this process include a tiered approach be implemented to respond to specific complaints, including identified noise and vibration issues. Tiering should include a system of applying mitigation in a progression (i.e., if the first level of mitigation is unsatisfactory, additional monitoring or adaptive management would be implemented) to sufficiently address concerns, as possible.

[28] A cushion placed at the top of the pile specifically designed to reduce noise and vibration from impact pile driving.

Mitigation M8.C-4 Noise Monitoring

Noise monitoring should be conducted during high-dB work where there are receptors within the identified setback distances and/or if complaints are received. If noise monitoring indicates an excess of general FTA daytime construction noise criteria (FTA 2018) of 80 dBA for residential receptors and 85 dBA for commercial receptors (see **Table 8-4**), additional mitigation measures should be considered.

Effectiveness monitoring, to assess whether Project design and associated mitigation are achieving the Project requirements related to noise, should be conducted as part of testing and commissioning of the system. Where design or mitigation is assessed as ineffective, additional mitigation may be required to meet Project requirements.

Mitigation M8.C-5 Temporary Noise Barriers

Temporary noise barriers are structures that absorb sound and reduce transmission to receptors. They can take the form of temporary construction buildings, material stockpiles, and dedicated walls with sound-absorbing material. When placed between the construction site and affected receptors, noise barriers can reduce noise exposure to affected receptors. The use of temporary noise barriers should be considered where noise monitoring suggests that there are exceedances of the general FTA construction noise criteria.

Mitigation M8.C-6 Scheduling of Work

Municipal noise bylaws in the Three Municipalities specify that construction activities are limited to the daytime, Monday through Saturday (specific hours vary by municipality). Construction activities, especially high-dB work, should be scheduled in consideration of the municipal bylaws, where possible. The Project is working with the Three Municipalities to define requirements for construction. Site-specific scheduling of work should also be considered for sensitive land uses or activities.

Mitigation M8.C-7 Vibration Monitoring

Table 8-12 identifies the recommended setback distances to minimize concerns regarding perceptible vibration. Where it is not feasible to avoid construction activity within the setback, potentially affected building owners and occupants should be notified in advance of construction work and the associated potential for vibration. If complaints result, investigations to determine the cause of vibration, and appropriate mitigation measures, as applicable, should be carried out.

Recommended measures to reduce potential effects on humans and building cosmetic damage due to high vibration activities within the identified setback distances of residential and commercial buildings include:

- Monitoring construction vibration;
- Completing pre-construction and post-construction building condition surveys and responding to complaints during construction; and
- Conducting high-vibration activities (e.g., impact piling, breaking of asphalt or concrete) away from the buildings, and using modified work methods as much as possible.

8.5.3 Project Operation

Mitigation M8.O-1 Rail Grinding

Standard TransLink procedures for SkyTrain maintenance employ rail grinding to remove defects and correct the rail profile, determined in part from SkyTrain in-car noise data. Rail grinding can also help to reduce noise and vibration from the wheel-rail interface by reducing roughness and corrugation, depending on the residual grinding surface finish. The use of more robust acoustic grinding specifications was assessed as part of TransLink's SkyTrain Noise Mitigation Study (SLR 2021) and shown to be beneficial along track sections that use harder rail steel as will be used for SLS (see Mitigation M8.D-3).

Mitigation M8.O-2 Friction Modifiers

Friction modifiers (i.e., solid or liquid lubricants or grease) have a proven record on many systems as an effective means to reduce roughness and corrugation growth rates on wheels and rails, thus reducing noise and vibration from the wheel-rail interface. The potential benefits of friction modifiers on the SkyTrain system are currently being investigated as part of the above-referenced SkyTrain Noise Mitigation Study. This study found that vehicle-mounted solid stick application of Top of Rail Friction Modifier (TORFM) reduced noise levels by 5 to 8 dB, and recommended implementation throughout the SkyTrain system.

Mitigation M8.O-3 Switch Monitoring and Maintenance

Standard TransLink procedures for SkyTrain maintenance include regular inspection and adjustment of switches as well as regular grinding and replacement of switches to maintain safe operation of the system. While the current switch maintenance procedures address larger scale defects, investigations are underway (as part of TransLink's SkyTrain Noise Mitigation Study) to identify and address smaller scale discontinuities, for example at crossover switches. One option is the measurement of vibration at SkyTrain axle-boxes - the component that supports the axle-load of the cars and houses the bearings.

Planning is currently underway to implement a switch monitoring program elsewhere on the system, as recommended by TransLink's study (SLR 2021). During initial operation of SLS, a bi-weekly monitoring program is recommended for the planned crossovers west of 140 Street and east of the 184 Street Station, as well as other crossover locations where vibration may exceed FTA criteria, to inform switch maintenance requirements.

8.5.4 Summary of Proposed Mitigation

Table 8-16 summarizes proposed mitigations specific to each Project phase (design, construction, and operation).

Table 8-16 Summary of Potential Project Effects and Mitigation Measures for Noise and Vibration

Potential Effect	Mitigation Number	Mitigation Measure	Project Phase (construction, operation)	Environmental Management
Change in Noise Levels; Change in Vibration Levels	M8.D-1	Elevated track	Design	Design Criteria
Change in Noise Levels; Change in Vibration Levels	M8.D-2	Linear induction system	Design	Design Criteria
Change in Noise Levels; Change in Vibration Levels	M8.D-3	Harder rail steel	Design	Design Criteria
Change in Noise Levels; Change in Vibration Levels	M8.D-5	Welded rail	Design	Design Criteria
Change in Noise Levels; Change in Vibration Levels	M8.C-1	Pile driving mitigation and alternatives	Construction	CEMP - Noise and Vibration Management Plan
Change in Noise Levels; Change in Vibration Levels	M8.C-2	Advance notification	Construction	CEMP - Noise and Vibration Management Plan
Change in Noise Levels; Change in Vibration Levels	M8.C-3	Complaint management	Construction	CEMP - Noise and Vibration Management Plan
Change in Noise Levels	M8.D-6	Noise barriers	Design	Design Criteria
Change in Noise Levels	M8.D-7	Rail dampers	Design	Design Criteria
Change in Noise Levels	M8.D-8	Station acoustics	Design	Design Criteria
Change in Noise Levels	M8.O-1	Rail grinding	Operation	Existing TransLink Procedures
Change in Noise Levels	M8.O-2	Friction modifiers	Operation	Existing TransLink Procedures
Change in Noise Levels	M8.O-3	Switch monitoring and maintenance	Operation	Existing TransLink Procedures
Change in Noise Levels	M8.C-4	Noise monitoring	Construction	CEMP - Noise and Vibration Management Plan
Change in Noise Levels	M8.C-5	Temporary noise barriers	Construction	CEMP - Noise and Vibration Management Plan
Change in Noise Levels	M8.C-6	Scheduling of work	Construction	CEMP - Noise and Vibration Management Plan
Change in Vibration Levels	M8.D-4	Resilient fasteners	Design	Design Criteria
Change in Vibration Levels	M8.C-7	Vibration monitoring	Construction	CEMP - Noise and Vibration Management Plan

8.6 Discussion

The use of construction equipment (e.g., pile drivers, excavators, hoe rams) represents the main source of noise and vibration during Project construction. Setback distances have been identified within which there may be noise effects that exceed FTA criteria and where there may be vibration effects on human response and building cosmetic damage. Due to the potential for noise and vibration effects, monitoring and mitigation is recommended where there are residential or commercial receptors within the identified setback of construction activities. It is therefore expected that remaining effects after the implementation of mitigation measures will be minimal and well managed. All effects will be short-term and reversible after the construction phase.

During Project operation, the main source of noise and vibration is the interaction of SkyTrain vehicle wheels along the rails. As such, modelling to estimate the change in noise levels associated with Project operation relative to baseline conditions took place. Locations have been identified for where the Project-related change in noise levels is expected to represent a moderate impact for residential receptors, based on FTA criteria. Mitigation measures, such as parapet or centreline noise barriers and rail dampers, are recommended to reduce noise levels in these locations, depending on predicted noise levels related to final design and monitoring at designated receptors. As part of TransLink's SkyTrain Noise Study, an evaluation of operational procedures is underway, which could further reduce Project-related noise effects. It is anticipated that, based on FTA criteria, there will be no impact to institutional receptors along the alignment due to Project-related changes in noise levels during operation.

Setback distances have been identified within which there may be vibration effects that exceed FTA criteria during Project operation. These setback distances depend on the distance of receptors to joints and crossovers where vibration levels may be higher due to the rail discontinuity. It is anticipated that, based on the RCD, potential vibration effects will occur at a small number of residences located near the crossovers west of the 140 Street Station and east of the 184 Street Station, as well as at a commercial business in the 18500 block of Fraser Highway (sometimes used for institutional purposes). Operational procedures under investigation as part of TransLink's SkyTrain Noise Study could further reduce Project-related vibration effects.

Limitations associated with the evaluation of noise and vibration effects have been managed by using conservative assumptions, as follows:

- Models and empirical equations approximate noise and vibration propagation processes using simplified approaches and may not replicate actual phenomena in the study area.
- The noise and vibration levels associated with the use of construction equipment, obtained from literature, represent average levels observed for a range of different construction activities, at a range of different construction sites. Actual noise and vibration levels may vary.
- The FTA models to estimate noise and vibration levels during Project operation may not be reflective of SkyTrain due to differences in technology. The most representative model has been employed, based on a comparison of model predictions to previous measurements along the Expo and Millennium Lines.
- Detailed information on train speeds by segment of guideway was not available. Potential noise and vibration effects were considered based on a nominal top speed of 80 km/h except near stations. Actual train speeds are likely to be less than this nominal top speed at most locations in the vicinity of sensitive receptors.
- Noise associated with pre-Project and post-Project road traffic is predicated on traffic modelling that is based on simplifications of the real world and may not accurately consider the multitude of travel patterns and behaviours of road network users. Traffic modelling results are provided for three times of day (AM and PM peak hours plus midday) and amalgamated using expansion factors to estimate overall daytime and nighttime traffic volumes.
- The noise effects evaluation is based on forecasted SkyTrain operations and road traffic in 2050 to consider potential worst-case effects. Future ridership demand and road traffic volumes cannot be foreseen with certainty and the noise effects evaluation represents the most likely scenario in a range of plausible outcomes.

To provide context for the modelled change in noise levels associated with the Project, baseline and post-construction monitoring was reviewed for 30 locations along the Evergreen Line (BKL 2017). Of the 30 locations, only eight revealed post-construction noise levels greater than a general threshold of 3 dBA for a perceptible change (i.e., that can typically be perceived by the human ear) relative to baseline noise levels. These eight locations were all situated near at-grade guideways, tunnel portals, or near curves. At all other locations, post-construction noise levels were similar to (less than the 3 dBA threshold) or lower than baseline noise levels. Similarly, only three of nine locations near stations indicated post-construction noise levels perceptibly higher (greater than the 3 dBA threshold) than baseline noise levels. These correspond to at-grade stations or stations located near curves. The results of the noise modelling are therefore considered a reasonably conservative representation of potential noise levels associated with the Project, which has a relatively straight elevated guideway.

In addition to the noise stemming from road traffic and SkyTrain that was included in the noise modelling, sensitive receptors may experience some localized noise effects associated with buses servicing the three new bus exchanges at the stations at 166 Street, 196 Street, and 203 Street. A quantitative assessment of potential noise effects associated with the bus exchanges was not completed as the number and scheduling of buses are still to be determined. TransLink's anti-idling policy will be in effect to minimize noise associated with bus idling. In addition, TransLink is actively replacing its current diesel bus fleet with battery-electric buses as part of its Climate Action Strategy. The aim is to have the entire fleet replaced by 2040. Noise from the bus exchanges is expected to decrease going forward due to the lower noise levels associated with electric engines versus diesel engines.

In addition, public address systems in stations will broadcast announcements, as needed, to notify passengers of special circumstances, which may temporarily increase noise in proximate areas. Sound levels associated with public announcements via the SkyTrain operations centre will likely be similar to a SkyTrain pass by, whereas sound levels associated with public announcements via a station attendant using a platform telephone handset or radio may be somewhat higher (SLR 2018). Noise from these public address systems will be infrequent and will not contribute substantially to overall peak hour or day-night noise levels.

8.7 Conclusions

Baseline noise levels measured in the Project study area are reflective of a busy urban transportation corridor, and baseline vibration levels measured in the study area are low and below the threshold of perception.

8.7.1 Project Construction

Based on noise modelling of equipment and activities during Project construction, setback distances to achieve general FTA construction noise assessment criteria (FTA 2018) for residential, commercial, and industrial receptors were identified. A number of residential and commercial receptors are located within these setback distances. However, the modelling approach is considered conservative and the potential for noise impacts during construction will be minimal and limited in duration for guideway construction considering the sequential approach. Where appropriate, the Project will conduct noise monitoring during peak construction activities to confirm whether noise levels exceed the relevant criteria. If criteria are exceeded, mitigations will be deployed, including the installation of temporary noise barriers.

Construction-related vibration setbacks for relevant criteria are shorter compared to noise thresholds. Although many receptors adjacent to Fraser Highway will be within the setback distance to trigger public queries or concern, setbacks associated with the potential damage to buildings is much shorter, and largely contained within the existing Fraser Highway ROW. The highest construction-related vibration levels will be generated during excavation, asphalt and concrete demolition, or during construction of foundations. Advance notice measures to receptors in the area will be incorporated into the CEMP Framework.

Several commercial buildings and one residential auxiliary building are located within the setback distances for potential cosmetic damage due to vibration. Construction vibration also has the potential to interfere with vibration-sensitive equipment at the JPOCSC, which is why the Project is involved in a robust analysis of these potential interactions to ensure there are no impacts to facility operations and communicating directly with Fraser Health. Vibration monitoring will be considered, where appropriate, to ensure construction-related vibration levels are not detrimental to adjacent buildings or facility operations. Potential Project construction effects remaining after mitigation are summarized in **Table 8-17**.

8.7.2 Project Operation

Potential noise effects associated with the SLS operation were modelled using the CadnaA noise propagation software. Moderate noise impacts, as defined by **Figure 8-1**, were predicted at residential receptors located in the following areas (see **Figure D8-2 and D8-3, Appendix D**: Noise and Vibration Figures):

- 13700 block Fraser Highway;
- 13900 block Fraser Highway;
- 15300 block Fraser Highway;
- 16700 block Fraser Highway;
- 18400-18500 block Fraser Highway; and
- 20100-20200 block Industrial Avenue.

The noise modelling represents worst-case noise effects associated with the Project in the foreseeable future and do not include all mitigation measures. Field monitoring of noise is recommended during and following commissioning to verify the results of the noise modelling. If noise impacts on residential receptors are confirmed, several mitigation measures can be implemented, where appropriate, including noise barriers and rail dampers, which have effectively reduced noise from SkyTrain and other systems. No noise impacts were predicted to affect any institutional receptors (e.g., churches).

Setback distances were identified for potential Project-related vibration effects, and vibration effects at the nearest receptors are expected to remain below criteria established by the FTA (2018), except for short sections of the alignment near the crossovers west of 140 Street, east of the 184 Street Station, and the 18500 block of Fraser Highway. To reduce potential impacts at these locations, SkyTrain axle-box vibration measurements should be collected to monitor switch condition and inform switch maintenance procedures as necessary. Potential Project operation effects remaining after mitigation are summarized in **Table 8-17**.

Table 8-17 Summary of Potential Effects Remaining After Mitigation for Noise and Vibration

Potential Effect	Criterion	Rating	Rationale for Rating
Change in noise levels	Magnitude[1]	Low	Implementation of mitigation measures are expected to reduce noise effects below relevant noise criteria.
	Geographic Extent	Low	Effects will be localized to the study area and perceptible effects will be localized to a limited number of locations.
	Duration[2]	Long-term	Effects will occur for the duration of Project construction and operation.
	Frequency	Continuous	During construction, effects may occur continuously during Project work (up to 10 hours per day), in areas of active construction. During operation, when SkyTrain is running.
	Reversibility	Reversible	Effects are fully reversible at the end of Project life, however, there are no plans to decommission the Project.
Change in vibration levels	Magnitude[1]	Negligible (O) to Low (C)	During construction, implementation of mitigation measures is expected to reduce vibration effects below thresholds for building cosmetic damage. During operation, implementation of mitigation measures is expected to reduce vibration effects below levels of perceptibility and public concern.
	Geographic Extent	Negligible	Effects may be perceptible at site-specific locations without mitigation during construction; during operation, several locations may have perceptible effects.
	Duration[2]	Long-term	Effects will occur for the duration of Project construction and operation.
	Frequency	Common	During construction, effects may occur commonly during use of select equipment, in areas of active construction. During operation, effects may be perceptible when rail and switch conditions elevate vibration levels above normal.
	Reversibility	Reversible	Effects are fully reversible at the end of Project life, however, there are no plans to decommission the Project.

Notes:

1. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance, and high (exceedance of criteria or threshold). Generally, magnitude is measured in terms of the proportion of the SE affected within the assessment area (for biophysical SE), or the degree within the interaction area relative to the range of natural or historic (in the case of human environment SE) variation.
2. The duration of an effect may be short-term (i.e., within the construction phase), medium term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (permanent) (i.e., extending past the life of the Project).

Addendum 8-1 Detailed Description of Noise and Associated Terminology

Abnormal Noise Events

Noises that are sufficiently infrequent as to be uncharacteristic of an area or that occur so close to the microphone as to dominate the measurements in an unrealistic manner. Consideration must be given to deleting occurrences of abnormal noise from the measurements to obtain a reasonably accurate representation of the sound environment. Examples of abnormal noises include a dog barking close to the microphone, people talking in the vicinity of the microphone in a quiet environment, or a passing road grader.

Airborne Sound

Sound that reaches the point of interest by propagation through air

Ambient Noise

All noises that exist in an area and are not related to the Project. Ambient noise includes human activity, vehicle traffic, animals, and nature.

Attenuation

The reduction of sound intensity by various means (e.g., air, humidity, porous materials, etc.).

Daytime

Defined as the hours from 07:00 to 22:00.

dB (decibel)

A unit of measure of sound pressure that compresses a large range of numbers into a more meaningful scale. Hearing tests indicate that the lowest audible pressure is approximately 2 x 10-5 Pa (0 dB), while the sensation of pain is approximately 2 x 102 Pa (140 dB). Generally, an increase of 10 dB is perceived as twice as loud.

dBA (A-weighted decibel)

The decibel sound pressure level filtered through the A filtering network to approximate human hearing response.

The resultant sound pressure level with the associated unit “dBA” is therefore a representation of the subjective response of the human ear. The weightings are assigned in a way to reflect the higher sensitivity of human ear to sound in the mid and high frequency band as shown in the curve labelled A-weighting below:

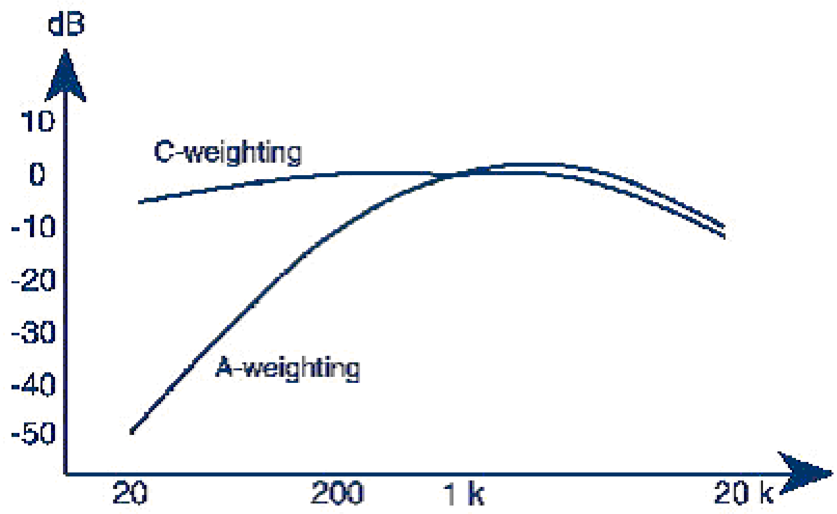

Figure A8-1 Sound Weighting Network

Energy Equivalent Sound Level (Leq)

The Leq is the average A-weighted sound level over a specified period of time. It is a single-number representation of the cumulative acoustical energy measured over a time interval. If a sound level is constant over the measurement period, the Leq will equal the constant sound level.

Frequency

The number of times per second that the sine wave of sound or of a vibrating object repeats itself. The unit is expressed in hertz (Hz), formerly in cycles per second (cps).

Ground-borne Noise

Audible sound that is generated when vibration radiates through a building interior, creating a low-frequency sound or rumble. Ground-borne noise is distinguished from conventional noise that reaches the receiver through an airborne path.

Ground-borne Vibration

Vibration waves that propagate through the ground and transmitted into foundations of nearby buildings. Ground-borne vibration may be manifested as rattling of windows or shaking of items on shelves.

Nighttime

Defined as the hours from 22:00 to 07:00.

Noise

Generally associated with the unwanted portion of sound.

Noise Level

This is the same as sound level except that it is applied to unwanted sounds.

Octave Band

A method of splitting the spectrum of a sound wave into smaller segments to identify sound levels at the different frequencies. Each octave band refers to a range of frequencies where the highest frequency is twice the lowest frequency. To common octave bands used to describe the audible spectrum are 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, and 8 kHz.

Peak Particle Velocity

The maximum instantaneous positive or negative peak of an oscillating vibration velocity waveform.

Root-Mean-Square Velocity

The square root of the arithmetic average of the squared amplitude of an oscillating vibration velocity waveform. The RMS velocity is used to describe a smoothed out vibration amplitude and is always less than the peak particle velocity. An illustration of a vibration signal is shown in the figure below.

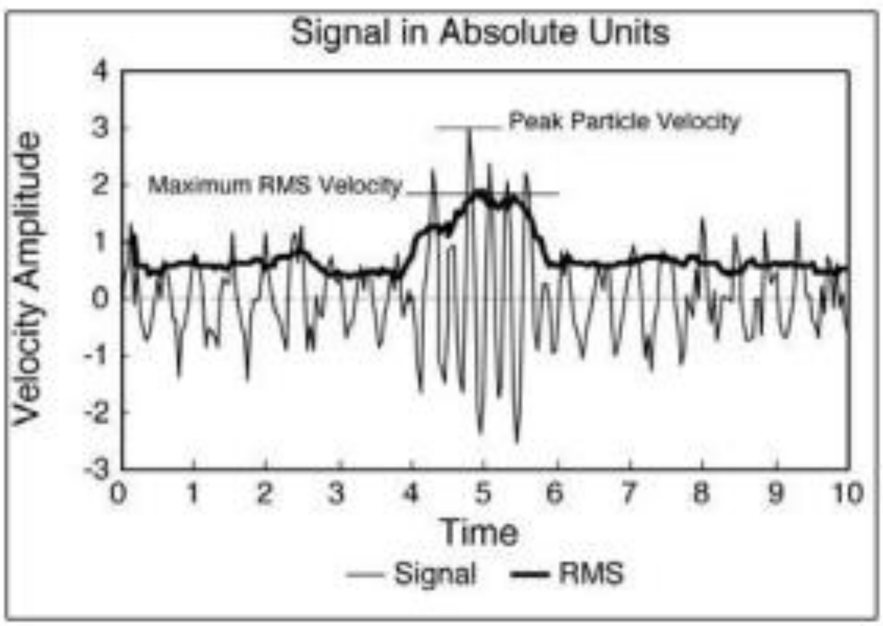

Figure A8-2 Vibration Signal

Sound

A dynamic (fluctuating) pressure.

Sound Level Metre

An instrument designed and calibrated to respond to sound and to give objective, reproducible measurements of sound pressure level. It normally has several features that would enable its frequency response and averaging times to be changed to make it suitable to simulate the response of the human ear.

Sound Pressure Level (SPL)

The logarithmic ratio of the RMS sound pressure to the sound pressure at the threshold of hearing. The sound pressure level is defined by equation (1) where P is the RMS pressure due to a sound and P_0 is the reference pressure. P_0 is usually taken as 2.0×10^{-5} Pascals.

$$SPL\ (dB) = 20 \log(P/P_0)$$

Common sounds on the logarithmic scale are illustrated in the figure below.

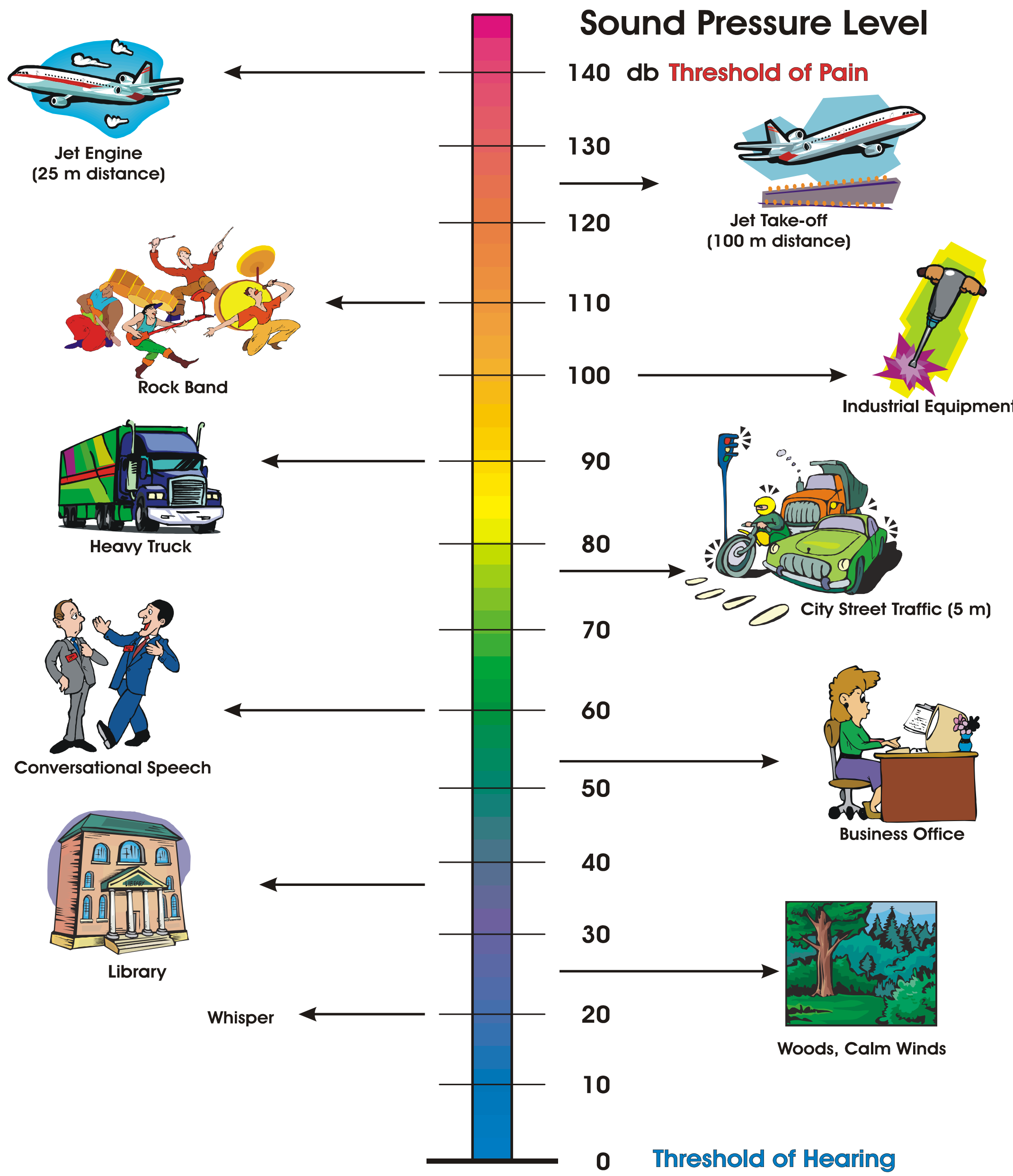

Figure A8-3 Common Sounds on Logarithmic Scale

Sound Power Level (PWL)

The logarithmic ratio of the instantaneous sound power (energy) of a noise source to that of an international standard reference power. The sound power level is defined by equation (2) where W is the sound power of the source in watts, and W_0 is the reference power of 10^{-12} watts.

$$(2) \quad PWL\ (dB) = 10\ \log(W/W_0)$$

Interrelationships between SPL and sound power level (PWL) depend on the location and type of source.

Spectrum

The description of a sound wave's resolution into its components of frequency and amplitude.

VdB (vibration decibel)

A unit of measure of ground-borne vibration that compresses a large range of numbers into a more meaningful scale. This unit of measure can be used for peak particle velocity and root-mean-square velocity.

Addendum 8-2 Institutional Sensitive Receptors within the Noise and Vibration Study Areas

ID	Name	Type	Location
NR1	Kids & Company King George	Child Care	9900 King George Boulevard, at intersection with Fraser Highway
NR2	JPOCSC	Health Care	9750 140 Street, at intersection with Fraser Highway
NR3	Surrey Nature Centre	Community Facility	9750 140 Street, in GTUF Park
NR4	First Memorial Funeral Services Fraser Heights Chapel	Place of Worship	14835 Fraser Highway, at intersection with 148 Street
NR5	Northwood United Church	Place of Worship	8855 156 Street, at Intersection with 88 Avenue
NR6	CEFA Fleetwood	Child Care	16050 Fraser Highway, at intersection with 160 Street
NR7	Surrey Pentecostal Assembly	Place of Worship	16870 80 Avenue, at intersection with Fraser Highway
NR8	Hope Community Church / Surrey Christian Early Learning Centre	Place of Worship / Child Care	18625 Fraser Highway, at intersection with 68 Avenue
NR9	Creative Kids Learning Centre	Child Care	19543 Fraser Highway, near intersection with 196 Street
NR10	Jellybean Park Langley	Child Care	19615 Willowbrook Drive, near intersection with Fraser Highway
NR11	Brookside Lodge	Senior Care	19550 Fraser Highway, at intersection with 196 Street

Addendum 8-3 Equipment List

Operation	Equipment	Fuel	Power Rating (hp)	Number of Units	Hours of Operation per Day	Sound Pressure Level at 10 m (dBA)
Pre-Cast Yard						
Concrete placement - pre-cast yard	Concrete pump truck [line type]	Diesel	320	1	8	78
Construction Staging Yard	Compressor	Diesel	21	2	8	68
Construction Zone General Support	Pickup Trucks F150, F350 etc	Gasoline	320	1	8	53
Segment lift	Rubber tired gantry crane [100t]	Diesel	320	1	4	77
Property Demolition						
Excavation - foundations, demolition, grading	Excavator	Diesel	160	1	8	78
Excavation - foundations, demolition, grading	Dump Truck	Diesel	464	1	8	85
Guideway Structure						
Asphalt removal	Asphalt saw	Gasoline	20	1	4	84
Concrete removal	Asphalt saw	Gasoline	20	1	4	84
Asphalt removal	Hoe-ram	Diesel	144	1	8	88
Excavation - foundations, demolition, grading	Excavator	Diesel	160	1	8	78
Excavation - foundations, demolition, grading	Dump Truck	Diesel	464	1	8	85
Caisson foundations (Augered)	Drill rig - vibratory	Diesel	1050	1	2	80
Caisson foundations (Steel Pipe piles)	Drill rig - hammer	Diesel	500	1	2	107
Caisson foundations - pipe assembly	Welder	Diesel	20	1	10	73
Steel placement - foundations, columns, beams, miscellaneous	Crane	Diesel	320	1	10	75
Concrete placement - foundations, columns, beams, slabs	Concrete pump truck [boom type]	Diesel	320	1	8	78
Concrete formwork placement and removal	Crane	Diesel	320	1	8	75
Install precast beam	Gantry truss	Diesel	100	1	10	77
Assemble steel special structure	Compressor for pneumatic impact wrench	Diesel	20	1	8	65
Install steel special structures	Crane	Diesel	320	1	8	75
Instal precast beam special structure	Crane	Diesel	320	1	8	75
Construction Zone General Support	Crane	Diesel	320	1	8	75
Trackwork						
Systems Installation	Hi-Rail Utility Truck - Cable Reel	Diesel	270	1	8	53
Rail Installation	Compressor for pneumatic impact wrench	Diesel	20	1	8	65
Rail Installation	Portable Diesel Generator	Diesel	40	1	8	74
Rail Installation	Portable Light Generator	Diesel	30	1	4	65
Rail Installation	Rail Saw	Gasoline	20	1	2	68
Rail Installation	Rail Welder	Diesel	350	1	8	73
Rail laying, moving most materials on guideway	Hi-Rail Pettibone	Diesel	163	1	8	79
Lifting rail	Crane	Diesel	320	1	6	75
Deliver LIM, power rail, misc to guideway	Boom truck	Diesel	450	1	4	82
Install precast walkway	Hi rail excavator/pettibone	Diesel	163	1	4	66
Stations						
Asphalt removal	Asphalt saw	Gasoline	20	1	8	84
Concrete removal	Asphalt saw	Gasoline	20	1	8	84
Asphalt removal	Hoe-ram	Diesel	144	1	8	88
Excavation - foundations, demolition, grading	Excavator	Diesel	160	1	8	78
Excavation - foundations, demolition, grading	Dump Truck	Diesel	464	1	8	85
Steel placement - foundations, columns, beams, miscellaneous	Crane	Diesel	320	1	8	75
Concrete placement - foundations, columns, beams, slabs	Concrete pump truck [boom type]	Diesel	320	1	8	78
Concrete formwork placement and removal	Crane	Diesel	320	1	8	75
Escalator installation	Crane	Diesel	320	1	8	75
Station roofing, glazing etc installation	Crane	Diesel	100	1	8	75
Station roofing, glazing etc installation	Man lift	Diesel	100	1	8	66
Construction Staging Yard, stations and associated work	Sky Jack	Diesel	55	1	8	78
Construction Zone General Support	Crane	Diesel	320	1	8	75

Operation	Equipment	Fuel	Power Rating (hp)	Number of Units	Hours of Operation per Day	Sound Pressure Level at 10 m (dBA)
Utility Relocations						
Asphalt removal	Asphalt saw	Gasoline	20	1	8	84
Concrete removal	Asphalt saw	Gasoline	20	1	8	84
Asphalt removal	Hoe-ram	Diesel	144	1	8	88
Excavation - foundations, demolition, grading	Excavator	Diesel	160	1	8	78
Excavation - foundations, demolition, grading	Dump Truck	Diesel	464	1	8	85
Compaction - trenches	Backhoe with plate compactor	Diesel	144	1	8	80
Construction Zone General Support	Crane	Diesel	320	1	8	75
Roadwork						
Asphalt removal	Asphalt saw	Gasoline	20	1	8	84
Concrete removal	Asphalt saw	Gasoline	20	1	8	84
Asphalt removal	Hoe-ram	Diesel	144	1	8	88
Asphalt milling	Milling machine	Diesel	750	1	8	82
Asphalt disposal	Dump truck	Diesel	464	1	8	81
Compaction - water delivery and spraying	Water Truck	Diesel	320	1	8	75
Compaction - granular, asphalt	Compactors (Double Drum Vibro + Pneumatic)	Diesel	157	1	8	77
Compaction - trenches	Backhoe with plate compactor	Diesel	144	1	8	80

Addendum 8-4 Vibration Adjustment Factors for Project Operations

Category	Adjustment	Comment
Speed	0 dB	Assessment conservatively based on design operational speed of 80 km/h. Vibration levels will be lower along sections where SkyTrain speeds are lower.
Vehicle Parameters		
Stiff Primary Suspension	+8 dB	Vehicles with a stiff primary suspension can create higher vibration levels than a soft primary suspension.
Resilient Wheels	0 dB	Resilient wheels not used on SkyTrain.
Worn Wheels	0 dB	Linear induction traction system and automatic train control minimizes wheel roughness.
Track Conditions		
Worn/Corrugated Track	0 dB	Track corrugation will be minimized with rail grinding.
Special Trackwork	0 to +10 dB	Vibration levels may be up to 10 dB higher within 30 m of special trackwork such as crossovers and pocket tracks.
Jointed Track	0 dB	SkyTrain utilizes continuously welded rail.
Track Treatment		
Floating Slab Trackbed	0 dB	SkyTrain uses fixed slab track on concrete guideways.
Ballast Mats	0 dB	Ballast mats not used on SkyTrain.
High-Resilience Fasteners	-5 dB	SkyTrain uses resilient fasteners that minimize vibration transmission to the deck.
Track Structure		
Elevated Track	-10 dB	Proposed track structure will be elevated along the entire alignment.
Ground-Borne Propagation Effects		
Geological Conditions	0 dB	Typical geological conditions assumed.
Coupling to Building Foundation	0 dB	Distance between building foundation and rock layer not known. Assessment conservatively assumes foundation in rock. Vibration levels may be 5 to 13 dB less depending on building construction.

9 Contaminated Sites

9.1 Introduction

The inclusion of a contaminated sites SE is due to potential Project-related effects, including the acquisition of contaminated properties, the need to manage contaminated soil and groundwater during construction activities, and required assessments of exposure of identified contaminants to human and ecological receptors.

The review of potential effects that relate to this SE is based on the information requirements identified in the SLS TOR. As of June 2022, several contaminated sites investigations were conducted, including a Contaminated Sites Overview Assessment (CSOA), seven Limited Phase I Environmental Site Assessments (ESAs) and one Phase II ESA. Additional assessments will take place prior to Project construction. It should be noted that the CSOA and Limited Phase I ESAs exclude historical record searches that are typical of a full Phase I ESAs[29].

9.1.1 Project Features Relevant to Contaminated Sites

Key features of the Project Description (**Section 2**) relevant to the contaminated sites SE include those that are intrinsic to the SLS design. The SLS will generally follow the existing transportation corridor on Fraser Highway. Except for new SkyTrain stations and associated connecting lengths of guideway, the SkyTrain will primarily be situated within municipal road ROW.

As much of the Project is elevated, the footprint at ground-level is limited to a few components (e.g., foundations for guideway, stations, and PPS). Similarly, ground-disturbing activities will be limited (e.g., excavation for foundations, pile-drilling). However, the Project does require some private property acquisitions, which may necessitate investigation, remediation, or risk assessments to mitigate contamination. The Project footprint of the RCD consists of permanent and temporary footprint areas (**Figure E9-1, Appendix E**: Contaminated Sites Figures). Permanent footprint areas are those associated with physical infrastructure necessary for operation of the Project (e.g., stations, PPSs, and guideway columns), while temporary footprint areas are those associated with Project construction only (e.g., the use of temporary laydown and other work areas).

The RCD footprint is approximately 59.0 hectares (ha), of which 93% (55.0 ha) are previously developed areas (e.g., pre-existing roadway, parking lots, buildings). Historical and current industrial and commercial operations of potential environmental concern that are located within, and adjacent to, the Project footprint include gas stations, manufacturing operations, automotive repair businesses, and dry-cleaning facilities. Pre-existing site contamination may be encountered during the following Project construction activities:

- Geotechnical investigations;
- Ground disturbance for foundations, including pile drilling for guideway support columns, and excavation (e.g., at SkyTrain stations and PPSs);
- Building demolition;
- Utility relocations;

[29] Full Phase I ESA typically include reviews of historical aerial photographs prior to 1998, street directories, land titles, fire insurance plans as well as owner/occupant interviews and assessments of structure interiors.

- Installation of permanent road works and drainage;
- Installation of temporary work areas and permanent parking areas (e.g., for buses, service vehicles); and
- Project-associated dewatering activities.

Site contamination during Project construction could occur due to accidental spills during operation and maintenance of construction vehicles, mishandling of demolition or excavated materials or during relocation of utilities. During operation, the potential for interaction with contamination is minimal but could occur during activities such as maintenance of utilities, or accidental spills.

9.1.2 Selection as a Review Element

Contaminated sites form part of the list of SEs because of the potential for contaminated sites to interact with Project activities, to meet regulatory requirements, and to understand the potential effects of contamination on human and environmental health. In addition, this SE was selected based on its importance to First Nations, stakeholders, and the public.

Historical and current land use in the Project study area includes industrial, commercial, residential and parkland use. Commercial and industrial operations that pose a potential environmental concern include gas stations, manufacturing operations, automotive repair businesses, and dry-cleaning facilities. For additional information on land use, please refer to **Section 14** Land Use of this ESR.

The evaluation of contaminated sites is based on the information requirements identified in the TOR (**Appendix A**) and a review of the potential effects of the SLS. Review Indicators are summarized in **Table 9-1.**

Table 9-1 Selection of Review Indicators

Potential Effect	Review Indicator(s)	Rationale for Selection
Environmental liabilities associated with the acquisition of potentially contaminated properties	Historical Schedule 2 activities as per the BC Contaminated Site Regulation[1] potentially occurred at acquired properties and known or potential contamination is present.	Acquisition of contaminated or potentially contaminated properties could incur additional costs to address on-site or off-site contamination sourced from the acquired property.
Soil and groundwater management during construction	Contaminated soil and/or groundwater identified during investigations completed prior to construction. Potential for suspect contaminated soil and/or groundwater where odours, staining, sheen, debris, or other potential indicators of contamination to be encountered during construction.	Contaminated soil and groundwater will incur additional costs for management and/or disposal during construction and could cause delays and impact the Project schedule.
Exposure risk to human health or ecological receptors during and following construction	Potential for contaminated soil, groundwater, and/or soil vapour to be encountered during construction and/or following construction.	A due diligence measure to assess ongoing risks related to any residual contamination during and following construction, or to facilitate future use of excess acquired property.

9.1.3 Spatial and Temporal Boundaries

This section presents the spatial and temporal boundaries for the evaluation of potential effects on the contaminated sites SE during Project construction and operation.

9.1.3.1 Spatial Boundaries

The study area for this SE includes a 100 m buffer around the Project centreline, which follows the future alignment from the existing King George SkyTrain Station along Fraser Highway to 203 Street in the City of Langley. This buffered distance is considered adequate to capture current and former offsite operations that could have caused contamination within the Project footprint, potentially impacting soil, groundwater, or soil vapour. Properties that have any portion within the 100 m buffer were considered during the investigation.

9.1.3.2 Temporal Boundaries

The temporal boundaries include Project construction and operation works and activities that are reasonably expected to affect the contaminated sites SE. The following temporal boundaries were considered in this evaluation:

- Planning phase: 2020 to 2024;
- Construction and commissioning phase: 2024 to 2028; and
- Operation (including maintenance) of Project: 2028 and beyond.

9.1.4 Regulatory and Policy Context

This section presents an overview of the provincial and municipal government regulatory and permitting requirements associated with the contaminated sites SE. Federal and provincial legislation that may apply to the Project are summarized **Table 9-2**, and key bylaws, policies, and guidelines are summarized in **Table 9-3**. In addition to the listed regulations and policies, Project Co will be required to follow the Design-Build Standard Specifications for Highway Construction (Government of BC 2019c)[30], including Section 165 Protection of the Environment.

9.1.4.1 Provincial Regulations

Soil and groundwater management along the Project alignment is under provincial jurisdiction and subject to the BC *Environmental Management Act*, SBC 2003, c. 53 (EMA), the BC Contaminated Sites Regulation (CSR), BC Reg. 375/96 and Hazardous Waste Regulation (HWR), BC Reg. 63/88. Dewatering of contaminated or uncontaminated groundwater or surface water during Project construction and operation must comply with the *Water Sustainability Act* (WSA), SBC 2014, c. 15, EMA, CSR and the Groundwater Protection Regulation, BC Reg. 299/2004.

Surplus soils generated during construction may require offsite relocation. Per Section 46.1 (1) of the CSR, the standards for relocating contaminated soil are determined based on the land use of the receiving site (e.g., commercial, industrial, parkland, residential, agricultural). Specifically, if any substance concentration exceeds either the numerical soil standards or soil vapour standards that are applicable at the receiving site, the soil would be considered contaminated and may require a Contaminated Soil

30 If this document is updated prior to the initiation of construction, it is anticipated that Project Co will be required to adhere to the most current version.

Relocation Agreement (CSRA). Specific requirements for CSRAs are provided in sections 40 through 46 of the CSR. Alternatively, the contaminated soil could be disposed offsite at a licensed facility for a fee; licensed facilities are exempt from the CSRA process.

The BC Ministry of Environment and Climate Change Strategy (ENV) is proposing to replace CSRAs with other processes deemed more effective and better understood, such as Waste Discharge Authorizations and Approvals in Principle. Changes are also proposed to the requirements for characterizing soil and notifications at sites with CSR Schedule 2 activities. These changes are not yet in effect but are worth noting, given the duration of this Project. A detailed description of proposed changes to the soil relocation regime can be found in the provincial Regulating Soil Relocation Intentions Paper (Government of BC 2021e).

9.1.4.2 Local Government Regulations and Permitting

Provincial projects do not require municipal development permits that could trigger various regulatory requirements but are subject to regulations from the BC ENV. The Province will continue to work with the Three Municipalities to define requirements for construction.

9.1.4.2.1 Water Discharges

Based on current understanding of expected activities during construction and the hydrogeological conditions within the study area, authorizations under the WSA and Groundwater Protection Regulation may be required, particularly if substantial dewatering is planned as noted in **Table 9-2**. Temporary dewatering required during Project construction may require local government approval for discharge to the storm sewer. Discharges to municipal and/or Metro-Vancouver sewers will need to meet requirements of their bylaws **.**

Table 9-2 Key Legislation

Legislation	Responsible Agency	Relevant Aspects of Legislation	Applicability to the Project
Provincial			
BC *Environmental Management Act* (EMA), SBC 2003, c. 53	Ministry of Environment and Climate Change Strategy (ENV)	EMA prohibits the introduction of waste into the environment in a way that will cause pollution, except in accordance with a regulation, permit, approval, or code of practice issued under the Act.	Management of soil and groundwater along the proposed Project alignment. Excavation dewatering and discharge to receiving environment, such as a watercourse, may be required. Waste will be generated by the Project.
EMA Contaminated Sites Regulation, BC Reg. 375/96	ENV	Outlines requirements for site remediation in BC. Schedule 2 of the CSR defines industrial activities that could cause site contamination. Mandates requirements for soil relocation. Specific requirements for CSRAs are provided In sections 40 through 46.	Surplus soil generated or contaminated soil encountered during construction to be relocated offsite may need a Contaminated Soil Relocation Agreement or disposal at a licensed facility. Chance finds of contaminated materials could occur during Project construction or associated utility works.
EMA HWR, BC Reg. 63/88	ENV	Addresses handling and disposal of hazardous wastes. Requires Transport Licence.	Project construction will use and require disposal of hazardous materials.

Legislation	Responsible Agency	Relevant Aspects of Legislation	Applicability to the Project
WSA, SBC 2014, c. 15	Ministry of Forests (FOR)	Changes in and about a stream may be made only with an approval under the WSA and Water Sustainability Regulation, or notification, as applicable. Requires Changes in and about a Stream Change Approval Application or Notification and Temporary Use Permit.	Dewatering of contaminated or uncontaminated groundwater or surface water during Project construction and operation.
WSA Groundwater Protection Regulation, BC Reg. 299/2004	FOR	The Groundwater Protection Regulation (GWPR) ensures that activities related to wells and groundwater are performed in an environmentally safe manner.	Dewatering of contaminated or uncontaminated groundwater or surface water during Project construction and operation
EMA Petroleum Storage and Distribution	ENV	Outlines the requirements for the design, operation, management and registration of petroleum storage and distribution facilities.	Project construction will require petroleum storage and distribution.

9.2 Baseline Conditions

A CSOA was completed to document baseline conditions in the Project study area by identifying potentially contaminated properties that may pose a risk to the Project. The results of the CSOA are summarized in **Section 9.2.2** below.

9.2.1 Methods

This section describes the methods used to conduct the CSOA, including a desktop assessment, field survey, and methods used to identify areas of potential environmental concern (APECs) and assign risk rankings for each APEC.

9.2.1.1 Desktop Assessment

The intent of the desktop assessment portion of the CSOA was to identify locations where pre-existing contamination may be encountered during construction. The scope of the CSOA was limited to the tasks listed below. The CSOA excludes historical record searches that are typical of a Phase I ESA (e.g., reviews of historical aerial photographs prior to 1998, street directories, land titles, fire insurance plans) as well as owner/occupant interviews and assessments of structure interiors.

A previous contaminated sites assessment along the Project alignment is documented in South of Fraser Rapid Transit Contaminated Sites Reconnaissance Report (Stantec 2016). The findings of this earlier report were evaluated for the Project study area to determine changes that may have occurred since 2016. The following tasks were then completed to identify any new APECs and re-evaluate the previously identified APECs:

- Searches were conducted of the BC ENV Online Site Registry, Federal Contaminated Sites Inventory (FCSI) and Contaminated Sites Approved Professionals (CSAP) Graphical Information System Mapping. The BC ENV Online Site Registry comprises a database of sites for which information has been submitted to BC ENV with respect to the BC EMA. The FCSI includes information on all known federal contaminated sites under the custodianship of departments, agencies, and consolidated crown corporations. The CSAP mapping tool identifies locations of properties for which BC ENV instruments have been issued;

- Historical aerial photographs from 1998 to 2021 were sourced from City of Surrey Mapping Online System (COSMOS) for select areas where additional background was required to assess operations of potential concern;
- Operations were reviewed within the Project study area using current and historical aerial and street view photography available in Google Earth or Google Street View; and
- The list of potentially contaminated sites along the corridor provided by City of Surrey was cross-referenced with information gathered from the searches described above.

9.2.1.2 Field Survey

Hemmera conducted site visits on May 6, 2019, and August 24, 2021, to confirm current operations and assess properties for:

- Potentially contaminating operations (e.g., auto repair, gas stations, manufacturing, industrial operations and/or Schedule 2 operations);
- Evidence of underground storage tanks or above-ground storage tanks (ASTs);
- Waste dumping or landfilling;
- Evidence of hazardous materials storage; and
- Previous environmental investigations (e.g., groundwater monitoring wells).

Due to lack of approvals to access private properties, the field surveyor relied on observations from nearby publicly accessible areas[31]. The results of the site visit were then cross-referenced with the information from the desktop assessment to identify and evaluate areas that constitute APECs.

9.2.1.3 Risk Ranking

Following the desktop assessment and field survey, the APECs were assigned a risk ranking of low, medium, or high based on the likelihood that the operation caused contamination in soil, groundwater, or soil vapour in the Project study area. The following factors were considered for each property when assigning a risk-ranking:

- Distance and geographic location (inferred downgradient versus upgradient location based on local topography) of the property or operation in relation to the Project alignment;
- Scale and sophistication (likelihood to have environmental policies) of the operation;
- Age and duration of potentially contaminating operations (older operations with longer durations having an increased likelihood of contamination); and
- Type and mobility of potential contaminants (e.g., metals versus petroleum hydrocarbons).

[31] Making observations from publicly accessible areas is not considered likely to significantly impact the findings for the following reasons: a) in most instances, this observation method still allowed for identification of larger-scale operations with potential to cause contamination; and b) due to close proximity to the proposed ROW, direct viewing of these areas was possible in most instances.

Generally, operations that included one or more commercial or industrial activities listed in BC CSR Schedule 2 were considered APECs, except for operations where the potential for migration was considered unlikely. The risk rankings are described as follows:

- **Low risk** – Potentially contaminating operations were identified but are unlikely to have resulted in contamination within the Project alignment.
- **Medium risk** – Potentially contaminating operations were identified that have likely resulted in some level of contamination within a portion of the Project alignment. For medium-risk sites, the nature of the APEC and its proximity and location have likely limited the extent of potential contamination.
- **High risk** – Operations were identified with significant potential for contamination to be present throughout adjacent areas of the Project alignment, or where contaminated soil or groundwater has been confirmed within the alignment. For high-risk sites, soil and/or groundwater management strategies are expected to be a requirement during Project construction. The extent of these strategies will depend on the type of construction activity occurring on that parcel.

9.2.2 Results – Contaminated Sites Overview Assessment

Based the results of the CSOA, Hemmera identified a total of 47 medium-risk and 17 high-risk APECs in the Project study area, which are shown listed on **Figure E9-1** of **Appendix E**: Contaminated Sites Figures. The high-risk and medium-risk APECs and associated potential contaminant of concerns (PCOC)s are summarized in **Table 9-3** and **Table 9-4** below. The identified PCOCs include benzene, ethylbenzene, toluene, and xylene (BTEX), volatile petroleum hydrocarbon (VPH), Light Extractable Petroleum Hydrocarbons (LEPH), Heavy Extractable Petroleum Hydrocarbons (HEPH), polycyclic aromatic hydrocarbon (PAHs), metals, VOCs, glycols, chlorinated aliphatics, dry-cleaning solvents, Tetraethyl Lead (TEL), and VOCs related to gasoline and diesel fuel storage and handling (VOC-fuels). The properties in **Table 9-3** and **Table 9-4** are listed west to east along the Project alignment.

Table 9-3 Summary of High-risk APECS

APEC ID	Location (Distance from Project Footprint[32])	Site Details (Current/Historical)	PCOC
C150.9	10 m north	Currently a Petro Canada gas station Historical operations suspected to include vehicle maintenance	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOCs, glycols
C151.0	10 m north	Off-property contamination migration from 13933 Fraser Highway (C150.9)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOCs, glycols
C151.1	Within Temporary Footprint	Off-property contamination migration from 13933 Fraser Highway (C150.9)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOCs, glycols
C153.53	Within Temporary Footprint	Currently, a tool and machinery rental business (Harrigan Rentals & Equipment Ltd.)	BTEX, VPH, LEPH, HEPH, PAHs, VOCs, metals
C153.65	Within Temporary Footprint	BC Site Registry (ID 23143) Limited Phase I ESA	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C153.7	Within Temporary Footprint	Ambassador Auto Repair	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C153.72	Within Temporary Footprint	Currently an auto repair operation (Mr. Lube) Former Esso gas station in City of Surrey records	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C153.8	Within Temporary Footprint	Currently a Petro Canada gas station and carwash	BTEX, VPH, LEPH, HEPH, PAHs, metals
C154.65	Within Temporary Footprint	Currently a Shell gas station	BTEX, VPH, LEPH, HEPH, PAHs, metals
C155.1	Within Temporary Footprint	Currently an Esso gas station Historical auto repair operation (Fleetwood Turbo)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOCs, glycols
C155.6	Within Temporary Footprint	Currently a Petro Canada Gas Station	BTEX, VPH, LEPH, HEPH, PAHs, metals
C156.0	Within Temporary Footprint	Currently an auto repair operation (KalTire)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols

32 Distances are measured from the "Temporary At-grade or Aerial Footprint", as shown on **Figure E9.1** in **Appendix E**: Contaminated Sites Figures.

APEC ID	Location (Distance from Project Footprint[32])	Site Details (Current/Historical)	PCOC
C156.5	Within Temporary Footprint	Currently an auto dealership (Basant Motors) on the western portion, and vacant and vegetated on the eastern portion	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C156.6	Adjacent south	Currently a gas station (West Coast Fuels) Historical Esso Gas Station	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C162.2	20 m north	Currently an Extra Foods gas station	HEPH, LEPH, VPH, BTEX, PAH
C163.1	Within Temporary Footprint	Currently a vacant parcel	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C164.8	Within Temporary Footprint	Currently a Husky gas station	HEPH, LEPH, VPH, BTEX, PAH

Table 9-4 Summary of Medium-risk APECS

APEC ID	Location (Distance from Project Footprint[33])	Site Details (Current/Historical)	PCOC
C152.86	Within Temporary Footprint	Currently an auto repair operation (Fleeting Pistons Auto Service Inc.) Suspect historical gas station as identified in City of Surrey records	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOCs, glycols
C153.75	Adjacent south	Currently a commercial plaza Former gas station in City of Surrey records	BTEX, VPH, LEPH, HEPH, PAHs, metals
C153.85	Within Temporary Footprint	Currently an auto repair operation (Budget Break and Muffler)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C153.9	Within Temporary Footprint	Currently an auto repair operation (Applewood Nissan Surrey dealership)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols

[33] Distances are measured from the "Temporary At-grade or Aerial Footprint", as shown on **Figure E9.1** in **Appendix E**: Contaminated Sites Figures.

APEC ID	Location (Distance from Project Footprint[33])	Site Details (Current/Historical)	PCOC
C154.0	10 m north	Currently an auto repair operation (Surrey Honda dealership)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C154.19	Adjacent south	Currently an auto repair operation (OK Tire)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C154.2	Adjacent south	Currently a vacant parcel Historical auto repair operation (Fountain Tire)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C154.25	10 m north	Currently auto repair operations (Pennzoil/BC Tires & Automotive)	HEPH, LEPH, VPH, BTEX, PAH, chlorinated aliphatics
C154.4	Adjacent south	Currently involves commercial retail use (pet store and insurance company) Historical dry cleaner operation (Genie's Fine Dry Cleaning) and prior Shell gas station	BTEX, VPH, LEPH, HEPH, PAHs, dry-cleaning solvents
C154.3	Within Temporary Footprint	Currently a car dealership (Sukhi Bath Motors)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C154.7	Adjacent south	Currently a Chevron gas station	BTEX, VPH, LEPH, HEPH, PAHs, metals
C154.9	15 m north	Currently an auto repair operation (NAPA Autocare Centre)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C155.7	Adjacent north	Currently a parking lot	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, chlorinated aliphatics
C155.75	Within Temporary Footprint	Fleetwood Trailer Park	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, chlorinated aliphatics
C155.65	Adjacent south	Currently a dry-cleaning operation (Fleetwood Dry Cleaners)	Dry-cleaning solvents, VPH
C155.80	Within Temporary Footprint	Currently an auto repair operation(Auto Tec Customs)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C155.85	Within Temporary Footprint	Currently an auto repair operation (Highland Motorcars/Top Carz Ltd)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C155.9	Within Temporary Footprint	Currently a used car dealership (Daytona auto sales)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols

APEC ID	Location (Distance from Project Footprint[33])	Site Details (Current/Historical)	PCOC
C155.90	Within Temporary Footprint	Currently a used car dealership (Truck Finders)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
155.95	Within Temporary Footprint	Currently a used car dealership (DND Auto Sales/Absolute Motor Cars	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C156.1	Within Temporary Footprint	Currently a car dealership (RK Autohaus)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
156.25	Within Temporary Footprint	Currently an auto repair operation (First-Rate Motors Ltd./Applewood)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C156.55	Adjacent south	Currently a vacant parcel	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC, glycols
C161.4	Within Temporary Footprint	Currently a vacant parcel	HEPH, LEPH, VPH, BTEX, PAH, VOC, metals
C161.5	Adjacent south	Currently a Husky gas station	HEPH, LEPH, VPH, BTEX, PAH
C161.87	Within Temporary Footprint	Currently auto repair businesses (Midas and Upperhill auto shops)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C163.0	Adjacent south	Currently an auto repair business (Caliber Automotive) Historical gas station	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C164.2	60 m north	Restaurant/former dry cleaner	HEPH, LEPH, chlorinated aliphatics.
C164.7	15 m south	Currently an Esso gas station	HEPH, LEPH, VPH, BTEX, PAH
C164.81	Within Temporary Footprint	Currently a commercial operation (dentist)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C164.95	Within Temporary Footprint	Currently an auto repair business (OK Tire − service bays)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.0	Within Temporary Footprint	Current auto repair (A&B Transmissions Ltd.)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.05	Within Temporary Footprint	Currently an auto repair business (C-Rich Auto Center)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.25	Within Temporary Footprint	Currently an auto repair business (Budget Brake and Muffler)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols

APEC ID	Location (Distance from Project Footprint[33])	Site Details (Current/Historical)	PCOC
C165.27	20 m south	Currently an auto repair business (Big O Tires)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.26	30 m north	Currently an auto repair business (Bert's Automotive)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.3	60 m south	Autoworld/Petro Canada Products (bulk storage and dispensing, oil waste processing)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.35	10 m south	Currently an auto repair business (Tireland)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.39	40 m south	Currently an auto dealership (Milani Norman Auto Dealership/Former Langley Auto Sales Ltd.)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.4	60 m south	Currently an auto dealership (Current Chevron Gas Station)	HEPH, LEPH, VPH, BTEX, PAH
C165.5	40 m south	Currently an auto dealership (Milani Norman Auto Sales)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.51	10 m south	Currently an auto repair business (Auto Folks/Auto Service)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.52	10 m south	Currently an auto repair business (Jim's Automotive)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.53	10 m south	Currently an auto repair business (Jan's Precision Autobody and Glass)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.75	90 m south	Currently an auto repair business, historical gas station (Jiffy Lube / former Shell gas station)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C165.6	10 m south	Currently an auto wrecking and auto repair business, former bulk plant (K&G Auto Recycling + Fraser Auto Detailing/ Former Petro Canada Bulk Plant)	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols
C166.15	Within Project alignment	Currently a vacant lot/unpaved parking lot	HEPH, LEPH, VPH, BTEX, PAH, metals, VOC, glycols

9.3 Project Interactions

Table 9-5 outlines the Project interactions with contaminated sites. The table also identifies activities not expected to interact with the contaminated sites SE (i.e., those without intrusive or subsurface work during construction). For example, no interactions are expected for the relocation of overhead guideway, use of temporary laydown areas, or management of access and traffic. Activities with no expected interaction are not discussed further in this section.

Table 9-5 Potential Project Interactions with Contaminated Sites and Potential Effects

Project Activities and Works	Environmental Liabilities for Land Acquisition	Soil and Groundwater Management during Construction[1]	Exposure Risk to Receptors during and Following Construction[1]
Construction			
Clearing and grubbing	-	✓	✓
Property acquisition (including demolition of inert building materials)	✓	-	-
Relocation of overhead BC Hydro transmission lines	-	-	-
Utility installation/relocation	-	✓	✓
Use of temporary laydown areas	-	-	o
Access and traffic management	-	-	-
Road widening (select locations)	o	✓	o
Drainage installation and / or realignment (select locations)	o	o	o
Installation of SkyTrain guideway foundations	-	✓	✓
Installation of overhead SkyTrain guideway	-	-	-
Stations (foundations, structure, lighting, access, service connections, security)	✓	✓	✓
PPS	✓	✓	✓
Management of non-contaminated excavated material	-	-	-
Management of contaminated and/or hazardous materials	✓	✓	✓
Testing, commissioning, and start-up	-	-	-
Operating and/or fuelling heavy equipment during construction activities	-	✓	o
Operation			
Operation of the Project	-	o	o
Maintenance of the Project	-	-	-

Notes:

1. Interaction Rating:
   - \- **No interaction:** interaction between a Project component and SE is unlikely.
   - o **Minor interaction:** impacts may result from an interaction, but standard measures to avoid or minimize the impact are available and well understood to be effective, and any remaining effects would be reduced to negligible. Interaction is not discussed further.
   - ✓ **Interaction:** an interaction occurs and likely requires additional mitigation. Carried forward and discussed in subsequent sections.

9.3.1 Potential Effects

This section examines the potential effects identified during the review of the Project interactions with the contaminated sites SE.

9.3.1.1 Property Acquisition Liabilities

Several properties will be fully or partially acquired to facilitate construction of SkyTrain stations and install foundations for the elevated guideway approaches. Historical operations at these properties as well as surrounding properties may have caused contamination, and therefore may require remediation if contamination is encountered during ground-disturbing construction activity. Under the EMA, remediation is the responsibility of the party that caused the contamination; however, environmental liabilities are typically disclosed or identified during due diligence investigations and are transferred during property acquisition.

9.3.1.2 Contaminated Soil and Groundwater Management

Project construction activities will involve intrusive work and are likely to generate surplus soil or groundwater, which will require appropriate management. Activities most likely to have potential interactions with this SE include grubbing, utility installation, construction of stations and PPSs, road widening, drainage realignment, and installation of SkyTrain guideway foundations. Contaminated media (e.g., soil or groundwater) may also be generated during construction through spills and / or accidental releases of fuels and lubricants during maintenance, fuelling, and operation of vehicles and heavy equipment. Any potentially contaminated soil that is encountered during Project construction must be characterized and managed in accordance with the EMA and Section 46.1 (1) of the CSR, and in accordance with MOTI Technical Circular T-03/20 (MOTI 2020), and MOTI Design-Build Standard Specifications for Highway Construction (Government of BC 2019c), Section 165. The standards for contaminated soil relocation are determined based on the land use of the receiving site. Refer to **Section 9.1** above for soil relocation considerations.

Suspect contaminated groundwater encountered during any required dewatering will require characterization and management in accordance with the municipal requirements for discharge and may incur a premium cost. Such encounters may impact the Project schedule because of regulatory requirements to characterize the impacted materials, select disposal options, or obtain permits and approvals.

9.3.1.3 Impacts to Human or Ecological Receptors

As remediation will likely be limited to appropriate management and disposal of soil and groundwater encountered during Project construction, residual contamination at the SkyTrain station and PPS properties could potentially impact human or ecological receptors, such as construction contractors, the public or TransLink employees. Possible pathways would include exposure to surficial contaminated soil, groundwater, and contaminated vapour intrusion within SkyTrain stations and PPS buildings.

9.4 Mitigation Measures

Mitigation measures to avoid or reduce the potential effects of Project activities and contaminated sites are described below. The mitigation measures, the effects they address, the Project phase in which they will be implemented, and their inclusion in a relevant environmental management plan are discussed below and summarized in **Table 9-6**. For Contaminated Sites, the relevant stages for implementing mitigation are during design (denoted as "D") and construction (denoted as "C").

Content from this section will be incorporated into the Project's CEMP Framework document (see the TOR for additional description of this document). The CEMP Framework will provide detailed guidance for the content of the Project Co's CEMP. In addition to identifying mitigation and performance objectives, the CEMP Framework will describe best practices intended to help meet performance objectives and required content for each sub-plan. The CEMP Framework will also include details on roles and responsibilities for Project Co's key team members.

9.4.1 Design Mitigation

Mitigation M9.D-1 Contaminated Sites Overview Assessment

The Project CSOA identifies areas in the Project study area with an increased likelihood of contaminated soil, groundwater, or soil vapour being encountered during construction. The CSOA identified low, medium-risk, and high-risk APECs.

As additional investigations are conducted and new information is obtained, the CSOA will be updated accordingly. This may include the inclusion or dismissal of APECs and/or the adjustment of risk rankings.

Mitigation M9.D-2 Due Diligence Investigations Prior to Acquisition

Prior to the acquisition of any properties, due diligence investigations (i.e., a Stage 1 Preliminary Site Investigation or a Phase I ESA) should be prepared that:

- Review historical operations on the property and surrounding properties.
- Identify APECs on the property, or on nearby properties with the potential for contamination to migrate to the property.
- Identify potential additional investigations in the form of a Stage 2 Preliminary Site Investigation or a Phase II ESA to assess the soil, groundwater, and soil vapour conditions.

Investigation findings would support estimates of environmental liabilities that can be used for property purchase negotiations, thus reducing the potential impact of future remediation costs during construction. Investigation findings would also identify potential exposure risk to human health or ecological receptors during and following construction and inform health and safety plans for construction and maintenance contractors.

To date, the following limited Phase I ESAs have been completed in the Project study area for due diligence purposes to support potential property acquisition:

- 15161 Fraser Highway;
- 15167 Fraser Highway;
- 15181 Fraser Highway;
- 16007 Fraser Highway;

- 16039 Fraser Highway;
- 16555 Fraser Highway; and
- 8215 166 Street.

The Limited Phase I ESAs identified APECs or Areas of Environmental Concern (AECs) associated with current or historical onsite and offsite activities that may have impacted soil, groundwater, or vapour at each of the properties in the Project study area. Completed Phase I ESAs are summarized in **Addendum 9-1.** Additionally, a Phase II ESA was completed at 15181 Fraser Highway. The Phase II ESA identified concentrations of VPH in soil, and BTEX, VOCs and polycyclic aromatic hydrocarbons (PAHs) in groundwater greater than applicable CSR standards. A summary of the Phase II ESA is provided in **Addendum 9-2**.

9.4.2 Construction Mitigation

Mitigation M9.C-1 Pre-Characterization of Soil and Groundwater

Where the CSOA or due diligence investigations identify an increased likelihood of encountering contaminated soil or groundwater, pre-characterization should be completed on fee simple properties. In addition to characterization programs on fee simple properties identified for the Project, opportunities may arise during advance or early works (e.g., geotechnical investigations, utility installation and relocation) to support appropriate management of excavated and/or discharged material.

Based on previous MOTI infrastructure projects, soil located adjacent to roads and highways can be contaminated with various heavy metals (i.e., chromium, copper, lead, zinc, cadmium) from vehicular traffic and salt compounds (i.e., sodium and chloride ions) from winter maintenance activities. While characterization of these soils is not required by the CSR or MOTI T-03/20, it may be required by the receiving site.

Mitigation M9.C-2 Due Diligence Investigations of Temporary Lands used During Construction

For any lands provided for Project Co’s temporary use during construction, such as equipment maintenance and storage areas, fuelling areas, or materials storage areas, it is recommended that due diligence investigations (e.g., surface soil investigations) are completed to determine the baseline conditions of these areas prior to construction, and then again following the completion of construction to assess any potential changes in environmental conditions.

Mitigation M9.C-3 Contaminated Site Management Plan

As part of the CEMP, a Contaminated Site Management Plan should be developed that includes a protocol to manage chance encounters with suspect contaminated soil or groundwater during construction. This plan will support appropriate management of excavated materials through defined procedures, and therefore requires a quality assurance protocol that provides demonstrated evidence of reporting, chain of custody and manifests. The objectives of this plan are to reduce the likelihood of potential contaminant releases to the environment during construction, reduce exposure risk to construction and maintenance contractors, and reduce future liabilities related to the improper handling of contaminated soil and groundwater.

9.4.3 Summary of Proposed Mitigation

Table 9-6 summarizes proposed mitigations specific to each Project phase (design, construction, and operation).

Table 9-6 Summary of Potential Project Effects and Mitigation Measures for Contaminated Sites

Potential Effect	Mitigation Number	Mitigation Measure	Project Phase	Environmental Management
Environmental liabilities associated with acquisition of potentially contaminated properties	M9.D-1	CSOA	Design	Design Criteria
	M9.D-2	Due diligence investigations prior to acquisition		
Soil and groundwater management	M9.D-1	CSOA	Design	Design Criteria
	M9.D-2	Due diligence investigations prior to acquisition		
	M9.C-1	Pre-characterization of soil and groundwater	Construction	CEMP – Contaminated Site Management Plan
	M9.C-2	Due Diligence investigations of temporary lands		
	M9.C-3	CEMP Contaminated Site Management Plan		
Exposure risk to human health or ecological receptors during and following construction	M9.D-1	CSOA	Design	Design Criteria
	M9.D-2	Due diligence investigations prior to acquisition		
	M9.C-1	Pre-characterization of soil and groundwater	Construction	CEMP – Contaminated Site Management Plan
	M9.C-2	Due Diligence investigations of temporary lands		
	M9.C-3	CEMP Contaminated Site Management Plan		

9.5 Discussion and Conclusion

The contaminated sites SE was selected due to potential Project-related effects, including the acquisition of potentially contaminated properties, management of contaminated soil and groundwater during construction activities, and assessment of potential exposure of identified contamination to human and ecological receptors.

As a preliminary step, a CSOA was completed to identify potential APECs along the Project alignment where potential PCOCs may be encountered in soil, groundwater, or soil vapour. In total, 47 medium-risk and 17 high-risk APECs were identified within the Project study area where pre-existing contamination is likely present due to historical and/or existing activities. These 64 properties represent potential risks and effects related to the contaminated sites SE, including liabilities associated with property acquisition, soil and groundwater management during construction, and exposure risk to human and ecological receptors.

To address the potential risks, a total of five mitigation measures were identified, including 1) updating the CSOA as additional information is acquired, 2) due diligence investigations prior to acquisition, 3) pre-characterization of soil and groundwater, 4) due diligence investigation of temporary lands used during construction, and 5) development of a CEMP. Effective implementation of these measures will avoid and/or reduce the risk and liability associated with the potential effects. However, even with the recommended mitigation measures, potential risk and effects may not be fully resolved prior to the start of construction. Potential Project effects remaining after mitigation are summarized in **Table 9-7.**

Table 9-7 Summary of Potential Effects Remaining After Mitigation for Contaminated Sites

Potential Effect	Criterion	Rating	Rationale for Rating
Environmental liabilities associated with acquisition of potentially contaminated properties	Magnitude	Low	Effects are anticipated to be low with effective implementation of mitigation measures, including a contaminated sites overview assessment to identify potentially contaminated sites and environmental investigations to determine the presence/absence of contamination at potentially contaminated sites.
	Geographic Extent	Low	Effects are predominately limited to the property boundary of the site, or adjacent site in the occurrence of off-site migration of any contamination.
	Duration	Long-term	Contaminated sites that are acquired may require long-term monitoring following remediation, resulting in long-term liabilities.
	Frequency	Uncommon	Environmental liabilities associated with the acquisition of potentially contaminated sites has been evaluated and mitigation measures have been/will be implemented. Following implementation, the frequency of identifying additional liabilities will be reduced.
	Reversibility	N/A	For confirmed contaminated sites that undergo remediation, the effect is improved over existing conditions.
Soil and groundwater management during construction	Magnitude	Low	The risk of requiring additional management of contaminated soil and groundwater outside of the identified APECs is reduced with effective implementation of mitigation measures.
	Geographic Extent	Low	Localized to the project disturbance area.
	Duration	Short-term	Effects will be limited to the construction phase.
	Frequency	Uncommon	With effective implementation of mitigation measures, the risk of requiring additional management of contaminated soil and groundwater outside of the identified APECs is low.
	Reversibility	N/A	Site conditions are expected to improve after management of contaminated soil and groundwater.
Exposure risk to human health or ecological receptors during and following construction	Magnitude	Low-Negligible	With effective implementation of mitigation measures, the exposure risk to human health or ecological receptors during and following construction would be reduced.
	Geographic Extent	Low	Localized to the project disturbance area.
	Duration	Short-Term	Effects will be limited to the construction phase.
	Frequency	Rare	With effective implementation of mitigation measures, the exposure risk to human health or ecological receptors would be rare.
	Reversibility	N/A	With effective implementation of mitigation measures, exposure risks will be reduced.

Notes:

1. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance, and high (exceedance of criteria or threshold). Generally, magnitude is measured in terms of the proportion of the SE affected within the assessment area (for biophysical SE), or the degree within the interaction area relative to the range of natural or historic (in the case of human environment SE) variation.
2. The duration of an effect may be short-term (i.e., within the construction phase), medium term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (permanent) (i.e., extending past the life of the Project).

Addendum 9-1 Phase I ESAs

Limited Phase I Environmental Sites Assessments (ESAs) were completed in the Project study area for due diligence purposes in support of potential property acquisition for the following seven properties in Surrey:

- 15161 Fraser Highway;
- 15167 Fraser Highway;
- 15181 Fraser Highway;
- 16007 Fraser Highway;
- 16039 Fraser Highway;
- 16555 Fraser Highway; and
- 8215 166 Street.

The objective of the Limited Phase I ESAs was to identify APECs, AECs, and PCOCs associated with current and/or historical onsite and offsite activities that may have impacted soil, groundwater, or vapour at each of the properties. The Phase I ESAs are considered 'limited' as the site visit observations were made from publicly accessible areas and no interviews with property owners or operators were conducted.

The Limited Phase I ESAs were completed in accordance with the *Canadian Standards Association's* (CSA) Standard Z-768-01 for Phase I Environmental Site Assessments and involved a review of current and historical operations on the Site as well as concerns associated with the current and historical use of adjacent and up-gradient properties. Information reviewed included:

- Current and historical land titles;
- Aerial photographs;
- Street directories;
- Municipal records;
- Topographical and surficial geology maps;
- BC Ministry of Environment and Climate Change Strategy (ENV) Site Registry;
- Federal Contaminated Sites Inventory (FCSI);
- CSAP mapping tool;
- Previous/existing environmental reports (if any); and
- Site visit, including site photographs, documentation of surrounding land use, and observations of any potential concerns or activities associated with the Site itself or surrounding properties).

Site visits included a review of the Site for APECs (i.e., observed or suspected spills, storage tanks, etc.), as well as other potential environmental concerns (i.e., proximity of the Site to sensitive areas, and activities on adjacent properties).

The results of the Phase I ESAs are summarized in the following sections.

1. 15161 Fraser Highway

The property at 15161 Fraser Highway, Surrey, BC (the Site) is a multi-unit strata currently occupied by various commercial tenants (ground floor) and residential units (second floor). The current building was constructed in the mid-to-late 1970s, and has paved parking areas to the west, south, and east of the building. Prior to 1969, the Site appeared vacant and undeveloped. The Site is currently occupied by residential apartment tenants and various commercial business owners as has been the case since its construction. Based on the Limited Phase I ESA, no APEC was identified on-Site.

In the 1940's, the area surrounding the Site was generally residential/agricultural. Commercial development commenced in the late 1950s and was ongoing until the mid-1980s. Limited changes appear to have taken place in the surrounding area from the mid-1980s until present. Several operations on nearby properties were identified as off-site APECs, including:

- **APEC-1:** Ambassador Auto Repair, adjacent to the east of the Site at 15167 Fraser Highway, appears to have been in operation since 1991 or earlier. In 1971, a machine shop was listed at the property, likely within the same building. Based on the duration and proximity of these operations to the Site, they have been identified as an APEC for the Site.
- **APEC-2:** Mr. Lube Auto Service and former Esso Gas Station, to the east of the Site at 15181 Fraser Highway. The Mr. Lube appears to have operated since the early 1990s, and the former gas station was located at the property from the mid to late 1950s until the early 1990s. Based on the duration and proximity of the operations at this property, it is considered an APEC for the Site.
- **APEC-3:** The property south of the Site at 15180 - 15192 Fraser Highway is currently a commercial plaza but operated as the Surrey Home Gas Station from the mid 1950s to the 1980s. Based on the duration and proximity of this operation, and in the absence of confirmed groundwater flow direction, it is considered an APEC for the Site.
- **APEC-4:** The property to the west of the Site at 15107 Fraser Highway currently operates as Harrigan Rentals and Equipment, which rents and services construction equipment and heavy machinery. It has been present since approximately the mid-to-late 1970s. Based on the duration and proximity of the operations at this property, it is considered an APEC for the Site.
- **APEC-5:** White Glove Dry Cleaners Ltd. is located south of the Site at 15156 Fraser Highway and was listed in the 1981 street directory. Based on the proximity of this operation, and in the absence of confirmed groundwater flow direction, it is considered an APEC for the Site.

The Petro Canada gas station at 15211 Fraser Highway (east of the Site, beyond 152 Street) was not included as an APEC based on its distance and cross gradient location with respect to the Site. Furthermore, considering the former gas stations on the property to the east of the Site (**APEC 2/3**), it is unlikely that contamination migrating to the Site from the east would be attributed to the Petro Canada gas station.

No other current or historical operations of concern were identified during the site visit or through the historical records review of properties adjacent to the Site.

The identified off-Site APECs and their potential risk to the Site are summarized below:

Table A9-1 Summary of Off-Site APECs and PCOCs

APEC	Source	PCOCs	Media
Off-Site			
1	Current Ambassador OK Service Centre and Former Machine Shop	BTEX, VPH, LEPH, HEPH, PAHs, VOCs, metals	Groundwater, soil vapour
2	Current Mr. Lube Auto Service and Former Gas Station	BTEX, VPH, LEPH, HEPH, PAHs, VOCs, metals, TEL	Groundwater, soil vapour
3	Former Surrey Home Gas Station	BTEX, VPH, LEPH, HEPH, PAHs, VOC-fuels, metals, TEL	Groundwater, soil vapour
4	Current Harrigan Rentals and Equipment	BTEX, VPH, LEPH, HEPH, PAHs, VOCs, metals	Groundwater, soil vapour
5	Former White Glove Dry Cleaners Ltd.	Drycleaner VOCs	Groundwater, soil vapour

Based on the findings, there is potential for PCOCs to be present in groundwater and/or soil vapour at the Site. A Phase II ESA is recommended to assess the presence of potential contamination related to the identified APECs.

2. 15167 Fraser Highway

The Site is comprised of one building constructed in the 1960s, paved parking areas and a small, landscaped area in the southeast corner. Prior to 1969, the Site appeared to be vacant and undeveloped. The Site is currently occupied by Ambassador OK Service Centre, an automotive maintenance shop in operation since at least 1991. The Site appears to have been occupied by commercial/industrial operations since the early 1970s/late 1960s as Dykstra Engineering Machine Shop was identified as present at the Site in 1971.

Previous environmental investigations at the Site included a Stage 1 Preliminary Site Investigation (PSI), Phase II ESA and additional detailed site investigation work completed by Next Environmental Inc. (Next) between March and September 2019, and a Supplementary Site Investigation (SSI) completed by Keystone Environmental Ltd. (Keystone) in November 2019. Approximately 27 boreholes were advanced at the Site and in the City of Surrey laneway adjacent to the west. The investigations identified glycols and heavy extractable petroleum hydrocarbons (HEPH) in soil at concentrations greater than the Contaminated Sites Regulation (CSR) commercial land (CL) use standards. Groundwater concentrations of solvent VOCs, including cis-1,2-dichloroethylene (cis-1,2-DCE), tetrachloroethylene (PERC), and trichloroethylene (TCE) were identified in groundwater on-site and off-site to the west at concentrations greater than the CSR drinking water (DW) standards.

Based on the Limited Phase I ESA, three on-site APECs/ AECs were identified, as summarized below:

- AEC-2 – Current Ambassador OK Service Centre and Former Automotive Repair and Machine Shop Operations. Previous investigations identified soil concentrations of ethylene glycol exceeding the CSR CL standard and groundwater concentrations of solvents (cis-1,2-DCE, PERC and TCE) exceeding the CSR DW standards both on-site and off-site. Glycol contaminated soil has been delineated and solvent impacted groundwater has been delineated to the north and east. Groundwater impacts have not been delineated vertically or horizontally to the west and southwest and impacts were identified at depths up to 11 m, however, this may be due to the drilling methodology. Based on the previous report review APEC-2 has been retained as AEC-2.

- APEC-3 – Potential Septic Field. A potential septic field was identified by Next and historical operations may have dumped waste from the operations into the septic system. Insufficient supporting data was available to determine if this APEC has been sufficiently investigated.
- AEC-4 – Fill Material. Previous investigations identified suspect fill material of unknown quality as an APEC and subsequent sampling identified soil HEPH concentrations greater than the CL standard. Therefore, fill material is retained as AEC-4, but insufficient supporting data was provided to determine if this area has been sufficiently investigated and delineated.

The area surrounding the Site was generally residential/agricultural in the 1940s, with commercial development commencing in the late 1950s and continuing until the mid-1980s, Limited changes appear to have taken place in the surrounding area from the mid-1980s until present. Several operations on nearby properties were identified as off-site APECs, including.

- **APEC-1**: **Former Esso Gas Station.** Located adjacent to the east of the Site at 15181 Fraser Highway, the former gas station was present at the property from approximately mid-late 1950s to early 1990s. Based on the findings presented in the Next Phase II ESA, this former operation is dismissed as an APEC for the Site.
- **APEC-5: Current Mr. Lube Automotive Service**. Located adjacent to the east of the Site at 15181 Fraser Highway, the Mr. Lube has operated since the early 1990s. Prior investigations did not consider this operation an APEC and no investigation has been completed to investigate the PCOCs related to this operation. Based on the duration and proximity of the operations at this property, it is considered an APEC for the Site.

The Limited Phase I ESA identified two on-site AECs, one on-site APEC, and two off-site APECs, as outlined below. No other current or historical operations of concern were identified during the site visit or through the historical records reviewed for the Site and surrounding area.

Table A9-2 Summary of APEC and PCOCs

APEC/AEC	Source	PCOCs	Media	Status
On-Site				
2	Current Ambassador OK Service Centre and Former Automotive Repair and Machine Shop Operation	BTEX, VPH, LEPH, HEPH, PAHs, VOCs, metals **Contaminants of Concern** **Soil: Glycols** **Groundwater: cis-1,2-dichloroetylene, tetrachloroethylene and trichloroethylene**	Soil, groundwater, soil vapour	**Retained as AEC-2**
3	Potential Septic Field	BTEX, VPH, LEPH, HEPH, PAHs, VOCs, metals	Soil, groundwater, soil vapour	**Retained as APEC-3**
4	Fill Material	LEPH, HEPH, PAHs, metals, non-chlorinated phenols **Contaminants of Concern:** **Soil: HEPH**	Soil, groundwater, soil vapour	**Retained as AEC-4**
Off-Site				
1	Former Esso Gas Station	BTEX, VPH, LEPH, HEPH, PAHs, VOCs, metals, TEL	Soil, groundwater, soil vapour	Dismissed
5	Current Mr. Lube Automotive Service	BTEX, VPH, LEPH, HEPH, PAHs, VOC-fuels, metals, TEL	Groundwater, soil vapour	**Retained as APEC-5**

Based on the findings, contaminants of concern have been identified in soil and groundwater at the Site and off-site to the west. Hemmera recommends additional Stage 2 PSI and detailed site investigation work to assess the uninvestigated APECs, and to delineate the previously identified soil and groundwater contamination.

3. 15181 Fraser Highway

The Site (15181 Fraser Highway) is currently occupied by a Mr. Lube quick service oil change facility, which includes a building and covered workspace in the north and parking and landscaped areas in the south. Prior to its current use, it was a gas station from the mid to late 1950s until the early 1990s. Based on aerial photography, the Site appeared undeveloped prior to 1954.

Through the Phase I ESA, two on-site APECs were identified, as follows:

- **APEC-1**: Current Automotive Repair (Mr. Lube); and
- **APEC-2**: Former Gas Station Operations (Esso Self Service, Olympic Esso, Olympic Service Gas Station).

The area surrounding the Site was generally residential/agricultural until the late 1950s when commercial development began. Commercial development continued until the mid-1980s when the land use was generally consistent with the current use. Several operations on nearby properties were identified as off-site APECs, including the former machine shop and current Ambassador Ok Service Centre adjacent to the west (**APEC-3**), the current Petro Canada Gas Station east of the Site beyond 152 Street (**APEC-4**), and the former Surrey Home Gas Station (**APEC-5**) and former White Glove Dry Cleaners (**APEC-6**) located south of the Site beyond Fraser Highway.

The Limited Phase I ESA identified two on-site and four off-site APECs, as outlined below. No other current or historical operations of concern were identified during the site visit or through the historical records reviewed for the Site and surrounding area.

Table A9-3 Summary of APEC and PCOCs

APEC	Source	PCOCs	Media
On-Site			
1	Current Mr. Lube Auto Service	BTEX, VPH, LEPH, HEPH, PAHs, VOCs, metals	Soil, groundwater, soil vapour
2	Former Esso Gas Station	BTEX, VPH, LEPH, HEPH, PAHs, VOC-fuels, metals, TEL	Soil, groundwater, soil vapour
Off-Site			
3	Current Ambassador Ok Service Centre and Former Machine Shop	BTEX, VPH, LEPH, HEPH, PAHs, VOCs, metals	Soil, groundwater, soil vapour
4	Current Petro-Canada Gas Station	BTEX, VPH, LEPH, HEPH, PAHs, VOC-fuels, metals, TEL	Groundwater, soil vapour
5	Former Surrey Home Gas Station	BTEX, VPH, LEPH, HEPH, PAHs, VOC-fuels, metals, TEL	Groundwater, soil vapour
6	Former White Glove Dry Cleaners Ltd.	Drycleaner VOCs	Groundwater, soil vapour

Based on the findings, PCOCs are potentially present in soil, groundwater, and/or soil vapour at the Site and Hemmera recommends completion of a Phase II ESA to assess the presence of potential contamination related to the identified APECs.

4. 16007 Fraser Highway

The Site (16007 Fraser Highway) is occupied by two commercial buildings constructed in the late 1950s or early 1960s, which were modified circa 1994. The Site has been used a parking area since the initial commercial development in the 1950s. Based on historical records, commercial operations have included retail stores, groceries, cafes, a bakery, salon, bank, locksmith, butcher shop, paint store, and an insurance broker. No current or historical operations of environmental concern were identified during the site visit or through the historical records review.

Properties in the surrounding area were residential or agricultural until the 1960s, at which time the area began to be redeveloped with commercial uses to the west, south, and east and with additional residential development to the north. Several operations on nearby properties were identified as off-site APECs, including:

- the Petro-Canada Gas Station (**APEC-1**) at 15961 Fraser Highway, which has been in operation since 1991 or earlier, to present; and
- the current Fleetwood Drycleaners and former gas stations (**APEC-2**) that operated at 15988 Fraser Highway from 1991 to present and from 1971 to the early 2000s, respectively.

Based on the findings, no on-site APEC were identified in the Limited Phase I ESA, but two off-site APECs were identified, as outlined below.

Table A9-5 Summary of APEC and PCOCs

APEC	Source	PCOCs	Media
Off-Site			
1	Current Petro-Canada Gas Station	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC-fuels	Groundwater and soil vapour
2	Current Fleetwood Dry Cleaners / Former Gas Stations	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOC-fuels, drycleaner VOCs	Groundwater and soil vapour

Based on the findings, PCOCs are potentially present in groundwater, and/or soil vapour at the Site and Hemmera recommends completion of a Phase II ESA to assess the presence of potential contamination migrating from the identified off-site APECs.

5. 16039 Fraser Highway

The Site (16039 Fraser Highway) is occupied by the Fleetwood Trailer Park, a residential mobile home community that was constructed in the early 1960s, on what was agricultural or vacant, undeveloped land. During the site visit, a heating oil AST was observed adjacent to one mobile home, and there is potential for other current or historical AST or underground storage tanks to have been, or still be present. These current and historical heating oil tanks are considered **APEC-1** for the Site. No other current or historical operations of environmental concern were identified on-site during the site visit or through the historical records review.

Properties in the surrounding area were residential or agricultural until the 1960s, at which time the area started to redevelop with commercial uses to the west, south, and east, and with additional residential development to the north. Operations on nearby properties identified as off-site APECs included:

- The Minit-Tune and Brake Auto Center (now Auto Tec Customs) (**APEC-2**) located at 16050 Fraser Highway that has operated since 2001, and
- Quality Drycleaners (**APEC-3**) formerly located at 16055 Fraser Highway that operated in 2001 for an unknown duration.

In summary, the Limited Phase I ESA identified one on-site and two off-site APECs, as outlined below.

Table A9-6 Summary of APEC and PCOCs

APEC	Source	PCOCs	Media
On-Site			
1	Current and Historical Heating Oil Tanks	BTEX, VPH, LEPH, HEPH, PAHs	Soil, groundwater, and soil vapour
Off-Site			
2	Minit-Tune & Brake Automotive Service (now Auto Tec Customs)	BTEX, VPH, LEPH, HEPH, PAHs, metals, VOCs	Groundwater and soil vapour
3	Former Quality Drycleaners	Drycleaner VOCs	Soil, groundwater and soil vapour

Based on the findings, PCOCs are potentially present in soil, groundwater, and/or soil vapour at the Site and Hemmera recommends completion of a Phase II ESA to assess the presence of potential contamination related to the identified APECs.

6. 16555 Fraser Highway

The Site (16555 Fraser Highway) is located within the parking area in the southeast corner of the Surrey Sport and Leisure Complex. The Surrey Sport and Leisure Complex includes pools, fitness facilities, and a small preschool room. Based on the earliest available historical records, the Property was vacant or residential in use until 1998 when the Surrey Sport and Leisure Complex was constructed. No current or historical operations of environmental concern were identified during the site visit or through the historical records review.

The current surrounding uses are primarily residential or parkland, with some commercial operations to the east, including restaurants, a hotel, and commercial stores. The adjacent property to the east was historically residential or vacant prior to the current development consisting of restaurants and a hotel. Historical operations of concern that were identified through the records searches were located greater than 300 m upgradient, or 50 m cross or downgradient, and based on the scale and type of operations, were considered to pose a low environmental risk to the Site.

Based on the findings of this Limited Phase I ESA, no on-site or off-site APECs were identified, and no further investigation is recommended at this time

7. 8215 166th Street

The Site is the southern portion of the property (8215 166th Street) occupied by a Tim Hortons restaurant and associated landscaping and parking areas. The northern portion of the property is occupied by Baselines Pub. Based on the reviewed historical records, the property was residential or vacant since the earliest records searched, until the current buildings were constructed in approximately 2005.

The current surrounding land use is residential to the south beyond Fraser Highway, parkland and commercial to the west, north and east with operations that include the Surrey Sport and Leisure Complex, a Comfort Inn hotel and a RONA/JYSK store. Properties to the south, west, and north were historically residential or vacant until they were developed for their current uses. The property to the east beyond 166 Street was historically a lumber yard that may have included a lumber mill operation prior to development with the current commercial buildings.

Based on the findings of this Limited Phase I ESA, no on-site or off-site APECs were identified, and no further investigation is recommended at this time.

Addendum 9-2 Phase II ESAs

1. 15181 Fraser Highway

A Phase II ESA was completed at 15181 Fraser Highway, Surrey, BC (the Site) for due diligence purposes.

The objective of the Phase II ESA was to determine the presence or absence of PCOCs in soil and groundwater at the following APECs, identified in the Limited Phase I ESA.

APEC	Source	PCOCs	Media
On-Site			
1	Current Auto Repairs	BTEX, VPH, LEPH, HEPH, PAHs, VOCs, metals	Soil, Groundwater
2	Historical Gas Station	BTEX, VPH, LEPH, HEPH, PAHs, VOC-fuels, metals, TEL	Soil, Groundwater
Off-Site			
3	Former Off-Site Ambassador Ok Service Center	BTEX, VPH, LEPH, HEPH, PAHs, VOCs, metals	Groundwater

The Phase II ESA consisted of advancing three boreholes (BHs), installing three monitoring wells (MWs), and associated soil and groundwater sampling and analysis. An additional five existing MWs were subsequently sampled as part of the groundwater investigation.

Soil analytical results were compared to BC CSR CL use and residential land use, low and high density (RL_{LD}, RL_{HD}) standards. Groundwater analytical results were compared to CSR aquatic life freshwater, marine (AW_f, AW_m), and DW standards.

The findings of the Phase II ESA are summarized as follows:

- Concentrations of VPHs greater than the CSR CL and RLLD standards were identified in one soil sample (BH21-03) located within APEC 2. The exceedance is delineated vertically, but not laterally.
- Concentrations of naphthalene and tetraethyl lead in BH21-03, collected from approximately 3.35 – 3.66 bgs (BH21-3-04) exceeded the RLHD/LD standards. These, in addition to VPH (at BH21-03), are not considered exceedances, as only CSR IL standards apply to soil at depths greater than 3 m.
- Concentrations of the remaining PCOCs in soil were less than the applied standards.
- MW21-03 (located within APEC-2) contained concentrations of light-extractable petroleum hydrocarbons (LEPH), VPH and naphthalene greater CSR AWf and AWm standards and 2-methylnaphalene greater than CSR DW standards, The exceedances are not delineated.
- MW-EX1 (located within APEC 2) contained concentrations of toluene greater than CSR AWf standards; benzene, ethylbenzene, xylenes, and 1,2-dichloroethane greater than CSR DW standards; and naphthalene greater than CSR AWf and AWm standards. The exceedances are not delineated.
- MW-EX4 (located southwest of APEC-2) contained concentrations of benzene greater than CSR DW standards. The exceedance is not delineated.
- MW-EX5 (located within APEC-2) contained concentrations of toluene greater than CSR AWf standards; benzene, ethylbenzene and 1,2-dichloroethane greater than CSR DW standards; and naphthalene greater than CSR AWf and AWm standards. The exceedances are not delineated.
- Concentrations of the remaining PCOCs in groundwater were less than the applied standards.
- The locations of the identified exceedances indicate that the source of contamination in soil and groundwater is APEC-2.

Based on the findings of the Phase II ESA, APEC 2 is confirmed as an AEC and further investigation would be required to determine the extent of contamination.

10 Fisheries and Aquatics

10.1 Introduction

Watercourses provide vital ecosystem functions, such as filtering pollutants, transporting nutrients, and supplying fish, wildlife, and aquatic organisms with food and habitat. Fish are important for economic, cultural, and recreational reasons. Additionally, fish provide commercial value to the economy and have cultural and ceremonial importance for Indigenous communities. As top predators in the aquatic food chain, fish are important indicators of overall aquatic health. Aquatic biota and fish are sensitive to changing water quality, habitat alterations, and other environmental effects caused by development.

10.1.1 Project Features Relevant to Fisheries and Aquatics

Key features of the Project Description (**Section 2**) relevant to the fisheries and aquatics SE include those that are intrinsic to the SLS design, such as its alignment and elevated components. The SLS will generally follow the existing transportation corridor on Fraser Highway. For the alignment adjacent to the GTUF and in the Serpentine Valley, SkyTrain will be primarily situated within the municipal ROW for Fraser Highway.

The Project design, including elevated guideway, minimizes requirements for at-grade infrastructure and consequent interactions with watercourses and aquatic environments. Some minor widening of Fraser Highway will be required to accommodate the guideway. The Project footprint for the RCD consists of permanent and temporary footprint areas (**Figure F10-1, Appendix F**: Fisheries and Aquatics Figures). Permanent footprint areas are those associated with physical infrastructure necessary for operation of the Project. Temporary footprint areas are those associated with Project construction only (e.g., the use of temporary laydown and other work areas) and include a combination of at ground as well as aerial use areas.

The Project’s eight new SkyTrain stations and guideway will be elevated, which limits footprint effects and interactions with fisheries and aquatics. The 140 Street Station design further minimizes its footprint at ground level to reduce impacts, including disturbance to riparian habitat. The SkyTrain will be powered by electricity from up to nine PPSs, six of which will be integrated into SkyTrain stations to minimize footprint disturbance. A standalone PPS will be situated just east of the Serpentine River dike.

Project-related activities with the potential to directly interact with fish and fish habitat during construction include land clearing, relocation of roadside drainages, and construction of watercourse crossings. Project activities may also interact indirectly with watercourses by altering riparian function and reducing the quality of habitat, or reductions in water quality through sedimentation or runoff.

The temporary footprint includes approximately 90% of ground-level workspace with the remainder being aerial requirements for use of a gantry to install guideway sections. Temporary footprint areas were estimated based on buffers for the following Project features:

- Road works and parking areas – 2 m buffer;
- Guideways – 5 m buffer from edge; and
- Support columns – 4 m buffer.

During operation, SkyTrain standard operating procedures will be used regarding spill and emergency management and maintenance activities. Stormwater management design incorporated into the RCD includes oil-grit separators at stations, parking areas and bus exchanges, and swales and other infiltration treatment of stormwater and guideway runoff. Operation and maintenance activities will typically occur within the permanent Project footprint.

10.1.2 Selection of Review Indicators

Fisheries and aquatics were selected as a SE in the ESR because of potential Project interactions with watercourses located within and adjacent to the proposed Project footprint. Project activities may affect natural watercourses and ditches located along the Project alignment between King George SkyTrain Station and 203 Street.

Review Indicators for the fisheries and aquatics SE were selected based on the information requirements in the TOR (**Appendix A**) and potential Project-related effects (**Table 10-1).**

Table 10-1 Selection of Review Indicators

Potential Effect	Review Indicator(s)	Rationale for Selection
Changes in fish habitat	Change in habitat structure: spatial extent (m^2) of instream and riparian habitat altered due to physical disturbance.	Quantifying the area of altered habitat w and determining the need for a *Fisheries Act,* RSC 1985, c. F-14 (last amended on 2019-08-28) *Fisheries Act* authorization (FAA) and/or potential need for habitat offsetting.
	Loss of habitat: spatial extent (m^2) of instream and riparian habitat destroyed due to physical disturbance.	Quantifying the area of lost habitat [1] and determining the need for a FAA and/or potential need for habitat offsetting.
	Change in access to habitat: spatial extent (m^2) of fish habitat made inaccessible due to physical disturbance or changes in flow.	Quantifying the area of fish habitat made inaccessible due to the Project[1] and determining the need for a FAA and/or potential need for habitat offsetting.
	Change in water quality: changes in total suspended solids, turbidity, pH, dissolved oxygen, and conductivity.	Determining thresholds for water quality parameters as a means of predicting potential effects.
Changes in fish mortality/ health	Changes to fish/egg mortality: predicted numbers of fish/eggs due to direct physical disturbance, changes in water quality, or changes in flows.	Predicting potential adverse health and mortality effects on fish.

Note: m^2 = square metres
1. As defined under the *Fisheries Act*

10.1.3 Spatial and Temporal Boundaries

This section presents the spatial and temporal boundaries identified for the Project study area.

10.1.3.1 Spatial Boundaries

The Project study area for the fisheries and aquatics SE encompasses any instream and riparian habitat associated with identified watercourses within 30 m of the Project footprint. If an identified watercourse interacts with this spatial boundary, effects are considered for a reach defined as up to 50 m upstream and 300 m downstream of the Project footprint (**Figure F10-1, Appendix F**: Fisheries and Aquatics Figures).

10.1.3.2 Temporal Boundaries

Temporal boundaries are the different phases of the Project that were considered in the assessment of potential effects in the fisheries and aquatics SE in the Project area. Also included are the Project works and activities that are reasonably expected to potentially affect fisheries and aquatic resources.

The following temporal boundaries were considered:

- Planning Phase: 2020 to 2024;
- Anticipated construction and commissioning phase: 2024 to 2028; and
- Operation (including maintenance) of Project: 2028 and beyond.

10.1.4 Regulatory and Policy Context

Project-related effects on fish and fish habitat are subject to regulatory requirements, including the provincial *Riparian Areas Protection Act*, the WSA, and the federal *Fisheries Act*. **Table 10-2** summarizes applicable federal, provincial, and municipal government legislation and bylaws that apply to Project activities with the potential to affect fisheries and aquatics. The Province will work with municipalities to define requirements for construction.

Key policies and guidelines are summarized in **Table 10-3**. Note that, in addition to the listed regulations and policies, Project Co will be required to follow the Design-Build Standard Specifications for Highway Construction (DBSS) (Government of BC 2019c), including Section 165 Protection of the Environment.

It is anticipated that, upon final design, submissions to Ministry of Forests (FOR) and Fisheries and Oceans Canada (DFO) will confirm the regulatory approach, including any requirements for offsetting. If offsetting is deemed necessary, the Project will consult with First Nations during the regulatory review process.

Table 10-2 Key Legislation for Fish and Fish Habitat Potentially Applicable to the Project

Legislation	Responsible Agency	Relevant Aspects of Legislation[1]	Applicability to the Project
Federal			
Species at Risk Act (SARA), SC 2002, c. 29	Environment and Climate Change Canada (ECCC)	This legislation regulates management of Canadian indigenous species, subspecies, and distinct populations. Section 32 of SARA prohibits killing, harming, harassing, capturing, or taking wildlife listed as extirpated, endangered, or threatened. Section 233 of SARA prohibits damage to defined residences and designated critical habitat of listed species and applies only on federal land.	Project activities may affect designated species.
Fisheries Act, RSC 1985, c. F-14 (last amended on 2019-08-28)	DFO	The legislation governs federal fisheries in Canada and provides a framework to properly manage and control fisheries, conserve and protect fish habitat, and prevent pollution. Provisions apply to all fish and fish habitat in Canada and include prohibitions against: • causing the death of fish by means other than fishing (section 34.4) • causing the harmful alteration, disruption, or destruction (HADD) of fish habitat (section 35) • the introduction of deleterious substances into waters frequented by fish (Section 36)	Project activities may affect fish and fish habitat.
Provincial			
WSA, SBC 2914, c. 15	FOR	In BC, changes in and around a stream are permitted only with an approval under section 11 of the WSA and section 4 of the Water Sustainability Regulation, or through a notification. The Act defines a "stream" as a natural watercourse, whether or not the stream channel has been modified or a natural source of water supply. Temporary use of water in BC (a prescribed quantity for a prescribed use over a prescribed period) or pumping of groundwater is only permitted with approval under section 10 of the WSA.	Project activities may result in changes in and about streams or may require dewatering of works.

Riparian Areas Protection Act, SBC 1997, c. 21
Riparian Areas Protection Regulation (RAPR), BC Reg 178/2019
	Ministry of Land, Water and Resource Stewardship	Legislation delegates responsibilities to local governments to protect riparian areas to maintain stream health during site development. Municipalities must adhere to the RAPR unless they have legislation that meets or exceeds protection afforded under the RAPR. The RAPR defines a "stream" as:
		• a watercourse or body of water, whether or not usually containing water
		• any of the following that is connected by surface flow to a watercourse or body of water:
		  ◦ a ditch, whether or not usually containing water
		  ◦ a spring, whether or not usually containing water.
			Project activities may occur within streamside protection and enhancement areas (SPEAs) of local watercourses.

Dike Maintenance Act, RSBC 1996, c, 95	Ministry of Environment and Climate Change Strategy (ENV)	The legislation requires that written approval from the Inspector of Dikes or a Deputy Inspector of Dikes is obtained prior to making any changes to a dike or to the area adjacent to a dike. Changes may include: • Alterations to the cross section or crest elevation of a dike • Any type of construction on or over a dike • Construction of any works on or over a dike right of way	Project activities overlap with established dikes along the Serpentine River.

Notes: 1. See **Table 11-2** Key Legislation for Vegetation and Wildlife Potentially Applicable to the Project for salvage requirements under the *Wildlife Act*.

Table 10-3 Key Bylaws, Policies, and Guidelines

Policy/Bylaw	Responsible Agency	Relevant Aspects	Applicability to the Project
Federal			
Fish and Fish Habitat Protection Policy Statement, (Government of Canada 2019b)	DFO	The purpose of the document is two-fold: 1) to set out how the Department and its regulatory partners will apply the fisheries protection provisions of the *Fisheries Act* and guide the development of regulations, standards and directives; and 2) to provide guidance to proponents of projects on the application of the fisheries protection provisions of the *Fisheries Act*.	Project activities have the potential to affect fish and fish habitat.
Applicant's Guide Supporting Authorizations Concerning Fish Habitat Protection Regulations (Government of Canada 2019a)	DFO	This document provides an applicant seeking an authorization for the purpose of paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* with guidance on how to develop and apply for an authorization in accordance with the Regulations, or how to request the amendment, suspension, in whole or in part, or the cancellation of an authorization already in their possession This guide should be read in conjunction with other Federal Acts and Regulations which may be relevant to the proposed work, undertaking or activity, including the: • *Species at Risk Act* • Aquatic Invasive Species Regulations • *Impact Assessment Act*	Project-related impacts to fish and fish habitat may require FAA and habitat offsetting.
Measures to Protect Fish and Fish Habitat (Government of Canada 2019c)	DFO	The statement sets out how DFO interprets and will apply the regulatory and non-regulatory tools available for effective and efficient conservation and protection of fish and fish habitat. The Policy Statement applies to proponents of existing or proposed works, undertakings or activities that may result in harmful impacts on fish or fish habitat, specifically the death of fish by means other than by fishing or the harmful alteration, disruption or destruction of fish habitat.	Project activities, including timing of works in proximity to streams, may affect fish and fish habitat.
Standards and Codes of Practice (Government of Canada 2021b)	DFO	This code of practice specifies procedures, practices or standards for avoiding the death of fish or the harmful alteration, disruption or destruction of fish habitat. This is in relation to works, undertakings and activities during various phases of their life cycle, such as construction, operation, maintenance, or decommissioning.	Project activities may require pumping of water into fish-bearing streams.
Water Quality Guidelines for the Protection of Aquatic Life (CCME 2003)	CCME	These guidelines are intended to protect water values, including: aquatic life, wildlife and their habitats, drinking water sources, agriculture (livestock watering and irrigation); and recreation. In addition, CCME provides the basis for the evaluation of ambient water quality and environmental impact assessments to inform resource management decisions.	Project activities have the potential to result in changes in water quality.

Policy/Bylaw	Responsible Agency	Relevant Aspects	Applicability to the Project
Provincial			
Guidance for Applications or Notifications for Changes in and about a Stream under the WSA in the South Coast Region	FOR	This guide helps applicants determine when a Change Approval or Notification of Authorized Change may be required, and what information may be needed to support submissions, including: • potential for impacts on fish and wildlife that depend on the natural stream environment) • any best management practices or mitigation measures that could offset impacts • potential for impact on public safety, land and property, such as riparian land • other legal requirements, including assessing potential effects on First Nations' interests	Project activities may require notifications or applications under the WSA for changes in and about watercourses.
Guidelines for Amphibian and Reptile Conservation During Urban and Rural Land Development in British Columbia	FOR	This guide supports environmental stewardship by helping to protect amphibians and reptiles and their habitats during land development. The guide is based on science, experience and the leadership of many local governments and developers to create sustainable communities and developments.	Project activities may overlap with amphibian and reptile habitats.
Standards and Best Practices for Instream Works	FOR	This document sets out provincial standards and recommended best practices for the planning, design and construction of instream projects, in keeping with provincial legislation.	Project activities may involve instream works.
Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture	ENV	These guidelines provide policy direction and supports regulatory decisions affecting water quality. It can be used to determine allowable water quality levels to protect aquatic life and wildlife.	Project activities may require work in and around streams.
Municipal[34]			
Surrey Zoning By-Law No. 12000 - Part 7A Streamside Protection	City of Surrey	This bylaw establishes streamside protection areas (SPEAs) – between the stream and the top of bank – in which construction and post-construction access for development projects is prohibited, except as permitted by the City of Surrey. The bylaw specifies riparian streamside protection widths based on fish presence, seasonal use by fish, the food and nutrient value of a stream to downstream fish habitats and fish classification of each watercourse (**Table 10-10**).	Project activities will occur within SPEAs of local watercourses.
Surrey Erosion and Sediment Control By-law No. 16138	City of Surrey	This bylaw is intended to protect the city's drainage system during construction, through mandated erosion and sediment control (ESC) measures. ESC permits are required prior to the start of any proposed construction footprints of over 2,000 m^2. For permitted works, no sediment or sediment-laden water shall be discharged with total suspended solid concentrations greater than 75 milligrams per litre (mg/L) or as otherwise permitted.	Project activities may mobilize sediments to the City's drainage system.
Surrey Stormwater Drainage Regulation and Charges By-law	City of Surrey	This bylaw prohibits the fouling, obstruction, or impeding of flow of any stream, creek waterway, watercourse, ditch, or stormwater drainage system.	Project activities may affect flows in local watercourses.

[34] Note that no watercourses occur in the Project study area in the Township of Langley and City of Langley, therefore no bylaws are listed for these municipalities.

10.2 Baseline Conditions

This section describes methods and results of the baseline assessment in the Project study area for fisheries and aquatic resources. Information was collected through desktop analysis and field surveys to characterize existing fish and fish habitat within watercourses that could be affected by the Project.

10.2.1 Methods

10.2.1.1 Literature Review

Fish and fish habitat information for potentially affected watercourses was compiled from publicly available reports, provincial and federal databases, and available spatial data. Information collected during desktop analysis was used to inform the scope of field surveys and included:

- Known fish distributions;
- Fish species present at the time of surveys;
- Fish habitat characteristics, including instream and riparian habitats;
- *In situ* water quality parameters, indicating aquatic health; and
- Locations of barriers to fish passage.

Available reporting and databases used for the desktop analysis included the following:

- BC Conservation Data Centre (CDC). 2019. BC Species and Ecosystems Explorer. BC CDC; BC Ministry of Environment, Victoria, BC. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed July 2019.
- Canadian Council of Ministers of the Environment (CCME). 2003. Canadian Water Quality Guidelines for the Protection of Aquatic life. Available at http://ceqg-rcqe.ccme.ca/en/index.html. Accessed August 2019.
- COSMOS. 2019. Available at http://cosmos.surrey.ca/. Accessed July 2019.
- DataBC. 2019. iMapBC 2. Available at http://maps.gov.bc.ca/ess/hm/imap4m/. Accessed May 2019.
- Ministry of Environment and Climate Change Strategy (ENV). 2017a. BC Ecocat Ecological Reports Catalogue. Available at https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/libraries-publication-catalogues/ecocat. Accessed July 2019.
- ENV. 2017. Fisheries Information Species Summary. https://cmnmaps.ca/DFO_FISS/. Accessed July 2019.
- ENV. 2018. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Available at https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf. Accessed August 2019.
- ENV. 2019. BC Water Quality Guidelines. Available at https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines. Accessed August 2019.
- Stantec. 2017. South of Fraser Rapid Transit: Fisheries and Aquatic Technical Report – Stage 3.

10.2.1.2 Field Studies

Using the complied desktop information, each identified watercourse that was deemed to have a potential interaction with the Project was further evaluated by an AQP during four site visits between April and October 2019 (**Figure 10-2**, **Appendix F**: Fisheries and Aquatics Figures). Site-specific data were collected from each potentially affected Class A, A(O), and B watercourse in Surrey. No watercourses in the Township of Langley or City of Langley have potential to interact with the Project. These habitat assessments were completed during low flows, since low flows facilitate observations and evaluations of key habitat features (e.g., substrates, residual pool depth, bank features) that would otherwise be obscured during periods of high flow. Watercourses with high habitat value, and for which Project-related effects are more likely, were visited on several occasions to observe stream conditions at varying flow levels. Class C watercourses were also visited during the baseline assessment to confirm desktop information. The City of Surrey's classifications of Class C watercourses in the Project area (i.e., not fish bearing and not providing significant food or nutrients downstream) were consistent with Hemmera field observations.

Visits to watercourses with high habitat value, and for which Project-related effects are more likely, took place in several seasons to observe stream conditions at varying flow levels. The sites and timing of field visits are summarized below:

- Lay Creek (Site 1) – April and July 2019 (identified as Quibble Creek on the City of Surrey Mapping Online System (City of Surrey 2021);
- Tributary to Lay Creek (Sites 3) – April, June, July, and October 2019 (referred to as Quibble Creek on (City of Surrey 2021);
- Tributary to Lay Creek (Site 3.5) – April, June, July, and October 2019;
- Tributary to Lay Creek (Site 4) – April, June, July, and October 2019;
- Tributary to Lay Creek (Site 5) – April, June, July, and October 2019;
- King Creek (Site 7) – April, June, and July 2019;
- Enver Creek (Site 11) – April, June, and July 2019; and
- North Creek (Site 42 and 43) – April, June, and July 2019.

Hemmera AQPs also visited an unclassified ditch that parallels to the north edge of the ROW along Fraser Highway between 148 Street and 96 Avenue several times in 2019, 2020, and 2021. Based on poor connectivity to downstream fish habitat (tributary to Lay Creek), Hemmera recommended classification of the latter ditch as a Class C watercourse.

10.2.2 Assessment/Interpretation

All watercourses within the study area are located in the Serpentine River watershed. The Serpentine River drains an area of approximately 144 km^2 and flows from its origin near 160 Street and 104 Avenue in Surrey to Mud Bay near its crossing of Highway 99. The Serpentine River watershed supports more than 25 species of fish and is a major drainage that supports salmon (Government of BC 2018b). Nine of these fish species are actively fished as part of a fishery, and the other 16 species support those fisheries (**Table 10-4**). Coastal cutthroat trout (*Oncorhynchus clarkii clarkii)* is provincially Blue-listed (special concern). White sturgeon (*Acipenser transmontanus*) is provincially Red-listed and likely only present in the lower Serpentine, rather than in the Project study area. None of the species are listed on the *Species at Risk Act* (SARA) Schedule 1 (Government of BC 2019a).

Table 10-4 Fish Species Present in Project Area Watersheds (BC MOE 2019)

Common Name	Scientific Name	Provincial Status[1]	SARA Status[1]
Species part of an Active Fishery			
Chinook salmon	*Oncorhynchus tshawytscha*	Yellow	None
Chum salmon	*Oncorhynchus keta*	Yellow	None
Coastal cutthroat trout	*Oncorhynchus clarkii*	Blue	None
Coho salmon	*Oncorhynchus kisutch*	Yellow	None
Dolly Varden	*Salvelinus malma*	Yellow	None
Pink salmon	*Oncorhynchus gorbuscha*	Yellow	None
Rainbow trout	*Oncorhynchus mykiss*	Yellow	None
Sockeye salmon	*Oncorhynchus nerka*	Yellow	None
Steelhead salmon	*Oncorhynchus mykiss*	Yellow	None
Other Fish Species			
American shad	*Alosa sapdissima*	Exotic	None
Black crappie	*Pomoxis nigromaculatus*	Exotic	None
Brassy minnow	*Hybognathis hankinsoni*	Blue	None
Brown catfish	*Ameiurus nebulosus*	Exotic	None
Coastrange sculpin	*Cottus aleuticus*	Yellow	None
Common goldfish	*Carassius auratus*	Exotic	None
Fathead minnow	*Pimephales promelus*	Exotic	None
Peamouth chub	*Mylocheilus caurinus*	Yellow	None
Prickly sculpin	*Cottus asper*	Yellow	None
Pumpkinseed	*Lepomis gibbosus*	Exotic	None
Redside shiner	*Richardsonius balteatus*	Yellow	None
River lamprey	*Lampetra ayresi*	Yellow	None
Threespine stickleback	*Gasterosteus aculeatus*	Yellow	None
Western brook lamprey	*Lampetra richardsonii*	Yellow	None
White sturgeon	*Acipenser transmontanus*	Red	None
Yellow perch	*Perca flavescens*	Exotic	None

Notes:

[1] Red-listed (BC List Status) – species that have extirpated, endangered, or threatened status in BC.

Blue-listed (BC List Status) – species of special concern in BC (having characteristics that make them particularly sensitive or vulnerable to human activities).

Yellow-listed (BC List Status) – species that are not at risk of extinction.

Exotic (BC List Status) – species that have moved beyond their natural range; introduced species.

The study area intersects with several named sub-drainages of the Serpentine River, including Lay Creek, Quibble Creek, King Creek, Enver Creek, and North Creek, all located in the City of Surrey (**Figure F10-1**, **Appendix F**: Fisheries and Aquatics Figures).[35] According to the City of Surrey's fish classification system[36], as represented in COSMOS and as confirmed with site visits by AQPs, the 44 watercourses in the Project study area were classified as follows:

- Six watercourses were classified as supporting fish year-round (fish class A).
- Fourteen watercourses were classified as providing or potentially providing overwintering habitat for fish species (fish class A(O)).
- Eight watercourses were classified as not fish bearing but are a source of significant food or nutrients for downstream watercourses (fish class B).
- Fifteen watercourses were classified as not fish bearing and not providing significant food or nutrients to downstream watercourses (fish class C).

Results of field surveys on Class A, A(O) and B watercourses are summarized in **Table 10-5**. Results of electrofishing and minnow trap sampling in Class A, A(O) and B watercourses are summarized in **Table 10-6**.

35 Baldi Creek is situated in the City of Langley east of 200 Street more than 100 m south of the SLS alignment (see **Section 13** for more information). Daylighted portions of Baldi Creek are located outside of the study area for fisheries and aquatics, therefore it is not considered further in this section of the ESR.

36 Note that the City of Surrey classification system is based on the presence of salmonids. For the federal *Fisheries Act*, streams containing any fish are considered fish-bearing.

Table 10-5 Summary of Habitat Survey Results in Class A, A(O), and B Watercourses

Site ID	Watercourse Name[1]	Watershed Code	Watercourse Type	Surrey Stream Class	Mean Channel Width (m)	Mean Wetted Width (m)	Mean Gradient (%)	Dominant Substrate[2]	Temperature (°C)	pH	DO (mg/L)	Conductivity (uS/cm)[3]	Comments
1	Lay Creek	900-005500-48100-75000-6220	Natural stream	A	4.2	2.9	2.0	G	16.5	6.7	4.5	386	Tributary to Quibble Creek crossing Fraser Highway at terminus of existing SkyTrain track. Watercourse is confined by concrete retaining walls. Abundant anthropogenic debris in Creek (e.g., shopping carts, containers, garbage).
2	Tributary to Quibble Creek		Natural stream	B	0.0	0.0	0.0	-	-	-	-	-	Engineered swale ~40 m from Fraser Highway. Flows into tributary to Quibble Creek ~ 20 m downstream.
3	Tributary to Lay Creek	900-005500-48100-75000-6220-4430	Natural stream	A(O)	3.9	0.0	2.3	G	-	-	-	-	Dry at time of habitat survey; was flowing in April 2019. Some small isolated wet patches. Difficult fish passage at both upstream and downstream ends of culvert beneath Fraser Highway.
3.5	Tributary to Lay Creek	-	Channelized stream	A(O)	1.5	0.0	0.5	O	-	-	-	-	Small tributary flowing into Site 3 from the east ~7 m upstream of the Fraser Highway culvert. The reach is short, straight, and low-gradient (~10 m long) that provides good access and rearing habitat for fish.
4	Tributary to Lay Creek	-	Ditch	B	2.2	0.0	10.5	F	-	-	-	-	Dry channel from pipe alongside Fraser Highway. Short, low-gradient section (~20 m length) with steeper armoured section immediately downstream of pipe. Would provide habitat in low-gradient section for any fish in Site 3 watercourse.
5	Tributary to Lay Creek	-	Ditch	Unclassified (Recommended C)	1.5	0.0	1.0	O	-	-	-	-	Ditch alongside Fraser Highway that flows into Site 4 tributary. Limited evidence of flows or scour.
7	King Creek	-	Natural stream	A	1.7	1.0	1.8	F	15.0	6.8	7.3	179	Flowing watercourse with salmonids present at time of survey.
9	Un-named ditch	-	Ditch	B	1.0	0.0	1.0	O	-	-	-	-	Dry ditch running from north to south along west side of 144 Street.
10	Un-named ditch	-	Ditch	B	0.8	0.0	1.0	O	-	-	-	-	Dry ditch running from north to south along east side of 144 Street.
11	Enver Creek	-	Channelized stream	B	1.8	0.0	1.5	O	-	-	-	-	Dry, poorly defined channel. Was flowing in April 2020.
12	Un-named watercourse	-	Channelized stream	B	2.2	0.5	1.5	F	15.2	5.8	1.6	284	Dry channel with isolated ponded sections. Poor water quality. DO <2.0 mg/L at time of survey, which lacked minimum requirements to support fish. Channel becomes poorly defined in wetland area ~20 m upstream of Fraser Highway.
15	Tributary to Serpentine River	-	Ditch	A(O)	1.4	0.3	0.5	O	16	6.9	0.14	606	Ditch completely filled with vegetation. Stagnant, very shallow water with sheen below matted vegetation. Very poor water quality.
16	Un-named pond	-	Pond	A(O)	0	0	0		20.6	7.07	7.6	950	Pond on Surrey Golf Course.
17	Tributary to Serpentine River	-	Ditch	A(O)	4.5	2	0.5	O	15.1	6.38	0.42	217.6	Ditch completely vegetated. Flow beneath matted vegetation.
19	Tributary to Serpentine River	900-005500-57500-68700	Ditch	A(O)	2.6	1.1	0.5	F	19.7	6.6	7	585	Ditch flowing east toward Fraser Highway on Fraser Golf Course.
20	Tributary to Serpentine River	-	Pond	A(O)	0	0	0	-	19.8	7.07	6.94	875	Pond on Surrey Golf Course.
21	Serpentine River	900-005500	Natural stream	A	-	-	-	-	-	-	-	-	Ditch flowing west along the north side of Fraser Highway near 180 Street.

Site ID	Watercourse Name[1]	Watershed Code	Watercourse Type	Surrey Stream Class	Mean Channel Width (m)	Mean Wetted Width (m)	Mean Gradient (%)	Dominant Substrate[2]	Temperature (°C)	pH	DO (mg/L)	Conductivity (uS/cm)[3]	Comments
23	LawDitch Creek	900-005500-62900	Ditch	A(O)	8	8	0.5	F	21	6.78	7.31	632	Very wide ditch paralleling north side of Fraser Highway east of the Serpentine River.
25	Tributary to Serpentine River	-	Ditch	A(O)	2	1	0.5	O	16.8	6.18	0.29	804	Ditch completely overgrown with instream vegetation. Sheen of water at bottom of ditch. Too shallow for fishing. Very poor water quality.
26	Tributary to Serpentine River	-	Ditch	A(O)	1	0	0.5	O	-	-	-	-	Ditch completely overgrown with instream vegetation. No sign of scour.
27	Tributary to Serpentine River	900-005500-60600-43100	Ditch	A(O)	1	0	0.5	O	-	-	-	-	Ditch completely overgrown with instream vegetation. No sign of scour.
28	Tributary to Serpentine River	-	Ditch	A(O)	0	0	0	-	-	-	-	-	Dry ditch with little evidence of flow. Wetted area with grasses.
29	Tributary to Serpentine River	900-005500-62900-11300	Ditch	A(O)	1.8	0.6	0.5	O	17.3	5.98	0.46	743	Ditch completely overgrown with instream vegetation. Shallow water running through vegetation. Very poor water quality.
29A	Tributary to Serpentine River	-	Ditch	A(O)	0.3	0.1	0.5	O	14.8	6.44	4.2	324	Dry ditch flowing north into Site 30 ditch from the south. Dry and completely choked with vegetation. No evidence of scour. Standing water.
30	Tributary to Serpentine River	-	Ditch	A(O)	0.8	0	0.5	O	-	-	-	-	Dry ditch along south side of Fraser highway. Completely vegetated.
31	Tributary to Serpentine River	-	Ditch	A(O)	2.5	2.5	0.5	O	14.7	6.58	4.45	336	Ditch paralleling north side of Fraser highway. Not flowing at time of survey.
31A	Tributary to Serpentine River	-	Ditch	A(O)	2.8	2.8	0.5	O	14.7	6.58	4.45	336	Ditch paralleling east side of Harvie Road. Not flowing at time of survey.
34	Tributary to Serpentine River	-	Ditch	B	-	-	-	-	-	-	-	-	Ditch paralleling north side of Fraser highway. Not flowing at time of survey.
42/43	North Creek	900-05500-62900-11300	Natural stream	A – south of Fraser Highway / B – north of Fraser Highway	4.45/2.0	2.7/1.5	3/1.5	R/F	18.1/18.4	6.93/7.06	8.98/6.89	350/278	Downstream (south) of Fraser Highway, the watercourse is primarily bedrock streambed downstream of two concrete stepped pool structures below culvert outfall. Fish abundant in concrete pool structures. Culvert and drainage structures downstream of Fraser Highway are barriers to fish passage.

Notes:

1. Watercourse names as listed on 1:20,000 TRIM maps.
2. Substrate codes: O = organics; F = fines; G = Gravel; C = cobbles; B = boulder; R = bedrock
3. uS/cm = microsiemens per centimetre

Table 10-6 Summary of Electrofishing and Minnow Trap Sampling in Class A, A(O), and B Watercourses – July 2019[1]

Site ID	Watercourse Name/ Class	Method[1]	Location of Sampling in Relation to Fraser Highway	Surrey Zoning By-Law Streamside Setback	Species	Count	Length Range (mm)	CPUE[2]
1	Lay Creek (A)	EF	Downstream	Natural	Coho salmon	2	68-70	0.0094
					Cutthroat trout	2	160-190	0.0094
					Threespine stickleback	15	30-51	0.0708
		EF	Upstream	Natural	No fish captured	0	-	0.0000
7	King Creek (A)	EF	Downstream	Natural	Coho salmon	2	68-70	0.0068
					Cutthroat trout	2	160-190	0.0068
					Threespine stickleback	15	30-50	0.0510
		EF	Upstream	Natural	No fish captured	0	-	0.0000
16	Un-named pond (A[O])	MT	Not applicable	Channelized	Brassy minnow	1	80-80	0.0429
					Brown catfish	1	85-85	0.0429
					Pumpkinseed fish	1	87-87	0.0429
					Redside shiner	2	62-62	0.0857
19	Tributary to Serpentine River (A[O])	MT	Not applicable	Channelized	Brassy minnow	1	69-69	0.0412
					Pumpkinseed fish	10	52-63	0.4124
20	Tributary to Serpentine River (A[O])	MT	Not applicable	Channelized	Brassy minnow	1	70-70	0.0403
					Pumpkinseed fish	12	-	0.4832
					Redside shiner	2	50-58	0.0805
					Oriental weatherfish	1	145-145	0.0403
23	Law Ditch Creek (A[O])	MT	Not applicable	Ditch	Pumpkinseed fish	73	40-75	2.9007
					Threespine stickleback	89	30-85	3.5364
31	Tributary to Serpentine River (A[O])	MT	Not applicable	Ditch	Threespine stickleback	10	32-65	0.4027
31A	Tributary to Serpentine River (A[O])	MT	Not applicable	Ditch	Threespine stickleback	80	29-67	3.2215
42	North Creek (A)	EF	Downstream	Natural	Cutthroat trout	22	145-265	0.0634
43	North Creek (B)	EF	Upstream	Natural	No fish captured	0	-	0.0000
Total Fish Captured						**344**		

Notes:

1. EF = electrofishing; MT = minnow trapping
2. Catch per unit effort = fish per second for electrofishing; fish per trap-hour for minnow trapping

10.2.2.1 Fish Habitat Descriptions

This section summarizes fish presence and fish habitat information in Class A, A(O), and B watercourses from historical and field surveys in the Project study area.

Class A Watercourses

Lay Creek (WSC 900-005500-4810075000-6220; Site 1)

Lay Creek crosses Fraser Highway at 138 Street (**Figure F10-1, Appendix F**: Fisheries and Aquatics Figures). Historical surveys have identified coho salmon and threespine stickleback in Lay Creek. Good cover for fish was primarily through overhanging vegetation and undercut banks with occasional large woody debris. Good flows and adequate substrates provide moderate to good spawning opportunities for salmonid species.

Upstream of Fraser Highway, the channel contained large amounts of anthropogenic debris (e.g., shopping carts, lawn chairs, metal containers). At low water levels, the culvert beneath Fraser Highway may pose a barrier to fish passage. No fish were captured upstream of the culvert. Environmental deoxyribonucleic acid[37] (eDNA) sampling using a general primer for salmonids did, however, confirm fish presence upstream of Fraser Highway.

Small pools, particularly downstream of Fraser Highway, afford good overwintering and rearing habitat. Coho salmon and cutthroat trout were captured downstream of the culvert during electrofishing sampling.

King Creek (Site 7)

King Creek flows beneath Fraser Highway approximately 100 m west of 144 Street (**Figure F10-1, Appendix F**: Fisheries and Aquatics Figures). Good cover for fish was mainly provided by overhanging vegetation with some large woody debris and undercut banks downstream of Fraser Highway. The culvert beneath Fraser Highway likely inhibits fish passage upstream during low water levels.

The predominance of fines limits spawning opportunities for salmonids in this reach. Good cover and some shallow pools provide moderate rearing and overwintering habitat for fish. Coho salmon, cutthroat trout, and threespine stickleback were observed or captured downstream of Fraser Highway during field surveys; eDNA sampling confirmed salmonid presence upstream of Fraser Highway in King Creek.

North Creek (Site 42 and 43)

North Creek crosses Fraser Highway immediately east of 184 Street **(Figure F10-1, Appendix F**: Fisheries and Aquatics Figures). Historical observations of coho salmon, cutthroat trout, rainbow trout, redside shiner, and threespine stickleback have been recorded in the creek downstream of Fraser Highway, and cutthroat trout have been recorded upstream of Fraser Highway. The City of Surrey fish classification system records North Creek as Class A downstream of Fraser Highway and Class B upstream.

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[37] eDNA sampling is a non-invasive sampling method to determine the presence of aquatic and semi-aquatic wildlife species and followed the protocol as described in *Standard Operating Procedure, Environmental DNA Protocol for Freshwater Aquatic Ecosystems* (Hobbs et al. 2017).

Downstream of Fraser Highway, the substrates were predominantly bedrock with most fines in three concrete pool structures immediately below the culvert. Numerous cutthroat trout were captured or observed in these pool structures, and no fish were captured or observed upstream of Fraser Highway; however, eDNA sampling suggested the presence of salmonids upstream of the culvert.

North Creek provides rearing and overwintering habitat for salmonids primarily in the concrete pools downstream of Fraser Highway. The abundance of fines upstream and the predominance of bedrock downstream of the pools limits spawning habitat availability for salmonids.

Class A(O) Watercourses

Tributary to Lay Creek (WSC 900-005500-4810075000-6220-4430; Site 3)

This tributary to Lay Creek crosses Fraser Highway immediately east of 140 Street (**Figure F10-1, Appendix F**: Fisheries and Aquatics Figures)[38]. Overhanging vegetation and large woody debris mainly provides the moderate fish cover. The wide channel with larger substrates (gravel/cobble) indicates that the watercourse is likely flashy due to storm events, with large flows immediately following these events. Flows are likely limited to none during dry periods. The culvert beneath Fraser Highway presents a barrier to fish passage; at its inlet, the culvert has a 0.5 m to 0.8 m drop over a concrete retaining wall into the culvert. The outlet is perched, also presenting a significant barrier to fish passage.

The seasonal flashiness of flows in this watercourse may limit spawning opportunities for salmonids. During wet periods, the watercourse may provide adequate rearing and overwintering opportunities for fish in pools downstream of the culvert beneath Fraser Highway and in a short tributary that flows into the main channel from the east, immediately upstream of Fraser Highway.

A small tributary (Site 3.5) flows into the mainstem from the east approximately 7 m upstream of the Fraser Highway culvert. The tributary comprises a short, straight, low-gradient section (approximately 10 m long) that provides good access and rearing habitat for fish. This short section is fed by two tributaries originating from parallel ditches that flow along the north side of Fraser Highway. Each of these ditches flow through 30 m-long culverts and form short, steep channels immediately upstream from the low-gradient, fish-bearing section downstream. Fish access to the ditches is limited by the steep (20% to 45%) gradients of their lower sections, and intermittent, low flows. Limited scour and the presence of instream vegetation and intact organic soil layers indicate that flows are restricted and likely occur only during high-precipitation events. Recommended classification for these watercourses is red-coded for the short, low-gradient section that directly enters the mainstem. For the tributaries that feed into the low-gradient section the recommended classification is as follows:

- Yellow-coded (Class B) for the southern ditch that parallels Fraser Highway; and
- Green-coded (Class C) for the northern ditch that parallels the ROW[39.]

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[38] At the time of habitat surveys, the watercourse was dry with small pools of standing water downstream of Fraser Highway. The watercourse was also dry during a site visit in early May 2019 but flowing in October 2019.

[39] This watercourse has been unclassified in the COMSOS database and was evaluated by Hemmera for Class B or C categorization. For the purposes of this report, the ditch is considered as Class C for the following reasons:

- It was not wetted during site visits during spring and summer 2019 and spring 2020; and
- It has sections of steep gradient (15-25%) that would limit fish access.

Ditches Flowing Directly into the Serpentine River (Sites 15–20 and sites 22–33)

Numerous ditches flowing along Fraser Highway and Highway 15 flow directly into the Serpentine River (**Figure F10-1, Appendix F**: Fisheries and Aquatics Figures). Fish access to these ditches is limited by flap gates and flood control structures that connect these ditches to the Serpentine mainstem. At the times of survey, these ditches were not flowing and were primarily dry with isolated pools. Fish sampling took place where water depths permitted. The only fish present were warm water species (e.g., minnows, shiners) and invasive species (**Table 10-8**). No salmonids were captured.

In February 2022, a site visit took place to gather further details on the ditch flowing northeast along the south side of Fraser Highway into the Serpentine River (Site 24), as it is adjacent to a proposed PPS location. During the site visit, much of the ditch and adjacent field was flooded due to high precipitation. The ditch itself has limited scour and constitutes a shallow swale for most of its length. The ditch flows through a culvert beneath a berm to the east of the Serpentine River dike. Between the berm and the Serpentine River dike, there was a small, ponded area with a dilapidated building (pump house) next to the dike. Minimal flow (turbid) was entering the pond from the culvert beneath the berm draining the flooded field. Two pipes appear to drain the flow from the ponded area. The pipes have flaps at the downstream end which prevent fish from the Serpentine River from entering the pipes. At observed water levels, the pipes were perched 0.5–0.75 m above the surface of the Serpentine River.

Class B Watercourses

Class B watercourses do not contain fish but provide flows and food and nutrient inputs to downstream fish-bearing waters. Six Class B watercourses are present in the Project study area.

A Class B watercourse that flows west along the north side of Fraser Highway between 140 Street and 96 Avenue will be directly affected by the permanent and temporary Project footprint (**Figure F10-1, Appendix F**: Fisheries and Aquatics Figures). (City of Surrey 2021). Site visits confirmed that this watercourse seasonally connects to downstream fish-bearing waters; however, obstructions prevent fish access upstream (e.g., rooted vegetation and organic debris). In addition, the lower end of the channel has sections of steep gradients (15% to 25%) with limited scour or evidence of flows that would prevent fish from accessing the ditches.

10.2.2.1 Fish and Fish Habitat Summary

Table 10-7 provides a summary of the fish and fish habitat baseline information for all fish-bearing or potentially fish-bearing watercourses potentially affected by the Project.

Table 10-7 Fish and Fish Habitat Summary for Fish-bearing Watercourses

Site ID	Watercourse Name	Surrey Stream Class	Fish Species Historically Present	Captured Fish Species	Dates of Sampling
1	Lay Creek	A	CO, TSB	CO, CT, TSB	April 3–4, 2019
3	Tributary to Lay Creek	A(O)	NR	None	April 3–4, 2019
3.5	Tributary to Lay Creek	A (O)	NR	Not sampled	Not sampled
7	King Creek	A	RB	CO, CT, TSB	April 3–4, 2019

Site ID	Watercourse Name	Surrey Stream Class	Fish Species Historically Present	Captured Fish Species	Dates of Sampling
15	Tributary to Serpentine River	A(O)	NR	Not sampled	Not sampled
16	Un-named pond	A(O)	NR	BMC, BNH, PMB, RSC	April 3–4, 2019
17	Tributary to Serpentine River	A(O)	PMB, TSB	Not sampled	Not sampled
19	Tributary to Serpentine River	A(O)	NR	BMC, PMB	April 3–4, 2019
20	Tributary to Serpentine River	A(O)	NR	BMC, PMB, RSC, Oriental weatherfish	April 3–4, 2019
21	Serpentine River	A	BCB, BMC, BNH, CH, CM, CT, CAL, CO, FM, GC, L, PCC, PK, CAS, PMB, RB, RSC, SK, SFL, ST, TSB, BL, WCT, YP	Not sampled	Not sampled
23	Law Ditch Creek	A(O)	TSB	PMB, TSB	April 3–4, 2019
25	Tributary to Serpentine River	A(O)	TSB	Not sampled	Not sampled
26	Tributary to Serpentine River	A(O)	TSB	Not sampled	Not sampled
27	Tributary to Serpentine River	A(O)	NR	Not sampled	Not sampled
28	Tributary to Serpentine River	A(O)	NR	Not sampled	Not sampled
29	Tributary to Serpentine River	A(O)	RSC, TSB	Not sampled	Not sampled
29A	Tributary to Serpentine River	A(O)	NR	Not sampled	Not sampled
30	Tributary to Serpentine River	A(O)	NR	Not sampled	Not sampled
31	Tributary to Serpentine River	A(O)	BMC, CO, CT, RB, RSC, PL, TSB	TSB	April 3–4, 2019
31A	Tributary to Serpentine River	A(O)	NR	TSB	April 3–-4, 2019
42/43	North Creek	A	CO, CT, RB, RSC, TSB	CT	April 3–4, 2019

Notes:

Fish Species Codes: BCB = black crappie; BMC = brassy minnow; BL = western brook lamprey; BNH = brown catfish; CAL = coastrange sculpin; CAS = prickly sculpin; CH = chinook; CM = chum; CO = coho; CT = cutthroat trout; FM = fathead minnow; GC = goldfish; L = lamprey; PCC = peamouth chub; PK = pink salmon; PL = Pacific lamprey; PMB = pumpkinseed; RB = rainbow trout; RSC = redside shiner; SK = sockeye salmon; SFL = starry flounder; ST = steelhead; TSB = threespine stickleback; WCT = westslope cutthroat trout; YP = yellow perch; NR = no records.

10.3 Project Interactions

Potential interactions between the fisheries and aquatics SE and the proposed Project activities and physical works are outlined in **Table 10-8**.

Table 10-8 Potential Project Interactions with Fisheries and Aquatics

Project Activities and Works	Changes in Fish Habitat	Changes in Fish Mortality/Health
Construction		
Clearing and grubbing	✓	✓
Property acquisition (including demolition)	-	-
Relocation of overhead BC Hydro transmission lines	-	-
Utility installation/relocation	o	o
Use of temporary laydown areas	o	o
Access and traffic management	-	-
Road widening (select locations)	o	o
Drainage realignment	✓	✓
Installation of guideway foundations	o	o
Installation of overhead SkyTrain guideway	-	-
Station at 140 Street (foundations, structure, lighting, access, service connections, security),	✓	✓
PPS	-	-
Management of non-contaminated excavated material	o	o
Management of contaminated or hazardous materials	o	o
Testing, commissioning, and start-up	-	-
Operation		
Operation of the Project	o	o
Maintenance of the Project	-	-

Notes:

Interaction Rating:

– **No interaction:** where interaction between a Project component and SE is not likely.

o **Minor interaction:** where impacts may result from an interaction, but standard measures to avoid or minimize the impact are available and well understood to be effective, and any residual effects would be reduced to negligible. Interaction is not discussed further.

✓ **Interaction:** where an interaction occurs and likely requires additional mitigation. Carried forward and discussed in subsequent sections. Project activities associated with property acquisition, utility installation/relocation, access and traffic management, PPS, commissioning and start-up, and operation are not anticipated to interact with fish and fish habitat. These activities either do not represent a physical disturbance or are located a minimum of 50 m from any watercourses, and therefore will not have any effect on instream or riparian fish habitat associated with local watercourses.

10.4 Potential Project Effects to Fish and Fish Habitat

This section assesses potential effects on fisheries and aquatics SE during the construction and operation phases of the Project that could remain after the application of environmental best practices. Activities that occur during construction have the greatest potential to affect fisheries and aquatics SE. Construction works in riparian and instream areas may physically alter or remove important aquatic habitat and alter the composition and function of fish habitat. Potential effects identified in the review of interactions with fisheries and aquatics SE are listed below, and each effect is discussed in the following subsections.

Content from this section will be incorporated into the CEMP Framework (see the TOR for additional description of this document). The Project's CEMP Framework document will provide detailed guidance for the content of the Project Co's CEMP. In addition to mitigation and performance objectives, the CEMP Framework will describe best practices that will help to meet the performance objectives and required content for each sub-plan. The CEMP Framework will also include details on roles and responsibilities for Project Co's key team members.

Since the proposed Project footprint generally follows the alignment of Fraser Highway, most of the construction footprint near watercourses and riparian areas will be located within the boundaries of the existing roadways (i.e., ROW). Activities that extend beyond the existing boundaries of roadways, including clearing and grubbing for infrastructure and temporary workspace, road widening, upgrading culverts, and realigning drainage, have the greatest potential to adversely affect fish habitat following implementation of mitigation measures discussed below.

10.4.1 Assessment Methods

The assessment focused on the potential adverse effects on the fisheries and aquatics SE, and possible design and mitigation measures to prevent a HADD of fish habitat, death of fish, or encroachment upon streamside protection areas (SPEAs). In accordance with federal and provincial requirements, the following questions were considered for each of the identified watercourses:

1. Will construction activities result in a harmful alteration or loss of fish habitat?
2. Will construction activities result in the death of fish?
3. Will the Project design necessitate clearing or construction in SPEAs, as established by the City of Surrey's Zoning By-law and by the Riparian Area Protection Regulation?
4. Can potential effects be avoided through the implementation of mitigation measures?

Table 10-9 outlines the streamside protection widths identified in the bylaw, based on watercourse classification shown in COSMOS (City of Surrey 2021). These classifications follow the WSA and Riparian Areas Protection Regulation (RAPR) definitions of "stream," and the *Fisheries Act* definition of "fish habitat."

Table 10-9 COSMOS Fish Classification System and Streamside Protection Widths

Fish Classification	Colour Coding	Description	Setback From Top of Bank (m) Based on Stream Type		
			Natural	Channelized	Ditch
A	Red	Inhabited by salmonids year-round or potentially inhabited year-round with access enhancement	30	25	10
A(O)	Red-dashed	Inhabited by salmonids primarily during the overwintering period or potentially inhabited during the overwintering period with access enhancement	30	25	10
B	Yellow	Significant food/nutrient value; no fish presence	15	15	7
C	Green	Insignificant food/nutrient value; no fish presence	2	2	2

Project-related activities that can be undertaken in keeping with DFO's applicable "Measures to Avoid Causing Harm to Fish and Fish Habitat" are unlikely to result in adverse habitat effects or fish mortality. Project activities that remain outside of SPEAs are also unlikely to pose an issue. Mitigation measures outlined in **Section 10.5** are expected to limit or eliminate potential effects for many Project activities. Adverse effects discussed in the following section focus on those that remain after the application of mitigation measures.

10.4.2 Potential Project Effects to Fish Habitat

DFO Pathway of Effects (POE) diagrams are effective in identifying known cause-effect relationships between development activities and the stressors that can cause adverse effects on fish habitat (DFO 2018). Using these POE diagrams, the Project team identified the following mechanisms that may result in adverse changes in fish habitat:

- **Vegetation Clearing and Maintenance:** Riparian vegetation that is cleared for the Project can reduce available cover from predators, eliminate temperature-regulating shade, and decrease the amount of nutrient inputs into a watercourse that come from insect and leaf litter drop. Removal of riparian vegetation during construction can destabilize stream banks, resulting in increased erosion and sedimentation into watercourses. Vegetation maintenance activities, such as trimming, removing understorey, and managing invasive species will occur during Project operation and could affect riparian areas.
- **Fish Passage:** Instream works associated with the Project may cause temporary physical impediments to fish movement or migration within the study area. Fish may become entrained through pump intakes during watercourse dewatering and isolation, and alterations in water depth and flow may temporarily disrupt fish access to important habitats.
- **Use of Heavy Equipment:** The use of heavy equipment within riparian areas (e.g., for clearing and grubbing) can reduce bank stability and increase erosion potential, resulting in disruption of important fish habitat. Heavy equipment in or adjacent to watercourses can result in the discharge oil, grease, and fuel into a watercourse, increasing contaminant concentrations. Use of heavy equipment instream can alter habitat structure and reduce its capacity to support fish.

- **Grading:** Grubbing, stripping, and grading in riparian areas adjacent to watercourses can reduce the quality and quantity of habitat structure and cover and increase the potential for erosion and sediment transport.
- **Excavation:** Instream excavation to accommodate road works, culvert upgrades, and drainage realignment can alter or remove instream habitat that directly and indirectly supports fish populations. Poor source and erosion control during excavation in upland areas can result in increased sedimentation into watercourses. High volumes of sediment can degrade fish habitat by infilling interstitial spaces in spawning gravels, covering gravels that are important for invertebrate production, or infilling pools that are important wintering habitats. Deposited sediments that penetrate greater than 1 cm into the substrates or infill more than 33% of the dominant substrate will not readily flush with smaller, commonly occurring storm flows (Anderson 1996; Waters 1995).
- **Placement of Material or Structures in or over Water:** Construction of bridges over streams can result in shading and changes in instream water temperature, riparian water temperature, and the amount of light available for photosynthesis which can alter aquatic productivity and riparian vegetation composition and abundance.

Direct effects in Class A, A(O) and B streams are likely to occur from the following construction activities:

- Clearing and grubbing within SPEAs required to accommodate the 140 Street Station, associated portions of the guideway, and utility works;
- Relocation or other changes to ditches, watercourses to accommodate the 140 Street Station, associated portions of the guideway, and utility works; and
- Structures constructed instream or within the SPEA of Serpentine River and tributaries to accommodate guideway and PPS structures.

The RCD was used as a basis to overlay Project-related infrastructure and clearing on known watercourses. Potential loss or alteration of instream habitat were then calculated based on the permanent and temporary footprints resulting from Project-related infrastructure and clearing. There are no predicted losses to instream habitat. The area of riparian habitat loss was estimated by overlaying the Project footprint with the mapped widths of the SPEAs for each affected watercourse. **Table 10-10** provides the estimated temporary and permanent changes to riparian habitat resulting from Project construction, based on the RCD. This estimate will be refined as the design progresses and is finalized. Where habitat areas overlap between watercourses, the watercourse with the higher classification takes precedence (e.g., area overlaps between a Class A watercourse and a Class A(O) watercourse will be considered as Class A).

Table 10-10 Area of Potential Instream and Riparian Habitat Alteration by Watercourse

Watercourse	Site No.	Stream Class	Project Activity	Habitat Affected (m^2)[1,2]			
				Permanent		Temporary	
				Instream	Riparian	Instream	Riparian
Lay Creek (Quibble Creek)	1	A	Clearing for foundation and guideway construction	0	2	0	531
Tributary to Lay Creek	3, 4	A(O)	140 Street Station	0	187	0	0
Fraser Hwy ditch (140 Street to 96 Avenue)	5	B	Clearing for foundation and guideway construction	0	32	0	0
Ditch flowing southeast on south side of Fraser Hwy adjacent to Surrey Golf Course	15	A(O)	As above	0	0	0	215
Ditch flowing southeast into Serpentine River on north side of Fraser Hwy	17	A(O)	As above	0	0	0	248
Serpentine River3	21	A	As above	0	669	0	2,011
Ditch flowing northwest into Serpentine River on south side of Fraser Hwy	24, 25	A(O)	As above	0	759	0	915
Ditch flowing north toward Fraser Hwy on east side of Hwy 15	29	A(O)	As above	0	17	0	4
Channel flowing north southeast of Hwy 15/ Fraser Hwy intersection	4 30	A(O)	As above	0	446	0	1,152
Ditch flowing northwest toward Harvie Road on north side of Fraser Hwy	31, 34	A(O)/B	As above	0	20	0	2,010
Ditch flowing northwest toward Hwy 15 on south side of Fraser Hwy	30	A(O)	As above	0	104	0	952
North Creek	42	A	As above	0	0	0	3,112
North Creek	43	B	As above	0	17	0	751
			Totals	**0**	**2,253**	**0**	**11,900**

Notes:

1. Area of riparian disturbance is accounted for in clearing for foundation and guideway construction activity. Areas may change slightly with final design.
2. Area calculations based on setbacks defined in **Table 10-9.**
3. RCD crossing structure spans the wetted perimeter.

Total area of predicted effects on fish habitat is summarized in **Table 10-11**.

Table 10-11 Predicted Habitat Effects of the Project RCD by Stream Class

Stream Class	Permanently Affected (m^2)		Temporarily Affected (m^2)	
	Instream	Riparian	Instream	Riparian
A watercourses	0	671	0	5,654
A(O) watercourses	0	1,533	0	5,495
B watercourses	0	17	0	751
B ditches	0	32	0	0
Totals	**0**	**2,253**	**0**	**11,900**

10.4.3 Potential Project Changes in Fish Mortality/Health

The DFO's POE diagrams are effective to help identify known cause-effect relationships between development activities and stressors that can cause effects on fish mortality (Government of Canada 2019a). Using these POE diagrams, the Project team identified the following Project mechanisms that could result in changes to fish mortality risk:

- **Vegetation Clearing**: Clearing riparian vegetation during Project construction can affect fish mortality and species at risk through localized increases in water temperatures and the introduction of sediments. Cold-water species may potentially experience reduced reproductive activity or direct mortality, including egg mortality. High water temperatures also lower dissolved oxygen solubility and encourage the microbial breakdown of organic matter, leading to a depletion of dissolved oxygen within the watercourse (DFO 2018). Increases in suspended sediments can cause damage to fish gills and reduce feeding success.
- **Water Extraction:** Water withdrawal or flow diversions in fish-bearing watercourses can result in dewatering of downstream areas, obstruction of fish passage, or impingement of fish against pump screens. During isolation of work areas, pumps will be used to dewater watercourses and divert flows around work areas. Powered to draw water at velocities that exceed the burst speed of most fish, pumps can impinge or entrain fish, potentially resulting in mortality (DFO 2018). Fish can also become stranded during isolation of watercourses, construction of pipeline crossings, and construction of pipeline-associated infrastructure. Isolation activities can dewater downstream sections of a watercourse and strand fish and embryos. Stress and mortality might also occur if isolated pools are created during Project activities, which can trap fish and expose them to decreased water quality and quantity, increased temperature, and increased predation.
- **Use of Heavy Equipment:** Instream activities may require the presence of construction equipment near watercourses during road and culvert works, and drainage realignment activities. As such, there is a risk of fish mortality in the work area, including direct crushing of fish, destruction of eggs in substrates, and disturbance of channel substrates that contain pre-emergent fish (DFO 2018).
- **Refuelling and Use of Hazardous Materials:** Accidental releases of fuel, oil, grease, hydraulic fluid, methanol, and other hazardous materials required for Project equipment may occur during refuelling, equipment malfunction (e.g., hydraulic line rupture), or other incidents. Spills into the aquatic environment have the potential to harm fish and degrade fish habitat and water quality (DFO 2018).

10.5 Mitigation Measures

Mitigation measures to avoid or reduce potential effects to the fisheries and aquatics SE are listed below. The mitigation measures, the effect(s) they address, the relevant Project phase, and details of implementation, as directed in a relevant environmental management plan, are summarized in **Table 10-13** Mitigation is categorized according to the stage of Project development: Design (denoted as "D"), Construction (denoted as "C"), and Operation (denoted as "O").

Content from this section will be incorporated into the CEMP Framework (see the TOR for additional description of this document). As its name implies, the Project's CEMP Framework will provide detailed guidance for the content of the Project Co's CEMP. In addition to mitigation and performance objectives, the CEMP Framework will describe best practices intended to help meet the performance objectives and required content for each sub-plan. The CEMP Framework will also include details on Project roles and responsibilities for the Project Co's key team members.

10.5.1 Mitigation for Changes in Fish Habitat

General mitigation measures to control possible changes to fish habitat during construction are summarized as follows:

- Avoidance by adhering to windows of reduced risk for instream works, redesign, and relocation, where species and habitat indicate the presence of fish;
- Mitigation within the Project design (e.g., measures that avoid effects such as elevated guideway, clearspan crossing of watercourse, and alignment changes to avoid sensitive habitat); and
- Offsetting measures to address adverse impacts to fish habitat, if required.

Additional mitigation measures to avoid or reduce potential effects from Project construction activities are listed below as well as in **Section 11** Vegetation and Wildlife Resources.

Effects during Project operation that result from chemical spills or minor maintenance works will be managed through TransLink's existing operational practices for spill response. These practices are outlined in **Section 18** Environmental Management during Operation.

10.5.2 Mitigation for Changes to Fish Health and Mortality

General mitigation measures to avoid changes to fish health and mortality during construction are summarized as follows:

- Avoidance of potential effects through:
  - Adherence to windows of reduced risk for instream works[40];
  - Redesign;
  - Relocation, where practicable;
  - Mitigation within the Project design; and
  - Offsetting, if impacts to fish habitat cannot be avoided.

[40] Based on the presence of cutthroat trout and Pacific salmon species, the recommended window of reduced risk is currently August 1 to September 15 of any given year; however, check the Ministry website for current information at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/working-around-water/work_windows_low_main.pdf

- Additional mitigation measures to avoid or reduce potential effects from Project activities are listed below. Mitigation measures applicable during construction, the effect(s) they address, and their inclusion in a relevant environmental management plan are summarized in **Table 10-13**. No adverse effects during operation were identified that require fisheries mitigation. Mitigation is categorized according to the stage of Project development. For Fisheries and Aquatics, the relevant stages for implementing mitigation are during construction (denoted as “C”), and operation (denoted as “O”).

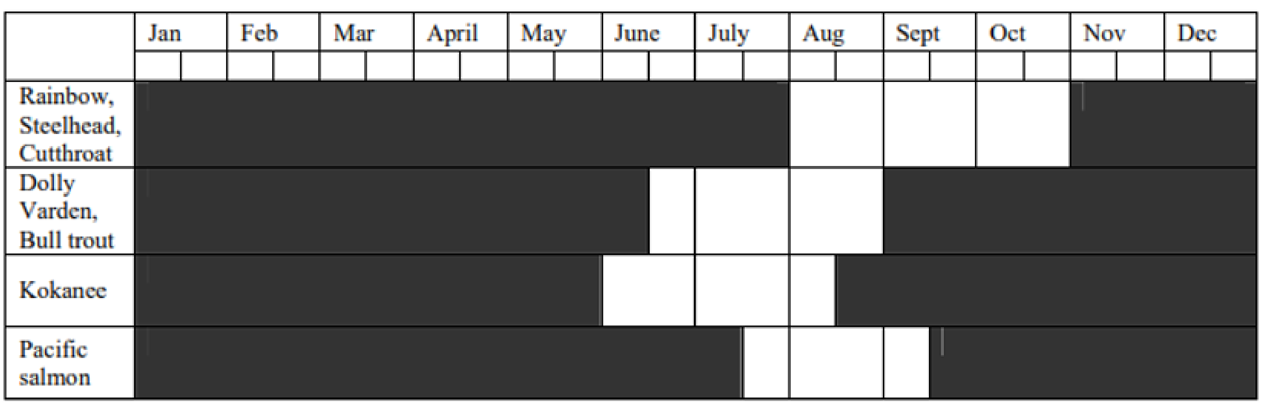
10.5.3 Construction Mitigation

To monitor effective implementation during construction for the following recommended mitigation measures and to check conformance with Project requirements, environmental monitoring by AQPs will take place in accordance with the DBSS (Government of BC 2019c), which includes provisions for monitoring during construction within Environmentally Sensitive Areas. All mitigation measures relevant to the Project should be identified in a Fish and Fish Habitat Management Plan, as part of Project Co’s CEMP.

Mitigation M10.C-1 Consider Reduced Risk Fisheries Windows in Construction Planning

- Consider reduced risk timing windows for the Lower Mainland region of BC for a number of salmonid species (Table 10-12) for timing of instream or near stream work. In general, the lowest risk period for fish streams is when no fish spawning is taking place, there are no eggs or alevins (fry with yolk sacs) within the stream gravels, and no over-wintering juveniles are present.
- Adhere to recommended reduced risk periods specified in approvals or implement additional mitigation acceptable to regulators to avoid adverse effects to fish and fish habitat.

Table 10-12 Reduced Risk Instream Work Windows (BC MOE 2006)



Mitigation M10.C-2 Minimize Disturbance of Environmentally Sensitive Areas and Maintain Riparian Buffers

- Establish and fence off Environmentally Sensitive Areas, including SPEAs, Class A, A(O), B, and C watercourses and ditches with visually obvious barriers (e.g., snow fencing) to prevent personnel and equipment from encroaching on riparian buffers prior to commencing construction activity;

- Do not remove vegetation within the streambank area unless otherwise necessary during construction. To protect riparian areas, avoid clearing extra temporary workspaces within 10 m of watercourses or within SPEAs if greater than 10 m in width;
- Schedule clearing, grubbing, drainage, and grading work near watercourses to occur during appropriate weather windows (e.g., periods of low to nil precipitation) to prevent erosion and control sediment to watercourses;
- Keep all equipment, works, and materials outside of the high-water mark of watercourses during construction;
- Schedule required grading in Environmentally Sensitive Areas, including banks of watercourses until immediately before construction;
- Do not permit clearing equipment within the Environmentally Sensitive Areas, unless approved by an AQP; and
- Fell trees away from watercourses or wetlands unless they will be used as coarse woody debris. Using equipment located outside the riparian area, immediately remove trees, debris, or soil inadvertently deposited below the high-water mark of a watercourse. Where felled trees can be used for coarse woody debris within the SPEA or riparian areas, ensure that they do not obstruct stream flows.

Additional mitigation measures to manage invasive species are described in **Section 11** Vegetation and Wildlife Resources.

Mitigation M10.C-3 Conduct Erosion and Sediment Control

Prepare and implement a site-specific ESC Plan (prepared and signed off by Project Co’s AQP) that meets all relevant industry and regulatory standards and best practices, and MOTI Design-Build Standard Specifications 165 (Government of BC 2019c). This plan will include mitigation measures to address erosion and prevent sediment mobilization. Key elements of this ESC Plan will include:

- Install and maintain ESC measures within 30 m of watercourses as directed by the AQP;
- Cover any exposed soils (e.g., stockpiles, grubbed and graded areas) with polyethylene sheeting, erosion control blankets, or other measures approved by the AQP when not in active use and in advance of precipitation events;
- Locate any stockpiles more than 30 m away from any watercourses;
- Implement other erosion protection or sediment control measures until re-vegetation (soil stabilization) can occur;
- Install silt fence (or other acceptable product) along the top of bank of watercourses prior to construction activities in that area to prevent surface runoff from entering the channel;
- Direct grading away from waterbodies. Do not place fill material in a waterbody;
- Direct sediment-laden water to stable, vegetated areas away from any watercourses to allow for infiltration back into the ground. Regularly monitor the site during discharge periods to ensure that sediment-laden water does not reach fish habitat;
- Develop water quality monitoring plans for instream construction at all watercourses. If monitoring reveals that turbidity is approaching threshold values, develop and implement corrective actions. If corrective actions are not successful, suspend construction activities until environmentally effective solutions are identified;
- Keep back-up pumps and fuel onsite in case of mechanical failure or an increase in flow;

- Construct drainage swales and lawn basins beneath the guideway to help aid in flow retention, infiltration, and additional filtering of stormwater runoff; and
- Install downpipes and accompanying splashpads on the upstream side of drainage swales to prevent erosion.

Mitigation M10.C-4 Manage Vehicle and Equipment Access

- Limit the number of vehicle access and egress points to minimize rutting and implement track out measures to minimize the potential for tracking sediment on site and off site;
- Use existing road access where available and design vehicle or equipment access to avoid adverse effects on fish and fish habitat;
- Prepare and implement a plan for temporary vehicle access if there is a demonstrated need for temporary access, which protects the surrounding area from erosion and adheres to WSA and other relevant permit requirements; and
- Re-contour and revegetate disturbed areas where vehicle and equipment access have left areas with exposed soil, in a way that stabilizes the site and facilitates its return to a natural vegetated state.

Mitigation M10.C-5 Manage Contaminants

- Use secondary containment for stationary equipment:
- Within 30 m of watercourses in the Project area, avoid refuelling and servicing of heavy machinery occurs, do not store fuel, and use biodegradable hydraulic oil only for all equipment;
- Maintain all equipment clean and free of excess oil and grease prior to initiating work;
- Make spill kits available in every vehicle and piece of equipment operating within the Project site; and
- Install oil and grit separators (OGS) at all stations to capture debris and sediment and to trap hydrocarbons and oils which may be present in stormwater runoff.

Mitigation M10.C-6 Erect and Maintain Signage

- Provide signage on site to remind crews of environmental protections and post environmental procedures in accessible locations to encourage environmental compliance.

Mitigation M10.C-7 Implement Contingency Protocols

- Ensure that management plans provide contingency protocols to address inclement or extreme weather, environmental emergencies, failures of existing mitigation, or other events that can adversely affect environmental conditions and protections on site.

Mitigation M10.C-8 Conduct Site Restoration Activities

- Restore disturbed areas, including streambeds and banks, as close as practical to their original pre-construction slope, substrate composition, and height;
- Replant disturbed areas, including banks and riparian areas with an approved native plant prescription (s) and approved seed grass mixture(s) in accordance with the Project site restoration plan and MOTI DBSS Section 165 (Government of BC 2019c). The AQP will determine on site whether other restoration or stabilization methods are needed, subject to Project requirements.

- Monitor restored sites to confirm successful plant cover re-establishment and long-term site stability.

Mitigation M10.C-9 Isolate Instream Works and Conduct Fish Salvage

Where instream works in flowing water that contains fish are proposed, retain an AQP to conduct fish salvage[41] using appropriate fishing methods, and release fish unharmed upstream or downstream of the isolated work area.

- Isolate and dewater the work area prior to commencing work in the dry; and
- Dewater using DFO requirements and industry-standard BMPs to prevent impingement, entrainment, and stranding of fish and other aquatic species.

10.5.4 Operation Mitigation

Mitigation M10.O-1 Implement SkyTrain Best Practices for Spill Management

- Use TransLink's best practices for spill and emergency management for works in the vicinity of storm drainage and watercourses.

10.5.5 Summary of Proposed Mitigation

Table 10-13 summarizes mitigation measures for fish and fish habitat to be included in the CEMP and implemented during construction.

Table 10-13 Summary of Fish and Fish Habitat Mitigation Measures

Potential Effect	Mitigation Number	Mitigation Measure	Project Phase	Environmental Management
Changes in fish habitat	M10.C-1	Consider reduced risk windows in construction planning.	Construction	CEMP – Fish and Fish Habitat Plan
	M10.C-2	Minimize disturbance of Environmentally Sensitive Areas and maintain riparian buffers		
	M10.C-3	Conduct erosion and sediment control		
	M10.C-4	Manage vehicle and equipment access.		
	M10.C-5	Manage contaminants.		CEMP – Spill and Emergency Response Plan
	M10.C-6	Erect and maintain signage.		CEMP – Fish and Fish Habitat Plan
	M10.C-7	Implement contingency protocols		
	M10.C-8	Conduct site restoration activities.		

41 See Mitigation M11.C-5 – Conduct Amphibian Survey and Obtain Salvage Permits for additional salvage requirements for aquatic species.

Potential Effect	Mitigation Number	Mitigation Measure	Project Phase	Environmental Management
Changes in fish mortality/health	M10.C-1	Consider reduced risk windows in construction planning.	Construction	CEMP – Fish and Fish Habitat Plan
	M10.C-2	Minimize disturbance of Environmentally Sensitive Areas and maintain riparian buffers		
	M10.C-3	Conduct erosion and sediment control		
	M10.C-4	Manage vehicle and equipment access.		
	M10.C-5	Manage contaminants.		CEMP – Spill and Emergency Response Plan
	M10.C-9	Isolate instream works and conduct fish salvage.		CEMP – Fish and Fish Habitat Plan
	M10.O-1	Implement SkyTrain best practices for spill management.	Operation	TransLink best practices

10.6 Discussion

Where changes to fish habitat or watercourses are identified in Project Co's detailed design that cannot otherwise be avoided or mitigated, approvals under federal or provincial legislation will be obtained prior to construction. Environmental permits/approvals[42] are anticipated under the federal *Fisheries Act* and the provincial WSA.

10.6.1 Potential Project Changes to Fish Habitat

Mitigation is anticipated to be effective at reducing Project effects to fish habitat. Based on the RCD, current estimates of effects to riparian habitat are as follows: 11,900 m^2 of temporary loss and 2,253 m^2 of permanent loss. The Project commits to restoring riparian habitat with native species to previous or better conditions. Project site restoration is outlined in the CEMP Framework.

Instream and riparian habitat losses in affected reaches will be further evaluated based on detailed design during permitting to determine if identified effects will require additional measures, including habitat offsetting.

With the implementation of mitigation measures, residual effects to fish habitat are expected to be low in magnitude and moderate in duration (the time needed for restoration, enhancement, or offsetting measures to become functional), will occur only once during construction, and are reversible.

10.6.2 Potential Project Changes in Fish Health and Mortality

Project construction may include limited instream works in areas where infilling or realignment of ditches or where culvert extensions are proposed. These activities have the highest potential to affect fish mortality and health by direct impact, entrainment of fish during dewatering, stranding of fish, or

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42 Although not a fisheries-related approval, the *Canadian Navigable Waters Act* is expected to apply as the Serpentine River is a scheduled navigable waterway. Any changes to the dikes will require permitting under the BC *Dike Maintenance Act.*

degrading the water quality downstream of proposed instream works. During instream works, measures such as isolating work areas from streamflow, and salvage of fish and amphibians from work areas will occur to prevent the death of aquatic species.

With the implementation of effective mitigation measures and adherence to least risk timing windows, such as those noted above, effects are anticipated to be limited or avoided completely. As a result, little to no change in fish mortality or health is expected during Project construction. Residual effects on fish mortality and health are predicted to be negligible in magnitude and short in duration, will occur only once, and will be reversible (see **Section 6** Scope and Methods).

10.7 Conclusions

The Project RCD avoids direct interactions with the fisheries and aquatics SE by locating the elevated guideway within the existing Fraser Highway ROW to the greatest extent practicable. Based on the current level of design, the Project is not anticipated to result in permanent or temporary changes to instream fish habitat. There are predicted changes to riparian habitat due to estimated alterations of vegetation within legislated stream setback areas, including permanent changes of 2,253 m^2 and temporary changes of 11,900 m^2 of riparian. These riparian areas will be restored and replanted with natural vegetation to similar or better than existing conditions.

Upon final design, submissions will be made to FOR and DFO to confirm regulatory requirements. If offsetting is deemed necessary, the Project will consult with First Nations during the regulatory review process.

The Project will adhere to published least risk timing windows or implement added mitigation measures, including the use of site isolation techniques paired with fish salvage operations. Application of industry standard BMPs, including those for sediment and erosion control and spill response, as well as other mitigations measures will be outlined in the CEMP and are anticipated to be effective at preventing the introduction of deleterious substances to fish-bearing waters. Current SkyTrain operation and maintenance practices and stormwater management will minimize adverse effects to water quality during Project operation.

Based on current Expo Line SkyTrain operation and maintenance practices and stormwater management design incorporated into the RCD, the likelihood, and magnitude of adverse effects to fish and fish habitat is expected to be low with the application of existing best management practices.

With the application of mitigation measures to prevent harm to fish, fish mortality and changes to fish health are predicted to be negligible or avoided completely. Mitigation measures to minimize effects on changes to fish habitat and fish mortality described in previous sections will be detailed in the Project's CEMP.

Table 10-14 summarizes potential effects remaining after mitigation for fish and fish habitat.

Table 10-14 Summary of Potential Effects Remaining After Mitigation for Fisheries and Aquatics

Potential Effect	Criterion	Rating	Rationale for Rating
Changes in fish habitat	Magnitude[1]	Negligible for instream Low for riparian habitat	No anticipated effects to instream habitat Approximately 2,253 m^2 of riparian habitat permanently affected.
	Geographic Extent	Low	Potential effects limited to GTUF and Serpentine Valley watercourses.
	Duration[2]	Long-term	Habitat function to return to existing condition or better within 5 years of replanting.
	Frequency	Rare	Effects will occur only once during construction and will be restored as soon as possible afterwards.
	Reversibility	Reversible	With the application of mitigation, including habitat enhancement, habitat function is anticipated to be fully restored.
Changes in fish mortality/ health	Magnitude[1]	Negligible	With only a small proportion of the Project taking place in the vicinity of watercourses, there is very limited potential for adverse interactions to occur.
	Geographic Extent	Negligible	Potential effects limited to GTUF and Serpentine Valley watercourses.
	Duration[2]	Short-term	Potential effects limited to active construction around fish habitat.
	Frequency	Rare	Potential incidents limited to active construction around fish habitat.
	Reversibility	Reversible	With the effective application of remediation, effects will be reversible.

Notes:

1. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance, and high (exceedance of criteria or threshold). Generally, magnitude is measured in terms of the proportion of the SE affected within the assessment area (for biophysical SE), or the degree within the interaction area relative to the range of natural or historic (in the case of human environment SE) variation.
2. The duration of an effect may be short-term (i.e., within the construction phase), medium term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (permanent) (i.e., extending past the life of the Project).

11 Vegetation and Wildlife Resources

11.1 Introduction

This vegetation and wildlife resources assessment describes potential changes from baseline conditions that could result from the Project on the vegetation and wildlife SE, as well as proposed mitigation measures to avoid or minimize any potential effects to the SE. The SE was selected because Project construction and operations activities could result in loss or alteration of vegetation and wildlife habitat or in potential conflicts with wildlife. The SE was also identified as important by regulatory agencies, First Nations, stakeholders, and the public.

This SE represents vegetation and wildlife species of management concern, associated wildlife habitat (e.g., green space, street trees), and wildlife habitat features (e.g., bird nests, tree cavities and roosts). For the purposes of the ESR, species of management concern include:

- Species at Risk - plant and wildlife species designated as Red- or Blue-listed in BC, or designated as Endangered, Threatened, or Special Concern by either the *Species at Risk Act* (SARA) or the Committee on the Status of Endangered Wildlife in Canada; and
- Invasive species - invasive plants or wildlife species and plant species considered to be noxious under the BC *Weed Control Act.*

Project construction has the potential to directly interact with vegetation, wildlife habitat, and wildlife species through vegetation clearing around the 140 Street Station and other stations where vegetation exists. Project construction could also indirectly affect wildlife resources through sensory (e.g., noise and lighting) disturbance, or changes to attractants (e.g., increased human presence and waste) that could increase the risk of injury or mortality for wildlife.

The assessment of potential effects on vegetation and wildlife resources was based on the information requirements identified in the ESR TOR (**Appendix A**).

11.1.1 Project Features Relevant to Vegetation and Wildlife

Key features of the Project Description (**Section 2**) relevant to the vegetation and wildlife SE include those that are intrinsic to the SLS design, such as its alignment and elevated components. The SLS will generally follow the existing transportation corridor on Fraser Highway, located primarily within the municipal ROW. Where the alignment is adjacent to the GTUF and in the Serpentine Valley, additional footprint has been minimized through careful planning for the RCD.

The installation of an elevated guideway within the existing ROW minimizes the need for tree and vegetation clearing; however, some vegetation and wildlife habitats will be lost either temporarily or permanently due to required vegetation removal. The Project footprint for the RCD consists of permanent and temporary footprint areas (**Figure G11-1 and Figure G11-2, Appendix G**: Vegetation and Wildlife Resources Figures). Permanent footprint areas are those associated with physical infrastructure necessary for operation of the Project (e.g., stations, PPSs, SkyTrain overhead guideway and foundations). Temporary footprint areas are those associated with Project construction only (e.g., the use of temporary laydown, aerial use, and other work areas).

The Project footprint for the RCD is approximately 59.0 ha, of which 93% (55.0 ha) is developed, non-vegetated areas (e.g., pre-existing roadway, parking lots, buildings). The remaining 4.0 ha (7% of footprint) abut natural areas in parks and green infrastructure (e.g., GTUF, North Creek) and within the ALR (i.e., Surrey Golf Course and farmlands surrounding the Serpentine River).

Project-related construction activities (e.g., utility location and relocation, temporary construction work areas) overlap with approximately 1.8 ha of natural areas. The temporary footprint (approximately 30 ha) comprises approximately 90% of both aerial and ground-level workspace – the remainder is needed only for aerial workspace (e.g., for a gantry to install guideway sections). This area was calculated by estimating temporary workspace areas for the following Project features:

- Road works and parking areas — 2-m buffer;
- Guideway — 5-m buffer from edge; and
- Support columns — 4-m buffer.

The Project's eight new SkyTrain stations and the entire guideway will be elevated, which limits footprint effects. The 140 Street Station's unique design further minimizes its footprint at ground level to reduce impacts in the vicinity of GTUF, including disturbance to vegetation and wildlife habitat. Station design criteria for sightlines for passenger security, such as lighting and the use of glass walls, will also have considerations for wildlife. Lighting will be replaced like-for-like with the existing service so a net increase in lighting infrastructure is not anticipated.

The SkyTrain will be powered by electricity from up to nine PPSs, six of which will integrate into SkyTrain stations to minimize footprint disturbance and potential removal of vegetation. Standalone PPSs are required to be situated along portions of the existing municipal ROW at three locations:

- At the intersection of Fraser Highway and 96 Avenue;
- East of the Serpentine River; and
- Near 201 Street.

During operation, the SkyTrain will travel at speeds consistent with the current practice (average 44 kilometres per hour (km/h), up to a maximum of 80 km/h), and operation and maintenance activities will typically occur within the permanent Project footprint.

11.1.2 Selection as a Screening Element

Vegetation and wildlife resources were selected as a SE because of potential interactions with Project activities, consideration of regulatory requirements, and the importance to First Nations, stakeholders, and the public. As such, potential effects were reviewed against the criteria outlined in the Project's TOR.

For the purposes of this report, species of management concern include the following:

- Species or habitats of conservation concern, i.e., designated as Endangered, Threatened, or Special Concern by either Schedule 1 of the federal SARA, SC 2002, c.29, or ecological communities or plant or wildlife taxa designated in BC as Red-listed or Blue-listed;
- Species or habitat features afforded legal protection under section 34 of the provincial *Wildlife Act*, RSBC 1996 c. 488;
- Migratory bird species and their nests protected under the federal *Migratory Birds Convention Act, 1994*, SC 1994, c. 22 (MBCA) and associated regulations;

- Invasive species, defined as exotic animal species as well as plant species categorized as noxious weeds under the *Weed Control Act*, RSBC 1996, c. 487; and
- Areas of management concern, such as protected areas (e.g., the GTUF) and movement corridors as per the GIN described in Surrey's Biodiversity Conservation Strategy (Diamond Head 2014) and other green space, such as ALR.

This assessment integrates information from **Section 2** Project Description, **Section 2** Noise and Vibration, and **Section 15** Transportation and Access. It also supports information in **Section 17** Environmental Management During Construction and provides guidance for Project operation (**Section 18** Environmental Management during Operations). Potential effects on Vegetation and Wildlife Resources were informed by **Section 2** Project Description and baseline assessment.

Potential effects and Review Indicators for the vegetation and wildlife SE, including the rationale for their selection, are summarized in **Table 11-1**.

Table 11-1 Selection of Review Indicators for Vegetation and Wildlife

Potential Effect	Review Indicators	Rationale for Selection of Review Indicators
Effects on species or habitats of management concern	• Presence and abundance of at-risk species and their habitats • Distribution and abundance of invasive species • Change in habitat availability or suitability for species at risk	• Change in the distribution and abundance of species and habitats of management/conservation concern can influence the viability of local or regional populations • Certain wildlife species and their nests are afforded legal protection under federal and provincial laws • Invasive plant and animal species threaten the ecological condition of communities and species at risk • Compliance with the BC Weed Control Act, Wildlife Act, and the MBCA
Effects on wildlife habitat and/or ecological communities	• Change to spatial extent of ecological communities at risk • Change in habitat quality for wildlife • Change in the availability or suitability of wildlife habitat features	• Changes in the abundance or quality of ecological communities can influence the long-term ecological integrity and function in these areas • Loss of habitat or change in habitat quality can negatively affect the sustainability of species populations
Effects on connectivity – green space	• Spatial extent of GIN elements and forest canopy cover • Occurrence of trees, including heritage or protected trees	• Changes in the quality and quantity of the GIN will affect the quality and quantity of green space • Spatial extent of canopy cover and number of trees support the quality, quantity, and connectivity of green space (e.g., the GTUF) • Project infrastructure and activities may act as barriers to wildlife movement or may result in habitat fragmentation
Effects on wildlife mortality or injury	• Increase in potential for injury or mortality to wildlife	• Project activities have the potential to adversely affect native wildlife species

11.1.3 Spatial and Temporal Boundaries

This section presents details on the spatial and temporal boundaries for the Project.

11.1.3.1 Spatial Boundaries

Project study areas were established to assess baseline vegetation and wildlife conditions, and included watercourses, grassland, forests, parks, roads, and existing infrastructure, such as residential and commercial development and aerial and underground utilities. The study areas are shown in **Figures G11-1** and **G11-2** in **Appendix G**: Vegetation and Wildlife Resources Figures and consist of:

- A vegetation study area (10 m buffer around the Project footprint); and
- A wildlife study area (100 m buffer around the Project footprint).

Project footprints include both temporary or permanent areas, and when combined, they form the overall footprint, highlighted in pink and purple on **Figures G11-1 and G11-2** of **Appendix G**: Vegetation and Wildlife Resources Figures.

11.1.3.2 Temporal Boundaries

The temporal boundaries for the vegetation and wildlife resources assessment include works and activities that are reasonably expected to potentially affect vegetation and wildlife, including.

- Planning Phase: 2020 to 2024;
- Construction and commissioning phase: 2024 to 2028; and
- Operation (including maintenance) of Project: 2028 and beyond.

11.1.1 Regulatory and Policy Context

This section highlights federal, provincial, and local government legislation and bylaws relevant to proposed Project activities that could affect vegetation and wildlife (see summaries in **Table 11-2** and **Table 11-3**). Note that in addition to the listed regulations and policies, Project Co will be required to follow the DBSS (Government of BC 2019c), including Section 165 Protection of the Environment. The Province will continue to work with municipal governments to define requirements for Project construction.

Table 11-2 Key Legislation for Vegetation and Wildlife Potentially Applicable to the Project

Legislation	Responsible Agency	Relevant Aspects of the Legislation	Applicability to the Project
Federal			
SARA, SC 2002, c. 29	ECCC	Protects wildlife species at risk in Canada. Manages species of special concern (endangered or threatened). Requires SARA Permit for certain activities.	Project activities may affect designated species. Species listed on Schedule 1 of SARA have informed the study and selection of wildlife SE.
MBCA, SC 1994, c. 22		Protects migratory birds, including prohibiting the disturbance, destruction, or removal of a nest or related shelter or egg of a migratory bird, or possession of a live migratory bird, or a carcass, nest, or egg of a migratory bird, without a permit.	Project activities may directly (i.e., habitat removal or mortality) or indirectly (i.e., sensory disturbance, habitat degradation) affect individuals or nests of migratory birds protected by the MBCA.
Provincial			
Wildlife Act, RSBC 1996, c. 488	FOR	Protects at-risk wildlife species from direct harm or harassment, including nesting birds and active nests (i.e., occupied by a bird or its egg(s) and nests of certain species (e.g., eagles) year-round. Regulates the collection of species for inventory and research through permitting (e.g., Wildlife Act Permit and Scientific Fish Collection Permit).	Project activities may affect protected species as well as habitat features of select species that are afforded year-round protection in BC on non-federal lands (e.g., eagle nests).
Weed Control Act, RSBC 1996, c. 487		Regulates invasive and noxious plant species on provincial Crown and private lands. Noxious weeds (listed in Schedule A of the Weed Control Regulation) must be controlled by land managers to prevent their spread.	Project activities may introduce or expand the distribution of noxious and other invasive plant species on Project lands.

Table 11-3 Key Municipal Bylaws and Policies

Bylaws and Policies	Responsible Agency	Relevant Aspects of Bylaws and Policies	Applicability to the Project
Surrey Tree Protection Bylaw No. 16100	City of Surrey	Protects trees, regulates their removal and specifies tree replacement as compensation.	Project construction activities will affect protected trees, as defined by the bylaw.
Surrey Biodiversity Conservation Strategy		Preserves large core habitat areas (hubs) and connectivity between them (corridors). Provides management direction and recommendations for existing and proposed hubs and corridors to enhance connectivity and restore degraded habitat.	Project activities will require some tree clearing adjacent to the GTUF.
Township of Langley Tree Protection Bylaw 2019 No. 5478	Township of Langley	Regulates tree cutting, prohibits and penalizes damage to or removal of protected trees, and imposes requirements for protected tree preservation, removal and replacement.	Project construction activities will affect protected trees as defined by the bylaw.

11.2 Baseline Conditions

To characterize the existing vegetated environment, Hemmera undertook both desktop and field reviews of vegetation and wildlife baseline conditions. The scope of the baseline assessment included: a description of habitat suitability for wildlife within the wildlife study area, documentation of any federally or provincially listed species with the potential to occur (**Figure G11-1**, **Appendix G**: Vegetation and Wildlife Resources Figures), and identification of trees greater than 3 m in height (**Figure G11-2**, **Appendix G**: Vegetation and Wildlife Resources Figures).

Existing conditions in the vegetation study area are typical of a developed urban environment, primarily within municipal ROW along Fraser Highway, but also within and adjacent to some vegetated areas. Some additional private land requirements for Project stations, transportation infrastructure connections, and utility relocation are situated within vegetated areas that may provide habitat for various wildlife species and ecosystems.

11.2.1 Methods

Hemmera conducted the following desktop and field-based baseline studies for this SE to inform the ESR:

- Vegetation and ecosystems in the vegetation study area, particularly those which are designated Environmentally Sensitive Areas in the City of Surrey;
- Invasive plant and wildlife species that may require management during Project construction and operation;
- Federal and provincial at-risk vegetation and wildlife species (and their habitat), areas designated as critical habitat under SARA, and provincially at-risk ecological communities;
- Bird species whose nests are afforded year-round protection under section 34b of the BC *Wildlife Act* and species protected under the MBCA; and
- Boulevard trees, heritage trees, and other green space features throughout the Project corridor.

11.2.1.1 Desktop Review

In May 2019, Hemmera completed a pre-field desktop review to determine the background to help characterize baseline conditions for vegetation and wildlife - on native vegetation and ecosystems in the vegetation study area as well as invasive vegetation with a high likelihood to occur along the alignment.

Resources reviewed included Project-specific data as well as data from the Province, municipalities, government databases, and citizen-science-driven web resources[43] as follows:

- eBird[44] (eBird 2022);
- Environment and Socio-economic Review – Surrey-Newton-Guildford Light Rapid Transit Project (Stantec 2018a);
- BC Species and Ecosystems Explorer (Government of BC 2020a);
- iMap BC (DataBC 2022);
- Invasive Alien Plant Program (IAPP) (Government of BC 2022c);
- Invasive Species Council of Metro Vancouver (ISCMV) website (ISCBC 2021b);

[43] Publicly available information on Traditional Use will be added if information is provided by First Nations for this intended use.

[44] eBird is a citizen science online registry that is often used by local birders. While data obtained on eBird cannot be relied on for species abundance information, it is generally accurate with respect to potential bird species presence in an area.

- Fraser Highway SkyTrain Corridor Environmental Study prepared for the City of Surrey (Shebib et al. 2020)
- Green Timbers Urban Forest Recreation and Access Management Plan (Coulthard and Cox 2002);
- Green Timbers Widening Tree Inventory (Diamond Head 2016a);
- City of Surrey Biodiversity Conservation Strategy (Diamond Head 2014);
- City of Surrey Agricultural Land Use Inventory – 2010 (Government of BC 2013c);
- Green Timbers Urban Forest Advisory Committee Position (2005);
- COSMOS (City of Surrey 2021);
- City of Langley Environmentally Sensitive Areas Mapping Study (Diamond Head and Zoetica 2016);
- BC Inter-Ministry Invasive Species Working Group (Government of BC 2021g);
- South of Fraser Rapid Transit Baseline Overview and Regulatory Strategy (Stantec 2016);
- TM-0328 Environmental Assessment (Pinchin Ltd. 2020); and
- Wildlife Tree Stewardship Program (WiTS 2022).

For the desktop tree inventory, trees taller than 3 m in height (estimated based on satellite and street view imagery from Google Earth) were mapped and classified as either coniferous or deciduous. These data were merged with two additional tree spatial datasets from the City of Surrey:

- Boulevard trees between King George Station and 196 Street (marking the boundary between Surrey and Langley); and
- 2021 tree survey by Diamond Head Consulting for the City of Surrey for the GTUF portion of the vegetation study area.

To calculate the potential number of trees that could be affected, geographic information system analysis was used to overlay the Project footprint on the merged tree dataset (**Figure G12-2**, **Appendix G**: Vegetation and Wildlife Resources Figures). Within the GTUF portion (i.e., between 140 Street and 148 Street), a 2021 Diamond Head dataset was used. For all areas in Surrey extending beyond the GTUF data, the City of Surrey boulevard trees dataset was merged with the Hemmera desktop tree inventory dataset to improve the accuracy of the tree data. For the remainder of the Project alignment in both the Township and City of Langley, the desktop tree inventory was used to calculate trees in the vegetation study area and the Project footprint.

11.2.1.2 Field Assessment

The desktop review was further supported by field studies to assess ecological communities, protected trees, native and invasive vegetation, wildlife habitat, at-risk species, such as Pacific water shrew (*Sorex bendirii*) (Government of Canada 2014), northern red-legged frog (*Rana aurora*) (Government of BC 2015), Oregon forestsnail (*Allogona townsendiana*) (Government of Canada 2016), and bird nests afforded year-round protection under section 34b of the BC *Wildlife Act*.

Field assessments consisted of reconnaissance-level surveys to determine potential rare plant and wildlife habitat and evidence of invasive plants in the study area. Assessments were based on the desktop review, which confirmed that much of the wildlife and vegetation study areas consist of areas of commercial and residential development, leaving only a few areas of potential habitat for most species. Habitats within privately-owned portions of the study area were assessed visually from the road. Natural ecosystems were limited to forested habitat in GTUF, riparian habitat along watercourses, and open agricultural habitat in the vicinity of the Serpentine River.

The study team assessed vegetation and wildlife habitat – by vehicle and by foot - along both sides of the full 16-km alignment, stopping to further investigate key areas, such as the GTUF, treed and well-vegetated areas, watercourses, and golf courses. The team collected information on general habitat conditions, notable trees, invasive plant species occurrences, the location and types of wildlife habitat features (e.g., nests afforded protection[45] under the BC *Wildlife Act*), and eDNA sampling for northern red-legged frog and Pacific water shrew. Sampling locations are shown in **Figure G11-1** and **Figure G11-2** in **Appendix G**: Vegetation and Wildlife Resources Figures**.** Three field assessments were conducted between 2019 and 2022, as described below.

- The field visit on June 10 2019 included a Registered Professional Biologist and two technicians. The field visit focused on areas with natural or semi-natural vegetation and assessed 30 locations within the study area. Habitat was evaluated visually for its suitability for species of concern, and for the presence of wildlife habitat features such as nests. eDNA surveys were used to investigate presence of northern red-legged frog and Pacific water shrew at four watercourses. No other targeted wildlife surveys were conducted.
- The field visit on Sept 9 2021 was a reconnaissance to determine whether there were any significant changes to existing conditions since 2019.
- The field visit on September 15 2021 was conducted by two Registered Professional Biologists (one wildlife biologist and one vegetation specialist) and a technician and focussed on the proposed section between 166 Street and 203 Street. During this visit, ten sites were surveyed for rare plant potential and for occurrences of invasive plants.

11.2.2 Results

This section presents the results of the baseline vegetation and wildlife resources assessment and tree inventory for the Project.

11.2.2.1 Desktop Review

Ecosystems in Project Study Area

GIN hubs are key areas (greater than 10 ha) that provide habitat for a range of species; GIN corridors act as linear habitat movement areas that connect GIN hubs. Both GIN hubs and corridors overlap with the vegetation and wildlife study areas. GTUF is a significant GIN hub, while Quibble Creek, Serpentine River, and North Creek are GIN corridors (**Figure G11-1 Appendix G**: Vegetation and Wildlife Resources Figures).

At-Risk Species and Protected Features

For context related to vegetation and wildlife SE, the portions of the study area most likely to have occurrences of at-risk species include the GTUF, the Serpentine Valley, and the area around North Creek near 185 Street and Fraser Highway (**Figure G11-1**, **Appendix G**: Vegetation and Wildlife Resources Figures). At-risk species identified in the desktop review that have an historic presence in the study area included barn owl (*Tyto alba*), northern red-legged frog, and the plant species Vancouver Island beggarticks (*Bidens amplissima*). A list of at-risk species with potential to occur are presented in **Table 11-4** and **Table 11-5**.

45 Surveys for protected nests were based on methods as described in *Inventory Methods for Raptors* (RIC (2001).

A bald eagle (*Haliaeetus leucocephalus)* nest located approximately 110 m north of the temporary footprint was identified in the North Creek drainage and is shown on **Figure G11-1.14 (Appendix G**: Vegetation and Wildlife Resources Figures)**.** It is identified as BAEA-204-038, according to the Wildlife Tree Stewardship Atlas (City of Surrey 2022g; WiTS 2022). Its activity status is unknown. Based on the Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (2013), bald eagle tolerance to human activity is moderate-high, and the recommended minimum buffer for nesting eagles in rural environments is 100 m, plus an additional 100 m 'quiet' buffer during the nesting season.

The desktop review confirmed that critical habitat has been proposed under SARA for barn owl in locations that overlap with the wildlife study area (**Figure G11-1, Appendix G**: Vegetation and Wildlife Resources Figures) (DataBC 2022). The draft federal recovery strategy for barn owl (ECCC 2021b) identifies proposed critical habitat that overlaps with the Project footprint in 1-km radius areas around documented nest and roost sites.

Egg masses of the provincially Blue-listed northern red-legged frog were salvaged for a construction project just outside of the wildlife study area in 2017 (Brooks 2017). An historical occurrence of the Blue-listed Vancouver Island beggarticks was documented in 1954 in a “moist site by the road” at 166 Street near Fraser Highway (BC CDC 2021). However, habitat for this species no longer exists at that location (Shebib et al. 2020), so the likelihood of this species occurring within the Project footprint has been ruled out. No other known occurrences of plant or wildlife species at risk or ecological communities at risk were located within the BC Conservation Data Centre database (BC Conservation Data Centre: Conservation Data Centre Mapping Service [web application]. 2022).

Table 11-4 At-risk Wildlife Species[1] with the Potential to Occur in the Project Study Area

Common Name	Scientific Name	SARA Schedule	BC Status	Habitat Needs	Occurrence in Project Study Area	Potential to Occur
Invertebrates						
Oregon forestsnail	*Allogona townsendiana*	1-E (Jan 2005)	Red	Forest with thick layer of leaf litter	Documented occurrences from Langley. Potential suitable habitat in GTUF, but no confirmed occurrences in Project study area.	Low to Moderate
Western thorn	*Carychium occidentale*	-	Blue	Forest with thick layer of leaf litter	No confirmed occurrences in the Project study area, but has been documented in Tynehead Regional Park (B.C. Conservation Data Centre 2004). Habitat may be suitable.	Low to Moderate
Amphibians						
Northern red-legged frog	*Rana aurora*	1-SC (Jan 2005)	Blue	Wetland, riparian habitat, watercourses, open water, open habitat, forest	Documented presence in GTUF and other points along Project corridor. Habitat is suitable.	Moderate
Western toad	*Anaxyrus boreas*	1-SC (Jun 2018)	Yellow	Wetland, riparian habitat, watercourses, open water, open habitat, forest	Uncommon in Metro Vancouver but known to sporadically occur. Habitat is suitable.	Moderate
Birds						
Bald eagle	*Haliaeetus leucocephalus*	-	Yellow	Forest, open habitat, wetland, open water, urban	Documented occurrence in Project study area, and habitat is suitable.	High
Band-tailed pigeon	*Patagioenas fasciata*	1-SC (Feb 2011)	Blue	Forest, open habitat, urban	Documented presence within Project study area.	Moderate
Barn owl	*Tyto alba*	1-T (Jun 2018)	Red	Open habitat, riparian habitat	Known to occur in Metro Vancouver, and habitat is suitable.	Moderate
Barn swallow	*Hirundo rustica*	1-T (Nov 2017)	Blue	Wetland, forest, watercourse, open habitat, urban, riparian habitat	Documented occurrence in Project study area, and habitat is suitable.	High
Common nighthawk	*Chordeiles minor*	1-T (Feb 2010)	Yellow	Wetland, watercourse, open habitat forest, urban, open water	Documented presence within 5 km south of Project study area.	Moderate

Common Name	Scientific Name	SARA Schedule	BC Status	Habitat Needs	Occurrence in Project Study Area	Potential to Occur
Double-crested cormorant	*Phalacrocorax auritus*	-	Blue	Wetland, watercourses, open water, forest, urban	Documented occurrence in GTUF, but habitat is not ideal.	Moderate
Great blue heron, *fannini* subspecies	*Ardea herodias fannini*	1-SC (Feb 2010)	Blue	Wetlands, open water, open habitat, forest, urban, riparian habitat	Documented occurrence in Project study area.	High
Green heron	*Butorides virescens*	-	Blue	Wetland, forest, riparian habitat, watercourse, open water	Confirmed occurrence in GTUF.	Moderate
Olive-sided flycatcher	*Contopus cooperi*	1-T (Feb 2010)	Blue	Wetland, forest, open water	Common in Surrey. Documented presence in Langley within 5 km south of Project study area.	Moderate
Peregrine falcon, *anatum* subspecies	*Falco peregrinus anatum*	1-SC (Jun 2012)	Red	Wetland, open water, watercourse, open habitat, urban, riparian habitat	Documented presence in Surrey and Langley, and within 5 km south of Fraser Highway.	Moderate
Short-eared owl	*Asio flammeus*	1-SC (Jul 2012)	Blue	Wetland, open habitat, urban, open water, riparian habitat	Some sightings in south Surrey, but no confirmed occurrences in the Project study area. Few relatively small areas of suitable foraging habitat.	Moderate
Mammals						
Little brown myotis	*Myotis lucifugus*	1-E (Dec 2014)	Yellow	Riparian habitat, forest, open habitat, urban	Assumed presence within Project study area as habitat is suitable and species is ubiquitous.	High
Long-tailed weasel, *altifrontalis* subspecies	*Mustela frenata altifrontalis*	-	Red	Wetland, forest, riparian habitat, open habitat, urban	Documented occurrence in GTUF.	Moderate
Townsend's big-eared bat	*Corynorhinus townsendii*	-	Blue	Forest, open habitat, urban, shrub	Documented occurrences within Project study area in GTUF.	Moderate
Pacific water shrew	*Sorex bendirii*	1-E (Jun 2003)	Red	Wetland, forest, riparian habitat, watercourse	Documented occurrences in Mahood Creek, within 5 km of Project study area.	Moderate

Table 11-5 At-risk Plants and Ecological Communities with the Potential to Occur in the Project Study Area

Common Name	Scientific Name	SARA Schedule	BC Status	Habitat Needs	Occurrence in Project Study Area	Potential to Occur
Vascular Plants						
American sweet-flag	*Acorus americanus*	-	Blue	Freshwater wetland habitat	None documented	Low – Unlikely
Cut-leaved water-parsnip	*Berula incisa*	-	Blue	Riparian areas in moderate elevation forests	None documented	Low – Unlikely
Henderson's checker-mallow	*Sidalcea hendersonii*	-	Blue	Coastal wet areas, mudflats, and high marshes	None documented	Unlikely
Howell's triteleia	*Triteleia howellii*	1-E (2005)	Red	Dry to mesic grassy coastal bluffs	None documented	Unlikely
Leafless wintergreen	*Pyrola aphylla*	-	Blue	Dry conifer forest	None documented	Low – Unlikely
Phantom orchid	*Cephalanthera austiniae*	1-T (2003)	Red	Mature mixed woods on sites with little to no ground cover and areas strongly correlated with limestone	None documented	Low
Pink water speedwell	*Veronica catenata*	-	Blue	Wet meadows, ditches, shores and shallow water pond edges	Outside of Project study area but relatively close on abandoned lot in North Surrey	Moderate
Streambank lupine	*Lupinus rivularis*	1-E (2005)	Red	Gravelly soils, predominantly along riverbanks, but also in railway beds near rivers	None documented	Moderate – Low
Tall bugbane	*Actaea elata var. elata*	1-E (2003)	Red	Seepage sites in mature, shady, mixed forest	None documented	Low – Moderate
Vancouver Island beggarticks	*Bidens amplissima*	1-SC (2003)	Blue	Moist to wet areas adjacent to wetlands	None documented	Low
Washington springbeauty	*Claytonia washingtoniana*	-	Blue	Moist to mesic mossy rock outcrops	None documented	Low – Unlikely
Whitebark pine	*Pinus albicaulis*	1-E (2012)	Blue	Mesic to dry slopes in subalpine to alpine	None documented	Unlikely
Yellowseed false pimpernel	*Lindernia dubia var. dubia*	-	Blue	Wet areas, low pH soils (i.e., bog)	None documented	Low – Unlikely

Common Name	Scientific Name	SARA Schedule	BC Status	Habitat Needs	Occurrence in Project Study Area	Potential to Occur
Ecological Communities						
Black cottonwood - red alder / salmonberry	*Populus trichocarpa - Alnus rubra / Rubus spectabilis*	N/A	Blue	Deciduous forest ecosystem requiring frequently-flooded, active fluvial deposits along coastal rivers	None documented	Unlikely
Black cottonwood / Sitka willow	*Populus trichocarpa / Salix sitchensis*	N/A	Blue	Deciduous forest ecosystem requiring low-bench fluvial deposits on rivers	None documented	Unlikely
Common cattail Marsh	*Typha latifolia Marsh*	N/A	Blue	Marsh wetlands, small to large	None documented	Moderate
Douglas-fir - western hemlock / salal Dry Maritime	*Pseudotsuga menziesii - Tsuga heterophylla / Gaultheria shallon Dry Maritime*	N/A	Red	Ridges, crests, and upper slopes in the driest sites of southern, very dry to dry maritime climatic regions	None documented	Unlikely
Douglas-fir / sword fern	*Pseudotsuga menziesii / Polystichum munitum*	N/A	Red	Dry, rich soil, sites	None documented	Low
Sitka spruce / salmonberry Very Dry Maritime	*Picea sitchensis / Rubus spectabilis Very Dry Maritime*	N/A	Red	Coastal, high bench floodplain sites with periodic (5-year interval) flooding. Medium to rich soils	None documented	Low
Western hemlock - Douglas-fir / Oregon beaked-moss	*Tsuga heterophylla - Pseudotsuga menziesii / Kindbergia oregana*	N/A	Red	Coastal forested sites with moderate slopes, and medium soil moisture and nutrient	None documented	Moderate
Western hemlock - western redcedar / deer fern	*Tsuga heterophylla - Thuja plicata / Struthiopteris spicant*	N/A	Red	Coastal forested sites with moderate slopes, and moist soils and poor to medium nutrients	None documented	Moderate
Western redcedar - Sitka spruce / skunk cabbage	*Thuja plicata - Picea sitchensis / Lysichiton americanus*	N/A	Blue	Swamp ecosystem with seasonally inundated soils, in low-lying areas on floodplains and toe slopes	None documented	Low - Nil
Western redcedar / black twinberry	*Thuja plicata / Lonicera involucrata*	N/A	Red	Sites subject to winter flooding and poor drainage and fine-grained, rich soils	None documented	Low - Nil
Western redcedar / salmonberry	*Thuja plicata / Rubus spectabilis*	N/A	Red	Sites subject to winter flooding and poor drainage and fine-grained, rich soils	None documented	Low - Nil

Common Name	Scientific Name	SARA Schedule	BC Status	Habitat Needs	Occurrence in Project Study Area	Potential to Occur
Western redcedar / slough sedge	*Thuja plicata / Carex obnupta*	N/A	Red	Sites with strongly fluctuating water levels and medium to very rich soils	None documented	Low - Nil
Western redcedar / sword fern - skunk cabbage	*Thuja plicata / Polystichum munitum - Lysichiton americanus*	N/A	Blue	Hummocky swamp ecosystem found in depressional receiving sites, toe slopes and peatland margins	None documented	Low
Western redcedar / sword fern Very Dry Maritime	*Thuja plicata / Polystichum munitum Very Dry Maritime*	N/A	Red	Relatively flat sites with moderate moisture and rich soils	None documented	Moderate
Western redcedar / three-leaved foamflower Very Dry Maritime	*Thuja plicata / Tiarella trifoliata Very Dry Maritime*	N/A	Blue	Relatively flat sites with rich, wet soils	None documented	Moderate

Note:

1. Fish species at risk are listed in **Table 10.4** Fish Species Present in Project Area Watersheds**.**

Invasive Species

Hemmera reviewed the provincial list of priority invasive species (plants and animals) to determine potential priority invasive species (Government of BC 2020b). The desktop review of the IAPP database for invasive plants within the vegetation study area revealed a single documented occurrence of Japanese knotweed at the southwest corner of Fraser Highway and 176 Street (Highway 15). The City of Surrey provided locations along Fraser Highway for two occurrences of invasive knotweeds, one site near 149 Street and the other at the corner of 189 Street. Knotweeds are considered noxious weeds in BC, under Schedule A of the Weed Control Regulation.

Multiple non-native animal species are known to be either present or potentially present in the wildlife study area (ISCBC 2021a). Species with the most potential to be spread and cause damage or pose significant nuisance as a result of Project activities include the European chafer beetle (*Amphimallon majale*), European fire ant (*Myrmica rubra*), brown rat (*Rattus norvegicus*), roof rat (*R. rattus*), European starling (*Sturnus vulgaris*), and rock pigeon (*Columbia livia*).

Culturally Important Plant Species

In correspondence and meetings, local First Nations identified seasonal plant species traditionally collected, cultivated, or traded for in the vicinity of the Project area that include fern species, fresh shoots, berry species, native nut and apple tree species, and aquatic plants, and have indicated interest in these species being used in Project plantings. Local First Nations have also identified interest in use of removed trees for cultural purposes or firewood.

11.2.2.2 Field Assessment

Native vegetation and ecosystems in the ROW primarily occurred adjacent to the GTUF and the North Creek riparian area. Some open habitat around the Serpentine River contained a mix of native and non-native vegetation. Elsewhere in the vegetation study area, vegetation north and south of Fraser Highway was composed of planted trees along streets (mainly boulevard trees), larger native trees in some residential lots, and small patches of young forest (e.g., on the north side of Fraser Highway at 164 Street, along North Creek, and near McLellan Creek ponds).

Habitat Suitability

Since the Project's alignment will mainly run through developed residential and commercial areas, habitat suitability for most wildlife species along the corridor is considered low, in general. However, areas of suitable habitat for terrestrial vegetation and wildlife observed along the Project alignment are summarized as follows (**Figure G11-3.1-3.21** in **Appendix G**: Vegetation and Wildlife Resources Figures):

- Habitat within the GTUF was assessed as highly suitable for numerous species of amphibians, songbirds, raptors, and bats;
- A small, wooded area on the north side of Fraser Highway at 164 Street was assessed to be potentially suitable as raptor nesting habitat;
- Habitat within the Serpentine Valley between 170 Street and 180 Street is suitable for many species of wildlife. Raptor foraging suitability is high, one coyote (*Canis latrans*) was observed, and an at-risk great blue heron (*Ardea herodias*) and barn swallows (*Hirundo rustica*) were observed foraging at the Surrey Golf Course and fields around the Serpentine River; and
- Along North Creek, aquatic and vegetated habitat is suitable for breeding amphibians and songbirds.

Outside of these areas, the most significant vegetation in the study area are trees and shrubs integrated into urban landscaping, resulting in generally small and fragmented areas with limited habitat values for most wildlife species. Overall, the vegetated habitat was suitable for some species of wildlife in certain areas (e.g., the GTUF, Serpentine Valley, North Creek area), but the developed urban areas offered few to no habitat features for most native wildlife not habituated to urban habitats. Baldi Creek and surrounding area in the City of Langley is situated outside of the study area for vegetation and wildlife, thus was not considered further for this SE.

Some wildlife species are tolerant of human activity or commonly use anthropogenic structures (e.g., American robin [*Turdus migratorius]*, barn owl, little brown myotis [*Myotis lucifugus])* and may breed in areas of human development. Although buildings were not inspected during the field surveys for signs of wildlife use due to private property concerns, any structure identified for demolition should first be assessed for wildlife use.

Invasive Species

Invasive plant species were documented throughout much of the vegetation study area as part of the baseline assessment and occurred predominantly on private properties. A notable multi-species patch was observed in the Quibble Creek Greenway at Fraser Highway near 137b Street. The most commonly observed invasive plant species in the vegetation study area were Himalayan blackberry, invasive knotweeds (*Reynoutria* sp.), reed canarygrass (*Phalaris arundinaceae*), Canada and bull thistles (*Cirsium arvense* and *C. vulgare*) as well as observations of Scotch broom (*Cytisus scoparius*), English holly (*Ilex aquifolium*), English ivy (*Hedera helix*), and common tansy (*Tanacetum vulgare*). Knotweeds and Canada thistle are listed as noxious under Schedule A of the Weed Control Regulation. Invasive plant species observations shown in **Figure G11-2** (**Appendix G**: Vegetation and Wildlife Resources Figures) are a general representation of invasive plants in the vegetation study area.

At-Risk Species

No at-risk plants were observed during the field visits.

Habitat values within the wildlife study area (**Figure G11-3.1-3.21** in **Appendix G**: Vegetation and Wildlife Resources Figures) were specifically assessed for at-risk species as follows:

- Habitat for at-risk invertebrates, including two species of snail, Oregon forestsnail and western thorn (*Carychium occidentale*), may occur in the GTUF portion of the study area;
- Northern red-legged frog was detected from eDNA surveys in King Creek but not in Serpentine River, North Creek, or Quibble Creek. Suitable habitat for at-risk amphibians (i.e., western toad (*Anaxyrus boreas*) and northern red-legged frog) occurred throughout the study area near various watercourse crossings;
- Past use by barn owl in the area (including the Project study area) is reflected in the identification of proposed critical habitat for this species in the Serpentine Valley near Fraser Highway (ECCC 2021b);
- Potentially suitable habitat in the GTUF for at-risk birds (e.g., green heron [*Butorides virescens]*, olive-sided flycatcher [*Contopus cooperi*] based on eBird observations [eBird 2021]); and
- Potentially suitable habitat in the GTUF for at-risk mammals (e.g., long-tailed weasel [*Mustela frenata altifrontalis]* and Townsend’s big-eared bat [*Corynorhinus townsendii]*).

Suitable foraging habitat for at-risk raptors (i.e., short-eared owl [*Asio flammeus*], peregrine falcon, and barn owl) was documented in open habitat adjacent to the ROW within the Serpentine Valley. Nesting habitat for short-eared owl in the study area was limited to open fields in the Serpentine Valley, was absent for peregrine falcon, and was possible for barn owl at several buildings within the study area. Two at-risk bird species (barn swallow and great blue heron) were observed flying over or foraging in the Serpentine Valley near the Surrey Golf Course, and this habitat was similarly considered suitable for common nighthawk (*Chordeiles minor*). Band-tailed pigeons (*Patagioenas fasciata*) may also forage or nest at treed areas along the Project study area.

No bird nests afforded year-round provincial protection (e.g., those of bald eagles and great blue herons) were observed during the field assessment; however, new nests can be constructed each year. A bald eagle nest location near Fraser Highway and Old Yale Road had been identified during the desktop review but its activity status in 2021 or 2022 could not be verified due to permissions for private land access.

Suitable roosting and foraging habitat for little brown myotis was present at several locations along the Project corridor. Foraging habitat suitability was highest near watercourses (i.e., the GTUF, Serpentine Valley, North Creek area), while potential roosting habitat was present throughout (i.e., many trees over 20 cm DBH and buildings throughout the study area). This species hibernates in cliff crevices, caves, and mines (COSEWIC 2013); due to lack of suitable habitat, hibernacula are not expected in the study area.

Pacific water shrew was not detected from eDNA surveys at Serpentine River, North Creek, King Creek, and Quibble Creek; however, negative eDNA results are not necessarily indicative of species absence. Some suitable habitat for this species was present in the GTUF along King Creek, but the overall habitat suitability for this species in the Project study area was considered low.

11.2.2.1 Tree Inventory

The desktop inventory of trees over 3 m in height in the vegetation study area is summarized by alignment section in **Table 11-6**. The approximate number of trees was calculated using three different datasets (as described in **Section 11.2.1.2**), and results are provided in **Table 11-6**. The desktop tree inventory was constrained by limitations in imagery quality, differences between data collection protocols of merged datasets, and temporal changes in tree numbers as trees grow, die, or are removed/replaced.

Table 11-6 Baseline Tree Inventory in the Project Vegetation Study Area

Section of SLS Alignment	# of Coniferous Trees	# of Deciduous Trees	Total Trees
King George Station to 140 Street, Surrey	20	14	34
140 Street to 148 Street, Surrey[1]	159	84	243
148 Street to 196 Street, Surrey	510	1,567	2,077
196 Street to Langley Bypass, Township of Langley	0	26	26
Langley Bypass to Terminus, City of Langley	4	71	75
Total Trees	**693**	**1,762**	**2,455**

Notes:

[1] Number of trees from the 2021 Diamond Head GTUF tree survey.

11.3 Project Interactions

Project activities during construction and operation may interact directly and indirectly with the vegetation and wildlife SE. For example, activities that result in the removal of vegetation or habitat, such as clearing and grubbing, or that may result in wildlife strikes (e.g., bird collisions with station glazing or moving trains) are considered direct interactions. Examples of indirect interactions include the creation of an edge on formerly contiguous forested areas (e.g., resulting in conditions that favour the incursion of invasive plants) or noise disturbance to wildlife in adjacent habitat. Project activities during operation will include operation and maintenance of the SkyTrain and associated infrastructure (e.g., stations, PPSs). Potential interactions between Project activities and physical works with the vegetation and wildlife resources SE are outlined in **Table 11-7**.

Table 11-7 Potential Project Interactions with Vegetation and Wildlife Resources and Potential Effects

Project Activities and Works	Effects on Species or Habitat of Management Concern[1]	Effects on Wildlife Habitat and/or Ecological Communities[1]	Effects on Connectivity of Green Space[1]	Mortality or Injury Risk to Wildlife[1]
Construction				
Clearing and grubbing	✓	✓	✓	✓
Property acquisition (including demolition of buildings)	✓	✓	-	✓
Relocation of overhead BC Hydro transmission lines	-	-	-	-
Utility installation / relocation	o	o	-	o
Use of temporary laydown areas	o	o	-	-
Access and traffic management	-	-	-	o
Road widening (select locations)	-	-	-	o
Culvert extension and drainage realignment (select locations)	o	o	-	-
Installation of SkyTrain guideway foundations	-	✓	-	-
Installation of overhead SkyTrain guideway	-	✓	-	-
Stations (foundations, structure, lighting, access, service connections, security)	-	✓	-	-
PPS	-	✓	-	-
Management of non-contaminated excavated material (including excavation)	✓	-	-	o
Management of contaminated or hazardous materials	✓	-	-	o
Testing, commissioning, and start-up	-	-	-	-

Project Activities and Works	Effects on Species or Habitat of Management Concern[1]	Effects on Wildlife Habitat and/or Ecological Communities[1]	Effects on Connectivity of Green Space[1]	Mortality or Injury Risk to Wildlife[1]
Operation				
Operation of the Project	o	✓	-	✓
Maintenance of the Project	o	o	-	o

Notes:

[1]Interaction Rating:

– **No interaction:** an interaction between a Project component and the SE is not likely.

○ **Minor interaction:** impacts may result from an interaction, but standard measures to avoid or minimize the impact are available and well understood to be effective, and any residual effects would be reduced to negligible. Standard mitigation measures are discussed in **Section 11.5**.

✓ **Interaction:** an interaction occurs and likely requires additional mitigation. Interactions are carried forward and discussed in subsequent sections. Project-specific mitigation measures are discussed in **Section 11.5**.

11.4 Potential Effects

Potential Project-related effects on the vegetation and wildlife SE are categorized as either direct physical effects due to the temporary or permanent footprint area (shown on **Figures G11-1 and G11-2**, **Appendix G**: Vegetation and Wildlife Resources Figures) or indirect effects, such as sensory disturbance from artificial light, noise, or other altered habitat conditions. If interactions with the SE are anticipated to occur (as identified in **Table 11-7**), the interaction is carried forward in the assessment and detailed below.

Areas where the Project overlaps with known invasive species occurrences, high-suitability habitats, and species at-risk detection locations are shown on **Figure G11-1** in **Appendix G**: Vegetation and Wildlife Resources Figures. Areas where the Project overlaps with trees are identified in **Figure G11-2** in **Appendix G**: Vegetation and Wildlife Resources Figures.

11.4.1 Effects on Species or Habitats of Management Concern

This section summarizes potential effects on species or habitats of management concern in the Project footprint during construction and operation. Species of management concern include species-at-risk as well as invasive species.

11.4.1.1 Construction Effects on Species-at-Risk

During Project construction, site clearing, and grubbing will remove vegetation, including trees, shrubs, and herbaceous plants, which may affect wildlife species at risk through the loss of habitat.

Several at-risk wildlife species occurring in the study area are dependent on moist, riparian and aquatic habitats. Low-suitability habitat for Oregon forestsnail and western thorn occurs in the wildlife study area within the GTUF. Despite the low habitat value, these species are potentially present, and habitat loss may occur. Northern red-legged frog and western toad habitats could include watercourses that cross the GTUF, and northern red-legged frog was confirmed in King Creek in 2019 (**Figure G11-1**, **Appendix G**: Vegetation and Wildlife Resources Figures) as well as near the GTUF in 2017 (Brooks 2017). North Creek and watercourses in the Serpentine Valley may also provide suitable habitat for at-risk amphibians.

Culvert extensions and drainage realignment in the ROW adjacent to the GTUF may potentially affect habitat for at-risk species that depend on aquatic habitat (e.g., northern red-legged frog, **Figure G11-1**, **Appendix G**: Vegetation and Wildlife Resources Figures) by changing water flow rate, quality, and volume.

Habitat along the Project alignment is suitable for various at-risk bird and bat species, and removal or alteration of habitat may affect their use of the wildlife study area. Proposed critical habitat for barn owl (Environment and Climate Change Canada 2021) overlaps with the wildlife study area. Due to their ubiquitous distribution throughout Metro Vancouver, little brown myotis are assumed to use the Fraser Highway ROW, especially where native vegetation or watercourses are present. Little brown myotis and barn owl may also inhabit structures.

11.4.1.2 Construction Effects on Invasive Species

Earthworks and the movement of equipment will increase areas of exposed soil and could provide vectors for spreading seeds and other plant materials. The movement and storage of excavated or contaminated materials may lead to the introduction or dispersal of noxious and invasive plants, such as knotweed species and Canada thistle (**Figure G11-1**, **Appendix G**: Vegetation and Wildlife Resources Figures). Excavation of areas containing invasive species can distribute propagules of species, such as knotweeds, Himalayan blackberry and reed canarygrass, all of which can regenerate from small fragments of root (Metro Vancouver and the Invasive Species Council of Metro Vancouver 2021).

There may also be temporary disturbances to ecological communities if temporary construction laydown areas are located within naturally vegetated areas. Any construction materials, equipment, or machinery in laydown areas have the potential to spread invasive and noxious plant species, especially to areas of disturbed soil.

It is important to recognize the potential for the inadvertent introduction of harmful exotic animal species, such as European fire ants. This species is not known to be present in the wildlife study area, but it can be spread by importation of soil or plants (ISCBC 2022). Other species, such as rock pigeons and brown and roof rats (*Rattus* spp.), may be attracted to improperly disposed-of construction waste.

11.4.1.3 Operation

Without active vegetation management during Project operation, noxious and/or invasive vegetation could spread from the Project area to adjacent naturally vegetated areas. The BC *Weed Control Act* requires the control of noxious species by the land manager. Other invasive species, such as the European chafer beetle and European fire ants, could be spread by landscaping materials, while rock pigeon and brown and roof rats may be attracted to improperly disposed waste. The SkyTrain infrastructure itself may provide nesting opportunities for non-native species, such as European starlings and rock pigeons.

11.4.2 Effects on Wildlife Habitat and Ecological Communities

This section presents the results of the assessment of Project-related effects on wildlife habitat and ecological communities in the footprint area during construction and operation.

11.4.2.1 Construction

Construction activities, including clearing, grubbing, and demolition, may result in direct or indirect effects to wildlife habitat. Where construction activities are adjacent to the GTUF, site preparation activities, including clearing and grubbing, will occur only within the ROW and adjacent non-park land (**Figure G11-I1**, **Appendix G**: Vegetation and Wildlife Resources Figures). However, a small number of trees within the ROW that will need to be removed (see **Table 11-8** below) may provide breeding, nesting, or roosting habitat for birds and small mammals (**Figure G11-2**, **Appendix G**: Vegetation and Wildlife Resources Figures). In addition, tree removals can create new edges to forests and affect the ability of the remaining trees to withstand strong winds. New edges may also potentially spread invasive plants into relatively undisturbed naturally vegetated areas, which could lead to reduced habitat quality. Removal of buildings may also reduce availability of wildlife habitat for bat roosting (under roofs or behind siding of older buildings) and bird nesting. Equipment contaminated with weed seeds or temporary construction laydown areas that are poorly managed may result in the spread of invasive plant species, which could reduce the overall suitability of habitat for native wildlife.

During construction, changes to drainage (e.g., realignment of ditches) can potentially affect amphibian habitats, especially in areas considered highly suitable (i.e., watercourses in the ROW adjacent to the GTUF, Serpentine Valley, and North Creek area) by changing water flow rates as well as water quality and quantity, which in turn can affect breeding habitat. Excavation and management of contaminated and non-contaminated materials could result in runoff that affects nearby aquatic habitats. Contamination from spilled oils, fuels, or hydraulic fluid from construction machinery could also affect the quality of aquatic habitat.

Construction of SkyTrain stations and the PPS, as well as the installation of SkyTrain guideway infrastructure (i.e., foundations and overhead guideway) may cause sensory disturbance to wildlife. Sensory disturbance could arise from construction-related noise and vibration, including during the use of vibratory, hydraulic, and impact pile-driving equipment. Such disturbance may cause some wildlife species to temporarily avoid or be displaced from the Project area (Gladwin et al. 1988; Shannon et al. 2016). In addition, construction lighting may affect the ability of bats or nocturnal bird species to forage or migrate (Rowse et al. 2016), or act as a barrier to movement for some terrestrial species (Rich and Longcore 2013).

11.4.2.2 Operation

Sensory disturbance to wildlife from SkyTrain operation, due to increased levels of artificial lighting or noise, is possible. Different wildlife species have varying levels of sensitivity to the different types of lighting (EDI Environmental Dynamics Inc. 2016; Rich and Longcore 2013). Any changes to lighting can affect activity patterns and behaviour. Increases in artificial light could affect wildlife use of the Project area. This may be the case, particularly where there is high habitat suitability for multiple wildlife species (e.g., in the GTUF and the Serpentine Valley). SkyTrain noise during Project operation is not anticipated to have a measurable effect on wildlife as already-present species are likely conditioned to existing traffic noise levels on Fraser Highway. Additional information about construction and operation noise levels is found in **Section 8** Noise and Vibration.

Minor increases to impervious surfaces, primarily due to the presence of new station and PPS infrastructure, may alter flows to adjacent watercourses, which may affect habitat for aquatic species including amphibians and small mammals.

Vegetation management during Project operation also has the potential to cause transitory disturbance to wildlife, including potential disturbance of bird nests (e.g., the use of power tools to manage vegetation around SkyTrain and associated stations).

11.4.3 Effects on Connectivity of Green Space

This section presents the assessment of Project-related effects on green space and the connectivity of green space in the Project footprint during construction and operation.

11.4.3.1 Construction

The Project footprint is located mostly within the ROW of Fraser Highway (**Figures G11-1 and G11-2, Appendix G**: Vegetation and Wildlife Resources Figures). The Project's RCD and assumed temporary work areas helped to inform required vegetation clearing, but final design and configuration of temporary work areas will be confirmed by the Project Co. As the temporary footprint includes both at-ground and aerial work spaces, the actual number of trees affected is likely to be less than depicted in **Table 11-8**.

Overall, 1,644 trees are located in the temporary and permanent Project footprints. The majority of these trees (estimated 1,323 trees) are street or boulevard trees located between 148 Street and 196 Street. As the Project footprint adjacent to the GTUF is located within the ROW, it is not likely that trees in the GTUF will be affected. Up to six deciduous trees located near 140 Street and Fraser Highway may require removal to make way for the permanent footprint at the 140 Street Station (**Figure G11-2, Appendix G**: Vegetation and Wildlife Resources Figures).

Table 11-8 Summary of Trees in the Project Footprint by Alignment Section[46]

Section of Project Alignment	Temporary Footprint			Permanent Footprint			Cumulative Totals
	Coniferous	Deciduous	Total Temporary Footprint	Coniferous	Deciduous	Total Permanent Footprint	
King George Station to 140 Street	0	1	1	0	0	0	**1**
140 Street to 148 Street [2]	0	0	0	0	6	6	**6**
148 Street to 196 Street	90	734	824	131	618	749	**1,574**
196 Street to Langley Bypass (Township of Langley)	0	11	11	0	11	11	**22**
Langley Bypass to Terminus (City of Langley)	0	6	6	0	35	35	**41**
Total Trees	**90**	**753**	**843**	**131**	**670**	**801**	**1,644**

Notes:

1. Number of trees to be confirmed with pre-clearing arborists' survey.
2. Trees in Project footprint within and outside of the GTUF.

The Project overlaps with approximately 1.7 ha of the GIN, including a GIN hub in GTUF, and GIN corridors along the BC Hydro ROW at Quibble Creek, Serpentine River, and North Creek (**Figure G11-1**, **Appendix G**: Vegetation and Wildlife Resources Figures). Most of the two GIN areas near GTUF (i.e., the corridor at Quibble Creek and the hub in the park) have been previously disturbed to accommodate the existing

[46] Tree numbers approximate as the level of accuracy of the desktop tree inventory is constrained by limitations in imagery quality and from merging independent datasets.

overhead transmission lines and underground utilities and are, therefore, lower in habitat quality compared to the rest of the GTUF. The Project is expected to have minimal impacts on the Quibble Creek corridor and GTUF hub due to the previous disturbances at these sites. Project interactions with GIN corridors near the Serpentine River and North Creek are also anticipated to have low impacts as vegetation removal in these areas will be minimal. Some impacts to existing vegetation in these GINs are expected from the required BC Hydro transmission system relocations to accommodate the elevated SkyTrain guideway.

Removal of street trees or other vegetation in the Project footprint could result in the direct loss of habitat, and subsequently alter the quantity, quality, or connectivity of green space corridors for migratory birds and other wildlife. Street trees and shrubs can also provide nesting habitat or function as movement corridors for migratory birds and other wildlife. Connectivity may be temporarily limited or altered due to fencing (e.g., for site security or sediment control), clearing, and other construction activities.

No net increase in edge habitat is anticipated as no additional linear features will be created. Although the Project alignment bisects the GIN hub at the GTUF, it will follow Fraser Highway within the City of Surrey road ROW, so the addition of the guideway is expected to have a minimal impact on the GIN network. The GIN hub's function as a connection point between corridors is not expected to change as a result of the Project.

11.4.3.2 Operation

Connectivity of green space is not expected to change adversely during Project operation, as the SLS is within an established transportation corridor that bisects the green space. Trees planted for the Project will mature and provide additional connectivity. However, trees identified by an arborist as being at high risk to the guideway or other infrastructure, will be selectively removed or pruned, as necessary, during operation.

11.4.4 Effects on Wildlife Mortality or Injury

This section presents an analysis of the potential for mortality or injury to wildlife during Project construction and operation.

11.4.4.1 Construction

The potential for injury to or loss of terrestrial wildlife is greatest during construction-related clearing and grubbing activities. Risk to tree-roosting bats and migratory birds may increase if vegetation clearing and grubbing activities occur during the roosting or breeding periods[47]. Similarly, roosting bats and nesting birds occupying buildings slated for demolition may also be at risk if demolition occurs during the breeding period and pre-demolition surveys are not conducted. Any clearing and grubbing activities near watercourses, including ditches, may result in loss of amphibians or other aquatic species (e.g., Lay Creek, King Creek, Serpentine River, North Creek (**Figure G11-1**, **Appendix G**: Vegetation and Wildlife Resources Figures**)**.

[47] Roosting period for bats in the Metro Vancouver is April through August (Government of BC 2016); the general nesting season for migratory birds in the Metro Vancouver is mid- March through mid-August (Government of Canada (2018).

The Project only requires limited widening of existing multi-lane roads and no new transportation corridors are being created. Reductions in traffic speeds during construction will help reduce wildlife mortality in construction zones. Any potential increases in wildlife injury or mortality will likely occur primarily during construction due to increased human activities, and vehicle and machinery use.

Open excavations pose a hazard to wildlife which could fall into excavations and potentially trapped and buried. In addition, stored excavated material or construction waste may attract species that forage in fresh soil, use stored material for nesting, or are attracted to garbage, such as striped skunk (*Mephitis mephitis*), or raccoon (*Procyon lotor*). If the presence of wildlife species increases in and around construction areas due to attractants, it may adversely affect their survival (e.g., due to animals being accidentally struck by vehicles or having to be controlled).

11.4.4.2 Operation

Widened road areas could disproportionately affect small, less-mobile species, such as amphibians, reptiles, and small mammals. However, Project-related road widening is anticipated to be negligible and primarily located in areas of low-quality wildlife habitat (e.g., at existing intersections). The presence of the elevated SkyTrain guideway, particularly in the vicinity of the GTUF and the Serpentine Valley where there is significant green space on either side of the Fraser Highway, will retain much of the existing habitat connectivity. However, the presence of the guideway may result in birds or bats flying across Fraser Highway below the guideway. Low-elevation flight may increase the potential for interactions with vehicles travelling along Fraser Highway and could result in injury of death of some wildlife.

The train is expected to operate at an average speed of 44 km/h - with a maximum speed of 80 km/h - compared to a speed limit of 60 km/h for vehicles on Fraser Highway. SkyTrain operation may result in increased risk for flying wildlife (i.e., birds and bats) that attempt to fly across the guideway while a train car is passing (Erickson et al. 2005; La García de Morena et al. 2017). There is, however, no available documentation of wildlife strikes on existing SkyTrain lines or similar transit infrastructure (i.e., elevated train lines) from other jurisdictions.

Increased human presence at and around SkyTrain stations during operation may also increase risk to species, such as coyotes or raccoons if they are attracted to waste, lighting, or general human activity. Rock pigeons attracted to stations may create issues with train operation if they land on the SkyTrain tracks. Animals that become problematic are at risk of being trapped and destroyed.

New SkyTrain stations, especially those with areas of glass or clear panels, also present a moderate to high likelihood of bird strike mortalities (Loss et al. 2014). Design criteria for new SkyTrain stations reflect improved passenger safety considerations and may result in the use of large amounts of external glass for natural lighting and passenger visibility and safety. Bird window strikes are a common source of bird mortality (Klem 1990) that is potentially underestimated for commercial buildings (Hager et al. 2008).

11.5 Mitigation Measures

The Province will follow a hierarchical approach to avoid or minimize effects on the vegetation and wildlife resources SE. A significant mitigation measure that was adopted as part of the RCD design process was the decision to locate the Project within the existing ROW, in a busy, developed urban transportation corridor. For Vegetation and Wildlife Resources, the relevant Project stages for implementing mitigation are during design (denoted as "D"), construction (denoted as "C") and operation (denoted as "O").

Content from this section will be incorporated into the CEMP Framework (see the TOR for additional description of this document). As its name implies, the Project's CEMP Framework document will provide detailed guidance for the content of the Project Co's CEMP. In addition to mitigation and performance objectives, the CEMP Framework will describe best practices to help meet the performance objectives and required content for each sub-plan. The CEMP Framework will also include details on Project roles and responsibilities for the Project Co's key team members.

11.5.1 Construction

The Project will prioritize the following mitigations:

- Avoid potential effects on vegetation and wildlife through Project design, location, layout and scheduling;
- Minimize potential effects when they cannot be fully avoided (e.g., limit temporal or spatial extents of work, conduct work in less-sensitive time periods, use technology that reduces known impacts to vegetation and wildlife);
- Restore areas where effects could not be avoided or minimized (e.g., revegetate areas after construction is complete); and
- Use native species for restoration of riparian areas affected during construction.

As this is a provincial Project, standard requirements for environmental protection described in the DBSS (Government of BC 2019c) will be used. Additional standard mitigation measures applied may include standards, guidelines, and best management practices that are framed by specific documents, including:

- Best Management Practices for Bats in British Columbia (Government of British Columbia 2021);
- Best Management Practices for Soil Movement and Disposal (ISCBC 2018);
- Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in British Columbia (Government of BC 2004);
- Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia (Government of BC 2014c);
- Guidelines for Raptor Conservation during Urban and Rural Land Development in British; Columbia (Government of BC 2013b);
- General Nesting Periods of Migratory Birds in Canada (Government of Canada 2018);
- Migratory birds: technical information on risk factors (Government of Canada 2017b);
- Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia (Government of BC 2014b);
- A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (Government of BC 2014a);
- Project and Environmental Review Guidelines – Lighting (PMV 2015)
- Various best management practices for invasive species in Metro Vancouver (ISCBC 2021b);
- Invasive Species Strategy: 2018-2022 (ISCBC 2017);
- Township of Langley's Tree Protection Bylaw (Township of Langley 2019); and
- City of Surrey's Tree Protection Bylaw (City of Surrey 2006).

Many of the standard mitigation measures to avoid or reduce potential construction-related effects will be described in a Vegetation and Wildlife Management Plan, which will be developed and implemented as a component of the CEMP, and will include:

- Best practices to avoid or limit potential effects on vegetation and wildlife;
- Best practices to prevent the spread and introduction of invasive species (e.g., soils management);
- Procedures developed by an AQP to mitigate potential effects to wildlife or wildlife habitat (e.g., garbage management);
- List of construction activities that will require an AQP on site;
- Environmental constraint drawings showing ESAs and habitats and timing windows; timing windows for vegetation clearing consistent with MBCA guidance and procedures, including if time frames cannot be met;
- Measures to retain existing vegetation wherever possible;
- Measures to securely store and dispose of waste generated by the Project;
- List of applicable environmental permits and approvals necessary for works;
- Measures to protect nearby aquatic habitat (e.g., erosion and sediment control, spill management);
- Vegetation restoration plans developed by an AQP, including use of native and recommended boulevard plant species;
- Measures to reduce wildlife injury and mortality; and
- Measures for monitoring the effectiveness of vegetation and wildlife mitigation during construction.

To monitor effective implementation of mitigation measures and to check conformance with Project requirements, environmental monitoring by AQPs will be undertaken in accordance with the DBSS (Government of BC 2019c).

11.5.2 Operation

During SLS operation, vegetation and landscaping management measures, similar to those in place for the existing SkyTrain system, will be implemented. TransLink will routinely manage unwanted vegetation, tree growth, and noxious weeds near the guideway up to 10 m as part of the Environmental Management System Program (BCRTC 2022). It is possible that management of a buffer area beyond that 10m will also occur to maintain visibility, reduce hazards, or improve aesthetics. An arborist will report on a routine basis to assess tree conditions along the alignment. TransLink has a statutory responsibility under the BC *Weed Control Act* to control the spread of noxious weeds along the SkyTrain.

11.5.3 Design Mitigation

During the development of the RCD, efforts to avoid or reduce unnecessary effects on terrestrial vegetation and wildlife were a key objective. This has been accomplished through its elevated alignment, and careful planning and route selection. As the design progresses, many potential areas of conflict can be avoided by taking an anticipatory approach to potential effects.

Mitigation M11.D-1 RCD Optimization

The Project team incorporated the following design measures into the RCD to reduce or avoid disturbance to wildlife and vegetation resources:

- The elevated guideway is contained within the existing transportation corridor (Fraser Highway) wherever possible;
- Within the GTUF section, the elevated guideway is located in the median of the Fraser Highway to avoid impacts to the areas of more mature forest; and
- Through the Serpentine Valley, the elevated guideway is located on the south side of Fraser Highway with a clearspan structure over the river to minimize effects to riparian and aquatic habitats.

Mitigation M11.D-2 Wildlife Mitigation Design

The performance objective of this measure is to reduce adverse effects to wildlife during the Project's operation, including bird strikes with station glazing, and potential disturbance to wildlife due to artificial lighting.

Birds may be injured or killed due to accidental collisions with the exterior glazing of SkyTrain stations. The *Vancouver Bird Strategy* (City of Vancouver 2015b) and *Bird-friendly Design Guidelines* (City of Vancouver 2015a) with respect to building and landscape design for SkyTrain stations identify mitigation to help to inform design. For example, where there is a 'fly-through' condition for birds at stations, bird-friendly glazing is recommended as follows:

- Apply bird-friendly pattern to station glazing;
- Use a pattern density of 100 millimetres (mm) x 100 mm or less;
- Use visual markers at least 5 mm in diameter, light in colour, and high contrast with a 50% translucency;
- Use a ceramic frit application that is tempered to create a permanent opaque coating; and
- Avoid tinted glass when selecting bird-friendly glazing.

Artificial lighting can adversely affect wildlife by either attracting some species while disturbing others. The City of Surrey has recommended the following measures to minimize impacts of street lighting to wildlife, particularly for the GTUF section of Fraser Highway (i.e., 140 Street to 148 Street):

- Pre-install hoods on fixtures to direct light downward to minimize light trespass;
- Allow for future dimming potential; and
- Ensure future ability to switch out bulbs for a more wildlife-friendly wavelength (e.g., amber or yellow green), as research into wavelength impacts on wildlife advances.

LED lighting can reduce potential effects on wildlife as it enables more precise control of where light is cast, allowing for reduced horizontal and upward light emissions that often contribute to skyglow (EDI Environmental Dynamics Inc. 2016). LED lighting also allows for a centralized management system that can be used to remotely dim streetlights to various degrees of brightness. LED technology is a rapidly evolving field and dimming technologies implemented for energy savings are anticipated to also benefit wildlife.

11.5.4 Construction Mitigation

An AQP should develop and oversee the implementation of the following environmental mitigation measures.

Mitigation M11.C-1 Minimize Vegetation Clearing Wherever Possible

The performance objectives of this measure are to retain as much green space as possible, minimize the amount of wildlife habitat removed, minimize the potential for wildlife mortality, and reduce the likelihood of spreading invasive species in the Project area.

Specific mitigation measures to meet these objectives include:

- Design the Project to avoid or limit vegetation clearing and tree removal wherever possible (described in M11.D-1);
- Develop Project-specific environmental constraint drawings;
- Clearly mark clearing boundaries with flagging, fencing, or signage at all work sites;
- Clearly mark GIN areas and Sensitive Ecosystem Development Permit Areas (i.e., streamside protection areas) to delineate avoidance or disturbance setbacks on construction drawings and in the field; and
- Ensure Environmental Monitors are present prior to and during activities conducted in ESAs.

Mitigation M11.C-2 Conduct an Arborist Survey Prior to Clearing

The performance objective of this measure is to accurately identify, locate, quantify, and document trees along the alignment prior to clearing with assessment by an arborist AQP. The Project will replace trees removed based on the AQP's recommendations and will work with municipalities to determine appropriate tree replacement. The desktop assessment of tree impacts has helped inform the general tree impacts and has informed the planned mitigation strategy and budgets. However, additional detail is required for implementation.

The arborist's report should provide the following:

- Danger tree assessments prior to and during construction;
- Detailed information about hazard trees, tree removal, tree root protection zones, and potential re-use of removed trees;
- Detailed information about the removal of any culturally important trees (such as western redcedar) or trees with firewood value that would then be shared with local First Nations;
- Identification and quantification of trees that require removal;
- Prescriptions for tree species appropriate for climate adaptation (Diamond Head 2016b) and meet TransLink requirements for size, siting and other parameters;
- Details about hazard trees and tree removal clearly marked on Project construction drawings and in the field:
    - Project clearing boundaries with flagging and signage at all work sites with monitoring to confirm that clearing boundaries are maintained to avoid encroachment on adjacent natural /vegetated areas; and
    - Defined boundaries for ESAs (e.g., streamside protection areas and GIN areas) for avoidance or disturbance setbacks.

The Project team will seek opportunities to plant replacement trees within the proposed SkyTrain corridor. Planning for any plantings will be undertaken in conjunction with the Three Municipalities. The replacement forest canopy and use of native tree species and/or climate-adapted species will provide habitat for wildlife and support continued connectivity of green spaces, enhancing the quality of the GIN hubs and corridors. For any trees that will be planted away from busy transportation corridors, consideration of species that provide significant habitat values for native wildlife will be given priority.

To support defining areas of vegetation clearing, pre-clearing rare plant and invasive plant surveys within the Project alignment are recommended.

Mitigation M11.C-3 Invasive Species Management

Invasive species management will seek to avoid or minimize the spread of invasive species into or out of the Project area during construction. Invasive species, such as noxious weeds and undesirable non-native species, are easily spread when soils are disturbed and moved to and from sites. These species are very difficult to eradicate once established, so the optimal approach is to prevent their spread.

Invasive species management, as part of the Vegetation and Wildlife Management Plan in the CEMP, will provide direction during construction on pre-clearing invasive plant survey, identification of species of concern, management of imported materials and materials moved around the Project area, treatment strategies (e.g., cleaning of equipment, soil management, removals) and plans for revegetation to prevent incursion of invasive species. Given that the Project area has identified areas with established noxious plant infestations, such as Japanese knotweed, the treatment, removal, and disposal methods should be considered and addressed in the Vegetation and Wildlife Management Plan to prevent the spread of this invasive species, particularly in ESAs (e.g., riparian areas, the GTUF) and adjacent to actively farmed areas (e.g., Serpentine Valley), using guidance from the ISCMV.

Mitigation M11.C-4 Conduct Vegetation Clearing Outside of Bat Roosting and Breeding Bird Seasons

This mitigation measure seeks to avoid risk to birds and bats, such as injury or mortality, during Project construction. Bat and bird species may use trees, shrubs, and other habitat along the alignment during critical life stages (e.g., nesting or maternity roosting). Clearing and grubbing activities during site preparation will be scheduled to avoid periods of bat roosting and migratory bird breeding (mid- March through September). Clearing and grubbing will take place during the least sensitive periods (e.g., September to February) as much as possible to minimize risk. If adherence to least-risk timing windows is not feasible, the AQP will conduct pre-clearing surveys for active bird nests, roosting of at-risk bat species, and complete pre-construction surveys for protected bird nests (e.g., eagle or heron) to meet MBCA and *Wildlife Act* requirements.

Mitigation M11.C-5 Conduct Amphibian Survey and Obtain Salvage Permits

Amphibian surveys are required to minimize the potential for mortality of amphibians present in aquatic habitats along the alignment, particularly in the ROW adjacent to the GTUF. As part of the Vegetation and Wildlife Management Plan, procedures for amphibian surveys and salvages will be developed following *Best Management Practices for Amphibian and Reptile Salvages in British Columbia* (Government of BC 2016b) and in accordance with permits. Surveys should be conducted no more than seven days prior to the start of construction to identify areas affected by the work where amphibians are present. Any required salvage of native amphibians will take place, prior to construction. These measures are to be implemented during Project activities that may affect aquatic habitats during the amphibian breeding season (approximately March through August).

Mitigation M11.C-6 Conduct At-risk Invertebrate Survey

Surveys are required to minimize the potential for injury or mortality of at-risk invertebrates (e.g., Oregon forestsnail, western thorn) where Project activities could affect suitable habitat along the alignment. The Vegetation and Wildlife Management Plan should include a program of surveys and salvages for as-risk invertebrates, that are developed and implemented by an AQP. To identify at-risk invertebrates, pre-clearing surveys should be conducted at suitable times of year and weather to optimize detection. For at-risk invertebrates encountered during surveys, a detailed translocation plan will be required in advance of salvages to identify suitable habitat to relocate salvaged individuals.

Mitigation M11.C-7 Conduct Pre-Clearing Surveys

The objective here is to minimize the potential loss of protected habitat features and/or species, including those not previously detected during baseline surveys. Pre-clearing surveys should be completed prior to construction to confirm locations of sensitive wildlife habitat features, such as raptor nests protected under the BC *Wildlife Act*, nests protected under the MBCA, amphibian breeding sites, and other protected habitats and species as well as of invasive and noxious species infestations.

Some wildlife habitat features are afforded protection under the BC *Wildlife Act* (e.g., nests of some bird species are protected year-round). While not observed during the field assessments, protected wildlife habitat features can be created each year. For example, bald eagles can begin construction of a new nest as early as January, while other species may be as late as March or April (MOE 2013). For this reason, pre-clearing surveys completed prior to construction are recommended to search for important habitat features, such as stick nests. .

Building demolition should be scheduled between October and March to minimize the potential for impacts on breeding wildlife. An AQP should inspect each building prior to demolition for presence of species-at-risk, bird nests, or bat roosts. Additional surveys or bat exclusion, following guidance in Craig (2016), may be needed based on the results of the assessment.

Mitigation M11.C-8 Adaptive Management of Mitigation

The performance objective of this measure is to refine mitigation if construction measures fail to achieve their intended performance objective (e.g., adequately protect at-risk species or encounter with a previously undetected noxious weed species). For example, although the Pacific water shrew has not been detected in the wildlife study area, it is possible that this species may be present

Spatial data provided by pre-construction inventories (e.g., for noxious weed species) and lessons learned during construction should be incorporated into environmental management planning and implementation to support adaptive management. Contingency measures should be developed to address a variety of potential scenarios (e.g., chance find of a previously undetected species at-risk) during construction. This information should be reflected in updated CEMP mitigation.

Mitigation M11.C-9 Landscaping and Revegetation Management

This mitigation measure seeks to improve and hasten revegetation of exposed soils, improve habitat for wildlife, provide a vegetated barrier between the transportation corridor and naturally vegetated areas (i.e., the GTUF, Serpentine Valley), and reduce the potential spread of invasive vegetation into naturally vegetated areas. Site-specific landscaping and revegetation can protect against soil erosion, provide barriers to weeds and unwanted vegetation, and hasten the naturalization of forest edges to provide habitat for wildlife more quickly following construction. Vegetated barriers protect forested areas outside of the Project from encroachment by people and undesirable conditions, such as dust, wind, and sun.

The Vegetation and Wildlife Management Plan and Site Restoration Plan are CEMP component plans and will provide specific directions for site preparation, planting, and maintenance, such as lists of appropriate species combinations for each type of site, information on the moisture regime and aspect, effective plant sizes and densities, and consideration of cultural importance and climate change. Site restoration will consider the need for tree replacement. Native vegetation species are preferable for long-term planting, but non-native species may be most suitable for initial site stabilization (e.g., erosion control) or site limitations for height and root dimensions (e.g., boulevard trees). For replacement trees that will be planted away from busy transportation corridors, priority consideration should be for species that provide significant habitat values for native wildlife. Species of importance to local First Nations, particularly those of native berry, nut and fruit shrub and tree species, should also be considered as priority planting prescriptions as should climate-resilient native species.

11.5.5 Operation Mitigation

Mitigation M11.O-1 Mitigation Effectiveness Surveys for Wildlife

Effectiveness monitoring is recommended to determine whether additional mitigation may be required to reduce bird or bat strikes that result from interactions with station glazing (see M11.D-2) or with moving SkyTrain cars. Although bird or bat strikes are likely to occur, the magnitude of the risk needs additional research, as actual occurrences from similar infrastructure projects may be under-reported (Erickson et al. 2005; La García de Morena et al. 2017). Once the SkyTrain testing and commissioning is underway or during initial operation, carcass surveys are recommended to determine if bird or bat strikes are a significant issue, particularly adjacent to suitable habitat where this situation is likely to occur. Survey data could then be used to determine whether existing mitigation is effective or additional mitigation measures are warranted.

Mitigation M11.O-2 Mitigation Effectiveness Surveys for Plantings in Operation Stage

To assess survival rates for shrubs and trees following Project planting and during the warranty period, a target of 90% survival over the required monitoring period is recommended. Post-construction effectiveness monitoring should be reported to the Province annually during the warranty period and should use standard vegetation assessment methods of Project plantings to estimate:

- Percent survival for planted vegetation; and
- Percent cover of native versus invasive species.

As spread of invasive species may affect the survival of Project plantings, pathways leading to and from SkyTrain stations should be designed with the most direct routes in mind and should incorporate replanting of appropriate shrub species along the edges of naturally vegetated areas to discourage off-trail public use. This would help to minimize the potential spread of invasive plant species during Project operation.

11.5.6 Summary of Proposed Mitigation

A summary of proposed mitigation measures and the effect(s) they address is provided in **Table 11-9**. Additional details on each measure are provided below, as well as in the CEMP Framework. Actual construction mitigation measures may vary from those listed in **Table 11-9**, depending on the Project Co’s plans and methods, but will be implemented to fulfill the stated performance objective and achieve the required level of protection. It is expected that these mitigation measures will be detailed in the Vegetation and Wildlife Management Plan and Site Restoration Plan of Project Co’s CEMP.

Table 11-9 Summary of Mitigation Measures for Vegetation and Wildlife Resources

Potential Effect	Mitigation Number	Mitigation Measures	Project Phase	Environmental Management
Effects on species or habitats of management concern	M11.D-1	RCD optimization	Design	Design Criteria
	M11.C-1	Minimize vegetation clearing wherever possible	Construction	CEMP – Vegetation and Wildlife Management Plan
	M11.C-2	Conduct an arborist survey prior to clearing		
	M11.C-3	Manage invasive species		
	M11.C-4	Conduct vegetation clearing outside of bat roosting and breeding bird seasons		
	M11.C-5	Conduct amphibian survey and obtain salvage permits		
	M11.C-6	Conduct at-risk invertebrate survey		
	M11.C-7	Conduct pre-clearing surveys		
	M11.C-8	Implement adaptive management		
Effects on wildlife habitat and/or ecological communities	M11.D-1	RCD optimization	Design	Design Criteria
	M11.C-1	Minimize vegetation clearing wherever possible	Construction	CEMP – Vegetation and Wildlife Management Plan
	M11.C-2	Conduct an arborist survey prior to clearing		
	M11.C-3	Invasive species management		
	M11.C-7	Conduct pre-clearing surveys		
	M11.C-9	Conduct landscaping and revegetation management		
	M11.O-2	Monitor effectiveness of plantings	Post-construction Operations	Design Criteria TransLink standards of practice

Potential Effect	Mitigation Number	Mitigation Measures	Project Phase	Environmental Management
Effects on connectivity of green space	M11.D-1	RCD optimization	**Design**	Design Criteria
	M11.C-1	Minimize vegetation clearing wherever possible	Construction	CEMP – Vegetation and Wildlife Management Plan
	M11.C-2	Conduct an arborist survey prior to clearing		
	M11.C-3	Invasive species management		
	M11.C-9	Landscaping and revegetation management		
	M11.O-2	Monitor effectiveness of plantings	Post-construction Operation	Design criteria CEMP – Vegetation and Wildlife Management Plan TransLink standards of practice
Mortality or injury risk to wildlife	M11.D-1	RCD optimization	Design	Design Criteria
	M11.D-2	Wildlife mitigation design		
	M11.C-1	Minimize vegetation clearing wherever possible	Construction	CEMP – Vegetation and Wildlife Management Plan
	M11.C-4	Conduct vegetation clearing outside of bat roosting and breeding bird seasons		
	M11.C-5	Conduct amphibian survey and obtain salvage permits		
	M11.C-6	Conduct at-risk invertebrate surveys		
	M11.C-7	Conduct pre-clearing surveys		
	M11.O-1	Monitor effectiveness of wildlife mitigation	Post-construction Operation	Design Criteria CEMP – Vegetation and Wildlife Management Plan TransLink standards of practice

11.6 Discussion

The four main categories of potential Project-related effects on the vegetation and wildlife SE discussed below are those that remain following the implementation of mitigation measures. This subsection provides a qualitative evaluation of the magnitude, duration, and intensity of potential effects after the application of mitigation.

11.6.1 Effects on Species or Habitats of Management Concern

Mitigation measures to limit potential effects on the abundance of species of management concern focus on detecting protected species (e.g., Oregon forestsnail, northern red-legged frog, and little brown myotis) prior to site preparation and either avoiding or managing them during construction. The Project's design limits its footprint to the extent possible (M11.D-1) and the specific need to clear vegetation should be assessed prior to construction (M11.C-1).

Other recommended mitigation includes:

- Scheduling site preparation (e.g., vegetation clearing) outside of the bat roosting and breeding bird seasons (M11.C-4), to the extent feasible;
- Documenting trees slated for removal to calculate replacement tree numbers (M11.C-2);
- Conducting amphibian surveys at watercourses where there is potential for amphibians to breed, including species at risk, such as the northern red-legged frog (M11.C-5);
- Conducting targeted pre-clearing surveys for the at-risk invertebrates in areas of potentially suitable habitat (i.e., the GTUF) (M11.C-6); and
- Conducting pre-clearing surveys to identify protected features for birds and previously undocumented habitat features, such as active migratory bird nests and nests for bald eagle or great blue heron (M11.C-7).

Mitigation measures to reduce the effects of invasive species focus on preventing the introduction or spread of invasive species, particularly noxious weeds, primarily during construction. The CEMP's invasive species management documentation (M11.C-3) should include measures to properly identify, control, handle, transport, and dispose of invasive species to limit the risk of their spread, and recommend pre-clearing invasive plant surveys to guide invasive plant management prior to construction. Revegetation with trees, shrubs, and herbaceous plants should occur shortly after soil disturbance to prevent the establishment of invasive plants in disturbed areas. To mitigate the risk of increased incursion of invasive species into natural areas and forest edges, Project landscaping and revegetation should incorporate replanting of native shrubs along the edges of natural areas. Similarly, pathways around SkyTrain stations should be designed with the most direct routes in mind and include plantings of native shrubs and ground covers to minimize unwanted foot traffic routes (M11.O-2).

Following the implementation of the mitigation measures discussed above, the change in the abundance of species of management concern, including plant and wildlife species at risk and undesirable invasive species, are expected to be low in magnitude and spatial extent, and uncommon in frequency since construction will occur in a narrow clearance corridor and in areas that have low potential for species of management concern, and vegetation clearing will only occur during construction. Mitigation measures are standard and can be implemented with confidence, and effects will be short-term in duration.

11.6.2 Effects on Wildlife Habitat and Ecological Communities

Mitigation measures to reduce effects on the abundance or quality of wildlife habitat and ecological communities are primarily focused on minimizing tree clearing to occur only where required (M11.D-1 and M11.C-1). Since the alignment is situated within an established transportation ROW, tree removal in the Project footprint will be limited, and consist primarily of street and boulevard trees.

No significant wildlife habitat features (such as stick nests) were identified as part of baseline field surveys; however, pre-clearing surveys are recommended, in accordance with best practices, prior to tree removal to confirm whether wildlife habitat features are present in the Project's permanent or temporary footprints (M11.C-7). Prior to construction, the activity status of the bald eagle nest in the Clayton neighbourhood should be assessed to determine if disturbance monitoring may be required for Project construction near the nest site.

The removal of street and boulevard trees will be required to make way for the Project and the loss of this habitat cannot be fully mitigated. To directly address the impact from the loss of this wildlife habitat, the Province has committed to replace removed trees in line with the arborist's report and municipal expectations. Vegetation will be restored in accordance with a Site Restoration Plan, focusing on tree replacement (M11.C-2) and the planting of appropriate vegetation (M11.C-9), primarily within the Fraser Highway corridor. The spread or introduction of invasive species will be managed through the implementation of invasive species management activities (M11.C-3) and described in the Vegetation and Wildlife Management Plan.

Although sensory disturbance to wildlife from artificial light and noise will occur during construction and operation, it is expected that – except for the GTUF and potentially in the Serpentine Valley – operational light and noise will be comparable to baseline conditions. Therefore, it is not expected that there will be negative sensory disturbance effects to wildlife during Project operation, particularly with the implementation of mitigation described in M11.D-2. Construction light and noise in the GTUF may interact with wildlife, but it is anticipated that the effects will be sufficiently mitigated by following measures and best practices identified in the Noise and Vibration Management Plan and the Vegetation and Wildlife Management Plan. Sensitive wildlife habitat, if documented, will be clearly marked on Project constraint mapping (M11.C-1). This habitat should be clearly demarcated in the field during construction so that disturbance to these areas can be limited by restricting the extent of clearing in these areas.

With the application of the above-listed mitigation measures and adherence to Project requirements including the CEMP, construction-related effects on habitat abundance and quality are anticipated to be low in magnitude since only a relatively small amount of habitat will be removed, and recommended mitigation measures should be in place to reduce sensory disturbance. These effects will also be limited in spatial and temporal extent such that:

- Effects will occur locally within the Project footprint;
- Effects in the temporary disturbance area will be short to medium-term in duration;
- Sensory disturbance will be limited to Project construction; and
- Replacement trees will take time to reach maturity.

During Project operation, effects are anticipated to be low in frequency, as changes in light and noise levels between baseline and Project operation are likely to be relatively minimal, and partially reversible, as construction activities end, and replanted trees provide canopy cover. Measures that minimize the impacts of street lighting to wildlife in Project areas that currently have relatively low levels of light and high wildlife values (see M11.D-2) are recommended.

11.6.3 Effects on Connectivity of Green Space

Project design (M11.D-1), minimization of vegetation clearing (M11.C-1), and tree replacement (as informed by M11.C-2) will reduce potential Project-related effects on the quantity, quality, and connectivity of GIN hubs and corridors. A key feature of the Project's design is that it is elevated and will have few adverse effects on habitat fragmentation or wildlife access.

The boundaries of GIN hubs will be clearly marked on Project constraints maps so they can be avoided wherever possible. In addition, potential effects will be limited by implementing the strategies described in invasive species management (M11.C-3), while tree planting should be designed to improve habitat connectivity for wildlife in previously unvegetated areas along Fraser Highway (M11.C-8).

Once these mitigation measures have been applied, Project-related effects during construction are expected to be:

- Low in magnitude, following tree replacements;
- Low as the effect will be limited in spatial extent, as activities will occur locally within the Project temporary or permanent footprint areas;
- Medium-term in duration, since replacing vegetation and trees will take time (e.g., 5 to 20 years) to reach maturity;
- Low in frequency, as trees will only be removed once; and
- Reversible, as trees are replanted, and the associated canopy cover is restored.

Planted trees will likely be younger and require some years to develop canopies that are similar in size to their predecessors, but this is expected to be offset by the increased number of trees that are planted. As well, 80% of trees within the footprint are relatively young boulevard trees so their replacement value will be achieved sooner than that of older trees. Overall, the minor change in quantity, quality, and connectivity of green space will extend through to Project operation.

11.6.4 Effects on Wildlife Mortality or Injury

Mitigation measures to limit potential Project-related effects of injury or mortality to wildlife are primarily focused on limiting the spatial extent of vegetation (habitat) clearing, where possible (M11.D-1 and M11.C-1), as well as planning construction activities to occur during lower sensitivity periods for wildlife (M11.C-4).

Amphibian and invertebrate pre-clearing surveys are recommended in areas of potentially suitable habitat (i.e., areas with persistent high moisture; intact tree, shrub, or herbaceous canopy cover; patches of stinging nettle; and coarse woody debris and leaf litter) to inform whether there is a need to conduct salvages for these species (M11.C-5 and M11.C-6). In addition, pre-clearing surveys will be conducted to identify habitat features that may provide habitat to wildlife (M11.C-7).

Stakeholders identified bird strikes as a topic of consideration in the Project's design and operation. Glazing at SkyTrain stations will be bird-friendly to reduce the potential for bird strikes (M11.D-2). As little data are available on the occurrence of bird injuries and deaths resulting from collisions with SkyTrain cars, surveys along the SkyTrain alignment to determine if additional mitigation is warranted is worth consideration (M11.O-1). A performance objective for the Vegetation and Wildlife Management Plan of the CEMP Framework will be to minimize adverse interactions with wildlife. Waste management mitigation measures in the Construction Waste Management Plan should outline proper waste disposal activities that control the generation of wildlife attractants during construction and minimize the potential for adverse wildlife-human interactions.

During Project construction, following application of mitigation, the potential for risk to wildlife is expected to be negligible in magnitude, low in extent (limited to the Project footprint), uncommon, and long-term in duration. It is expected that Project-related effects during operation will be negligible as the SkyTrain will operate along an existing multi-lane transportation corridor.

11.7 Conclusion

The Project alignment is located in a developed, urban environment predominantly within the ROW of existing municipal roadways. Project activities, particularly during construction, may interact with species of management concern, alter the abundance and quality of wildlife habitat, affect the green space adjacent to the GTUF and the Serpentine Valley, or otherwise affect some species and their habitat. Habitat for species at risk is located primarily outside of the Project footprint. Lands adjacent to the Fraser Highway ROW (where the Project is situated), particularly in the GTUF and Serpentine Valley, contain more favourable habitat. The location of the Project (within the existing transportation ROW) is anticipated to successfully mitigate most interactions with vegetation and wildlife resources. Additional mitigations, such as abiding by least risk timing windows, reducing construction phase vegetation clearing, and conducting pre-construction surveys of ESAs, should help to further avoid or minimize potential changes to vegetation and green spaces, wildlife movement, and wildlife habitat.

Despite design optimization, some of the 1,644 trees in the Project footprint (temporary and permanent) will require removal for construction purposes. The Project's elevated design and aerial construction method will help to minimize tree removal. Approximately 80% of trees in the footprint are relatively young street or boulevard plantings. No trees in the GTUF are slated for removal as the Project alignment is located entirely within City of Surrey ROW. To confirm the number of tree removals, an arborist's survey will form part of the final design and construction plan. Site restoration for areas disturbed by the Project, but not otherwise addressed with landscaping, will be required.

While not subject to municipal Tree Protection Bylaws, the Province is committed to delivering the Project in a manner that is consistent with the intent of local environmental guidance. As such, the Project will replace trees inline with the arborist's report and municipal expectations. Opportunities to plant replacement trees within along the SkyTrain alignment is optimal, but determination of suitable locations for any remaining plantings outside this area will be in conjunction with the Three Municipalities. The replacement forest canopy, which will comprise native and climate-resilient tree species, will provide habitat for wildlife, and support the continued connectivity of green spaces to enhance the quality of the GIN hubs and corridors.

The CEMP Framework and the CEMP will specify requirements to manage invasive and noxious species. The application of recommended mitigation measures will reduce the potential spread of invasive and noxious species in the Project area.

It is expected that sensory disturbance due to light and noise and increased risk to wildlife during construction will be limited following effective implementation of recommended mitigation.

Project-related effects on this SE are not expected to affect the sustainability of biodiversity in Surrey or Langley. Since the Project is relatively limited in size, elevated and situated within existing multi-lane roadways, the Project's effects on vegetation and wildlife resources during construction are anticipated to be temporary and reversible. In addition, during operation, with best practices implemented, impacts are anticipated to be negligible. It is recommended that post-construction effectiveness monitoring of vegetation plantings and wildlife mitigation is conducted to confirm their effectiveness.

Potential remaining effects following mitigation during construction and operation are summarized in **Table 8-17**.

Table 11-10 Summary of Potential Effects Remaining After Mitigation for Vegetation and Wildlife Resources

Potential Effect	Criterion	Rating	Rationale for Rating
Effects on species or habitats of management concern	Magnitude[1]	Low	Construction will occur in a narrow corridor, much of which is already heavily disturbed.
	Geographic Extent	Low	Most of Project area has low potential to support species at risk or their habitats. There is potential for the spread of invasive species.
	Duration[2]	Short-term	Habitats are heavily disturbed along much of corridor and clearing will only occur during construction. Localized invasive plant establishment could occur beyond construction.
	Frequency	Uncommon	Clearing will occur once.
	Reversibility	Partially reversible	Revegetation will restore some areas of habitat, but some habitat will be permanently converted.
Effects on wildlife habitat and/or ecological communities	Magnitude[1]	Negligible	During construction, clearing will remove small and site-specific areas of edge habitat. Disturbance effects during operation will likely be similar to baseline conditions.
	Geographic Extent	Low	Effects will occur locally in the Project footprint.
	Duration[2]	Medium-term	Replacement trees and plant restorations will take some time to reach maturity.
	Frequency	Uncommon	Sensory disturbance will likely be limited to Project construction
	Reversibility	Partially reversible	Replanted trees and site restoration will mitigate vegetation removal however some areas will be permanently converted to infrastructure.
Effects on connectivity – green space	Magnitude[1]	Low	Project activities will take place primarily within an active transportation corridor. Elevated Project infrastructure will maintain connectivity.
	Geographic Extent	Low	Key areas of habitat are limited to GTUF and the Serpentine Valley. Project activities will be primarily within an active transportation corridor.
	Duration[2]	Medium-term	Replanted vegetation will take time (5-20 years) to achieve function.
	Frequency	Low	Vegetation will only be removed once, during clearing.
	Reversibility	Reversible	Vegetation will be replanted and the associated canopy cover will be restored.

Potential Effect	Criterion	Rating	Rationale for Rating
Effects on wildlife mortality or injury	Magnitude[1]	Negligible	Minimal differences expected from baseline due to existing road corridor.
	Geographic Extent	Negligible	Potential risks (e.g., bird strike) only within the Project footprint
	Duration[2]	Long-term	Potential risk throughout operation phase.
	Frequency	Uncommon	Injury and mortality to wildlife are expected to be uncommon occurrences.
	Reversibility	Permanent	Potential risk is not reversible without additional mitigation.

Notes:

1. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance, and high (exceedance of criteria or threshold). Generally, magnitude is measured in terms of the proportion of the SE affected within the assessment area (for biophysical SE), or the degree within the interaction area relative to the range of natural or historic (in the case of human environment SE) variation.
2. The duration of an effect may be short-term (i.e., within the construction phase), medium term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (permanent) (i.e., extending past the life of the Project).

12 Archaeology and Heritage

12.1 Introduction

Indigenous cultural heritage is deeply connected to, but also extends beyond, the tangible objects classified as archaeological resources. Defined as culturally meaningful, connecting community members to the past, and representing a collective identity, archaeological resources represent ways of knowing and knowledge passed on through the generations. In addition to physical artifacts, archaeological resources can also include Traditional Use sites, named areas or features, and landscapes. Every Indigenous group may manage cultural heritage in a unique way, but always with respect for the past and future generations. Archaeology and heritage were selected as an SE because Project construction may result in the loss of archaeological and heritage resources that are non-renewable, very susceptible to disturbance, and finite in number. The SE was also identified as important by First Nations, regulatory agencies, stakeholders, and the public.

This SE represents archaeological and heritage resources and assessing potential effects to physical remains of the past such as ancient stone implements and petroglyphs (carvings). It also includes evidence of traditional use of the area, as evidenced by features such as shell middens and culturally modified trees. Heritage aspects of this SE include buildings, landscapes, or locations of heritage value that are registered with a municipality or the Province.

The assessment of potential effects on archaeology and heritage resources was based on the information requirements identified in the ESR TOR (**Appendix A**), conditions of First Nation and provincial permits, and guidance from the BC Archaeology Branch. This section describes AOA and AIA work completed between 2019 and 2021 for the Project.

12.1.1 Project Features Relevant to Archaeology and Heritage

Key features of the Project Description (**Section 2**) relevant to the archaeology and heritage SE include those that are intrinsic to the Project's RCD, such as its alignment and elevated components. The SLS alignment generally follows the existing transportation corridor on Fraser Highway. For the section that runs through the GTUF and the Serpentine Valley, the SkyTrain will be situated within the City of Surrey's road ROW.

The Project design, including the elevated guideway, minimizes ground-level disturbance; however, some ground-level disturbance will occur in areas of interest (AOI)s. The Project footprint for the RCD consists of permanent and temporary footprint areas (**Figure H12-1**, **Appendix H**: Archaeology and Heritage Figures). Permanent footprint areas are those associated with the physical infrastructure necessary for Project operation (e.g., stations, PPSs, SkyTrain overhead guideway and foundations), while temporary footprint areas are those associated with Project construction only (e.g., the use of temporary laydown and other work areas). Temporary footprint areas will include areas of ground-level disturbance as well as areas where only an aerial footprint is anticipated. The RCD was developed to provide proof of design concept; final design, particularly locations of guideway columns, may differ from the RCD.

The Project footprint for the RCD is approximately 59.0 ha, of which 93% (55.0 ha) is previously developed areas (e.g., pre-existing roadway, parking lots, buildings). The remaining 4.0 ha (7% of footprint) are adjacent to natural areas in parks and green infrastructure (e.g., GTUF, North Creek) and the ALR (e.g., Surrey Golf Course and farmlands surrounding the Serpentine River) where previous ground disturbance has been typically less extensive.

Project-related construction activities (e.g., utility location and relocation, temporary construction work areas) overlap with approximately 1.7 ha of natural areas. This area was calculated by estimating temporary workspace areas for the following Project features:

- Road works and parking areas – 2-m buffer;
- Guideways – 5-m buffer from edge; and
- Support columns – 4-m buffer.

SkyTrain operation and maintenance activities will typically occur within the permanent Project footprint and are not expected to interact with this SE due to the absence of ground disturbing activities beyond assessed and mitigated areas. As no interactions are expected during Project operation, this phase of the Project is not discussed further.

12.1.2 Selection as a Screening Element

Archaeology and heritage have been selected as a SE because they are non-renewable, susceptible to disturbance, and finite in number. Archaeological and heritage sites are valuable resources that are protected for their historical, cultural, scientific, and educational importance to First Nations, stakeholders, and the public. The regulatory context for these resources is outlined below in **Section 12.1.4**.

Project activities with the potential to directly interact with archaeology and heritage are primarily restricted to construction and include clearing, excavation, and movement or disturbance of soils (any surface or subsurface alterations). These activities typically occur at the beginning of projects and may result in the damage or destruction of archaeological and or heritage resources that may be present.

Review indicators for the archaeology and heritage SE were selected based on the Project scope in the TOR and a review of potential Project-related effects. **Table 12-1** presents the potential effects of the SLS on archaeology and heritage SE, a description of review indicators, and the rationale for their selection.

Table 12-1 Selection of Indicators

Potential Effect	Review Indicator(s)	Rationale for Selection
Disturbance or destruction of archaeological resources, including sites and areas of archaeological potential (known and unknown)	• Areas of designated high archaeological potential that may be affected • Number and description of archaeological sites with the potential to be altered	Project activities involving surface or subsurface alterations may interact with archaeology and heritage sites and may result in the damage or destruction of these resources.
Disturbance or destruction of heritage resources, including buildings, landscapes, or locations of heritage value (known and unknown)	• Number and description of heritage sites with the potential to be altered	Project activities involving surface or subsurface alterations may interact with heritage sites and may result in the damage or destruction of these resources.

12.1.3 Spatial and Temporal Boundaries

This section presents the spatial and temporal boundaries identified for the Project study area.

12.1.3.1 Spatial Boundaries

The spatial boundaries for the archaeology and heritage assessments are described below. The Project AIA study area is defined as a 200 m buffer on either side of the centreline [48] of the 16 km-long alignment. The AIA study area is shown in **Figure H12-1** of **Appendix H**: Archaeology and Heritage Figures.

12.1.3.2 Temporal Boundaries

The following temporal boundaries were considered in this assessment:

- Planning phase: 2020 to 2024;
- Construction and commissioning phase: 2024 to 2028; and
- Operation (including maintenance) of Project: 2028 and beyond.

As direct effects to archaeological and heritage resources and objects would most likely occur during Project construction, the assessment is focused on this phase.

12.1.4 Regulatory and Policy Context

This section outlines provincial and municipal government[49] legislation as well as bylaws that apply to Project activities and have the potential to affect archaeology and heritage. Note that, in addition to the listed regulations and policies, Project Co will be required to follow the DBSS (Government of BC 2019c), including Section 165 Protection of the Environment. Applicable legislation is summarized in **Table 12-2**, and key bylaws, policies, guidelines, and permitting requirements are summarized in **Table 12-3**.

48 Note that, for the AOA, a spatial boundary of 1 km on either side of the alignment was used to better understand where known archaeological sites that may occur.

49 No federal lands occur in the Project footprint, therefore federal requirements for heritage protection do not apply.

Table 12-2 Key Legislation Summary

Legislation	Responsible Agency	Relevant Aspects of Legislation	Applicability to the Project
Provincial			
HCA, RSBC 1996, c. 187	FOR (Archaeology Branch)	Archaeological sites in BC pre-dating 1846 are protected under the HCA on provincial, regional, municipal, or private lands. Heritage inspection and investigation permits are issued under HCA s.12.2 and are used to assess the archaeological significance of land or other property and determine the presence of archaeological sites that require protection. Heritage investigations are undertaken to recover information that might otherwise be lost due to site alteration or destruction. Site alteration permits are issued under HCA s.12.4 to authorize the removal of residual archaeological deposits once an inspection and/or investigation are complete and a mitigation plan is accepted by the Archaeology Branch.	Project development will require ground-altering activities that could disturb/impact archaeological and or heritage resources.
BC Local Government Act, RSBC 2015, c. 1	FOR	Under this act, local governments have the authority to manage registered historic places and or properties.	Project development activities may interact with historic places.

Table 12-3 Key Bylaws and Policies Relevant to Archaeology and Heritage

Bylaws and Policies	Responsible Agency	Relevant Aspects of Bylaws and Policies	Applicability to the Project
International			
The Declaration on the Rights of Indigenous Peoples	United Nations	Articles relating to the management of archaeological and historical resources in the Declaration include: Article 11: 1. “Indigenous peoples have the right to practise and revitalize their cultural traditions and customs. This includes the right to maintain, protect, and develop the past, present, and future manifestations of their cultures, such as archaeological and historical sites, artifacts, designs, ceremonies, technologies, and visual and performing arts and literature. 2. States shall provide redress through effective mechanisms, which may include restitution, developed in conjunction with Indigenous peoples, with respect to their cultural, intellectual, religious, and spiritual property taken without their free, prior, and informed consent or in violation of their laws, traditions, and customs.” Article 12: 1. “Indigenous peoples have the right to manifest, practice, develop, and teach their spiritual and religious traditions, customs, and ceremonies; the right to maintain, protect, and have access in privacy to their religious and cultural sites; the right to the use and control of their ceremonial objects; and the right to the repatriation of their human remains. 2. States shall seek to enable the access and/or repatriation of ceremonial objects and human remains in their possession through fair, transparent, and effective mechanisms developed in conjunction with Indigenous peoples concerned.”	Project development will require activities that could disturb/impact archaeological, historical, cultural, ceremonial and/or traditional use resources and sites.

Bylaws and Policies	Responsible Agency	Relevant Aspects of Bylaws and Policies	Applicability to the Project
		Article 31: 1. “Indigenous peoples have the right to maintain, control, protect, and develop their cultural heritage, traditional knowledge, and traditional cultural expressions, as well as the manifestations of their sciences, technologies, and cultures, including human and genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs, sports and traditional games, and visual and performing arts. They also have the right to maintain, control, protect, and develop their intellectual property over such cultural heritage, traditional knowledge, and traditional cultural expressions. In conjunction with Indigenous peoples, states shall take effective measures to recognize and protect the exercise of these rights.”	
Provincial			
Archaeological Overview Assessments as General Land Use Planning Tools – Provincial Standards and Guidelines (Government of BC 2009a)	Archaeology Branch	Outlines Provincial AOA standards.	AOAs are used to determine the need for detailed archaeological studies and mapping of archaeological potential to assist planning. The Project has undertaken an AOA to assess potential impacts to archaeological and/or heritage resources and determine appropriate management of these resources.
Archaeological Impact Assessment Guidelines (Government of BC 1998)	Archaeology Branch	Outlines procedures for archaeological resource assessment, review and permitting.	AIAs are initiated in response to development proposals that could disturb or alter archaeological sites and support decision-making for effective management of archaeological resources (Government of BC 2021a). Archaeological site evaluation criteria are based on scientific, public, ethnic, economic, and historic significance. The Project’s ground-altering activities could affect archaeological and or heritage resources. The Project has an HCA permit and is reporting on AIA.

Bylaws and Policies	Responsible Agency	Relevant Aspects of Bylaws and Policies	Applicability to the Project
Found Human Remains Policy (Government of BC 1999)	Archaeology Branch	Provides guidelines for handling human remains that may be protected under the HCA.	This policy provides directives regarding found human remains, guidelines for Archaeology Branch staff, archaeologists, other agencies, and the public regarding Branch procedures for handling human remains that may be protected under the HCA, and requirements that facilitate the respectful treatment of these remains (Government of BC 2021b). The Project requires ground-altering activities, which have the potential to disturb/impact human remains, if present.
Indigenous Community			
Indigenous Archaeology and Heritage Permits Kwantlen First Nation (Seyem' Qwantlen), Stó:lō Research and Resources Management Centre; xʷməθkʷəy̓əm (Musqueam Indian Band), Katzie First Nation	First Nations	Archaeological sites in BC are protected under the HCA and may not be altered or changed in any manner without a permit.	Recognized as an Indigenous engagement and archaeological best practice, application for Indigenous-specific heritage and archaeology permits is required The Project has obtained and maintains these permits for the planning phase of the Project.

Bylaws and Policies	Responsible Agency	Relevant Aspects of Bylaws and Policies	Applicability to the Project
Municipal[50]			
Zoning By-Law, 12000, 1993, and Surrey By-Law, 13282, 1997	City of Surrey	Properties and features designated as heritage by law, heritage revitalization agreement, or heritage conservation covenant are listed in the City of Surrey Community Heritage Register. For new structures adjacent to designated heritage properties/ features, the bylaw requires details on the proximity to heritage features, permitted uses and amount of parking.	Project development activities may interact with designated heritage sites.
Heritage Strategic Review (City of Surrey 2010) Heritage Strategic Review Implementation Plan Update (City of Surrey 2016b)	City of Surrey	Offers a vision for Surrey's Heritage Program to enable it to effectively conserve, interpret, and celebrate Surrey's heritage. These documents provide a background of past heritage awareness and planning initiatives; define the community's vision, goals, and strategies for the program; and describe an implementation plan.	The Project has the potential to affect heritage properties and features.
Zoning/Development By-Law, 2500, 2021	Township of Langley	Properties and features designated by heritage bylaw, heritage revitalization agreement, or heritage conservation covenant, are listed in the Township of Langley Community Heritage Register. This bylaw requires details on the proximity of new structures to designated heritage properties/features.	Project development activities may interact with designated heritage sites.
Official Community Plan (Township of Langley 2018)	Township of Langley	The OCP outlines policies for heritage that play a key role in the development of complete and sustainable communities.	Project development activities may interact with designated heritage sites.
Asset Management Plan (Hemmera 2017; City of Langley 2020)	City of Langley	The management of designated Heritage sites within the City of Langley falls under their 'Asset Management Plan,' which is aimed at exercising good stewardship, and commitment to delivering affordable services, while maintaining the City's sustainability (City of Langley n.d.).	The plan outlines policies for management of the City's physical infrastructure, including buildings, parks, and park facilities.

50 Municipal information is provided for context. The Province will work with municipalities to define requirements during construction.

12.2 Baseline Conditions

Baseline conditions for archaeology and heritage were informed by the AOA (Kleanza 2019), including:

- Any known (previously recorded) archaeological and heritage sites within the Project footprint;
- Traditional use information provided by First Nations;
- Identified areas of archaeological potential; and
- List of designated heritage properties, as identified by the City of Surrey.

The Project is located within a developed urban environment and is primarily situated within the ROW for Fraser Highway. Previous extensive ground disturbance is evident due to existing structures, landscaping, agricultural practices, roads, and utilities.

12.2.1 Methods

Archaeological studies and investigation, including methods for preliminary field reconnaissance (PFR), AOA, AIA and archaeological monitoring have been completed for the Project following the BC Archaeology Branch's standards and guidelines (Government of BC n.d.).

12.2.1.1 Overview

In August 2019, Kleanza completed an AOA, including the PFR of the Project footprint - that was conducted under First Nation Heritage Permits - to provide a baseline for the SLS's full scope (i.e., King George SkyTrain Station in Surrey, BC to 203 Street in Langley, BC). The AOA included a planning-level evaluation of the archaeological potential for the Project footprint and surrounding areas (within 1 km) and identification of any known archaeological and heritage resources. In addition, the AOA focused on areas of cultural concern for First Nations that could be affected by ground disturbance in the Project footprint. This AOA identified 19 AOIs considered to have high archaeological potential. These AOIs were ground-truthed by Kleanza and First Nations during a visual PFR of each candidate site.

Between 2019 and 2021, Kleanza conducted AIA field programs and monitored geotechnical and utility investigations under BC Heritage Inspection Permit 2019-0444 and First Nation Heritage Permits. Kleanza carried out subsurface investigations to support definition of the Project's potential impacts to archaeological and heritage resources, and to develop management options. These are briefly summarized below and described in detail in **Section 12.2.1.3.**

- In 2019, 2020, and 2021, archaeological monitoring of geotechnical investigations was conducted along the 16 km alignment; No archaeological materials or deposits were identified during the monitoring program;
- In August 2020, an AIA field assessment took place along Fraser Highway between 140 Street and 148 Street. One pre-contact period archaeological site, DhRq-117, was newly identified by this field assessment; Two management areas were identified, where additional and more intensive subsurface inspection were recommended;
- In December 2020, supplemental archaeological monitoring and subsurface testing occurred in relation to utility locates at the intersection of Fraser Highway and Green Timbers Greenway and in areas adjacent to archaeological site DhRq-117;
- In July and August 2021, an AIA field program was carried out to investigate proposed ditch and culvert development footprints along Fraser Highway at 140 Street (the tributary to Lay Creek), within Green Timbers Greenway, at King Creek, Enver Creek, and Unnamed Creek locations; No archaeological materials or deposits were identified during this program;

- In December 2021, an AIA field assessment took place in publicly accessible portions of AOIs between 168 Street in Surrey and 203 Street in Langley; No additional archaeological materials or deposits were identified during this field program; and
- Additional field assessment will take place on private properties once the Project team is granted access.

Comments received from First Nations on Project AOA and AIA reporting are reflected in this report, and include those on archaeological finds, management recommendations and naming of sites.

12.2.1.2 Literature Review

Information reviewed for the AOA were publicly available historical and contemporary sources including:

- Previous archaeological investigations in the vicinity of the Project;
- Local and regional histories, prehistories, and ethnographies (published and unpublished sources from documents filed with the Archaeology Branch, libraries, archives, and repositories);
- The provincial online database Remote Access for Archaeological Data (Government of BC 2021f) – July 2019; and
- Ortho photos and maps.

Kleanza requested Traditional Land Use information from Katzie First Nation, Matsqui First Nation, Seabird Island Band, Semiahmoo First Nation, Kwantlen First Nation (Seyem' Qwantlen), Shxw'ow'hamel First Nation, Stó:lō Nation, Tsawwassen First Nation, and xʷməθkʷəy̓əm (Musqueam Indian Band). To date, three First Nations have provided Traditional Land Use information, including written information, online mapping, and a database.

To conduct the AOA and PFR, Kleanza applied for and received the following First Nation permits:

- Seyem' Qwantlen: SQ 2020-05;
- Stó:lō Research and Management Centre: Stó:lō Heritage Investigation Permit #2019-130; and
- xʷməθkʷəy̓ əm (Musqueam Indian Band): MIB-2019-099-AIA.

To conduct the 2019 – 2021 AIA's, Kleanza applied for and received a Project-specific HCA Section 12 inspection permit in December 2019 (Permit 2019-0444). The work has been conducted under current versions of the following First Nation Heritage permits:

- Katzie Development Limited Partnership Archaeological/Heritage Permit 2020-06;
- xʷməθkʷəy̓əm (Musqueam Indian Band) Heritage Permit: MIB-2019-099-AIA;
- Seyem' Qwantlen Heritage Investigation Permit: 2020-05; and
- Stó:lō Heritage Investigation Permit: SHIP 2019-131.

To inform Project AIA field programs and assessment and the definition of Archaeological AOIs, the AOA utilized background data, including documentary and ethnographic data, archaeological studies and reports, historic aerial photographs and Traditional Use data. AIA field programs focused on these AOIs, which were considered to have higher potential for presence of archaeological/cultural materials.

12.2.1.3 Field Studies

All Project-associated AIA field programs have been completed in accordance with the requirements of HCA Heritage Inspection Permit 2019-0444, First Nations permits and the British Columbia Archaeological Impact Assessment Guidelines (Government of BC 1998). Any additional AIA fieldwork that may be required for the Project will conform to permit requirements and relevant guidance. Methods for AIA field programs are summarized from Kleanza (Kleanza 2021a, 2021d, 2021c, 2021b) and presented in **Table 12-4**. AIA results are discussed in **Section 12.2.2**.

Table 12-4 AIA Methods for SLS Monitoring and Investigation – 2019 to 2021

Date	Location	Archaeological Testing / Monitoring	Methods
2019 - 2020	Between King George Station, City of Surrey and 203 Street, City of Langley	Monitoring of geotechnical investigations	• Archaeological monitoring was conducted of 38 geotechnical boreholes (ranging from 2 m to 22 m below the surface)
August 2020	AOI 4 (between 140 and 148 Streets)	• Field survey • Shovel testing	• In total, 206 shovel tests were excavated across 34 shovel test areas where soil was present, and areas were accessible • Systematic and judgmental placement of shovel tests was conducted with spacing of 5 m to 10 m (depending on terrain and landforms). One new archaeological site (DhRq-117) was identified, and two archaeological management areas were recommended for further investigation (further discussed in **Section 12.5**)
December 2020	Management Area 2 (King Creek and Site DhRq-117)	• Shovel testing • Monitoring of hydrovac excavation	• 23 shovel tests were placed within or adjacent to each of the six utility locates prior to hydrovac excavation and within previously untested areas. • Drill returns were inspected visually and manually, and soils were screened if they were suspected of containing cultural materials.
July – August 2021	Watercourses intersecting with Fraser Highway between 140 Street and 148 Street	• Shovel testing	• 98 shovel tests within 12 test areas were conducted in proposed ditch and culvert footprints, including area adjacent to the site boundary of DhRq-117.
August – September 2021	Between 168 Street, City of Surrey and 203 Street, City of Langley	• Monitoring of geotechnical investigations	• Archaeological monitoring of geotechnical borehole investigation was conducted, including visual and manual inspection of: • hydrovac excavation (30 x 30 cm) to a maximum depth of 3 m at each borehole location • drill returns, including screening of soil deposits that were suspected to contain cultural materials
December 2021	Between 168 Street, City of Surrey and 203 Street, City of Langley	• Shovel testing • Field Survey	• 187 shovel tests were conducted at linear intervals of 5m where feasible, (dependent on vegetation, paved surfaces, and/or private properties) within accessible areas of AOIs 18, 20, 23, and 24.

12.2.2 Assessment/Interpretation

This section describes the AOA and AIA programs completed to date for archaeology and baseline review of heritage information for the Project.

12.2.2.1 AOA

The AOA involved a review of existing archaeological and historical background information, including previous archaeological studies and Traditional Use information provided by First Nations[51] (Kleanza 2019). The AOA assessed the archaeological potential of the Project footprint and surrounding vicinity (within 1km) and determined the following:

- Of 11 previously recorded archaeological sites within 1 km of the Project alignment, none occur within the Project footprint; and
- Of 12 previously recorded or designated heritage sites within 1 km of the Project footprint, three overlap with the proposed Project footprint. (**Table 12-6**).

During the AOA desktop overview, AOIs were identified and divided into sections based on their level of development and geographic area (**Figure H12-1 Appendix H**: Archaeology and Heritage Figures). **Table 12-5** provides Kleanza's ratings of the archaeological potential for each AOI based on the results of the PFR and desktop review. Archaeological potential ratings of 'high' accounted for factors such as lack of development, lack of prior disturbance, topography, proximity to watercourses, and proximity to previously recorded archaeological sites and ethnographic resources.

Table 12-5 AOI Archaeological Potential Rating for Sites within 1 km of the Project

Project Section	Section Characterization	Section Description	AOI	Archaeological Potential Rating
Section 1	King George SkyTrain Station to 140 Street	• High level of previous urban development	AOI 1, AOI 2, AOI 3	High
Section 2	140 Street to 148 Street, including the GTUF	• Although previously logged, it is generally undeveloped and includes several natural watercourses (tributary to Lay Creek, Enver Creek, and King Creek) • A previously recorded archaeological site is located 340 m southwest of the Project alignment	AOI 4	High
Section 3	148 Street to the western boundary of the Surrey Golf Course	• Generally urban and largely consists of residential and commercial buildings	AOI 5, AOI 6, AOI 16, AOI 17, AOI 18	High
			AOI 7, AOI 8, AOI 9, AOI 10, AOI 11, AOI 12, AOI 13, AOI 14, AOI 15	Low[1]

[51] Traditional Land Use information provided by First Nations to the Project and relevant to all SE is described in **Section 4** First Nations Engagement.

Project Section	Section Characterization	Section Description	AOI	Archaeological Potential Rating
Section 4	The western boundary of Surrey Golf Course to 184 Street, City of Surrey.	• Includes the Serpentine Valley, which is mostly farmland with some residential development on the eastern slope of the valley	AOI 20, AOI 21	High
Section 5	184 Street, City of Surrey to 204 Street, City of Langley	• Primarily residential, commercial, and mixed employment, with limited green space	AOI 22, AOI 23, AOI 24, AOI 25, AOI 26, AOI 27, AOI 29, AOI 31	High
			AOI 28, AOI 30	Low

Note: (1) As per standard archaeological practice in BC, low potential areas are generally not investigated further.

The AOA recommended completion of an AIA under HCA Section 12 to fully investigate those AOIs designated as having high archaeological potential, and AOIs located in areas of potential Project-related ground-disturbing activities.

12.2.2.2 Heritage Sites

Provincially designated heritage properties identified within the study area that potentially interact with Project activities are listed in **Table 12-6**. These sites are shown on **Figure H12-2** and **Figure H12-3** in **Appendix H**: Archaeology and Heritage Figures**.**

Table 12-6 Registered Heritage Sites Proximal to the Project Footprint

Borden Number	Heritage Site Type	Proximity to Project Footprint	Potential for Interaction?[1]
DhRr-444	English Oaks Grove	1 m	No
DhRr-445	Arboretum	2 m	No
DhRq-107	Cape Cod Forestry Building	170 m	No
DhRq-108	Commemorative Plantation	55 m	No
DhRq-59	Green Timbers Inaugural Plantation	0 m	No (south edge of site abuts Project footprint, however, no interaction anticipated)
DgRq-72	Great Northern Railway ROW	Overlap	Yes (south edge of site overlaps Project footprint at Harvie Road)
DgRq-96	Old Yale Road in North Cloverdale	Overlap	Yes (north and east edges of site intersect the Project footprint on south side of Fraser Highway)
DgRq-142	Clayton United Church	25 m	No
DgRq-119	Calkins House & Store	0 m	No (north edge of site abuts Project footprint, however, no interaction anticipated)
DgRq-91	George E. Lawrence House at 18431 Fraser Highway	Overlap	Yes (heritage property overlaps Project footprint on north side of Fraser Highway)

Note:

1. Please refer to **Section 12.1** for definitions and provincial approach for site designation

12.2.2.3 AIA: King George SkyTrain Station, City of Surrey, to 203 Street, City of Langley

Kleanza's results of archaeological monitoring and AIA conducted between the King George SkyTrain Station in the City of Surrey and 203 Street in the City of Langley (Kleanza 2021a, 2021b, 2021c) are summarized in **Table 12-7.** One pre-contact-period archaeological site (DhRq-117) was identified east of King Creek. Additional details regarding archaeological site DhRq-117 are provided in **Table 12-8**. Beyond the identification of DhRq-117, no archaeological materials, features, or deposits were identified during the AIA; however, the possibility remains that disturbed archaeological deposits exist beneath the roadbed and sidewalk. Portions of AOI 18, 20, 23, and 24 could not be assessed due to compact roadbed or permissions not being granted to access private property.

As noted in **Table 12-3** the British Columbia Archaeological Impact Assessment Guidelines require that identified sites be rated based on the following significance criteria: scientific, public, ethnic, economic, and historic. Kleanza (2021a) assessed the overall significance of site DhRq-117 as low to moderate based on the following:

- Scientific significance is assessed as moderate - the site contains intact deposits of lithic material not local to the area – and could contribute to the understanding of local and regional prehistory;
- Public and economic significance is rated as low - the site is located near Fraser Highway and has minimal surficial details, which would be a poor candidate for public educational or interpretive purposes);
- Ethnic significance is rated high; and
- Historic significance was not rated as there are no historic components present at the site.

Table 12-7 AIA Results – King George SkyTrain, Surrey to 203 Street, Langley

Date	Location	Archaeological Testing / Monitoring Completed	Cultural Materials or Features identified?	Comments
2019 - 2020	Between King George SkyTrain Station, City of Surrey and 203 Street, City of Langley	• Monitoring of geotechnical investigations	No	No cultural materials or features were observed.
August 2020	AOI 4 (between 140 Street and 148 Street)	• Field survey • Shovel testing	Yes	Two archaeological management areas were identified within AOI 4 (as shown in **Figure H12-3 Appendix H**: Archaeology and Heritage Figures), including newly identified archaeological site DhRq-117. Management areas are locations where Kleanza identified additional archaeological measures to address the higher potential for archaeological materials to be present in areas where Project impacts may occur. Additional investigation was recommended as follows: • Management Area 1 – tributary to Lay Creek (east of the proposed 140 Street Station) – includes the area surrounding Fraser Highway crossing, contains features and landforms associated with high archaeological potential. Additional subsurface testing or construction monitoring is recommended for previously untested locations within Management Area 1 where development impacts are anticipated. • Management Area 2 – King Creek and Archaeological Site DhRq-117 – one pre-contact-period archaeological site located east of King Creek. At site DhRq-117, five positive shovel tests contained a low-density assemblage of subsurface lithics, primarily composed of debitage and a hammerstone (**Table 12-8**, **Photo 12-1** and **Photo 12-2**). • Shovel test results outside of archaeological site DhRq-117 were negative for archaeological materials, and no features of interest were observed during pedestrian surveys. Additional archaeological assessment was recommended only for Management Areas 1 and 2 of AOI 4.
December 2020	Management Area 2 (King Creek and Site DhRq-117)	• Shovel testing • Monitoring of hydrovac excavation	No	No further archaeological work is recommended for development impacts within the specific test hole locations.

Date	Location	Archaeological Testing / Monitoring Completed	Cultural Materials or Features identified?	Comments
July – August 2021	Watercourses intersecting with Fraser Highway between 140 Street and 148 Street	• Shovel testing	No	No cultural materials or features were observed, including testing in the vicinity of DhRq-117; thus site boundaries were not expanded or altered. No additional archaeological inspection work was recommended for the proposed ditch and culvert development footprints, specifically, 140 Street culvert, Class B ditch, King Creek north culvert, Enver Creek culvert, and Unnamed Creek culvert.
August – September 2021	Between 168 Street, City of Surrey and 203 Street, City of Langley	• Archaeological monitoring of geotechnical investigations	No	No cultural materials and/or features were observed within AOIs 20, 24, 25, and 27, including some locations outside of the previously identified AOIs.
December 2021	Between 168 Street, City of Surrey and 203 Street, City of Langley (AOIs 18, 20, 23 and 24)	• Shovel testing • Field survey	No	187 shovel tests were dug across 63 shovel test areas between 170 Street and 64 Avenue either within or adjacent to Fraser Highway. Compact roadbed was encountered in 98% of the tests. No archaeological materials, features, or deposits were identified.
	AOI 18		No	Proposed development impact zones that lie within AOI 18 were not inspected during the field assessment due to permissions not being granted to access private property.
	AOI 20		No	Subsurface testing was only possible for portions of AOI 20 due to permissions not being granted to access private property; where possible, these areas were shovel tested. Adequate assessment of the underlaying sediment was not possible due to presence of compact roadbed.
	AOI 23		No	Due to the compacted roadbed, adequate assessment of the underlaying sediment was not possible.
	AOI 24		No	Subsurface testing was only possible for portions of AOI 24 due to permissions not being granted to access private property. Where possible, shovel testing was conducted. Adequate assessment of the underlaying sediment was not possible due to presence of compact roadbed.

Table 12-8 Archaeological Site DhRq-117 Artifacts and Belongings

Catalogue Number	Artifact/ Belonging Type	Material	Quantity	Notes
DhRq-117:1	Lithic Debitage	Fine-grained volcanic	2	1 secondary-stage flake; 1 tertiary-stage pressure flake
DhRq-117:2	Lithic Debitage	Volcanic	2	2 tertiary waste flakes: A fine-grained volcanic and a coarse-grained volcanic
DhRq-117:3	Lithic Debitage	Coarse-grained volcanic	1	1 tertiary-stage waste flake
DhRq-117:4	Lithic Debitage	-	4	1 chert[52], 2 fine-grained volcanic, and 1 coarse-grained volcanic
DhRq-117:5	Hammerstone	Granite	1	Pitting on both the side and end
DhRq-117:6	Lithic Debitage	Fine-grained volcanic	1	One tertiary-stage flake

(Source: Kleanza 2021a)

Photo 12-1 Lithic Artifacts/Belongings Recovered from Subsurface Tests at Archaeological Site DhRq-117 and STA9

[52] Hat Creek is a potential origin for the chert, but provenance is unconfirmed.

(Source: Kleanza 2021a)

Photo 12-2 Hammerstone Recovered from Subsurface Tests at Archaeological Site DhRq-117 and STA9

Kleanza (Kleanza 2021a) was not able to investigate the following AOIs as part of this AIA field program:

- AOIs 1, 3, and 18: Shovel testing was not feasible due to the paved pathways or the location on private property. The assessment was deferred until it is possible to determine whether the area will be subject to Project-related ground disturbance, and the Archaeologist (a) receives permission to conduct subsurface testing, or (b) initiates an archaeological monitoring program for initial ground disturbance from construction-related impacts.
- AOIs 2, 5, 6, 16, and 17: These areas do not intersect with the Project's footprint and activities. Should development impact zones be altered or revised to intersect these AOIs, an additional AIA inspection will be required.

As feasible prior to construction, AOIs likely to interact with the Project footprint will be investigated in accordance with the Archaeologist's recommendations.

12.3 Project Interactions

Potential interactions between archaeological and heritage resources, and Project activities and physical works are outlined in **Table 12-9**.

The City of Surrey's widening of Fraser Highway between 138 Street and 148 Street anticipated SLS Project requirements, which therefore eliminates or minimizes the incremental ground disturbance effects of SLS. The City has obtained an HCA Section 12.4 Alteration Permit for potential effects to DhRq-117 that may occur due to road widening.

For the heritage component of the assessment, the team reviewed the proximity of provincially registered heritage sites within the Project study area and their potential to interact with activities during Project development. Once a final design is available, it will be reviewed for the potential for interaction with heritage properties or features; if interactions are identified, appropriate steps will be taken to mitigate the effects to these sites.

Table 12-9 Archaeology and Heritage − Potential Project Interactions and Effects

Project Activities and Works	Disturbance or Destruction of Archaeological Resources[1]	Disturbance or Destruction of Heritage Resources[1]
Pre-construction		
Subsurface investigations	✓	✓
Construction		
Clearing and grubbing	✓	✓
Property acquisition transactions	o	o
Relocation of overhead BC Hydro transmission lines	o	o
Utility installation/relocation	✓	✓
Use of temporary laydown areas	✓	✓
Access and traffic management	-	-
Road widening (select locations)	✓	✓
Culvert extension and drainage realignment	✓	✓
Installation of SkyTrain guideway foundations	✓	✓
Installation of overhead SkyTrain guideway	-	-
Stations (foundations, structures, lighting, access, service connections, security)	✓	✓
PPS	✓	✓
Management of excavated material (excluding contaminated or hazardous materials)	✓	✓
Management of contaminated or hazardous materials	✓	✓
Testing, commissioning, and start-up	-	-
Operation and Maintenance		
Operation of the Project	-	-
Maintenance of the Project	-	-

Note:

[1]**Interaction ratings:**

- **No interaction:** Interaction between a Project component and the SE is not likely.

o **Minor interaction:** Impacts may result from an interaction, but standard measures to avoid or minimize the impact are available and well understood to be effective, and any residual effects would be reduced to negligible. Interaction is not discussed further.

✓ **Interaction:** Interaction may occur and likely requires additional mitigation; carried forward and discussed in subsequent sections.

Project pre-construction and construction activities have a higher probability of affecting archaeological resources in the seven AOIs, including Management Areas 1 and 2. Potential Project interactions with Management Area 2 would occur after the City of Surrey completes its widening of Fraser Highway. SLS construction activities with higher probabilities of affecting archaeological resources include ground disturbance associated with subsurface investigations, clearing and grubbing, utility installation and relocation, use of temporary laydown areas, road widening, culvert extension and drainage realignment, installation of SkyTrain guideway foundations, stations (foundations, structure, lighting, access, service connections), and PPS, and management of excavated materials.

Project activities that do not involve ground disturbance and therefore are unlikely to interact with archaeological or heritage resources include property acquisition transactions, overhead BC Hydro distribution and communication line relocation, access and traffic management, installation of overhead guideway, commissioning, start-up, and operation and maintenance activities.

In general, only ground-disturbing activities that occur within soil strata that is associated with tangible evidence of human interaction or habitation will affect archaeological materials. Below these strata (e.g., sterile or unaltered glacial till) and below organic material that pre-dates potential human interaction (e.g., 10,000 years before present), no interaction with archaeological resources is anticipated. The potential to encounter intact archaeological materials is likely to be much lower in areas where imported fill (e.g., gravel and asphalt) is present and / or where there is prior ground disturbance. Partially intact sites or disturbed archaeological resources could be present, which hold equal importance to First Nations.

12.4 Potential Effects

As noted in **Table 12-9**, Project interactions with archaeology and heritage could result in the following potential effects:

1. Changes (e.g., disturbance) to archaeological resources (known and unknown sites); and
2. Alterations to heritage buildings or other registered sites, including buildings, landscapes, or locations of heritage value (known and unknown).

12.4.1 Potential Changes to Archaeological Resources

Project activities that involve excavation, movement, or disturbance of soils have the potential to impact archaeological resources, if present. As noted in the above section, archaeological resources are found in soil strata associated with tangible evidence of human interaction or habitation, i.e., organic layers of soil found above glacial till. Intact archaeological sites have the most potential to provide information on the age and characterization of cultural materials that are present. This includes wetter areas, such as watercourses and marshes, where organic cultural materials may be preserved (termed “wet sites”). Even areas with previous development history, such as where fill has been placed, may have intact archaeological resources in native soil underlying the fill.

Given the developed nature of the Project corridor, the potential for intact archaeological sites is low. Partially intact sites include those where previous development activities removed or relocated cultural materials. Once archaeological resources are removed from their contextual location, valuable information may be lost resulting in inaccurate or incomplete understanding of the site. Fragile organic cultural materials (e.g., baskets) may quickly decompose (in the case of wet sites) or become irreversibly damaged when removed, if not done correctly. However, partially intact sites can also provide extremely valuable information.

The following ground-altering construction activities and associated development of temporary access may disrupt, damage, or destroy archaeological resources at known or unknown sites:

- Subsurface investigations and testing activities (i.e., geotechnical and contaminated sites) could bore through and/or remove archaeological resources from their contextual locations;
- Clearing and grubbing, through the removal of vegetation, roots, and upper soil layers, could disturb or remove organic soil layers where archaeological materials may be present;
- Utility or drainage installation and relocation, road widening, establishment and use of temporary laydown areas, and installation of foundations for guideway columns, PPS and stations could disrupt organic soil layers where archaeological materials may be present; and / or
- Management of excavated material and soil remediation activities may inadvertently remove archaeological resources or damage them in the process through excavation.

Without implementation of appropriate mitigation measures (discussed in **Section 12.5** below), the above-noted construction activities may affect archaeological resources that are protected under the HCA, specifically, in areas of identified high archaeological potential and concern, i.e., noted AOIs and Management Areas 1 and 2.

12.4.2 Potential Changes to Registered Heritage Sites

The Project footprint overlaps with three registered heritage sites: DgRq-72, DgRq-96, and DgRq-19 (**Table 12-6)**. However, field investigation concluded that the portions of sites DgRq-72 and DgRq-96 have been previously affected/destroyed by road development. Further investigation also determined that site DgRq-91 is a replica of the original heritage building – the original having been destroyed by fire in 2014 – and the replica will not be affected by Project activities. As such, no effects to heritage sites are anticipated.

Mitigation measures pertaining to the protection and management of heritage sites near the Project are discussed in **Section 12.5** below.

12.5 Mitigation Measures

Proposed mitigation measures described in this section aim to avoid or reduce potential effects from Project construction activities on archaeological and heritage resources. **Table 12-10** summarizes the mitigation measures, the effect(s) they address, the Project phase in which they should be implemented, and their implementation in a relevant environmental management plan. Mitigation measures are discussed for two phases: design (denoted as “D”) and construction (denoted as “C”).

All mitigation and management options summarized from interim AIA reporting were prepared in accordance with the Archaeological Impact Assessment Guidelines (Government of BC 1998) and are subject to Archaeology Branch approval. Draft interim reporting has been reviewed by First Nations, in accordance with provincial guidance. Note that the HCA provides equal protection for recorded and unrecorded sites, as well as for intact and disturbed sites.

Content from this section will be incorporated into the CEMP Framework (see the TOR for an additional description of this document). As its name implies, this Framework document will provide detailed guidance for the content of the Project Co’s CEMP. In addition to mitigation and performance objectives, the CEMP Framework will describe best practices and required content for each sub-plan. The CEMP Framework will also include details on roles and responsibilities for Project Co’s key team members.

12.5.1 Design Mitigation

During the development of the RCD, efforts to avoid or reduce unnecessary effects on archaeological and heritage resources were a key objective. This has been accomplished through its elevated alignment, and careful planning and route selection. As the design progresses, many potential areas of conflict can be avoided by taking an anticipatory approach to potential effects.

Mitigation M12.D-1 Conduct Additional AIA

After final design is confirmed, the need for additional AIAs will be assessed. Any AIA must be completed under an HCA Section 12.2 Heritage Inspection Permit in Project areas that were not previously assessed through field programs and where ground-disturbing activities could occur. The objectives of this additional AIA would be to:

- Meet HCA requirements;
- Identify archaeological and heritage resources that may be affected during Project activities;
- Determine if further mitigation is required (i.e., site alteration) (also see Mitigation M12.D-2); and
- Identify areas where archaeological monitoring may be required during Project activities (also see Mitigation M12.C-1).

Based on field assessment to date, additional AIA works at specified locations should be considered in areas with high potential for archaeological materials including AOIs 13, 18, 20, 23, 24 and untested areas of Management Areas 1 and 2. However, the need for additional AIA works may change based on the final design and associated Project footprint. Project design revisions within AOIs should be reviewed by an archaeological AQP to determine the need for additional assessment. Where additional AIAs are not feasible prior to construction, archaeological monitoring should be considered.

Mitigation M12.D-2 Prepare Archaeological and Heritage Management Plan

As part of the CEMP, an Archaeological and Heritage Management Plan should be developed that:

- Is in accordance with the HCA and provincial guidelines;
- Ensures proper management and mitigation of potential impacts to previously identified archaeological and heritage sites;
- Incorporates recommendations from the Project’s AOA and AIA for impact mitigation to archaeological and heritage resources;
- Provides management guidance for the protection of archaeological and heritage resources as well as making provision for potential unknown resources; and
- Describes the training program for all Project Co field staff regarding cultural importance, recognition, and care of archaeological resources as well as implementation of the Archaeological Chance Find Procedure (CFP) (see Mitigation M12.D-3).

Mitigation M12.D-3 Archaeological Chance Find Procedure

The aim of the Archaeological CFP developed for the Project is to manage activity if unknown archaeological resources are discovered during ground-altering activities and following completion of all feasible AIA field programs. The CFP provides guidance for chance find scenarios while meeting the requirements of the HCA, First Nation permits, and other obligations. Ground alteration that requires use of the CFP may occur during pre-construction geotechnical investigations as well as during Project construction, including utility re-locations.

A CFP has been developed for the Project which will be appended to the CEMP Framework and is intended to aid in Project planning, including any additional pre-construction geotechnical and environmental site assessment investigations, as well as for confirming roles and responsibilities for construction.

Mitigation M12.D-4 Plan Site-specific Mitigation Measures

Once the SLS design is finalized and the means and methods of construction have been determined, recommendations from the AIA will need to be reviewed and possibly modified by the archaeological AQP named on the Project permit. Any such modifications will occur during construction planning and through discussions with regulators, First Nations, and landowners. Site-specific mitigation for construction is to be included in the Archaeological and Heritage Management Plan (see Mitigation M12.D-2).

If mitigative management is required, it should rely on systematic data recovery, analysis, and interpretation of specific archaeological resources in accordance with BC Archaeology Branch guidance, including a site alteration permit under Section 12.4 of the HCA. An AQP will be required to submit a detailed research proposal to the BC Archaeology Branch, prior to initiating these studies, on behalf of the Project.

Mitigation M12.D-5 Heritage Site Mitigation Measure

Once design is finalized and the means and methods of construction have been determined, locations of heritage properties, features, and structures should be reviewed and if needed, additional measures taken to preserve and protect these sites from damage. An alteration permit is required if impacts are anticipated to any formally recognized or designated property.

12.5.2 Construction Mitigation

This section presents the mitigation measures proposed during Project construction to minimize or resolve potential effects to archaeology and heritage resources in the Project footprint.

Mitigation M12.C-1 Implement Archaeological Chance Find Procedure

Once all feasible AIA investigations are complete, the previously developed Archaeological CFP will provide certainty on how to manage chance encounters of archaeological resources during construction-phase ground-altering activities. Implementation of the CFP should include training in the identification of cultural resources and requirements of the HCA and First Nation permits for various chance find scenarios. Ground alteration that requires the use of the CFP may occur during pre-construction geotechnical investigations as well as during Project construction, including utility re-locations. It is recommended that the Archaeological CFP accompanies the CEMP.

Mitigation M12.C-2 Conduct Archaeological Monitoring

Archaeological monitoring programs are necessary where recommended by an AIA to protect archaeological resources during Project construction and should be documented in the Archaeological and Heritage Management Plan (see Mitigation M12.D-2). Monitoring programs should all share the following design, implementation, and monitoring approaches:

- Implement monitoring program where archaeological resources are considered to have a high probability of occurrence in a proposed development area, but are not likely to be identified through an AIA (e.g., deeply buried sites or areas under pavement);

- Design the monitoring program to ensure compliance with best practices, the HCA, and associated permitting; and
- Incorporate the Archaeological CFP (also see Mitigation M12.D-4).

12.5.3 Summary of Proposed Mitigation

Proposed mitigations specific to each Project phase (design and construction) for archaeological resources is summarized in **Table 12-10**.

Table 12-10 Summary of Potential Project Effects and Mitigation Measures for Archaeological Resources

Potential Effect	Mitigation Number	Mitigation Measure	Project Phase	Environmental Management
Disturbance or inadvertent destruction of archaeological resources, including sites and areas of archaeological potential (known and unknown)	M12.D-1	Conduct additional AIA.	Design	CEMP: Archaeological and Heritage Management Plan and CFP
	M12.D-2	Prepare Archaeological and Heritage Management Plan		
	M12.D-3	Archaeological Chance Find Procedure		
	M12.D-4	Plan site-specific mitigation measures.		
	M12.D-5	Heritage site mitigation measures		
	M12.C-1	Implement Archaeological Chance Find Procedure.	Construction	Approved Archaeological and Heritage Management Plan and CFP
	M12.C-2	Conduct archaeological monitoring.		

12.6 Discussion

Archaeological assessments (AOA, AIA, and archaeological monitoring) were completed in 2019 to 2021 by Kleanza. The AOA identified 17 AOIs (1, 2, 3, 4, 5, 6, 16, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 29, and 31) with the potential to interact with the Project footprint (due to the location and to landforms present in the Project footprint) and therefore should be investigated as part of AIA.

Desktop analysis determined that three designated heritage sites overlap with the Project footprint.

Key findings of the systematic shovel testing conducted during AIA field programs were as follows:

- Between 140 Street and 148 Street: Identification of a previously unidentified archaeological site DhRq-117, and recommended additional investigation of previously untested portions of Management Areas 1 and 2 if final design directly interacts with these sites;
- AOIs 1, 2, 3, 5, 6, 16, 17, and 18 and portions of AOIs 20, 23, and 24 were inaccessible due to physical or institutional constraints; future investigation will be required where the footprint interacts with these AOIs;
- Archaeological monitoring conducted in association with geotechnical investigations along the full Project alignment and site-specific utility investigations did not identify any archaeological resources; and
- AIA shovel testing conducted between 166 Street and 203 Street encountered compact roadbed; therefore, underlaying natural sediments could not be assessed.

During detailed design, the Project footprint should be updated and then compared with that for the RCD. Any untested areas in AOIs that could have ground-level disturbance during construction should either be subject to subsurface archaeological testing or where that is not feasible, construction archaeological monitoring should be conducted. If the updated Project footprint results in overlap with registered heritage sites, these overlaps should be reviewed to determine whether avoidance is feasible. If not, then additional mitigation will be required.

The CFP should be updated with appropriate contact information prior to construction. Implementation of the CFP during construction should be conducted by appropriately trained members of the Project Co team.

12.7 Conclusion

With effective implementation of the recommended management and mitigation measures, no interactions between Project activities and the archaeological and heritage SE are expected. As such, Project effects on archaeological resources are anticipated to be low, and no effects on heritage resources are likely. Therefore, no effects on archaeological and historic resources are anticipated from the Project (**Table 12-11**). Mitigation measures should be further refined prior to construction, in consideration of input from the appropriate regulatory agencies, potentially affected First Nations, and landowners.

Proposed mitigation measures to avoid potential effects to archaeological resources are described in **Section 12.5** and summarized below:

- **Additional AIA:** Complete additional AIA work prior to construction for areas not previously assessed, that require further assessment, and / or where there is potential for ground-disturbing Project activities to occur.
- **Avoidance:** Where feasible, and where Project impacts to known archaeological sites are identified, avoid impacts to these sites by design refinement or appropriate construction means and methods.
- **Monitoring:** Develop and implement monitoring programs overseen by AQPs based on AIA recommendations to manage and protect unidentified archaeological resources (e.g., deeply buried sites) where ground disturbance is anticipated within the Project footprint.
- **Site-specific mitigation measures:** Mitigate impacts to identified archaeological sites within the Project footprint through site-specific measures and in accordance with the HCA, provincial guidance, and associated permitting. Develop measures in discussion with regulators, First Nations, and landowners.
- **Archaeological and Heritage Management Plan:** Develop and implement an Archaeological and Heritage Management Plan as part of the CEMP that includes provisions to plan and implement the Archaeological CFP, promptly identify the need to the Province for conducting additional AIA in AOIs, conduct archaeological monitoring, train Project staff, and implement site-specific mitigation as per permit requirements and following archaeological AQP direction.
- **Archaeological CFP:** Implement the approved Archaeological CFP (developed in collaboration with First Nations) to manage the potential discovery of unknown archaeological or heritage resources during ground-altering Project activities.

Table 12-11 Summary of Potential Effects Remaining After Mitigation for Archaeology and Heritage Sites

Potential Effect	Criterion	Rating	Rationale for Rating
Disturbance or destruction of archaeological resources, including sites and areas of archaeological potential (known and unknown)	Magnitude[1]	Negligible	Though archaeological resources are unique and valuable in nature, potential changes to existing conditions are not anticipated with effective implementation of recommended mitigation measures, including pre-construction archaeological assessment of the Project area.
	Geographic Extent	Low	Potential effects are restricted to the Project footprint, and only at locations impacted by ground disturbing activities.
	Duration[2]	Short-term	Potential effects could only occur during ground disturbing activities associated with Project construction.
	Frequency	Rare	Unlikely to occur with effective implementation of recommended mitigation measures, including pre-construction assessment of the Project area.
	Reversibility	Reversible Permanent (see rationale)	Should unanticipated archaeological resources be encountered during construction, effective implementation of mitigation measures should ensure appropriate management of resources and would therefore be reversible. If significant damage occurs to an archaeological site, the effect could be permanent.
Disturbance or destruction of heritage resources, including buildings, landscapes, or locations of heritage value (known and unknown)	Magnitude[1]	Negligible	Though heritage resources are unique and valuable in nature, potential changes to existing conditions are not anticipated given the application of recommended mitigation measures, including avoidance of known heritage buildings and properties.
	Geographic Extent	Low	Potential effects could only occur during ground disturbing activities associated with Project construction.
	Duration[2]	Short-term	Potential effects could only occur during ground disturbing activities associated with Project construction.
	Frequency	Rare	Unlikely to occur with effective implementation of recommended mitigation measures, including pre-construction assessment of the Project area.
	Reversibility	Reversible	Should unanticipated resources be encountered during construction, effective implementation of mitigation measures should ensure appropriate management of resources.

Notes:

1. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance, and high (exceedance of criteria or threshold). Generally, magnitude is measured in terms of the proportion of the SE affected within the assessment area (for biophysical SE), or the degree within the interaction area relative to the range of natural or historic (in the case of human environment SE) variation.
2. The duration of an effect may be short-term (i.e., within the construction phase), medium term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (permanent) (i.e., extending past the life of the Project)

13 Agricultural Land

13.1 Introduction

Agricultural land is a valuable and limited resource in BC. that is recognized through provincial and local government regulation and management policies. Lands used for agriculture occur along the Project alignment in the Serpentine Valley in the City of Surrey. This section of the ESR evaluates the potential effects of the Project on these agricultural lands.

The review of potential Project-related effects on agricultural land was conducted based on the information requirements identified in the TOR for the Project (**Appendix A**). This section is supported by information from **Section 7** Air Quality, **Section 8** Noise and Vibration, **Section 10** Fisheries and Aquatics, **Section 11** Vegetation and Wildlife and **Section 14** Land Use.

13.1.1 Project Features Relevant to Agricultural Land

Key components of the Project Description (**Section 2**) that are relevant to the agricultural land SE include those that are intrinsic to the SLS design, including its alignment and elevated components. Within the Serpentine Valley, the SLS will follows the existing transportation corridor on Fraser Highway, which includes an approximate 1.8 km stretch of elevated guideway and a PPS. The Project footprint in the Serpentine Valley is within the ALR and the existing Fraser Highway ROW. Land within the ROW is designated for Non-Agricultural Use (Transportation) by the Agricultural Land Commission (ALC).

The Project design, including its elevated guideway, limits any required change in land use for ALR lands. The Project footprint for the RCD consists of permanent and temporary footprint areas. Permanent footprint areas are those associated with physical infrastructure necessary for operation of the Project (e.g., stations, PPSs, SkyTrain overhead guideway and columns, a dedicated crossing of the Serpentine River), while temporary footprint areas are those associated with Project construction only (e.g., temporary laydown, aerial workspace and other work areas).

The Project's guideway will be elevated and contained within the existing road ROW, which will avoid permanent interactions with land designated for agricultural use. Potential interactions with stations and associated guideway approaches may occur.

SLS will be powered by electricity from PPSs, most of which will integrate into SkyTrain stations to minimize footprint disturbance. Due to the distance between stations in this portion of the alignment (between 166 Street and 184 Street), a standalone PPS is needed within the Serpentine Valley; this PPS will be situated within the existing Fraser Highway ROW, east of the Serpentine River.

Project-related construction activities relevant to agricultural land include clearing and grubbing, pile installation for bridge and guideway columns and other foundation supports, utility location and relocation, and temporary construction work areas. Temporary workspace areas for Project features assume the following buffer areas:

- Road works and parking areas – 2-m buffer;
- Guideways – 5-m buffer from edge; and
- Support columns – 4-m buffer.

The Project footprint for the RCD is approximately 59.0 ha. Of that, 5.7 ha (0.85% of footprint) is within the ALR (mostly Fraser Highway ROW), and 1.1 ha is in agricultural land use outside of the ALR, all located within the City of Surrey. The Fraser Highway ROW is land designated for Non-Agricultural Use (Transportation) by the ALC.

During operation, sound levels from the SkyTrain will be consistent with current practice. In addition, operation and maintenance activities will typically occur within the permanent Project footprint, avoiding interaction with agricultural operations.

13.1.2 Selection as a Review Element

The agricultural land SE was selected because of the potential for Project activities to affect - directly or indirectly - agricultural use, access, and/or agricultural infrastructure. In addition, regulatory requirements may be triggered as they relate to potential changes from agricultural land use designations in provincial legislation, and regional and municipal bylaws. Baseline conditions, such as agriculturally designated land and agricultural land uses, are summarized in this section of the ESR.

The selection of Review Indicators for agricultural land, summarized in **Table 13-1**, is based on the information requirements in the TOR as well as a review of the potential effects.

Table 13-1 Selection of Review Indicators

Potential Effect	Review Indicator(s)	Rationale for Selection
Inconsistency with agricultural land use regulations and policy	Alignment with provincial and municipal agricultural land use designations	Permitting may be required and land use designations may need amendment to accommodate the Project
Loss of agriculturally designated land (permanent and temporary) and land in agricultural use	Area (m^2) of agriculturally designated land and in agricultural use lost due to Project activities	Potential effects to agricultural operators
Loss of non-designated land in agricultural use	Area (m^2) of non-designated land in agricultural use lost due to Project activities	Potential effects to agricultural operators
Alteration of agriculturally designated land	Alteration of land through effects to infrastructure, and changes in sensory conditions (noise, light)	Potential effects to agricultural operators and quality of the land for agricultural purposes

13.1.3 Spatial and Temporal Boundaries

This section presents the identified spatial and temporal boundaries for the Project study area.

13.1.3.1 Spatial Boundaries

The study area comprises a 200 m buffer on each side of the Project centreline from the existing King George SkyTrain Station to 100 m beyond the City of Langley terminus station at 203 Street (**Figure I13-1**). This buffer was selected to reasonably comprise an area in which parcels of land in agricultural use may be directly and indirectly affected by Project activities during construction and operation.

13.1.3.2 Temporal Boundaries

Temporal boundaries are the Project phases in which works and activities could affect agricultural land use designations and uses. The following temporal boundaries were considered in this assessment:

- Planning Phase: 2020 to 2024;
- Construction and commissioning phase: 2024 to 2028; and
- Operation (including maintenance) of Project: 2028 and beyond.

13.1.4 Regulatory and Policy Context

The BC government is responsible for land use through the ALC, an independent provincial agency. Local governments have a role in agricultural use through zoning and other planning tools. The federal government does not regulate land use. Note that, in addition to the listed regulations and policies, Project Co will be required to follow the DBSS (Government of BC 2019c), including Section 165 Protection of the Environment. The relevant legislation and policies for the agricultural land evaluation are summarized in **Table 13-2** and **Table 13-3**.

Table 13-2 Key Legislation Applicable to Agricultural Land Use

Legislation	Responsible Agency	Relevant Aspects of Legislation/Policy	Applicability to the Project
Provincial			
Local Government Act, RSBC 2015, c. 1,	Municipal Affairs	Mandates local governments to prepare regional growth strategies to direct long-term planning for regional districts and municipal OCPs. Directs local government to prepare an OCP; Part 14 describes the long-term vision of communities.	Under the *Local Government Act,* Project land use activities must comply with the designated land uses in the RGS and the City of Surrey OCP (no ALR is affected by the Project in the Township of Langley, and City of Langley).
Agricultural Land Commission Act, *SBC 2002, c. 36* (as amended in 2018)	ALC	Sets the legislative framework for the establishment and administration of the agricultural land preservation program in B.C. Project activities in the ALR must be permitted uses or a permitted non-farm use. Section 34(6) of the Act applies to transportation, utility, and recreational trail use.	The Project may affect slivers of ALR outside of the existing municipal ROW. An application via the ALC Application Portal for Transportation, Utility or Recreational Trail Uses within the ALR will be required for Project activities within and outside of the Fraser Highway ROW. Applications are reviewed by the South Coast Administration Region of the ALC.
ALR Use Regulation, BC Reg. 30/2019	ALC	Specifies land uses permitted in the ALR.	
General Regulation, BC Reg. 171/2002	ALC	Identifies procedures for submitting applications if uses are not permitted.	
Farm Practices Protection (Right to Farm) Act, RSBC 1996, c. 131	BC Ministry of Agriculture, Food and Fisheries	The Act protects farmers' rights to farm within the ALR. ALR land zoned by local governments for farming represents locations in B.C. where farming is a priority and specifically permitted (Government of BC 2021d).	Agricultural operations adjacent to the Project have the right to continue their operations.

Table 13-3 Key Bylaws and Policies

Bylaws and Policy	Responsible Agency	Relevant Aspects of Legislation/Policy	Applicability to the Project
Regional			
Metro Vancouver's RGS, Bylaw No. 1339, 2022	Metro Vancouver	Provides direction for regional growth and use of agricultural land in Metro Vancouver and shows land use designation boundaries.	Project land use activities must comply with RGS designated land uses
Municipal[1]			
Surrey Official Community Plan (OCP) By-law, 2013, No. 18020	City of Surrey	Provides land use designations and agricultural policies that support the ALR, and continued designation and use of agricultural land for agricultural purposes, regardless of soil types and capabilities. Surrey's neighbourhood plans do not include land in the ALR, and none of the plans propose agricultural uses outside of the ALR (City of Surrey 2022g).	The Project study area includes agricultural land designated in the OCP and designated as ALR. Project land use activities must comply with the designated land uses in the OCP, which reflect desired future uses. Regional Context Statements in the OCP provide for consistency with Metro Vancouver's RGS.
Surrey Zoning By-law, 1993, No. 12000	City of Surrey	Provides detailed land use requirements.	Amendments to the Zoning By-law are guided by the OCP and neighbourhood plans.
Surrey Agricultural Plan (City of Surrey 1999)	City of Surrey	Proposes protection of the land base as well as other steps to enhance farming.	Policies apply to agriculturally designated areas of the Project footprint.
Langley Township OCP Bylaw 1979 No. 1842	Township of Langley	Provides land use designations and policies.	There are no agricultural areas within the Project study area so this plan is not considered further
Langley City OCP Bylaw No. 3200	Langley City	Provides land use designations and policies.	There are no agricultural areas within the Project study area so this plan is not considered further.

Notes:
[1] The Province will continue to work with municipalities to define requirements for delivery of the Project.

13.2 Baseline Conditions

This section describes agricultural land use in the Project study area, including soil resources and agricultural capability, as well as agricultural land use designations. Information is focused on Surrey, as there are no agricultural lands in the Project study area within the Township of Langley or the City of Langley.

13.2.1 Methods

Information to characterize baseline conditions for the agricultural land assessment was collected through a review of publicly available baseline and contemporary sources, including:

- Land Use Inventory Report (Government of BC 2010);
- Other planning and policy documents from the ALC;
- BC Soil Information Finder Tool (Government of BC 2022a); and
- Planning and policy documents from the City of Surrey, Township of Langley and City of Langley (Langley City 2022; City of Surrey 1999b, 2022b; Township of Langley 1991, 2013).

Soil and agricultural use information was derived from soil survey information in the BC Soil Information Finder and the Land Use Inventory Report. Information on the regulatory environment and the spatial designations for agricultural land use are based on the provincial information available from the ALC and municipal planning documents.

13.2.2 Results

Agricultural land uses in the Project study area occur only in the City of Surrey in and near the Serpentine Valley. There are no agricultural designations for the uses outside of the ALR[53], therefore the information below on soil and agricultural capability focuses on areas in the ALR.

13.2.2.1 Agricultural Land Use Designations

The ALR is a provincially designated agricultural land use zone for land with agricultural capability and in which agriculture is recognized as the priority use (**Figure I13-2** in **Appendix I**: Agricultural Lands Figures). Such designations have been determined based on agricultural capability, supported by the soil resources.

Metro Vancouver's RGS identifies regional land use designations in support of its five sustainability goals (GVRD 2011). The RGS agricultural designation is primarily intended for agricultural uses, facilities, and support of services, with an emphasis on food production, where appropriate. The regional agricultural designation for areas south of the Fraser River in the vicinity of the Project are highlighted in (**Figure I13-2** in **Appendix I**: Agricultural Lands Figures).

Surrey's OCP and a zoning bylaw designate agricultural land uses, including land in the ALR (**Figure I13-2** in **Appendix I**: Agricultural Lands Figures)**.** The OCP also identifies agricultural lands outside of the ALR in southeast Surrey (designated rural in the RGS). Zoning-designated lands (either within the ALR or designated agricultural) per Surrey Zoning Bylaw 12000 (City of Surrey 2021, 2022h) are as follows:

- CPG Golf Course Zone (south side of Fraser Highway);
- A-1 Agriculture for most of the other ALR in the study area (from approximately 170 Street to Old Yale Road); and
- Zone RA, One-acre Residential in the northeast portion of the ALR (with no crossroad).

13.2.2.2 Soil Resources and Agricultural Capability

The ALC considers information on soil resources and their agricultural capability to support decisions regarding changes to permitted uses and municipal agricultural land use designations. Information on soil series classifications, their parent materials, and their characteristics are drawn from the BC Soil Information Finder Tool (Government of BC 2022a).

The Project study area includes soils developed on the following types of deposits (Luttmerding 1980):

- Deltaic fluvial;
- Floodplain;
- Glaciomarine;
- Marine;
- Aeolian (usually less than 1 m thick over other parent materials); and
- Organic deposits of varying thicknesses**.**

53 Note that land that is farmed or otherwise used for agricultural purposes occurs outside lands designated as ALR. These lands may not be in the ALR due to small parcel size or long-term planning objectives for the area.

Agricultural capability is rated through the Land Capability Classification for Agriculture in B.C., which ranks capability between Class 1 (no or slight agricultural limitations) to Class 7 (no capability for soil-bound[54] agriculture) (**Table 13-4**). Two ratings are typically assigned to a soil unit: the first (unimproved rating) reflects the natural soil, drainage, and terrain properties, and the second (improved rating) reflects the soil capability after implementation of management improvements (i.e., drainage/irrigation systems, soil amendments) to offset limitations (**Addendum 13-1**) (ALC 2013). The system also ranks Class 2 to Class 7 soils into capability subclasses based on types of limitations. The limitations found in the study area, along with the improvement measures that are typically taken, are listed in **Table 13-5.** Agricultural capability mapping polygons, and the key to the agricultural capability ratings, are presented in **Figure I13-1** (**Appendix I**: Agricultural Lands Figures)**.**

Agricultural capability ratings in the Project study area range from Class 2 to Class 7, with most of the ALR soil polygons rated Class 4 or Class 04 (organic), usually with limitations for undesirable soil structure (D) and excess water (W) and some for salinity (N). Improvements, such as drainage, can improve these ratings to 3, although the limitations would remain. The existing infrastructure in the Serpentine floodplain to manage water levels, including the diking and pump house, have improved the agricultural capability.

The Soil Management Handbook for the Lower Fraser Valley (Bertrand et al. 1991) provides guidance for soil management groups that consist of several soil series. It addresses suitability of crops and management inputs. Well-suited crops require a low to moderate level of management input, whereas suited crops require a moderate to high level of management input. ALR lands in the study area have soils that:

- are mainly poorly drained fluvial and marine deposits with varying depths of organic horizons and classified as organic or gleysolic soils (Luttmerding 1981a, 1981b)[55]; and
- generally do not have well-suited crops, and the suited crops require several management inputs, notably those for drainage.

Table 13-4 Land Capability Classes for Agriculture

Class	Description of Land Capability
Class 1	No or only very slight limitations that restrict land use for the production of common agricultural crops.
Class 2	Minor limitations that require ongoing management and/or slightly restrict the range of crops.
Class 3	Limitations that require moderately intensive management and/or moderately restrict the range of crops.
Class 4	Limitations that require special management practices and/or severely restrict the range of crops.
Class 5	Limitations that restrict capability to produce perennial forage or other specially adapted crops.
Class 6	Non-arable but capable of producing native and/or uncultivated perennial forage crops.
Class 7	No capability for arable culture or sustained natural grazing.

Note: Adapted from (ALC 2013).

[54] 2 Soil-bound agriculture means not in green houses or in aquaculture.
[55] Soil polygons are predominantly mapped as Annis, Banford, Cloverdale, Vinod, and McLellan soils.

Table 13-5 Limitations to Agriculture and Associated Improvements

Symbol	Limitation	Common Improvements
A	Soil moisture deficiency	Irrigation
D	Undesirable soil structure	Organic matter additions
F	Fertility	Fertilizer additions
I	Inundation (by flooding)	Diking
L	Permeability (organic soils)	Cannot be improved
N	Salinity	Difficult to improve; drainage with regular flushing with non-saline irrigation water possible in some situations
P	Stoniness	Stone picking
T	Topography	Cannot be improved unless exceptional circumstances are present
W	Excess water	Drainage systems

Note: Adapted from (ALC 2013).

13.2.2.3 Agricultural Land Use in the Study Area

Identified agricultural land uses are located within and outside of the designated agricultural areas in the ALR and OCPs. This assessment reflects land use and infrastructure information available at the time of the 2016 agricultural land use inventory (crop, livestock, and land use categories), supplemented by 2021 Google Earth Street View imagery. These provide a good indication of existing agricultural uses although confirmation of detailed use and infrastructure will be required prior to construction. Identified uses for the study area in the 2016 inventory are shown in **Figure I13-3** (**Appendix I**).

ALR lands within the Project study area comprise 69.4 ha (**Figure I13-3** in **Appendix I**: Agricultural Lands Figures) and include the following:

- Farmed lands north and south of Fraser Highway used for forage crops and pasture (highway access to one field, fencing not evident);
- Lands not farmed and used for the Surrey Golf Course, the Honeybee Centre, and storage (mapped as anthropogenic); and
- Lands not farmed, in natural and semi-natural land cover north and south of Fraser Highway (one rough highway access point on the north side, fencing adjacent to path on the south side, fencing not evident on the north side).

Table 13-6 summarizes the proportions of lands in each use.

Table 13-6 Summary of ALR Land Uses in the Study Area (Government of BC 2022a)

Land Use	Percent (%) of ALR in the Study Area
Forage	19%
Forage and Pasture	0%
Anthropogenic (not farmed) (Golf course and Honeybee Centre)	30%
Natural and Semi Natural	51%

Note: Area of ALR in the study area is 69.4 hectare (ha).

Actively farmed ALR land adjacent to the Project study area in the Serpentine Valley includes a nursery, located south of the Surrey Golf Course, and a greenhouse and nursery complex located further north, as well as a blueberry operation (Government of BC 2016a). A dairy farm on 168 Street and an equine operation on Highway 15 are both located more than 200 m south of Fraser Highway, outside the study area.

As the ALR in the study area is within the Serpentine floodplain, drainage is supported by dikes, drainage ditches, and access routes. The City of Surrey is the diking authority responsible for diking along the Serpentine River to manage the water regime and flood potential (Government of BC 2009b). Fry's Corner Pumpstation is located on the edge of the study area north of Fraser Highway on the east dike adjacent to the river. Watercourses, including drainage ditches (registered with COSMOS) (City of Surrey 2021) located within the ALR, are shown on **Figure I13-3** (**Appendix I**: Agricultural Lands Figures). Existing drainage improvements, such as drain tiles, if present for individual agricultural parcels, will need to be investigated by Project Co during detailed design.

Fencing and dedicated agricultural access are important considerations for any anticipated changes to land use. Fencing is not evident on the north side of Fraser Highway where ditches act to restrict access from the highway. On its south side, the Fraser Greenway multi-use pathway is bounded by a low fence and a high net barrier associated with the Surrey Golf Course. East of the Serpentine River and on the south of Fraser Highway within the ALR, there is unpaved access to two parcels. Access to the Honeybee Centre is from Harvie Road.

Non-ALR lands in agricultural use in the Project study area (although with improved agricultural capability ratings greater than Class 4) are as follows:

- Two areas on the north side of Fraser Highway between 182 Street and 184 Street:
  a. parcel with mixed vegetable production and greenhouses (Fraser Highway access, sidewalk, fenced);
  b. nursery with greenhouses: (Fraser Highway access, sidewalk, fenced);
- North of Fraser Highway, access from 184 Street: sheep, poultry, and horse operations (use not evident on Google Earth 2021);
- North side of Fraser Highway, either side of 189 Street: forage and pasture with cultivated field crops (no highway access on the west side of 189 Street, sidewalk and mainly fenced along Fraser Highway); and
- Fraser Highway and 68 Avenue: Use has changed to residential (Google Earth 2021).

13.3 Project Interactions

Potential interactions between agricultural land and Project activities and physical works are outlined in **Table 13-7**. There may be potential interactions between activities that have a spatial component within agricultural land or that could affect adjacent agricultural operations.

Table 13-7 Potential Project Interactions with Agricultural Land and Potential Effects

Project Activities and Works	Inconsistency with Agricultural Land Use Regulations and Policy[1]	Loss of Agriculturally Designated Land and Land in Agricultural Use[1]	Loss of Non-designated Land in Agricultural Use	Alteration of Agriculturally Designated Land[1]
Construction				
Clearing and grubbing	✓	✓	✓	✓
Property acquisition (including demolition of inert building material)	✓	✓	✓	✓
Utility location/relocation	✓	o	o	o
Use of temporary laydown areas	-	✓	✓	✓
Access and traffic management	-	✓	✓	✓
Road widening (select locations)	-	✓	✓	✓
Drainage realignment (select locations)	-	✓	-	✓
Installation of SkyTrain guideway foundations	-	✓	✓	✓
Installation of overhead SkyTrain guideway	-	o	o	o
Stations (foundations, structure, lighting, access, service connections, security)	-	✓	✓	✓
Power propulsion substations	-	o	o	o
Management of non-contaminated excavated material (including excavation)	-	o	o	o
Management of contaminated or hazardous materials	-	o	o	o
Testing, commissioning, and start-up	-	o	o	o
Operation				
Operation of SLS	-	✓	✓	✓
Maintenance of SLS	-	o	o	o

Note:

[1] Interaction Rating:

– **No interaction:** an interaction between a Project component and an SE is not likely.

o **Minor interaction**: an adverse effect may result from an interaction, but standard measures to avoid or minimize the potential effect are available and well understood to be effective, and any residual effects would be reduced to negligible. Interaction is not discussed further.

✓ **Interaction**: an interaction occurs and and likely requires additional mitigation. Carried forward and discussed in subsequent sections.

13.2 Potential Effects

The evaluation of the regulatory and land use effects is supported by an analysis of the Project's construction (temporary) and operation (permanent) footprints on agricultural lands (ALR and non-ALR land used for agriculture). These footprints, including the Fraser Highway ROW, for ALR and non-ALR lands are summarized in **Table 13-8** and **Table 13-9** respectively The effects assessment below focuses on the footprint of agricultural lands outside the Fraser Highway ROW as the lands within the ROW in the ALR are permitted for use for transportation purposes by the ALC. That said, indirect effects are possible and addressed below.

Table 13-8 Summary of Project Footprint in ALR

Footprint Type	Temporary	Permanent	Total Footprint (construction phase)	Percent of Study Area (temporary plus permanent)
Project Footprint	27.6 ha	31.4 ha	59.0 ha	8.81%
Total Footprint within ALR (including ROW)	2.9 ha	2.7 ha	5.7 ha	0.84%
Footprint within ALR outside of ROW	0.24 ha (aerial)	< 0.01 ha (aerial)	0.25 ha	0.04%
Footprint in non-ALR agricultural land	0.62 ha	0.48 ha	1.1 ha	0.16%

Note: Agriculture Study Area = 669.8 ha

Table 13-9 Project Use of Non-ALR Agricultural Land Outside of Fraser Highway ROW Based on the RCD

Location[1]	Permanent (m^2)	Temporary (m^2)	ALR (Yes/No)	OCP Designation	Comments
North side of Fraser Highway between 182 Street and 184 Street	5,609	5,218	No	Urban and Commercial	Mixed vegetable production, greenhouses, nursery. Location of Station.
North side of Fraser Highway, either side of 189 Street	1,399	2,617.5	No	Urban	Forage, pasture, cultivated crops. Permanent and temporary property takes on west and east sides noted as actively farmed in 2016.
7700 168 Street	0	524	Yes	Agricultural	Temporary use of Surrey Golf Course, west of Serpentine River including dike
17126 Fraser Hwy	0.0	1,007	Yes	Agricultural	
17278 Fraser Hwy	1.0	831.4	Yes	Agricultural	
17911 Fraser Hwy	0.0	19.2	Yes	Agricultural	North side of Fraser Hwy east of Harvie Rd, after alignment crosses to north. Natural and semi-natural site.

Note:

[1] Parcels outside of the ALR identified with anthropogenic use are not included in the analysis. Areas less than 2 m^2 are not included in the analysis as they are within the error for the determination.

13.2.1 Consistency with Agricultural Land Use Regulations and Policy

As noted in **Section 13.1**, changes in land use in the ALR for proposed transportation projects need an application for Transportation, Utility, and Recreational Trail Use under Section 22 of the Agricultural Land Reserve General Regulation. In addition, infill and excavation of soil in the ALR requires an application under section 20.3(5) of the *Agricultural Land Commission Act*.

The Province has initiated consultation with the ALC regarding Project application requirements for ALR land within the Fraser Highway ROW and temporary uses of ALR land outside of the ROW. The Project design avoids permanent acquisitions of land in the ALR outside of the ROW, (**Table 13-8**). Temporary acquisitions are anticipated for narrow strips paralleling the south side of Fraser Highway. Once the Project's final design is determined, consultation with the ALC will take place to confirm the required applications and associated processes, such as notification procedures.

Agricultural land is also regulated through the Surrey OCP, Policy No. O-51, and the Agricultural Plan. Given that there are no anticipated permanent use of ALR land outside of the Fraser Highway ROW, it is consistent with Surrey policy. In addition, Project development will be guided by the SPA, which focuses development in accordance with the RGS and municipal policies.

13.2.2 Loss of Agricultural Land

Analysis of the Project's land requirements indicate that there is no potential permanent change to ALR land outside of the Fraser Highway ROW. Approximately 0.25 ha in the ALR will be required during Project construction (i.e., temporary plus permanent footprint) in narrow areas paralleling the Fraser Highway ROW. Of the 8,654 ha of ALR in Surrey, this area constitutes significantly less than 1%[56] of the land. Given the configuration of the temporary parcels and the present use of these parcels (golf course, and semi-natural), a loss of agricultural productivity is not anticipated.

For non-ALR agricultural land, the Project footprint for the RCD indicates the potential need for temporary and permanent uses of land near 184 Street and either side of 189 Street (currently with plant nursery, forage, and pasture uses) to support station infrastructure and guideway approaches.

13.2.3 Alteration of Agricultural Land

The use of agricultural land adjacent to the Project footprint may be altered by Project activities that affect agricultural infrastructure and by changes in soil quality, access, invasive species spread, and sensory conditions. Soils in the Serpentine Valley tend to be poorly drained, and management of the land has required investment in drainage, including the dikes along the Serpentine River, the pump station north of Fraser Highway, and drainage ditches in the agricultural lands. No effects to the pump station are anticipated as it is approximately 200 m north of Fraser Highway and outside of the footprint.

Existing uses of ALR land south of the alignment are for golf course and forage crops as well as land in natural and semi-natural condition. In this area, alterations to field drainage and the Serpentine River dike as well as associated water management are likely required for the Project. Based on the RCD, the SLS crossing of the Serpentine River needs a permanent column in the western dike. Construction activities

56 0.000029% of the City of Surrey ALR lands.

may temporarily utilize dike access on either side of the Serpentine River. To accommodate the PPS, the adjacent portion of ditch may require relocation to maintain its functionality during and following construction.

Soil quality could be affected through sedimentation from runoff during construction and by inadvertent releases of contaminants, such as hydrocarbons from vehicles and concrete wash. Potential effects to agricultural soils will be managed through identified performance objectives in the CEMP Framework and though mitigation measures identified in the CEMP, including the Sediment and Erosion Control Plan and the Spill and Emergency Response Plan.

The functionality of the two unpaved accesses to ALR parcels should be maintained during construction, and restored during operation, following consultation with the landowners. Mitigation for access to non-ALR properties is described in the **Section 14** Land Use. Project activities that disturb, move, store, and replace soil may increase the potential for invasive species to spread in nearby agricultural areas (see **Section 11** Vegetation and Wildlife Resources).

Changes in air quality and noise during construction and operation may also temporarily affect agricultural productivity, depending on the crops and livestock. No livestock operations were identified in the study area. Baseline noise levels measured along Fraser Highway by Hemmera in 2019, and day-night sound levels ranged from 62.6 dBA to 71.5 dBA[57], which is typical of busy thoroughfares in Surrey. As evaluated in **Section 7** Air Quality and Greenhouse Gas and **Section 8** Noise and Vibration, effects from air quality and noise are unlikely to affect the existing pasture and forage crops in the ALR.

The Honeybee Centre, located on the northeast corner of Fraser Highway / Highway 15 intersection within the ALR, is a commercial honey farm, store, and educational facility that provides colony rentals. Bees may be affected by sensory disturbances from air quality, sound, and light (Collison 2016; Shepherd et al. 2018; Government of BC 2010; Owens and Lewis 2018). However, incremental effects to the Centre due to the Project are considered unlikely due to facility’s location at a busy intersection where existing sound levels are high, no SkyTrain stations are slated for the ALR, PPS do not generate noise that would exceed ambient levels[58] and the SkyTrain does not operate 24 hours a day.

Potential for shading of agricultural land due to the elevated guideway was considered for the ESR. Any shading in winter months will not affect agricultural production. Assuming a typical height of 6 m from roadway to the top of the guideway, properties within a 45-degree shadow angle of the guideway may be affected by shading up to 6 m away. During summer months, when the sun is at its highest and crop productivity is peaking, the shadow would be completely contained within the existing ROW in the ALR and therefore, no shading effects are anticipated. Outside of the ALR, the elevated guideway is located on the north side of Fraser Highway where some shading of non-ALR agricultural land may occur.

13.3 Mitigation Measures

The proposed mitigation measures to avoid or reduce potential effects from Project activities are listed below. The mitigation measures, the effect(s) they address, the Project phase in which they will be implemented, and their implementation in a relevant environmental management plan are summarized in **Table 13-10**. For Agricultural Land, the relevant stages for implementing mitigation are during design (denoted as "D"), construction (denoted as "C") and operation (denoted as "O").

57 Noise at these levels can be disruptive of telephone conversations.

58 TransLink’s noise studies (2020, 2021) do not identify PPS as a noise source warranting assessment or mitigation.

Content from this section will be incorporated into the CEMP Framework (see the TOR for additional description of this document). As its name implies, the Project's CEMP Framework document will provide detailed guidance for the content of the Project Co's CEMP. In addition to mitigation and performance objectives, the CEMP Framework will describe best practices intended to meet the performance objectives and required content for each sub-plan such as the Erosion and Sedimentation Plan. The CEMP Framework will also include details on roles and responsibilities for Project Co's key team members.

Potential effects to agricultural operations from noise, air quality and water quality are managed through the mitigation measures presented in **Section 7** Air Quality and Greenhouse Gas, **Section 8** Noise and Vibration and **Section 10** Fisheries and Aquatics. Potential effects to nearby agricultural operations from increased spread of invasive species will be managed through the implementation of the mitigation measures in **Section 11** Vegetation and Wildlife Resources.

13.3.1 Design Mitigation

Mitigation M13.D-1 Implement SPA with City of Surrey

- Implement the SPA with the City of Surrey to address potential inconsistencies with land use designations and zoning during Project construction and operation and guide associated changes in growth patterns.

Mitigation M13.D-2 Consult with ALC

- Consult with the ALC regarding the Project design in the ALR to confirm what approvals may be required, and then seek them.

Mitigation M13.D-3 Minimize Use of Agricultural Land

- Minimize the need for temporary and permanent use of land in the ALR outside of the Fraser Highway ROW while ensuring safe construction and operation of the SLS.

13.3.2 Construction Mitigation

Mitigation M13.C-1 Engage Potentially Affected Agricultural Operators

- Engage farm operators in Project planning (i.e., TMPs and road work schedules) to help inform the development of specific mitigation measures;
- Conduct a field survey to verify agricultural operations and agricultural infrastructure potentially affected by the Project's final design; and
- Communicate proactively and clearly, indicating all temporary access routes during construction.

Mitigation M13.C-2 Maintain Agricultural Operations and Infrastructure

- During design and construction, avoid or minimize disturbances to agricultural infrastructure, such as from Project-related changes in drainage;
- Maintain functionality of the Serpentine River dikes and agricultural drainage affected by the Project ;

- If the function of agricultural infrastructure is altered during construction, restore it to the same condition, where possible, and otherwise replace it in a manner that provides the same functional service; and
- Restore existing access points, or provide permanent alternatives, during operation.

Mitigation M13.C-3 Restore Agricultural Capability in ALR

- Restore temporarily disturbed land in the ALR and outside of the Fraser Highway ROW to existing or improved agricultural capability. Following construction:
    - Safely store and replace topsoil (30 cm or from the surface to the rooting depth of crop, whichever is greater).
    - Avoid infill or excavation of agricultural land, where possible. If required, remove any fill and contour to original topography.
    - Replace disturbed infrastructure, such as drain tiles.
    - Improve structure of potentially impacted soils.

13.3.3 Operation Mitigation

Mitigation M13.O-1 Vegetation Management during Operation

It is expected that during operation there will be a minor interaction with SkyTrain maintenance practices for vegetation management of agricultural lands under the guideway and around the 184 Street. Station. See **Section 18** Environmental Management During Operations for information on BCRTC's System Program for vegetation management, which focuses on control of invasive and noxious weed species.

13.3.4 Summary of Proposed Mitigation

Table 13-10 summarizes potential effects and mitigation measures during design (denoted with a D) and construction (denoted with a C).

Table 13-10 Summary of Potential Project Effects and Mitigation Measures for Agricultural Land

Potential Effect	Mitigation Number	Mitigation Measure	Project Phase (construction, operation)	Environmental Management
Inconsistency with agricultural land use regulations and policy	M13.D-1	Implement SPA with City of Surrey	Design	CEMP: Agricultural Land Management Plan
	M13.D-2	Consult with the ALC		
	M13.C-3	Restore agricultural capability in the ALR	Construction	
Loss of agricultural land	M13.D-3	Minimize use of agricultural land	Design	CEMP: Agricultural Land Management Plan
	M13.C-1	Engage potentially affected agricultural operators	Construction	
	M13.C-2	Maintain agricultural operations and infrastructure		
	M13.C-3	Restore agricultural capability in the ALR		

Potential Effect	Mitigation Number	Mitigation Measure	Project Phase (construction, operation)	Environmental Management
Alteration of agricultural land	M13.C-1	Engage potentially affected agricultural operators	Construction	CEMP: Agricultural Land Management Plan Spill and Emergency Response Plan Erosion and Sediment Control Plan Vegetation and Wildlife Management Plan
	M13.C-2	Maintain agricultural operations and infrastructure Employ mitigation measures for noise, air quality, water quality and invasive species		
	M13.O-1	Manage vegetation during operation	Operation	TransLink standards of practice

13.4 Discussion

The Project traverses agricultural lands within the Serpentine Valley, including portions of the ALR with established agricultural use and extensive water management infrastructure. ALR lands immediately adjacent to the Project include non-agricultural uses, land that is presently under-utilized for agriculture and lands currently used for agriculture.

13.4.1 Consistency with Regulation and Policy

Design measures to minimize the Project footprint are expected to avoid permanent loss of agricultural land within agricultural designations outside the Fraser Highway ROW. The Province will consult with the ALC to determine the need for permits for temporary use of land, which may include an aerial footprint and a footprint for a laydown area, in compliance with regulation and guidance for transportation, utility or recreational trail uses. With these measures and commitments in place, the Project is considered consistent with regulations pursuant to the *Agricultural Land Commission Act*. During operation, TransLink agreements with the City of Surrey are expected to provide consistency with local bylaws and policies.

13.4.2 Loss of Agricultural Land

The Project design minimizes the permanent and temporary loss of ALR land. The potential loss of agricultural land outside of the ROW during construction is considered low in magnitude as the potentially impacted areas are narrow and parallel to the existing ROW. Most areas of potential encroachment are currently used as golf course or are not in agricultural production and therefore unlikely to affect current agricultural productivity. The extent of this effect is considered very low (much less than 1% of the ALR in Surrey), and short term, as the lands will be available for use following construction. As the design progresses, the Project will endeavour to reduce effects on ALR even further. With effective implementation of the mitigation measures to restore land and infrastructure to its previous state, the effects are considered reversible.

For non-ALR agricultural lands, the Project will temporarily and permanently require parcels of land currently used for agriculture along Fraser Highway in Surrey. However, the City of Surrey's land use plans have not designated these parcels as agricultural (see Section 14 Land Use). The station at 184 Street is likely to permanently affect an existing commercial operation. In the area around 189 Street, the permanent land losses parallel the ROW, and the temporary use may affect residences east of 189 Street. For areas outside the Project footprint, agricultural uses are expected to be able to continue.

13.4.3 Alteration of Agricultural Land

Engaging with potentially affected agricultural operators prior to and during construction will help to identify agricultural infrastructure and manage potential effects. Project layout and design measures for water, air quality, and noise management are anticipated to avoid or minimize any potential land alteration adjacent to the Project (**Section 7** Air Quality and Greenhouse Gas, **Section 8** Noise and Vibration, **Section 10** Fisheries and Aquatics, and **Section 11** Vegetation and Wildlife Resources). In addition, no changes to the functionality of the Serpentine diking and pumping system are anticipated.

Additional mitigation measures to avoid and manage potential effects to soil and water quality from sedimentation, invasive weeds, and accidental release of hazardous materials during construction are identified in **Section 10** Fisheries and Aquatics and **Section 11** Vegetation and Wildlife Resources of this ESR. During construction, adverse effects from water flow changes, air quality, invasive species and noise are likely to be low in magnitude and extent (within or close to the construction footprint), short term, and reversible. During operation, adverse effects to land in the ALR are anticipated to be negligible, with the application of recommended mitigation.

13.5 Conclusions

The Project footprint overlap with agricultural lands is limited to areas within the ALR in the Serpentine Valley and non-ALR parcels along Fraser Highway in Surrey. Potential Project-related effects on agricultural land that remain after the application of mitigation are described below and summarized in **Table 13-11**. Potential effects to agricultural uses on ALR and non-ALR are addressed separately.

Agricultural capability ratings for soils in the Project study area range from Class 2 (minor limitations) to Class 7 (no agricultural capability). Most of the ALR soil polygons in the Project study area have agricultural capability ratings of Class 4 or Class 04 (organic), usually with limitations for undesirable soil structure (D) and excess water (W) and some for salinity (N).

Project design measures to locate the Project within the existing Fraser Highway ROW have avoided permanent property impacts to the extent feasible. As the design progresses, these effects may be further reduced. Project development will continue to be guided by the SPA. The proposed changes to agricultural land use outside of the ALR from property impacts are in alignment with the RGS and City of Surrey policies. The Project is considered consistent with regulation and policy, and it is expected that overall effects regarding the loss of designated ALR lands will be low.

Analysis of the Project land requirements indicate that there is no permanent change to ALR land outside of the Fraser Highway ROW. Approximately 1.48 ha of non-ALR agricultural land outside of the ROW overlaps with the Project footprint and could be affected during construction. During operation, this land area decreases to 0.7 ha. Due to the identified need for land to accommodate a SkyTrain station at 184 Street, loss of non-ALR land in agricultural use is anticipated to be moderate, although very limited in geographic extent.

It is expected that engagement with agricultural operators will identify, avoid, or minimize, potential effects to agricultural infrastructure. Management plans in the CEMP will prevent potential soil quality effects in adjacent lands resulting from sedimentation, invasive species and hazardous materials. Sensory disturbance for air quality and noise will be managed by mitigation measures described elsewhere in this ESR, including **Section 7** Air Quality and Greenhouse Gas, **Section 8** Noise and Vibration and **Section 10** Fisheries and Aquatics. Although a limited amount of land in agricultural use may be required temporarily for construction, it is anticipated that most of this land will be returned to a similar function afterward. Overall, this effect is assessed as having a low impact.

Table 13-11 Summary of Potential Effects Remaining After Mitigation for Agricultural Land

Potential Effect	Criterion	Rating	Rationale for Rating
Inconsistency with agricultural land use regulations and policy	N /A	N /A	No Project-related effects are anticipated.
Loss of agriculturally designated land (permanent and temporary)	Magnitude	Low	Project-required areas in the ALR outside the Fraser Highway ROW are narrow and parallel the ROW.
	Geographic Extent	Negligible	The temporary Project footprint area (0.25 ha) is negligible in relation to the ALR area in Surrey.
	Duration	Short-term	The temporary Project footprint will be available for agricultural use following construction.
	Frequency	Uncommon	Lands may be affected periodically for portions of the construction phase.
	Reversibility	Reversible	Lands in the temporary Project footprint are likely to return to their previous function following construction.
Loss of non-designated land in agricultural use	Magnitude	High	Agricultural uses will be discontinued for some land in the permanent Project footprint.
	Geographic Extent	Site	A limited number of parcels, and portions of parcels, in agricultural uses will be affected.
	Duration	Permanent	Agricultural uses will be discontinued for some land in the permanent Project footprint.
	Frequency	Continuous	Use of agricultural lands in the Project footprint will be continuous for the Project duration.
	Reversibility	Permanent	Non-ALR agricultural lands in the Project footprint will be permanently affected.
Alteration of agriculturally designated land during construction	Magnitude	Low	Mitigation measures presented in the ESR are expected to avoid or minimize effects. Project construction activities are unlikely to affect current agricultural productivity.
	Geographic Extent	Low	Extent will be limited to agricultural areas parallel and adjacent to the Project footprint.
	Duration	Medium term	Effects may last throughout Project construction where there are affected ALR lands.
	Frequency	Common	Effects may be common during Project construction.
	Reversibility	Reversible	Adjacent agricultural areas are likely to return to their existing condition following Project construction.

Notes:

1. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance, and high (exceedance of criteria or threshold). Generally, magnitude is measured in terms of the proportion of the SE affected within the assessment area (for biophysical SE), or the degree within the interaction area relative to the range of natural or historic (in the case of human environment SE) variation.
2. The duration of an effect may be short-term (i.e., within the construction phase), medium term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (permanent) (i.e., extending past the life of the Project).

Addendum 13-1 Key to Agricultural Capability Polygons (shaded in ALR)

The percentile of the polygon with the rating is presented as the first number in the description. It is followed, first, by the rating and limitation(s) for that proportion, and then by the other proportions within the polygon.

Polygon ID	Agricultural Capability	
	Unimproved	Improved
1	3ADW	3DT
2	5:4APT~3:3AT~2:4WAT	5:4TAP~3:3TA~2:3TWA
3	4:3DAW~3:2ADT~3:4WA	4:3DT~3:2TD~3:2WA
4	5:4APT~3:3AT~2:4WAT	5:4TAP~3:4TA~2:3TWA
5	4WD	3DWT
6	7:3DAW~3:5W	7:3DT~3:3DW
7	O4WL	O3LW
8	4WND	3NDW
9	O4W	O3WL
10	6:4W~4:O4WL	6:3WD~4:O3LW
11	4:O4W~3:4WD~ 3:4WND	4:O3LW~3:3DWT~3:3NWD
12	4W	6:2WN~4:3WD
13	4W	2WN
14	6:4WD~4:O4WL	6:3DW~4:O3LW
15	6:4WD~4:O4WL	6:3DW~4:O3LW
16	4W	2WN
17	4:O4W~3:4WD~ 3:4WND	4:O3LW~3:3DWT~3:3NWD
18	6:O4WL~4:4WD	6:O3LW~4:3DW
19	4:4WD~3:4WND~3:O4WL	4:3DWT~3:3NWD~3:O3LW
20	4WD	3DW
21	4WD	3DW
22	O4WL	O3LW
23	7:4TAP~3:3DTA	7:4T~3:3TD
24	6:2AWT~4:4ATP	6:2TD~4:2AT
25	6:5W~4:4WA	6:3DW~4:2AW
26	7T	
27	6:5W~4:4WA	6:3DW~4:2WAT
28	7:4APT~3:3ADT	7:3ATP~3:2DT
29	5:4WA~3:3AWD~2:3A	5:2WAD~3:2ADT~2:2AT
30	7:4WA~3:4A	7:2WAP~3:2AT

Polygon ID	Agricultural Capability	
31	7:4APT~3:3ADT	7:3ATP~3:2DT
32	7:4APT~3:3ADT	7:3APT~3:3TD
33	4WD	3DW
34	7:3ADW~3:4WD	7:2DT~3:3DW
35	7:2ADW~3:4WD	7:2DT~3:3DW
36	7:4AWD~3:3WAD	7:2AD~3:2D
37	3WAD	2D

14 Land Use

14.1 Introduction

The ESR evaluation of land use[59] [60] considers the potential for Project activities to affect or alter existing land use as well as designated land use plans along the alignment. Changes to land use are inevitable as construction requires property acquisition and changes to land use designations to accommodate the SkyTrain, including infrastructure such as stations, PPSs, and guideway foundations. Currently, the Fraser Highway corridor services lower density urban uses. However, municipal planning calls for increased densities in anticipation of the Project and to accommodate planned growth and drive transit ridership to reduce VKTs.

This land use SE section presents the:

- Rationale for selecting the SE;
- Relevant provincial legislation and local and regional bylaws;
- Baseline conditions for land use planning designations and land uses within the Project study area; and
- Analysis of potential Project-related effects.

The review of potential effects on land use was based on the information requirements identified in the ESR TOR (**Appendix A**). Refer to **Section 13** Agricultural Land of the ESR for a detailed review of agricultural land use. See **Section 15** Transportation and Access for land use related to transportation and access. This ESR section's scope is limited, leaving areas of interest, such as effects of population growth and density as well as commercial and residential zoning to be addressed through regional and municipal planning processes. This analysis focuses on the potential effects of Project-related activities on land use.

14.1.1 Project Features Relevant to Land Use

Key features and components of the Project Description (**Section 2**) that are relevant to the land use assessment include those that are intrinsic to the SLS design, including its alignment and elevated components. The guideway alignment will follow the existing transportation corridor along Fraser Highway until it veers north from Fraser Highway near Production Way to follow Industrial Avenue to the terminus station at 203 Street.

The Project design, including the elevated guideway, limits encroachment onto land outside of the Fraser Highway ROW. The Project footprint for the RCD consists of permanent and temporary footprint areas (**Figures J14-1** to **J14-4** in **Appendix J**: Land Use Figures). Permanent footprint areas are associated with physical infrastructure necessary for Project operation (e.g., stations, PPSs, SkyTrain overhead guideway, a new SkyTrain bridge across the Serpentine River, foundations), while temporary footprint areas are associated with construction only (e.g., temporary laydown and other work areas).

[59] For information on Traditional Land Use related to the Project based on information provided by participating First Nations, see **Section 4**: First Nations Engagement.

[60] Publicly available information on land use planning documents of participating First Nations were reviewed; no overlaps with the Project study area occurs.

In many cases, temporary requirements may only require aerial clearance and workspace. The following buffer areas are assumed for the Project's temporary workspace areas:

- Road works and parking areas – 2-m buffer;
- Guideways – 5-m buffer from edge; and
- Support columns – 4-m buffer.

The Project's eight new stations will be elevated, which will limit ground-level footprint-related effects. The stations will be located generally along Fraser Highway at the following street locations: 140, 152, 160, 166, 184, 190, 196, and 203. Stations at 166 Street, 196 Street, and 203 Street will include transit exchange facilities. Criteria that helped to inform station locations included:

- Analysis and forecasts of current and projected ridership demand, based on planned future employment and population growth;
- Local context, development scale, and community objectives;
- Intermodal connectivity with established bus routes and transit exchanges;
- Avoidance of Environmentally Sensitive Areas;
- Response to municipal land use policies and zoning that encourage higher-density town centres, transit-oriented development, and ridership growth;
- Access requirements for passenger pick-up and drop-off, HandyDART, maintenance, and emergency response; and
- Minimizing effects on existing properties, GTUF, and ALR areas.

The majority of the elevated guideway is located within existing ROW which reduces land use impacts. Property acquisition is required to accommodate new stations, but details about specific land parcels will not be confirmed until a later stage of design. As such, this analysis relies on information in the RCD. Some lands will be acquired fee simple, but most property needed for the Project will be existing ROW. The new guideway areas will be acquired as statutory ROw.

SLS operation will support provincial, regional, and municipal land use objectives for regional town centres and transportation objectives outlined in the Metro Vancouver RGS and OCPs for the Three Municipalities.

14.1.2 Selection as a Screening Element

Land use was selected for evaluation because of the potential for Project-related activities to interact with designated land uses in adopted local and regional land use plans, and with existing land uses. The assessment of potential effects to land use designations, zoning and existing land uses is based on the Review Indicators in the ESR TOR (see **Appendix A**), as outlined in **Table 14-1** below.

Table 14-1 Selection of Review Indicators

Potential Effect	Review Indicator(s)	Rationale for Selection
Inconsistency with land use regulation and policy	• Alignment with local and regional government land use policies	• Existing regional, local, and neighbourhood land use plans may need to be amended to accommodate the Project
Effects to commercial and residential land uses	• Residential and commercial properties affected by the Project and anticipated changes	• Potential effects to existing ownership of residential and commercial properties • Potential effects on access to some properties in proximity to the alignment during construction and operation • Potential effects to commercial activity for some businesses in proximity to the alignment due to traffic changes during construction and operation
Effects to industrial land use	• Industrial properties affected by the Project and anticipated changes	• Potential effects to existing ownership of industrial properties • Potential effects on access to some properties in proximity to the alignment during construction and operation • Potential effects to industrial activity for some businesses in proximity to the alignment due to traffic changes during construction and operation
Effects to conservation and recreation land	• Area of parkland affected • Parkland features affected	• Potential effects to GTUF, neighbourhood parks, and recreation features as well adjacent park areas during construction and operation

14.1.3 Spatial and Temporal Boundaries

14.1.3.1 Spatial Boundaries

The land use study area boundary comprises a 200 m buffer on either side of the centreline of the Project alignment (**Figures J14-1**). This study area was selected based on a review of land use and the diverse types of residential, commercial and mixed employment[61] property uses as well as J14-1 parks and recreational land uses near the Project.

14.1.3.2 Temporal Boundaries

Temporal boundaries correspond to the different stages of the Project when work and activities would be reasonably expected to potentially affect land use. The following temporal boundaries were considered in this assessment:

- Planning phase: 2020 to 2024;
- Construction and commissioning phase: 2024 to 2028; and
- Operation phase (including maintenance) of Project: 2028 and beyond.

[61] Mixed Employment areas are intended for industrial, commercial, and other employment-related uses that complement employment uses in Urban Centres and Frequent Transit Development Areas (Metro Vancouver 2020a).

14.1.4 Regulatory and Policy Context

Legislation, regulations, and policies frame the discussion of the land use SE. Applicable provincial and municipal government legislation and bylaws are summarized in **Table 14-2**, and key policies and guidelines are summarized in **Table 14-3**[62]. Land use planning documents pursuant to the *Local Government Act* are covered in more detail in **Section 14.2.** Note that, in addition to the listed regulations and policies, Project Co will be required to follow the DBSS (Government of BC 2019c), including Section 165 Protection of the Environment.

Table 14-2 Key Legislation

Legislation	Responsible Agency	Relevant Aspects of Legislation	Applicability to the Project
Provincial			
Local Government Act, RSBC 2015, c. 1	Ministry of Municipal Affairs and Housing	Primary legislation for municipalities and regional districts: • Provides the framework for structure and operations and sets out the powers and responsibilities of local governments. • Establishes authority of municipalities to regulate land use through OCPs and zoning bylaws. • Requires regional districts to prepare a RGS.	The Project is located in the Three Municipalities, which are regulated under this Act.
Community Charter, SBC 2003, c. 26	Ministry of Municipal Affairs and Housing	Identifies a municipality's core areas of authority, including: • Broad powers, such as municipal services, public health regulation and entering into agreements, property taxation, and financial management. • Procedures to adopt and enforce bylaws.	The Project is located in the Three Municipalities, which are regulated under this Act.
Land Act, RSBC 1996, c. 245	FOR	Governs conveyance of Crown land, including the granting of land and issuance of Crown land tenure in the form of leases, licenses, permits, and rights of way.	The Act applies to provincial land parcels in the study area, which include: • JPOCSC (Fraser Highway and 140 Street) • GTUF (parcel between Fraser Highway and 96 Avenue) • Insurance Corporation of BC (Production Way near Fraser Highway

[62] Information on Crown land disposition, including First Nations consultation, is available at: https://www2.gov.bc.ca/gov/content/industry/crown-land-water/crown-land/land-policies.

Legislation	Responsible Agency	Relevant Aspects of Legislation	Applicability to the Project
Dike Maintenance Act, RSBC, 1996, c. 95*,*	Provincial Inspector of Dikes	Under the Act, changes must not be made to a dike or to the area adjacent to a dike without the prior written approval of the Inspector or a Deputy Inspector of Dikes. These changes include: • Construction of a new dike • Alterations to the cross-section or crest elevation of a dike • Any type of construction on or over a dike or dike ROW • Alteration of the foreshore or stream channel, which could increase flood levels or impact dike integrity	Serpentine River dikes regulated under this Act will be affected by the Project.

Key policies for municipal land use planning are contained in bylaws, strategic plans, OCPs, Neighbourhood Concept Plans (NCPs), and District Policies. NCPs guide land use planning for neighbourhoods in more detail than OCPs.

Table 14-3 Key Bylaws, Policies, and Guidelines

Bylaw / Policy	Responsible Agency	Relevant Aspects of Bylaws, Policies and Guidelines	Applicability to the Project
Regional			
Metro 2050: Regional Growth Strategy	((Metro Vancouver 2022)M)	This RGS sets out land use policies to guide future development in the region. The RGS is an integration of regional and local land use planning to ensure alignment and achieve common goals. Metro 2040 was updated in 2022 to extend the strategy to 2050 (Metro Vancouver 2022).	The strategies in this plan were adopted by TransLink. The Project supports the RGS.
Municipal[1]			
Surrey OCP	(City of Surrey 2013)	The OCP outlines objectives and policies that guide the City of Surrey's planning decisions for land use designations. As per section 866 of the *Local Government Act*, the Surrey OCP includes a statement to indicate how the OCP meets the goals and objectives of Metro Vancouver's RGS to develop a stable, environmentally responsible, transit-oriented city.	The Project is integral to planning decisions for OCP land use and objectives to develop a stable, environmentally responsible, transit-oriented city. Note that the OCP predates the decision to specifically proceed with SLS.
Surrey Zoning By-law 12000	(City of Surrey 1993)	The bylaw divides the City of Surrey into zones to regulate building location, use, and height; land use and size of yards; and other open spaces.	The zoning bylaw is applicable to the proposed property acquisitions.
Greenways Plan	(City of Surrey 2012)	This plan establishes general policies for the routing and designing of greenways and encourages the integration of greenway planning with land use planning among other purposes.	Greenways that may be affected by the Project are part of this plan.

Bylaw / Policy	Responsible Agency	Relevant Aspects of Bylaws, Policies and Guidelines	Applicability to the Project
Transportation Strategic Plan	(City of Surrey 2008)	This plan is the framework for implementing the City of Surrey's transportation system.	Walking and cycling paths that may be affected by the Project are part of this plan.
Building the Next Metropolitan Centre: Economic Strategy overview 2017 – 2027	City of Surrey (2017a)	This document provides strategies and objectives to transform Surrey into a metropolitan centre, including those for transit	The Project supports the economic strategy in relation to transit.
Township of Langley OCP Bylaw 1979 No. 1842	(Township of Langley 2013)	The OCP establishes the objectives and policies that guide the Township of Langley's planning decisions for land use.	The Project is integral to planning decisions for land use designations. Note that the OCP predates the decision to specifically proceed with SLS.
City of Langley OCP Bylaw No. 3200	(City of Langley 2021c).	The OCP states objectives and principles to guide Langley City's land use planning and land use designations	The Project is integral to planning decisions for land use designations.
Neighbourhood			
Surrey City Centre Plan	(City of Surrey 2017b) (City of Surrey 2022b)	Outlines land use for the main urban centre area of Surrey, including King George SkyTrain Station (City of Surrey 2014b, 2017a).	Updates are underway to address changing market conditions and new transportation policies (City of Surrey 2017b)
Fleetwood Plan	(City of Surrey 2022h).	This plan will update the Fleetwood Town Centre Plan and guide land use planning for Fleetwood in more detail than the OCP. The City released plan concepts for public review in early 2021, with a final plan expected in early 2023	The Project is working with the City to ensure consistency of objectives.
City of Surrey secondary Plans – east of the Serpentine Valley	(City of Surrey 1999a). City of Surrey (2022d) City of Surrey (2003) City of Surrey (2013a) City of Surrey (1994) City of Surrey (1996).	The Neighbourhood Concept Plans (NCPs) provide additional guidance for implementing goals for the OCP Urban designation. The Clayton General Land Use Plan guides the City of Surrey's land use planning in Clayton Heights (north of Fraser Highway). The following plans were developed under this framework: • West Clayton NCP • East Clayton NCP • North Clayton NCP • Aloha Estates Infill Plan (ACP) Other neighbourhood plans adjacent and south of the Fraser Highway are: • North Cloverdale East NCP • North Cloverdale West NCP	Generally identified as urban and suburban areas with potential for long term development with accessible public transit.

Bylaw / Policy	Responsible Agency	Relevant Aspects of Bylaws, Policies and Guidelines	Applicability to the Project
Clayton Corridor Plan	(City of Surrey 2022c)	The City is currently updating land use plans in the Clayton Corridor along Fraser Highway and around future SkyTrain stations to support the enhancement of transit.	This plan will support the development of the Project.
Green Timbers Access and Recreation Management Plan	City of Surrey, Culture and Recreation (2002)	This plan guides the management of the GTUF and includes proposed actions to address public recreation concerns, ecological integrity, and heritage values (Coulthard and Cox 2002).	The Project is located within the City of Surrey's road ROW adjacent to GTUF.
Township of Langley OCP	(Township of Langley 2013).	The OCP establishes objectives and policies to guide long-term planning decisions for land use designations and includes a Regional Context Statement indicating how the OCP policies and objectives align with those of Metro Vancouver.	Policy 4.1.6 directs the Township to work with TransLink to update future OCPs, Master Transportation Plans, and Area Transit Plans, and support transit-oriented land use changes in the 200 Street corridor between Carvolth Exchange and Langley City Centre.
Willowbrook Community Plan (Bylaw 1991 No. 3008)	(Township of Langley 1991)	This plan states the goals, objectives, and policies to guide the Township of Langley's planning decision for land use designations.	The Project is integral to planning decisions for land use designations.
City of Langley OCP	(City of Langley 2021c).	This plan highlights objectives and principles to guide planning decisions for land use designations and rezoning applications and contains a Regional Context Statement to indicate how the OCP policies and objectives are consistent with Metro Vancouver's RGS.	The Project supports the OCP's Transit-Oriented Core and Transit-Oriented Residential land use designations, including objectives for densification and the greatest mix of uses near the planned 196 and 203 Street stations and along Fraser Highway.
City of Langley District Policies Appendix B of OCP, District Policies	(City of Langley 2021a).	These OCP supplemental policies guide the City of Langley's planning decision for land use designations in planning districts, which include Downtown Langley, 196 Street Station Area, 203 Street Station Area, and Fraser – Industrial.	The Project is integral to planning decisions for land use designations.

Notes:

1. The Province will continue to work with municipalities to define requirements for delivery of the Project.

14.2 Baseline Conditions

The Project study area encompasses several scales of land use designation, including provincial (agriculture), regional, municipal and neighbourhood. Although the Project is primarily situated within statutory ROWs, a limited amount of private land outside of the ROW will be required for stations, transportation infrastructure connections, and utility relocation.

14.2.1 Methods

A desktop review was conducted to characterize baseline conditions for existing land use. The information dates to February 2022; ongoing processes to update plans may change the baseline conditions presented herein.

Land use planning sources reviewed include the following:

- Metro Vancouver RGS (; (Metro Vancouver 2022);
- City of Surrey OCP (City of Surrey 2014b);
- City of Langley OCP (City of Langley 2021c);
- Township of Langley OCP (Township of Langley 2013);
- Fleetwood (City of Surrey 2022h), City Centre (City of Surrey 2017b), West Clayton, (City of Surrey 2022g), East Clayton (City of Surrey 2003), North Cloverdale East (City of Surrey 1994), and North Cloverdale West (City of Surrey 1997) Neighbourhood Plans;
- Willowbrook Community Plan (Township of Langley 1991);
- City of Langley District Areas (City of Langley 2021a);
- COSMOS for land use designations and zones within the study area (City of Surrey 2022d);
- City of Surrey OCP (2014a);
- Fleetwood and City Centre Neighbourhood Plans (City of Surrey 2017a, 2020);
- COSMOS (for land use designations and zones within the study area) (COSMOS 2020); and
- TransLink’s Project planning resources, including ESR TOR (Appendix A), and Section 2 Project Description.

Land use designations in the study area were determined using shapefile data from the City of Surrey, City of Langley, and Township of Langley for their respective OCPs. Land use information was derived from COSMOS and Google Earth (in February 2022 and imported in an ArcGIS platform for analysis and interpretation. In addition, parcels of land that could be directly affected by the Project were derived from the RCD.

14.2.2 Synopsis of Land Use Planning Relevant to the Project

Land use planning in the study area is governed by Metro Vancouver and the Three Municipalities. Municipal planning documents must be in accordance with Metro Vancouver regional plans. Relevant planning documents and policies for the study area are covered in the following sections.

The 2021 City of Langley OCP incorporates the SLS extension; however, the OCPs for the Township of Langley and the City of Surrey (both prepared in 2013) pre-date planning for the SLS. Public engagement by these two municipalities on land use planning is in progress and therefore could not be included within this ESR. Updates to relevant OCPs, expected in the coming months, will be considered as they become available.[63]

The City of Surrey's OCP aligns with Metro Vancouver's RGS and guides future development in Surrey, including decisions on rezoning applications and the creation of secondary plans. A secondary land use plan for Fleetwood is in development, with concepts released for public review in early 2021 and a final plan expected for public review in early 2023 (City of Surrey 2022e) (**Figure J14-2**, **Appendix J**: Land Use Figures).

The Township of Langley OCP sets out land use designations that provide a general framework for development. More explicit land use designations for the Willowbrook area, indicating specific land uses, densities, policies, and design guidelines are outlined in the Willowbrook Community Plan (Township of Langley 1991).

The City of Langley OCP provides policy guidance to manage land use and development in the City. Appendix B of this OCP identifies nine special districts that require a more detailed level of policy to meet OCP land use objectives and policies (City of Langley 2021a).

In order to co-ordinate appropriate levels of transit service, TransLink formalizes individual Supportive Policy Agreements (SPAs) with individual municipalities. These SPAs are used to better define commitments to specific geographic areas and implications for population density. These SPAs include commitments for:

- Initiatives related to land use planning, urban design, housing, and transportation which are to be achieved by defined times;
- Collaboration with partner agencies (Province, TransLink, and Metro Vancouver) on key initiatives; and
- Formal monitoring of both the SPA commitments and related performance measures/outcomes.

The Province has signed an Overarching Supportive Policies Agreement (OSPA) (Government of BC 2022b) with the Three Municipalities and TransLink to ensure a consistent approach by Project partners to meet provincial, regional and municipal objectives, such as transit delivery, land use planning, and active transportation.

14.2.2.1 Metro Vancouver RGS

Metro Vancouver's RGS includes land use planning designations in the Project study area include General Urban, and Conservation and Recreation (Metro Vancouver 2020). The Project generally lies within the Urban Containment area, except for:

- Conservation and recreation area in the GTUF;
- Agricultural area in the Serpentine Valley;
- Mixed employment areas in Fleetwood Town Centre and City of Langley; and
- Industrial area in the City of Langley along the Canadian Pacific Railway ROW.

[63] Current status of City of Surrey planning initiatives is available at https://www.surrey.ca/renovating-building-development/land-planning-development/land-use-planning. Current status on Township of Langley planning initiatives is available at https://www.tol.ca/your-township/about-the-township/community-plans/. Current status of Cilty of Langley planning initiatives is available at: https://city.langley.bc.ca/cityhall/nexus/ocp-zoning-bylaw

These land use planning designations are presented in **Table 14-4** and illustrated in **Figure J14-1** of **Appendix J**: Land Use Figures.

The RGS also identifies urban centres and Frequent Transit Development Areas. Urban centres are intended to be focal points for concentrated growth and transit service and include boundaries identified by municipalities in their Regional Context Statements. The RGS identifies a number of urban centres within the Project study area, including Surrey Metro Centre, a Regional City Centre in the City of Langley, and Municipal Town Centres in Fleetwood and Cloverdale. Fraser Highway is a TransLink-designated Frequent Transit Area route which transects all these planning designations.

Table 14-4 Metro Vancouver 2050 Land Use Designations in the Study Area (Metro Vancouver 2022)

Land Use Planning Designation	Designation Description
General Urban	Residential neighbourhoods and centres that include shopping retailers, service providers, institutions, recreational facilities, and parks. General Urban areas are intended to emphasize place-making of enriched public realms and promote transit-oriented communities where transit, multiple-occupancy vehicles, cycling, and walking are the preferred modes of transportation.
Mixed Employment	Areas intended for industrial, commercial, and other employment-related uses to help meet the needs of the regional economy. Mixed Employment areas provide locations for employment activities and more intensive forms of commercial development outside of Urban centres and Frequent Transit Development Areas.
Conservation and Recreation	Areas for protection of significant ecological and recreation assets, including those for conservation, wildlife management, forests, riparian corridors, and major parks.
Agricultural	Areas intended primarily for agricultural uses, facilities, and supporting services with an emphasis on food production where appropriate.
Frequent Transit Development	Designation for TransLink's Frequent Transit Development Area networks and is intended to complement the network of urban centres characterized by higher-density residential, commercial, and mixed uses. May include community, cultural, and institutional uses. Urban design for these areas promotes transit-oriented communities.
Industrial	Areas primarily intended for heavy and light industrial activities with limited commercial uses that support industrial activities. This land use is restricted to the rail corridor.

City of Surrey

The City of Surrey's land use planning initiatives are documented primarily in the OCP, City of Surrey Zoning By-law, and NCPs for Surrey City Centre, North Cloverdale West, North Cloverdale East, East Clayton, and West Clayton. Where relevant, other City of Surrey land use policies are also described.

The City is also engaged in updating secondary plans, in part to plan for land use changes associated with the Project. Updates to the City Centre Plan, the Fleetwood Plan and a Clayton Corridor Plan are being updated.

City of Surrey Official Community Plan

The City of Surrey OCP defines land use designations and guides rezoning applications for urban planning initiatives to ensure new development achieves planning goals across the entire municipality (City of Surrey 2013). Several designations overlap with the Project study area including: Central Business District, Multiple Residential, Mixed Employment, Conservation and Recreation, Commercial, Urban, Town Centre, Agriculture, and Suburban. These designations, their intended purpose and locations along or near the Project alignment are outlined in **Table 14-5** and **Figure J14-2** of **Appendix J**: Land Use Figures.

The OCP also designates Development Permit Areas for Hazard Lands (steep slopes and flood-prone areas) and Sensitive Ecosystems (defined as stream sides and green infrastructure). Per the SPA, and as needed, Surrey will revise the OCP Development Permit guidelines to support transit-oriented development in the SLS corridor (City of Surrey 2013). Hazard Lands in the study area include steep-slope areas and required setbacks along sections of Quibble Creek west of the BC Hydro ROW and east of the JPOCSC.

A GIN is also considered in the OCP. The GIN is an interconnected network that conserves natural ecosystem values and functions, sustains clean air and water, and comprises hubs, sites, potential corridors, and the surrounding matrix (City of Surrey 2014a; HB Lanarc and Raincoast Applied Ecology 2011). Greenways are a hierarchy of paved multi-use pathways (MUPs) separated from roadways by barriers or boulevards. Within the study area, greenways overlap with the GIN along Quibble Creek, GTUF Park, Cloverdale Greenway, and North Creek Greenway (**Figure J14-4**, **Appendix J**: Land Use Figures). A greenway is proposed for the Fraser Highway corridor (City of Surrey 2012). Additional proposed greenways in the City of Surrey could interact with the study area, including: Clow Greenway, Coast Meridian Greenway, Serpentine Flats, Fleetwood Greenway, Great Northern Greenway, Armstrong Greenway, Clayton Greenway, Katzie Greenway, and Bose Greenway (City of Surrey 2022d). More information on streamside areas is provided in **Section 10** Fisheries and Aquatics.

The OCP policy for transit corridors is focused on creating compact, complete urban neighbourhoods through the development of Frequent Transit Development Areas (City of Surrey 2014b). The Project passes through two areas designated as Frequent Transit Development Areas in the City of Surrey, around 152 Street and the Clayton area. The OCP also designates frequent transit corridors, including along Fraser Highway (TransLink n.d.) See **Section 15** Transportation and Access for more information.

Table 14-5 City of Surrey OCP Land Use Designations (City of Surrey 2013) in the Project Study Area

OCP Land Use Designation	Intended Purpose	Location Study Area
Agricultural[64]	Support agriculture, complementary land uses, and public facilities. This designation includes lands within the ALR as well as rural lands outside of the ALR that are used for farming and various other complementary uses.	Between 170 Street and 180 Street in the Serpentine Valley, the area is primarily designated as Agricultural with some smaller areas designated as Suburban.
Central Business District	Support the continued development of Surrey City Centre as the primary commercial, civic, institutional, transit, and high-density residential centre for Surrey and as the primary metropolitan centre for the “South of the Fraser” area of metropolitan Vancouver.	Whalley Boulevard east to 138 Street, including the existing King George SkyTrain Station, is designated Central Business District.

64 See **Section 13**: Agricultural Land Use for more detail.

OCP Land Use Designation	Intended Purpose	Location Study Area
Commercial	Support major commercial developments, including neighbourhood-serving and city-serving retail and office developments.	Designated areas: • around 152 Street - Commercial and Multiple Residential • east of the Surrey Sport and Leisure Complex near 166 Street - Commercial and Mixed Employment • in Clayton, around the 188 and 192 Street intersections with Fraser Highway • at the border with the Township of Langley and City of Langley
Conservation and Recreation	Protect significant natural ecosystems and extensive outdoor recreation areas and parks.	GTUF (between 140 Street and 148 Street)
Mixed Employment	Support mixed industrial, commercial, business, and office uses not suited for Town Centres or commercial centres. Examples include large-scale retail outlets with warehousing needs (e.g., for furniture, building and landscaping supplies, outdoor storage or vehicle and equipment servicing).	Designated areas: • JPOCSC at 140 Street • northwest of the Fraser Highway intersection with 168 Street
Multiple Residential	Support higher-density residential development, including local neighbourhood-serving commercial and community uses.	Designated areas: • between 138 and 140 Streets • around 152 Street • south of Fraser Highway around 168 Street • around Fleetwood Town Centre
Suburban	Support low-density residential uses, complementary institutional, agricultural, and small-scale commercial uses, and public facilities consistent with a suburban neighbourhood character.	Designated areas: • north of Fraser Highway around 181 Street and 73 Avenue) • north of Fraser Highway and east of 19a Avenue in the Serpentine Valley
Town Centre	Support the development of Surrey's five Town Centres outside of City Centre as the primary commercial, institutional, and civic hearts of their communities.	Designated areas: • small area southwest of the Fraser Highway and148 Street intersection • Fleetwood Town Centre near 160 Street is designated Town Centre, Commercial, and Multiple Residential
Urban	Support low and medium-density residential neighbourhoods.	Designated areas: • between 148 and 170 Street • Between 180 and 196 Street

Addendum 14-1 provides a summary of the zoning bylaw and secondary plans for the City of Surrey.

14.2.2.2 Township of Langley

The Township of Langley's land use planning initiatives are concentrated in the OCP and the Willowbrook Community Plan. The Project study area that overlaps with the area covered by the Township of Langley OCP is entirely designated as Urban. Land areas designated as Urban can consist of commercial, residential, institutional, entertainment, and recreational uses. These designations guide urban planning and rezoning applications to ensure that the Township of Langley achieves its planning goals (Township of Langley 2013).

A multi-use recreational greenway and trail network provides a connected system for walking and cycling throughout the Township of Langley. No trails or greenways overlap with the Project study area. The closest trails or greenways beyond the study area in the Township are the Carvolth Trail, which follows 200 Street from 62 Avenue to 68 Avenue where it then joins Carvolth Greenway and the Langley Meadows Trail, which begins in Langley Meadows Park (Township of Langley 2022) (Figure J14-4).

14.2.2.3 City of Langley

The City of Langley's land use planning initiatives are concentrated in the OCP and district policies. Several land use designations in the City of Langley OCP overlap with the study area, including: Civic Centre, Industrial, Mixed Employment, Service Commercial, Transit-Orientated Core, and Transit-Orientated Residential (City of Langley 2021c). Information on the overlapping land use designations, associated floor area ratios (as an indicator of allowable density) and their intended purpose is summarized in **Table 14-6** and illustrated in **Figure J14-4 (Appendix J**: Land Use Figures)**.**

The Project study area between 196 Street and Highway 10 is designated as Transit-Orientated Core. From Highway 10 to 200 Street, land in the Project study area is designated as Service Commercial and Mixed Employment. The Service Commercial lands are identified as an area that could potentially change to a Transit Oriented Core Use. East of 200 Street, the land use designations are meant to accommodate higher densities and transit, and include land designated as Mixed Employment, Transit-Orientated Core, Transit-Orientated Residential, and Civic Centre.

An active transportation network of bike routes, trails, and greenways connects residents to major employment, education, amenities, and service centres in the City of Langley. TransLink's Major Bike Network follows Fraser Highway the entire length of the study area **(Figure J14-4).** There are additional bike routes along 56 Avenue, Production Way, Logan Avenue, 200 Street, and 204 Street (City of Langley 2021c).

There is a small area of Parks and Open Space in the triangle formed by Fraser Highway, Production Way and the rail line. New Park and Open Space has been preliminarily identified close to Fraser Highway at 126A Street, between 200 Street and 201 Street, and 203 Street.

Table 14-6 City of Langley OCP Land Use Designations (City of Langley 2021c)

OCP Land Use Designation	Floor Area Ratio FAR) Designations	Intended Purpose
Within Study Area		
Transit-Oriented Core	3.0 – 5.5 FAR	Support the creation of a vibrant, transit-oriented area with high densities and a mix of uses in close proximity to future SkyTrain stations, and existing high-frequency transit.
Transit-oriented Residential	2.5 – 4.5 FAR	Support the creation of a high-density residential area with limited ground-level commercial use close to future SkyTrain stations and existing high-frequency transit.
Historic Downtown Core	Up to 3.5 FAR	Retain a lively shopping destination with sufficient retail ground floor and commercial or residential units above.
Civic Centre	Up to 5.0 FAR	Enable a mixed-use civic hub to complement Langley City Hall and Timms Community Centre.
Mixed Employment	Up to 3.0 FAR	Allow flexibility and diversity of employment uses, including office, research, and post-secondary educational uses.
Service Commercial	Up to 0.5	Support the provision of commercial uses on a regional scale.
Industrial	Variable	Protect and enhance a range of industrial employment uses on a local and regional scale.

Planning districts are areas within the City of Langley that require a more detailed level of policy to meet OCP land use objectives and policies. Nine special districts were identified in Appendix B of the Langley City OCP. The study area overlaps with six of these districts: 196 Street Station Area, 203 Street Station Area, Downtown Langley, Fraser – Industrial, Innovation Boulevard, and Langley Lions Senior District (see **Figure J14-3** in **Appendix J**: Land Use Figures) (City of Langley 2021a). Information on the overlapping land use designations and their intended purpose are outlined in **Table 14-7**. Additional information on neighbourhoods in the City of Langley is available in **Section 15** Transportation and Access.

Table 14-7 City of Langley OCP Land Use Designations by District (City of Langley 2021a)

OCP Land Use Designation in the Study Area by District	Intended Purpose
Downtown Langley	Support the development of a thriving retail destination for the region; home to community events.
196 Street Station Area (future SkyTrain station)	Support the development of a high-density, mixed-use, transit-oriented community with public spaces anchored by the 196 Street SkyTrain Station.
203 Street Station Area (future SkyTrain station)	Foster the development of a high-density, mixed-use, transit-oriented hub that supports key destinations, such as the Civic Centre and Downtown Langley core to create a complete, vibrant downtown area.
Fraser Industrial District	Support the development of a high-density, mixed-use, and transit-oriented neighbourhood with green public open spaces that act as a gateway into the core of Langley's downtown core.
Innovation Boulevard	Guide the development of a dynamic corridor for transportation, technology, science, research, and manufacturing in the City of Langley.
Langley Lions Seniors District	Support the development of an integrated senior's care precinct in a vibrant and walkable urban setting, close to downtown Langley and Douglas Park.

14.2.3 Existing Land Uses

Existing land uses within the Project study area consist of multiple types of residential, commercial, industrial, and park uses. Land use within the Project study area generally aligns with OCP land use designations and with current zoning, and these designations support the discussion for land uses.

14.2.3.1 City of Surrey Existing Land Use

Existing land uses along Fraser Highway in Surrey Include residential, commercial, mixed employment, recreational/park and agriculture.

Residential: Residential dwelling types include apartment buildings, single-family houses, duplexes, townhouses, and mobile homes. Higher-density residential uses are located west of 140 Street. Residential areas surround both sides of the SLS alignment on Fraser Highway between 168 Street and 170 Street and east of 180 Street. Most residential properties east of 148 Street are single-family homes or townhouses that typically:

- Do not have direct access to Fraser Highway; and
- Have a yard and a fence or a vegetation barrier that separates the house from the roadway.

Commercial: Existing commercial building types include independent and chain businesses, such as shops, restaurants, and gas stations. Shopping centres include strip malls and small malls with essential services like grocery stores. These existing commercial areas are focused in the areas around the Fleetwood Town Centre (around 152 Street), Fleetwood Park Village (around 160 Street) and the Clayton Crossing Shopping Centre (between 68 Avenue and 188 Street). New SkyTrain stations are slated for 152 and 160 Streets in Fleetwood as well as 190 Street, near the Clayton Crossing Shopping Centre (**Figure J14-2**, **Appendix J**: Land Use Figures). The commercial land parcels are typically accessed through driveways directly from Fraser Highway and include parking spaces.

Mixed employment: Mixed employment areas are located within the study area at 140 Street (JPOCSC) and 168 Street (including the FortisBC offices). Other mixed employment areas near the study area include:

- RCMP headquarters immediately north of the study area on Green Timbers Way;
- Surrey Memorial Hospital south of the study area on King George Boulevard; and,
- Amherst Hospital and Nursing Home north of the SLS alignment on 188 Street

Recreational and Civic Facilities Other than Greenways: Recreational uses consist of parks, recreational areas, and civic facilities identified in the OCP, the City Centre Plan, and the Greenways Plan (City of Surrey 2012). The Fleetwood Community Centre is located just outside the study area, on 160 Street just south of Fraser Highway. It is co-located with a public library and park. The Surrey Sport and Leisure Complex abuts the north side of Fraser Highway around 164 Street with and additional access via 166 Street. The complex provides a full range of community recreation facilities, including an Olympic-sized pool, a leisure pool, a large weight and exercise room, fitness studio, and three full-size ice rinks, along with off-street parking.

The Surrey Golf Club abuts the south side of Fraser Highway and features both 18 hole and 9 hole courses. Membership to access both courses (Surrey Golf Club n.d.) is required. To prevent the incursion of golf balls onto Fraser Highway, several sections of high fence border the Fraser Highway ROW. Access to the facility is via 168 Street.

North Creek Park includes an area on the east side of the Serpentine floodplain, and an area along North Creek from the floodplain to Fraser Highway either side of 184 Street. North Creek is also considered a greenway. A small corner of the park on the floodplain and portions near 184 Street lie within the study area (Figure J14-4).

Greenways: The City Centre Plan defines a City Centre GIN that includes the Quibble Creek Greenway, the Fraser Highway Greenway, and the GTUF (**Figure J14-4, Appendix J**: Land Use Figures) (City of Surrey 2022d, 2014b).

Quibble Creek Greenway contains a paved MUP for walking and cycling, and is located adjacent to Quibble Creek, a green space. The GTUF, located north and south of Fraser Highway, includes Surrey's Nature Centre, a playing field, and paved and unpaved paths through wooded areas. A portion of the Bon Accord Greenway, which traverses the GTUF from north to south between 100 Ave and Fraser Highway, is part of the study area (City of Surrey 2012). The Green Timbers Greenway traverses the GTUF east to west, connecting to the Bon Accord Greenway before linking eastward to Tynehead Park.

The Fraser Greenway MUP extends primarily along the southern side of the Fraser Highway from 160 Street to 64 Avenue and 194 Street and is meant to extend the length of the Project alignment along Fraser Highway to 196 Street (City of Surrey 2012). Several greenways meet the Fraser Greenway from adjoining roads south of the Highway, including the Coast Meridien Greenway which follows 168 Street, the Cloverdale Greenway which follows 176 Street, and North Creek Greenway which follows 180 Street. The Serpentine River is also considered part of the GIN.

Other active transportation facilities: King George SkyTrain Station is an existing hub for cycling in Surrey and houses a bike parkade, bike lockers and bike racks.

In general, between King George Station and 168 Street, Fraser Highway has sidewalks on both sides of the street. The City of Surrey is currently widening Fraser Highway between 137b Street and 148 Street, which will include a MUP on the north side and a bike lane on the south side. Sections of sidewalk are located on the north side of Fraser Highway in the following locations:

- 200 m around the 170 Street intersection;
- between the Serpentine River and Highway 15; and
- between 180 Street and 68 Avenue.

Sidewalks are generally in place on both sides of Fraser Highway from 189 Street to 196 Street.

Fraser Highway has bike lanes that run in both directions from King George Sky Train Station to 64 Avenue, which extend into the GTUF and connect to the Green Timbers and Quibble Creek greenways. More information on cycling is included in **Section 15** Transportation and Access.

In addition to the greenways noted above, a proposed greenway and MUP would run adjacent to Fraser Highway within the Project study area (City of Surrey 2012, 2022d). The City of Surrey also commissioned a baseline report on environmental conditions in a broad corridor along the SkyTrain alignment, which recommends forest block areas to be added to the GIN (Shebib et al. 2020). Recommended areas are outside the Project study area.

Agricultural: A detailed assessment of agricultural land use is provided in **Section 13** Agricultural Land. The existing Fraser Highway crosses the ALR between 170 Street and 180 Street, in the Serpentine Valley. The ROW is part of the ALR but designated for transportation purposes. Future Life Farm, the Honeybee Centre, and Misung Farm are located north of the Fraser Highway; small parcels of both active and inactive agricultural land are located immediately to the south.

14.2.3.2 Township of Langley Existing Land Use

Within the Township of Langley, the Project study area (i.e., between 196 and 200 Streets) consists solely of Designated Urban uses and is dominated by the Willowbrook Shopping Centre, a single-level mall featuring over 140 retail outlets. The shopping centre is set back from Fraser Highway by a pedestrian pathway, grassy area, and parking lot, which can be accessed from the Fraser Highway, Langley Bypass, Willowbrook Drive, and 200 Street.

14.2.3.3 City of Langley Existing Land Use

Within the City of Langley, the Project study area consists of multiple types of residential, commercial, industrial, and community uses. The existing land uses in the City of Langley are more reflective of the existing consolidated Zoning Bylaw (City of Langley 2022) than the OCP designations that look ahead to future uses and anticipated higher density areas serviced by transit (City of Langley 2021c).

Residential (Transit Oriented Core, Transit Oriented Residential OCP designations): Land designated as Transit-Oriented Core is intended to support the creation of a vibrant, transit-oriented area with high densities and a mix of uses close to the future 203 Street station, and existing high-frequency transit. Transit-Oriented Core areas include a major portion of the study area between 200 Street and Glover Road. This area currently includes a range of retail outlets, food and beverage outlets, a hotel, a car wash, a gas station, and various industrial uses along Industrial Avenue. The area from 203 Street to the eastern edge of the study area includes a range of retail and beverage outlets, an apartment, offices for Langley Public Health, a fitness centre, and Cascades Casino. TransLink's bus exchange is located on Logan Avenue between 203A Street and Glover Road, a key feature of the Transit Oriented Core.

Existing uses of the Transit Oriented Residential area located south of Fraser Highway, between 200 and 201 Streets (south of the Transit Oriented Core) include apartment buildings and duplexes, as well as retail outlets and food and beverage outlets.

Commercial (Mixed Employment and Service Commercial OCP designations): The study area south of the Fraser Highway from Landmark Way to 200 Street, designated Mixed Employment, includes retail outlets, food and beverage outlets, and industrial spaces. Land uses in an area north of Industrial Avenue between 200 and 201A Streets, also designated Mixed Employment, include auto repair and parts businesses.

From the Langley Bypass to 200 Street, the study area north of Fraser Highway is designated as Service Commercial. This area includes a range of retail outlets, a gas station, and a leisure centre, an insurance claim centre. From the Langley Bypass to Landmark way, the area south of Fraser Highway within the study area, is also designated as Service Commercial. This area includes food and beverage outlets and a car dealership.

Institutional (Civic Centre OCP designation): South of the Fraser Highway from 203 Street to the edge of the study area, the Civic Centre area lands include City Centre Square, City Hall, and the library.

Industrial: The Fraser-Industrial area (a planning district), located between Fraser Highway and Industrial Avenue, consists of primarily single storey, auto-orientated commercial and light industrial uses (City of Langley 2021c). The train tracks, classified as industrial in the RGS, are not classified in the OCP.

Current industrial use in the study area is reflected more closely in the zoning by-law than in the OCP and is included in the Mixed Employment designation (see **Section 14.2**).

Recreation and Conservation areas: Baldi Creek is situated within the study area between 200 Street and 57A Avenue south of the alignment. The Baldi Creek surrounding area is listed in the City of Langley OCP as an environmentally sensitive area of moderately high sensitivity value, as well as a natural hazard. (City of Langley 2021c). A small park is located at Fraser Highway and Production Way.

14.3 Project Interactions

Potential interactions between land use and Project activities and physical works are summarized in **Table 14-8** inclusive of those with a spatial component.

Table 14-8 Potential Project Interactions with Land Use and Potential Effects

Project Activities and Works	Inconsistency with land use regulation and policy	Effects to commercial and residential land uses	Effects to industrial land	Effects to conservation and recreation land
Construction				
Clearing and grubbing	-	✓	✓	✓
Property acquisition (including demolition of inert building materials)	✓	✓	✓	✓
Utility installation/relocation	-	o	o	o
Use of temporary laydown areas	✓	✓	✓	✓
Access and traffic management	-	✓	✓	✓
Road widening (select locations)	✓	✓	✓	✓
Drainage realignment (select locations)	-	o	o	o
Installation of SkyTrain guideway foundations	✓	✓	✓	✓
Installation of overhead SkyTrain guideway	✓	✓	✓	✓
Stations (foundations, structure, lighting, access, service connections, security)	✓	✓	✓	✓
Power propulsion substations	✓	✓	✓	✓
Management of non-contaminated excavated material (including excavation)	-	✓	✓	✓
Management of contaminated or hazardous materials	-	-	-	-
Testing, commissioning, and start-up	-	-	-	-
Operation				
Operation of SLS	-	✓	✓	✓
Maintenance of SLS	-	-	-	-

Note: Interaction Ratings:

– **No interaction**: Interaction between a Project component and SE is not likely.

o **Minor interaction**: impacts may result from an interaction, but standard measures to avoid or minimize the impact are available and well understood to be effective, and any remaining adverse effects would be reduced to negligible, and interaction is not discussed further.

✓ **Interaction:** an interaction occurs, likely requires additional mitigation, is carried forward and discussed in subsequent sections.

14.4 Potential Effects

Potential indirect effects to commercial and residential land use include changes in air quality and noise during construction and operation, which are addressed in **Section 7** Air Quality and Greenhouse Gas, and in **Section 8** Noise and Vibration. Potential indirect effects to residential land use due to changes in visual aesthetics are described in **Section 16** Visual Landscape Assessment. Potential effects and mitigation for agricultural lands are discussed in **Section 13** Agricultural Land.

Most of the Project will be constructed on municipal ROWs designated for transportation uses. However, some stations and their associated guideway approaches will be located outside of existing ROWs. Project design has minimized impacts where feasible, using an elevated design for the guideway and station footprints by and large. The Project will require the acquisition of some commercial, institutional, industrial, and residential properties outside the ROW. In addition, temporary use of properties will be needed to facilitate construction work, resulting in changes to access along the alignment. Changes in access are described in described in **Section 16** Transportation and Access. The Project will obtain temporary easements to facilitate access during construction as well as ROWs for permanent operation of the Project.

This assessment focuses on land outside road ROWs (i.e., properties needed either on a temporary or permanent basis for the Project). Road ROWs are already designated for transportation use. This study examined these areas to identify their OCP land use designations, and how these areas might change in land use during construction and operation. The construction-related footprint includes temporary work areas as well as the permanent footprint. For the purpose of the ESR, the extent of the construction footprint is based on the RCD, but this footprint will be refined during detailed design. Only the permanent footprint is required for operation. The temporary and permanent footprints on land outside ROWs, and categorized by OCP land use designation, are summarized in **Table 14-9, Table 14-10** and **Table 14-11.**

Table 14-9 Land Summary of Total Project Footprint

Footprint Category	Temporary	Permanent	Percent of Study Area*
Project footprint	27.6 ha	31.4 ha	8.8%
Footprint within ROW	21.3 ha	24.5 ha	7%
Footprint outside of ROW	6.3 ha	6.9 ha	~2%

**Note: ***Land Use Study Area = 654.5 ha

Table 14-10 Lands in Project Footprint by OCP Land Use Designation

Land Use Designation (OCP)	Construction Footprint (Temporary Plus Permanent)		Operation Footprint (Permanent)	
	Area of Parcels Outside the ROW (ha)	Percent of Study Area	Area of Parcels Outside the ROW (ha)	Percent of Study Area
City of Surrey OCP				
Agricultural	0.02	0.0%	0.01	0%
Commercial	2.41	0.4%	1.54	0.2%
Mixed Employment	0.36	0.1%	0.27	0.1%
Multiple Residential	1.05	0.2%	0.52	0.1%
Town Centre	4.27	0.6%	2.37	0.4%
Urban	0.02	0%	0.01	0%
Total	**9.22**	**1.3%**	**5.31**	**0.8%**
Township of Langley OCP				
Urban	3.23	0.5%	2.08	0.3%
Total	**3.23**	**0.5%**	**2.08**	**0.3%**
City of Langley OCP				
Mixed Employment	0.00	0%	0	0%
Service Commercial	1.14	0.2%	0.91	0.1%
Transit-Orientated Core	1.82	0.3%	1.77	0.3%
Other	0.05	0%	0.03	0%
Total	**3.01**	**0.5%**	**2.70**	**0.4%**

Note: Details on preliminary locations are not provided for privacy reasons.

Table 14-11 Summary of Project Footprint Outside of ROW

Location	Construction Footprint		Operation Footprint	
	Area of Parcels Outside the ROW (ha)	Percent of Study Area	Area of Parcels Outside the ROW (ha)	Percent of Study Area
Surrey	9.22	1.4%	5.31	0.8%
Township of Langley	3.23	0.5%	2.08	0.3%
City of Langley	3.01	0.5%	2.70	0.4%
Total	**15.46**	**2.4%**	**10.09**	**1.5%**

14.4.1 Inconsistency with Land Use Regulation and Policy

During construction and operation, Project activities will extend onto land that is not within road ROWs and is currently designated and zoned for other uses. The Project may displace these uses and be considered inconsistent with the existing land use regime. Supportive policy agreements (SPAs) recently signed for the Project between TransLink and the municipalities will address and accommodate potential changes to land use designations, and existing transit policies will be implemented throughout the development of this Project (see **Section 15** Transportation and Access). These SPAs commit the municipal partners and TransLink to policies, initiatives and other actions that are outside the direct scope of the Project but have significant influence on the Project's success. For example, transit policies may be revised in the Transit Corridor policies section of the Surrey OCP, although not on a parcel-by-parcel level, and Surrey is presently updating neighbourhood plans in light of the proposed Project. The municipal agreements (SPAs) are anticipated to be applicable to the areas identified for property acquisition by the Project in the RCD. The Province's OSPA with TransLink and the Three Municipalities will help to complement the SPA and enables the Province to explore new ways to maximize the Project's benefits.

In the City of Surrey, the SPA includes land use designations for the SLS corridor and statements demonstrating the City's commitment to planning for development around station areas. It also includes a commitment to preparing and adopting land use plans along the SLS corridor, including updates to the Surrey Centre Plan and development of the Fleetwood Plan (City of Surrey 2020). The Fraser Highway ROW does not have a specific land use designation; it shares the same land use designation as the adjacent parcels. In the City of Surrey, 5.31 ha is anticipated to have permanent changes to land use due to the Project, as shown in **Table 14-11**.

In the Township of Langley, 2.08 ha of land currently designated for Urban use is anticipated to have permanent changes to land use due to the Project. The Township of Langley OCP recognizes the influence that major transportation corridors will have on the community and includes a policy specific to land designated as urban use considering development options on major east-west transportation corridors, including along Fraser Highway, at interchanges along the Trans-Canada Highway and along 16 Avenue.

The City of Langley OCP incorporates specific Transit-Oriented Core and Transit-Oriented Residential land use designations for areas around the planned SkyTrain station. The Project is identified in the Future Transit Network (City of Langley 2021c). Approximately 2.70 ha is anticipated to have permanent changes to land use due to the Project, including 1.77 ha designated as Transit-Oriented Core, 0.91 ha designated as Service Commercial and 0.001 ha designated as Mixed Employment (see **Table 14-10**). Land at the terminal station is presently used for parking.

The Metro Vancouver RGS includes Frequent Transit Development Areas that overlay regional land use designations. These Frequent Transit Development Areas are priority locations to accommodate concentrated growth in higher density forms of development, located along TransLink's Frequent Transit Network. The study area overlaps with two Frequent Transit Development Areas, in Fleetwood where the 152nd Street Station will be situated, and in Clayton where the 190th Street Station will be located (Metro Vancouver 2022).

14.4.2 Effects to Commercial and Residential Land Uses

Potential effects to commercial and residential land include direct effects from the Project land parcel acquisition during construction (temporary) and operation (permanent) and indirect effects to remaining portions of the parcels and adjacent properties through changes in access as well as sensory disturbance from air quality, noise, vibration, and visual effects. Effects due to sensory disturbance are most likely to affect residential properties and are further discussed in **Section 7** Air Quality and Greenhouse Gas, **Section 8** Noise and Vibration, and **Section 16** Visual Landscape Assessment.

Based on the RCD, temporary disruptions to commercial and residential properties will be required for Project construction activities, such as utility works, temporary laydown areas, widening and reconfiguring roadways, and constructing the guideway, stations, and PPSs. Effects are anticipated to be localized to portions of the alignment at a time and would not be continuous at that location for all of construction.

In the City of Surrey, 5.31 ha of land associated with commercial and residential land uses is anticipated to be permanently changed due to the Project (see **Table 14-10**). Of this, most of the land use changes will be to areas designated as Urban (2.37 ha) and Commercial (1.54 ha). Effects to commercial and residential land uses are mainly associated with the stations at 140 Street, 152 Street, 160 Street, 166 Street, 184 Street, and 190 Street.

In the Township of Langley, 2.08 ha of land, designated Urban and associated with commercial and residential land uses is anticipated to be permanently impacted by the Project. The Project alignment and 196 street station will be located mainly within the parking areas for the Willowbrook Shopping Centre. The Willowbrook Transit Exchange and bus layover are located adjacent to this station.

In the City of Langley, 2.67 ha of land associated with commercial and residential land uses are located in the permanent Project footprint, primarily in areas designated as Transit-Orientated Core (1.77 ha) and Service Commercial (0.91 ha) (see **Table 14-10**). The alignment supports the intent of the land use plan to support the future development of a high-density, mixed-use, transit-oriented community with public spaces. Property acquisitions, with exceptions for the station area, are generally narrow strips paralleling the road ROW, and while some land area will be removed from the parcels, the loss is not anticipated to preclude ongoing uses.

Traffic management controls included in the Project Description and assessed for constructability will mitigate effects to property and business owner access. Access during construction will be managed through traffic controls implemented by Project Co. Additional information on traffic management planning requirements for the Project is provided in **Section 15** Transportation and Access.

Commercial, institutional, and residential properties that lie outside of the Project footprint, but in immediately adjacent areas, may experience some indirect impacts, such as an increase or decrease of vehicle or pedestrian traffic, and temporary changes in access to businesses due to short-term traffic management changes required to facilitate construction. For more detail, refer to **Section 15** Transportation and Access. Once the Project is in operation, significantly enhanced access to residential, commercial, and institutional properties is expected, particularly for active travel modes (e.g., pedestrians).

14.4.3 Effects to Industrial Land Use

The acquisition of Industrial land use designated parcels is not required in the City of Surrey or the Township of Langley. In the City of Langley, parcels of land along Industrial Avenue between 200A and 201A Streets are presently zoned and utilized for development of service industrial uses and industrial facilities. The Project footprint along Industrial Avenue between 200 and 203 Streets, includes narrow strips of land that parallel the road. While some land area may be temporarily used for Project construction from these parcels, it is expected that the changes will not preclude ongoing and future use.

Industrial properties in the City of Langley that overlap with the Project footprint or are immediately adjacent to it, may experience temporary changes in access due to short-term traffic management to facilitate construction. For more detail, please refer to **Section 15** Transportation and Access.

14.4.4 Effects to Conservation and Recreation Land Use

The Project RCD avoids direct effects to conservation and recreation lands by staying within municipal road ROWs. The 140 Street Station is the closest to Conservation and Recreation designated lands, with the GTUF immediately east of the station.

Use of and access to recreational land features that lie adjacent to or intersect with the Project, such as trails and other amenities in the GTUF, greenways (Quibble Creek, Green Timbers, Bon Accord, Cloverdale, and North Creek), bike lanes, and sidewalks, may be affected by construction activities, including road widening, access and traffic management, and clearing and grubbing. As noted for commercial and residential uses, detailed TMPs will be implemented to manage vehicular traffic, public transit, pedestrians, and cyclists. It is expected that effects will be localized to select portions of the alignment at any given period and limited in duration, particularly for guideway construction.

Effects during operation are expected to be minimal due to planned restoration of recreational features and access to original functions, such as re-instating curbs and sidewalks, bike lanes, trails, and crosswalks. To accommodate the anticipated uptick in the number of people using different modes of active transportation during operation, additional or enhanced crosswalks and cycling features are included in the Project design. During operation, there may be indirect effects to certain recreational amenities due to improved access for more people, which stems from the fact that they will have more frequent and higher-capacity transit options. This could potentially lead to periodic overcrowding.

14.5 Mitigation Measures

Proposed mitigation measures to avoid or minimize potential effects from Project activities are listed below and summarized in **Table 14-12**. For Land Use, the relevant stages to implement mitigation are during design (denoted as "D") and construction (denoted as "C").

Content from this section will be incorporated into the CEMP Framework which will provide detailed guidance for the content of the Project Co’s CEMP. In addition to mitigation and performance objectives, the CEMP Framework will describe best practices intended to meet the performance objectives and required content for each sub-plan. The CEMP Framework will also include details on roles and responsibilities for Project Co’s key team members.

The Province seeks to minimize Project-related effects on the natural and human environments, including land and land users, as much as possible. With the exception of M14.D1, mitigation measures will be implemented by the Province, Project Co or the Province and Project Co combined.

14.5.1 Design Mitigation

Mitigation M14.D-1 Implement SPAs with the Three Municipalities

- Implement SPAs with the Three Municipalities to address potential inconsistencies with land use designations, zoning for Project construction and operation, and associated changes in growth patterns.
- SPAs will be implemented by TransLink in collaboration with the Three Municipalities.

Mitigation M14.D-2 Minimize Property Acquisition

- Minimize the need for private property through design refinements and innovative construction techniques, while ensuring the safe construction and operation of the Project.

Mitigation M14.D-3 Engage with Communities Prior to Construction

- Engage with First Nations, stakeholders, and the public to understand potential effects on land use, which may be perceived as beneficial to some community members and detrimental to others. See **Section 4** First Nations Engagement and **Section 5** Stakeholder and Public Engagement for more details.
- Provide Project information, including timeframes and proposed interim and permanent changes in access (for all modes of transportation). See **Section 15** Transportation and Access for more details.

Mitigation M14.D-4 Engage with Potentially Affected Private Property Owners and Businesses

- Conduct field surveys to identify private property owners and businesses potentially affected by the Project's detailed design.
- Engage with private property owners and businesses in pre-construction planning (i.e., share TMPs and road work schedules) to help inform the development of specific mitigation measures.

14.5.2 Construction Mitigation

Mitigation M14.C-1 Engage with Communities, Property Owners and Businesses During Construction

- Conduct ongoing engagement with First Nations, stakeholders, and the public during construction to inform them of Project activities, including work plans, schedules, and relevant changes in access. Use diverse approaches to disseminate information.
- Conduct ongoing engagement with property owners and businesses during construction to inform them of Project activities, including work plans, schedules, and relevant changes in access. Use diverse approaches to disseminate information.

Mitigation M14.C-2 Maintain Recreational Features

- Where feasible, avoid or minimize disturbances to recreational features (e.g., greenways) during Project design and construction.
- Identify specific effects to recreational features (greenways, trails, bike lanes, sidewalks) prior to construction and provide like-for-like function of recreational features during construction (e.g., through detours and clear signage).
- Following construction, restore features to the same condition, where possible, or replace in a manner that provides the same functional services.

Mitigation M14.C-3 Retain Access Functionality

- Provide temporary alternatives for vehicle, bike and pedestrian routes, access points, and trails during construction to provide uninterrupted access for all during construction.
- Communicate proactively and clearly all temporary access routes during construction (see M14.C-1).
- Restore existing access points, or provide permanent alternatives, during operation.

14.5.3 Summary of Proposed Mitigation

Proposed mitigations specific to each Project phase (design, construction, and operation) are summarized in **Table 14-12**.

Table 14-12 Summary of Potential Project Effects and Mitigation Measures for Land Use

Potential Effect	Mitigation Number	Mitigation Measure	Project Phase	Environmental Management
Inconsistency with land use designations	M14.D-1	Implement SPAs with the Three Municipalities.	Design	Design Criteria
	M14.D-3	Engage with communities prior to construction.		
	M14.C-1	Engage with communities, private property owners and businesses during construction.	Construction	CEMP – Transportation Access Communications Plan
Effects to Commercial and Residential Land Use	M14.D-2	Minimize property acquisition.	Design	Design Criteria
	M14.D-3	Engage with communities prior to construction.		
	M14.D-4	Engage with potentially affected private property owners and businesses.		
	M14.C-1	Engage with communities, private property owners and businesses during construction.	Construction	CEMP – Transportation Access Communications Plan
	M14.C-3	Retain access functionality.		TMP
Effects to Conservation and Recreational Land Use	M14.D-3	Engage with communities prior to construction.	Design	Design Criteria
	M14.C-1	Engage with communities, private property owners and businesses during construction.	Construction	CEMP – Transportation Access Communications Plan
	M14.C-2	Maintain recreational features.		TMP
	M14.C-3	Retain access functionality.		
Effects to Industrial Land Use	M14.D-2	Minimize property acquisition.	Design	Design Criteria
	M14.D-3	Engage with communities prior to construction.		
	M14.D-4	Engage with potentially affected private property owners and businesses		
	M14.C-1	Engage with communities, private property owners and businesses during construction.	Construction	CEMP – Transportation Access Communications Plan
	M14.C-3	Retain access functionality.		

14.6 Discussion

This section focuses on potential Project-related effects that may not have been completely addressed through mitigation measures. Construction planning will include requirements for robust mitigation to minimize impacts to businesses and residents (as well as drivers, transit users, cyclists, and others) and communicate any changes proactively and clearly.

14.6.1 Inconsistency with Land Use Regulation and Policy

Following implementation of the SPA, no Project-related effects are anticipated that are inconsistent with land use plans. For example, commercial and residential land use will change over time around the new SkyTrain stations to accommodate bus access, increased pedestrian and cycling activity, and increased commercial and residential density. Increases in commercial and residential capacities near rapid transit corridors is a significant element of the SPAs, OCP policies (Surrey and the City of Langley), and updates to neighbourhood plans. These capacity increases are generally considered positive effects that align with municipal policies and Metro Vancouver's RGS goals for planned density around transit nodes. Joint planning processes by the Province, the Three Municipalities and TransLink, will support economic and residential growth.

14.6.2 Effects to Commercial and Residential Land Uses

Effects to commercial, institutional, and residential land uses will be minimized through an appropriate Project design and property acquisition process, as well as engagement with potentially affected businesses, residents, community groups, institutions, and commercial and recreational facility operators to identify alternate access points (temporary or permanent) during construction and operation. Communication and engagement to provide information on upcoming construction activities will assist to offer predictability and minimize effects, such as impacts to access and traffic flow. Effects from property acquisition for future SkyTrain stations will be minimized through careful consideration in the development of a final design.

Disturbance to adjacent land uses from construction activities within the temporary footprint and access changes will not be fully mitigated. However, the effects will be temporary and reversible and are anticipated to be localized and not continuous at any single location for the entire construction period.

14.6.3 Effects to Industrial Land Use

Project-related effects may include permanent and temporary use of narrow portions of properties adjacent to Industrial Avenue in the City of Langley; however, these effects would not preclude the continued use of the land parcels. Land use complies with the future direction of the City for a transit focused core. It is expected that the Project will support the increased densification in these areas as planned in the City of Langley OCP.

14.6.4 Effects to Conservation and Recreation Land Use

Project-related effects to conservation and recreational land uses will be minimized through mitigation measures, particularly regarding the retention or restoration of function. Where recreational lands are disturbed either during or following construction, like-for-like features will be replaced to maintain the functionality of the feature. Measures to replace (e.g., through trail detours, signage, or other measures) or restore recreational functions are anticipated to minimize adverse effects. However, limited changes to the temporary and permanent use of conservation and recreation lands will be required (e.g., temporary use of MUPs). While Project-related activities during construction will lead to some disruptions, the effects will be temporary and reversible.

14.7 Conclusions

The Project footprint has been minimized to the extent possible to avoid potential effects on land use plans and existing land uses. The guideway alignment lies mainly within the Fraser Highway and other road ROWs. Stations are located in areas designated for higher density future uses (i.e., town centres) and transit-oriented uses. The SPA and other agreements (between TransLink and the Three Municipalities), which provide for robust planning, are expected to manage and avoid effects due to changes in land use plans while accommodating anticipated growth during Project operation. Overall, effects to land use regulation and policy are considered negligible.

During construction, the Project will require the use of approximately 15.5 ha of land outside of transportation ROWs, of which 10.1 ha will be permanently required for operation. Some of these acquisitions may require changes to the current land use designations but are expected to conform to community planning of transit-oriented centres.

It is expected that measures to minimize the Project footprint as well as engaging with property owners, businesses, and residents and managing disturbance during construction will limit potential effects to existing land uses. Measures to maintain the function of recreational features during construction and restore like-for-like functionality following construction are anticipated to mitigate effects to recreational uses. Alternatives for access to and across the alignment and to potentially affected properties and recreational features during construction will be available. Access points will be restored or permanent alternatives will be created during operation.

With the design measures and mitigation, the overall effects to residential and commercial land uses are considered low as the Project footprint outside of ROWs is relatively small. However, there may be parcels that cannot continue with their current use. Effects to industrial land are localized to the City of Langley, are not anticipated to preclude existing uses, and are located within areas planned for transit uses. These effects are therefore considered minimal. Effects to recreational land uses are avoided or reduced such that the overall disturbance to users is anticipated to be minimal and limited to the construction phase.

Effects following implementation of mitigation measures to commercial and residential land, industrial land, and conservation and recreation features are characterized in **Table 14-13** utilizing the effects characteristics defined in **Section 6** Scope and Methods.

Table 14-13 Summary of Potential Effects Remaining After Mitigation for Land Use

Potential Effect	Criterion	Rating	Rationale for Rating
Inconsistency with land use regulation and policy	N/A	N/A	No Project-related effects are anticipated.
Effects to commercial and residential land uses	Magnitude[1]	Low (C) High (O)	Effects to lands within the temporary construction footprint and properties adjacent to the footprint are limited where no laydown of materials is required. Effects in the permanent Project footprint outside of the road ROWs are rated as high, where land acquisitions are no longer available for their current use.
	Geographic Extent	Low	Direct effects to properties adjacent to the Project footprint will be localized to areas outside of the road ROW in the Project footprint.
	Duration[2]	Medium-term (C) Permanent (O)	Effects to lands within the temporary construction footprint, and properties adjacent to the footprint, are considered medium-term. However, lands within the temporary construction footprint could be required only intermittently. Changes to land use for the permanent Project footprint outside of road ROWs will be permanent.
	Frequency	Continuous	Land acquisition effects will be continuous during construction for the entire footprint and continuous for the permanent Project footprint during operation.
	Reversibility	Reversible (C) Permanent (O)	With mitigation, effects to properties in the temporary Project footprint are likely reversible. Land acquisition effects within the permanent Project footprint will be permanent.
Effects to industrial land use	Magnitude[1]	Low (C) Moderate (O)	Parcel portions remaining after land acquisition can likely continue with their current use. Effects to lands within the temporary construction footprint, and properties adjacent to the footprint, are considered low magnitude.
	Geographic Extent	Negligible (Site)	Industrial land acquisition and land use effects are limited to the temporary and permanent Project footprint in the City of Langley
	Duration[2]	Medium-term (C) Permanent (O)	Effects to lands within the temporary construction footprint, and properties adjacent to the footprint, are limited to construction and potentially intermittent. Changes to land use for the permanent Project footprint outside of road ROWs will be permanent.
	Frequency	Continuous	Land acquisition effects will be continuous during construction for the entire footprint and continuous for the permanent Project footprint during operation.
	Reversibility	Reversible (C) Permanent (O)	Effects to temporary footprint areas are reversible. Land acquisition effects within the Project footprint are permanent.

Potential Effect	Criterion	Rating	Rationale for Rating
Effects to conservation and recreation land	Magnitude[1]	Low	Recreational activities may be disrupted during construction, however like-for-like function to be maintained.
	Geographic Extent	Low	Effects localized to areas the Project footprint overlap with recreational features (e.g., trails, bike lanes and greenways).
	Duration[2]	Medium term	Effects are anticipated to be intermittent and limited to Project construction.
	Frequency	Common	Effects will commonly occur in the Project footprint during construction.
	Reversibility	Reversible	Recreational feature functionality will be restored by end of Project construction.

Notes:

1. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance, and high (exceedance of criteria or threshold). Generally, magnitude is measured in terms of the proportion of the SE affected within the assessment area (for biophysical SE), or the degree within the interaction area relative to the range of natural or historic (in the case of human environment SE) variation.
2. The duration of an effect may be short-term (i.e., within the construction phase), medium term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (permanent) (i.e., extending past the life of the Project).

Addendum 14-1 City of Surrey Neighbourhood and City Centre Plans

City of Surrey Official Zoning By-law

The City of Surrey Zoning By-law allows for public transit, including SkyTrain, within any zone (City of Surrey 1993). Zones within the study area are listed in **Table A14-1A**. The bylaw further defines land use within the OCP designations, and amendments must be consistent with the OCP. Each zone is intended to accommodate and regulate the development of land uses within that zone. Roads, including Fraser Highway, are included within the zones adjacent to the road. There are also a variety of Comprehensive Development Zones.

Table A14-1A City of Surrey Zoning within the Study Area (City of Surrey 1993)

Zone	Intended Purpose
Multiple Residential 70	Medium-density, high-rise, multiple-unit residential buildings and related amenity spaces that will be developed in accordance with a comprehensive design
Multiple Residential 30	Medium-density, multiple-unit, ground-oriented residential buildings and related amenity spaces that will be developed in accordance with a comprehensive design
Multiple Residential 15	Family-oriented, low-density, ground-oriented, multiple-unit residential buildings and related amenity spaces that will be developed in accordance with a comprehensive design in existing and new urban areas where density bonus is provided
Duplex Residential	Duplex dwellings on urban lots
Single-family Residential	Single-family dwellings
One-Acre Residential	Single-family housing on suburban lots of 1 acre or larger
Manufactured Home Residential	Manufactured homes in mobile home and trailer parks
Comprehensive Development	Mixture of uses as an integrated unit based on a comprehensive plan in conformance with the use and density stated in the OCP
Self-service Gasoline Station	Self-service gasoline stations and accessory uses
Combined Service Gasoline Station	Full-service gasoline stations or combined full-service and self-service gasoline stations and accessory uses, including convenience store and automotive repair
Highway Commercial Industrial	Commercial and related uses requiring large lots and exposure to major highways, which are generally not accommodated in shopping centres, the Town Centre, or Surrey City Centre
Local Commercial	Local, small-scale commercial developments
Community Commercial	Community shopping centres serving several neighbourhoods
Town Centre Commercial Zone	Retail and service commercial facilities, offices, recreation, and associated uses as well as residential uses developed in a comprehensive manner, serving several communities
Light-impact Industrial Zone	Light-impact industry, transportation industry, warehouses, distribution centres, and limited office and service uses

Surrey City Centre Plan

The Project study area west of 140 Street is covered by the Surrey City Centre Plan. Surrey has initiated a process to strengthen policies and encourage office and employment growth in the City Centre, including consideration of the SLS. Within the existing plan, the main land use designations in the study area are Mixed Use west of Whalley Boulevard, Creek Buffer along Quibble Creek, Park along the BC Hydro utility ROW, and Low to Mid-rise Residential on the eastern side of the plan area (west of 140 Street). Surrey City Centre land use designations within the study area are explained in **Table A14-1B** and displayed in **Figure J14-3.1** of **Appendix J**: Land Use Figures). Designated areas are differentiated by their use and density, with density measured as the gross floor area permitted on a site divided by the total net area of the site (Floor Area Ratio (FAR)).

Table A14-1B Surrey City Centre Plan Land Use Designations (City of Surrey 2017b)

Land Use Designation	Floor Area Ratio Designations	Intended Purpose
Mixed-use Medium and High Density	5.5	Facilitate residential access to urban amenities, shopping, entertainment, education, and employment while supporting higher levels of walking, cycling, and transit use. Mixed-use facilities include commercial, retail, high-density residential, and civic and cultural facilities.
Residential High Rise	Up to 5.5 FAR	For high-rise towers within walking distance of SkyTrain stations.
Residential Mid to High Rise	Up to 3.5 FAR	For mid-rise towers to serve as a transition area between higher-density and lower-density areas.
Residential Low to Mid Rise	Up to 2.5 FAR	For transitions between mid-rise areas and single-family areas along the outer boundaries of the City Centre Plan.
Park (including utility ROW) and Creek Buffer (along Quibble Creek)	n/a	For park types interconnected with a network of pathways and separated bike lanes. These places are intended to support a range of amenities and provide a platform for recreation, community, and social uses. The BC Hydro ROW is designated as Park.
BC Parkway	n/a	The BC Parkway Greenway is a multi-use path that roughly parallels the existing SkyTrain corridor and connects to Quibble Creek Greenway.
Arterial Road	n/a	Fraser Highway is considered an arterial road designed to support other transportation modes.
Plaza	n/a	Areas intended as accessible open public spaces in a variety of sizes.

North Cloverdale West NCP

North Cloverdale encompasses the neighbourhoods along the eastern ALR escarpment, south of the Fraser Highway, and north of 64 Avenue. The area is separated into two plan areas, North Cloverdale West and North Cloverdale East, and each area was planned through separate NCP processes. The two land use plans are now largely built out and provide direction on the type and density of development, urban design, parks and community amenities, and engineering infrastructure (City of Surrey 1996).

The land uses covered by the North Cloverdale West NCP are generally rural residential with varying lot sizes (City of Surrey 1996). The Project study area overlaps with several land uses in the area covered by the North Cloverdale West NCP, including commercial, residential, and park uses. These uses are largely set back from the SkyTrain alignment, except for commercial space at the corner of Fraser Highway and 184 Street (Figure J14-3.4, **Appendix J**: Land Use Figures).

North Cloverdale East NCP

Existing land uses in the North Cloverdale East NCP are largely rural residential, and commercial with some agricultural uses (City of Surrey 1994). The Project study area overlaps with several land uses in the area covered by the North Cloverdale East NCP, including commercial and residential uses. Like the uses identified in the North Cloverdale West NCP area, these uses are largely set back from the SkyTrain alignment, except for some residential use along the Fraser Highway between the 189 Street and 64 Avenue junctions where the permanent footprint will expand beyond the open-space buffer (**Figure J14-3.5**, **Appendix J**: Land Use Figures).

East Clayton NCP

East Clayton is the first urban neighbourhood developed in Clayton Heights. The East Clayton area is separated into four plan areas, and each is developed through a separate NCP process. These include the main East Clayton NCP, two subsequent extensions to the west and north, and a transit-oriented development along Fraser Highway. Combined, the plans encompass an area of approximately 314 ha, generally located North of Fraser Highway and west of the Township of Langley. These land use plans provide more direction than the OCP on the type and density of development, urban design, parks, community amenities, and engineering infrastructure. Originally characterized by its rural and agricultural uses, the area now has more than 15,000 residents. The Project study area overlaps with several land uses in the East Clayton NCP, including residential, commercial, educational, institutional, park, and stormwater pond uses. Within the East Clayton Extension west of 188 Street, additional institutional and high-density residential uses are set back by open space and park use (**Figure J14-3.3**, **Appendix J**: Land Use Figures).

West Clayton NCP

West Clayton is the second urban neighbourhood development in Clayton Heights. The plan encompasses an area of approximately 288 ha, generally located north of the Fraser Highway and east of the ALR. Originally characterized by its rural and agricultural uses, the area now has more than 12,000 residents (City of Surrey 2022g).

The Project study area overlaps with several land uses in the area covered by the West Clayton NCP, including residential, commercial, and mixed use. These uses are largely set back from the Project by a landscape buffer, except for the mixed-use commercial and residential space west of the junction at Fraser Highway and 184 Street (**Figure J14-3.2**, **Appendix J**: Land Use Figures).

Other Surrey Policies

The City of Surrey's economic development strategies and the Sustainability Charter (City of Surrey 2016c) support the development of public transit. The value of transit, including rail transit to support economic development, is noted in the Employment Lands Strategy (Cushman & Wakefield LePage, Inc. 2008) and in Surrey's Economic Strategy (City of Surrey 2017a).

The Sustainability Charter is aligned with the OCP and the Transportation Strategic Plan (City of Surrey 2008). The charter identifies an integrated and multi-modal transportation network that offers affordable, convenient, accessible, and safe transportation choices within the community and to regional destinations as an outcome for transportation strategies. Transportation policies are presented in **Section 15** Transportation and Access.

Township of Langley

Willowbrook Community Plan

The Willowbrook Community Plan provides a statement of the Township of Langley's policies for development of the Willowbrook area. The plan covers the area immediately north of the City of Langley and east of the City of Surrey. The plan encompasses approximately 615 ha, including the Willowbrook Mall and adjacent commercial development, the Mufford Industrial area, the Langley Meadows subdivision, and multi-family development along 64 Avenue. The remainder of the area consists of rural residential development, with many lots around 1 acre in size (Township of Langley 1991).

The Project study area overlaps with regional commercial land uses in the area covered by the Willowbrook Community Plan (**Figure J14-3.6**, **Appendix J**: Land Use Figures).

15 Transportation and Access

15.1 Introduction

The ability to move quickly and efficiently through communities whether by foot, bicycle, transit, or vehicle to access jobs, housing, health care, institutions of higher learning, goods, services, and recreation sites is critical to our health, well being and the economy. It is expected that there will be Project-related impacts during construction, such as temporary lane closures and increased numbers of construction-related vehicles that will affect travel times and access to properties, including for emergency services. Once in service, SLS operation will change travel patterns, improving regional connections, and introduce public safety, security, and access considerations for new stations.

This section of the ESR describes baseline conditions and assesses potential Project-related changes to transportation and access in the study area. In addition, this section proposes relevant mitigation measures to avoid or minimize potential effects. See **Section 14:** Land Use for additional discussion of access as it relates to land use designations.

15.1.1 Project Features Relevant to Transportation and Access

Key features of the Project Description (**Section 2**) relevant to the transportation and access SE include those that are intrinsic to the SLS design, such as its alignment and elevated components. The SLS will generally follow Fraser Highway with the permanent footprint situated primarily within the municipal road ROW. Given that the SLS is elevated, its design minimizes permanent adverse effects to private and public property access along the alignment, and greatly enhances regional connections by extending the SkyTrain to several growing communities south of the Fraser River.

The Project's detailed design will confirm guideway height and site-specific requirements. Each station will have designated spaces for HandyDart buses, parking for maintenance and emergency vehicles as well as passenger pick-up and drop-off spaces. Operational considerations at some station locations include integration with cycling and pedestrian facilities and bus exchanges.

In general, the main components of the Project's permanent footprint that relate to potential changes in access points are:

- SkyTrain stations;
- Guideway;
- Support columns;
- PPSs;
- Permanent road works; and
- Parking areas (e.g., for buses, service vehicles).

Construction activities relevant to transportation and access include utility relocations; guideway, station, and PPS construction; changes to cycling and pedestrian facilities and related road works. There could also be changes around some stations that permanently affect adjacent properties.

Relevant aspects of the Project related to transportation and access during operation include anticipated ridership, motor vehicle volumes, levels of cycling and walking activity, and travel times. **Table 15-1** provides modelling results for ridership projections based on a system capacity of 600 people per train every 6 to 8 minutes. Typical travel time for trains operating between King George and Langley City Centre stations will be 22 minutes.

The assessment of potential effects on transportation and access is based on the information requirements identified in the Project's TOR.

Table 15-1 Summary of Ridership Projections for the Project

Time	Opening Day (2028)	2035	2050
Annual Incremental Transit Trips	6,500,000	7,790,000	10,320,000
Annual reduction in automobile trips (vs. business-as-usual scenario)	-6,780,000	-8,080,000	-10,350,000
AM Peak Hour Boardings	5,500	6,400	7,900
Weekday daily boardings	56,000	64,000	80,000

Source: McElhanney 2022

15.1.2 Selection as a Screening Element

Transportation and access were selected as a SE because of potential interactions with road users on and adjacent to the alignment, including emergency vehicles, buses and users of different modes of active transportation. There will also be changes to access points for residential, institutional, and business properties.

During Project construction, temporary effects to transportation and access will occur as a result of the need to build stations, relocate utilities, conduct earthworks and roadworks, develop foundations, and erect guideway structures. Temporary changes to existing transportation infrastructure include those to sidewalks, cycling lanes, motor vehicle lanes, and traffic signals as well as temporary changes in access for many residential, commercial, and institutional properties.

During operation, Project infrastructure will change transportation and access, particularly around stations. Importantly, transit connections across the region will improve as will travel times (e.g., 65 minutes between Downtown Vancouver and Langley City Centre).

15.1.3 Selection of Review Indicators

The selection of Review Indicators for transportation and access, based on the information requirements in the TOR, and a review of potential Project-related effects is summarized in **Table 15-2**.

Table 15-2 Selection of Review Indicators for Transportation and Access

Potential Effect	Review Indicator(s)	Rationale for Selection
Change in transportation from baseline	Changes in: • roadway profile (e.g., number of lanes, traffic flow characteristics) • vehicle volume (vehicles per day, VKT) • vehicle travel times (select origin/ destinations) • transit operation (travel times, ridership) • pedestrian and cycling facilities	Effects on: • Detours or roadway lane closures during construction, which may affect existing traffic volumes and flows • Effects on transit routes, travel times, and ridership during construction • Effects on existing traffic patterns, transit routes, and parking or pick-up/drop-off around new stations during Project operation
Change in access from baseline	Changes in: • access to residential, commercial, and institutional (i.e., schools, emergency services) properties • access to parking	Effects on: • access to properties during construction • supply or access to parking during construction • access and parking around new stations during operation
Change in public safety and security from baseline	Changes to: • emergency services routes • safety and security around new SkyTrain infrastructure	Effects on: • access and response times for emergency service providers during construction • safety and security (i.e., at new stations) during operation

15.1.4 Spatial and Temporal Boundaries

This section describes the spatial and temporal boundaries for the assessment of potential Project-related effects on transportation and access.

15.1.4.1 Spatial Boundaries

The spatial boundary for this assessment represents the area within which most effects on transportation and access are likely to occur during Project construction (study area) (**Figure K15-1** in **Appendix K**: Transportation and Access Figures). The study area for this SE is defined as the neighbourhoods and travel routes that are within 400 m of the Project alignment and facilities. This study area best reflects potential changes to transportation and access activities that may be influenced by the Project, which occur over a larger area than those for other SEs, such as land use.

The Project alignment follows Fraser Highway from Whalley Boulevard in the City of Surrey (near the existing King George SkyTrain Station) and the Langley Bypass (Highway 10) in the City of Langley. Between the Langley Bypass and 200 Street, the alignment runs through a laneway to Industrial Avenue and then follows Industrial Avenue from 200 Street to 203 A Street. The alignment is shown in **Figure K15-1** (**Appendix K**: Transportation and Access Figures).

15.1.4.2 Temporal Boundaries

Temporal boundaries are the Project phases that are reasonably expected to affect transportation and access. This assessment considers the following temporal boundaries:

- Planning phase: 2020 to 2024;
- Construction and commissioning phase: 2024 to 2028; and
- Operation (including maintenance) of Project: 2028 and beyond.

15.1.5 Regulatory and Policy Context

Table 15-3 summarizes government legislation, including regulations and bylaws, that may apply to the Project's transportation and access-related activities. The alignment follows Fraser Highway and Industrial Avenue, which are municipal roads. The route also crosses two provincial highways (Highway 15 and Highway 10) and a federally regulated rail line. **Table 15-4** summarizes key policies and guidelines applicable to the Project. Note that, in addition to the listed regulations and policies, Project Co will be required to follow the DBSS (Government of BC 2019c), including Section 165 Protection of the Environment.

The Province will continue to define requirements with municipalities for delivery of the Project.

Table 15-3 Summary of Key Legislation, Regulations, and Bylaws

Legislation/Regulation/Bylaw	Responsible Agency	Relevant Aspects of Legislation	Applicability to the Project
Federal			
Standards Respecting Railway Clearance (TC 1992)	Transport Canada	Provides guidance on railway clearance and applies on all tracks owned or operated by a railway company.	The Project passes over the Page Subdivision, owned by the BC Hydro and is used only for freight by Canadian Pacific Railway.
Notice of Railway Works Regulations (SOR/91-103)	Transport Canada	Outlines the schedule and content, and other notification requirements about railway works, including the construction of a structure above a line of railway.	The Project requires a railway crossing.
Provincial			
Transportation Act (SBC 2004, c. 44)	MOTI	Deals with public works related to transportation as well as the use, operation, alteration and closing of provincial highways.	The Project crosses provincial Highways 15 and 10.
Regional			
South Coast British Columbia Transportation Authority Major Road Network Bylaw, No. 128-2018	TransLink	Designates Fraser Highway, 96 Avenue, 152 Street, 88 Avenue, 160 Street, 64 Avenue, and 200 Street as part of the region's Major Road Network.	The Project will affect Fraser Highway, 96 Avenue, 152 Street, 88 Avenue, 160 Street, 64 Avenue, and 200 Street of the Major Road Network.
By-Law No. 13007	City of Surrey	Regulates traffic, parking, and the use of highways, boulevards, sidewalks, and public land in the City of Surrey.	The Project will require lane closures, parking, and the use of boulevards, sidewalks, and public land in the City of Surrey.

Legislation/Regulation/Bylaw	Responsible Agency	Relevant Aspects of Legislation	Applicability to the Project
Highway and Traffic Bylaw, 2010 No. 4758	Township of Langley	Regulates traffic, parking, and the use of highways, boulevards, sidewalks, and public lands in the Township of Langley.	The Project will require lane closures, parking, and the use of boulevards, sidewalks and public land in the Township of Langley.
Subdivision and Development Servicing Bylaw 2019 No. 5382	Township of Langley	Provides design criteria for roads, lighting, traffic signals, and utilities.	The Project design criteria will need to be consistent with relevant requirements for roads, lighting, traffic signals and utilities
Highway and Traffic Regulation Bylaw, 2013, Bylaw No. 2871	City of Langley	Regulates traffic, parking, and the use of highways, including boulevards, lanes, and sidewalks in the City of Langley.	The Project will require lane closures, parking, and the use of boulevards, sidewalks and public land in the City of Langley.

Table 15-4 Key Policies and Guidelines

Policy/Guideline	Description	Applicability to the Project
Federal		
A Healthy Environment and A Healthy Economy (Government of Canada 2021a)	Presents a plan to achieve federal climate targets and a healthier economy, including goals and direction.	The Project supports the strategy by aligning with key goals and direction.
Provincial		
2020 Traffic Management Manual for Work on Roadways (Government of BC 2020c)	Outlines fundamental principles and guidelines for traffic management and traffic control with the goal of safe, efficient movement of road users through a work zone while protecting worker safety.	Project activities will require traffic management in work zones.
2019 Active Transportation Design Guide (Government of BC 2019b)	Outlines considerations to manage active transportation facilities during temporary and special events, including construction work.	Project activities will require active transportation management in work zones.
CleanBC, Roadmap to 2030 (Government of BC 2021c)	A strategy to achieve the Province's climate targets that provides measures, and key actions.	The Project supports the strategy by aligning with key actions.
Overarching Supportive Policies Agreement (Government of BC 2022b)	Commits the Province, TransLink and the Three Municipalities to a shared set of overarching principles to support the Project and to complement TransLink's SPAs with individual municipalities.	Agreement is specific to the Project.
Regional		
Regional Transportation Strategy (TransLink 2022b)	A long-term strategy to guide transportation decisions in Metro Vancouver over a 30-year period by establishing goals, principles, objectives, and key initiatives.	The Project supports the Plan by aligning with key goals and objectives.
Mayor's Council *10-Year Vision for Metro Vancouver Transit and Transportation* (TransLink 2022b, 2022c)	A 10-Year Vision for investments in public transit, major roads, cycling and walking infrastructure in Metro Vancouver.	The Project forms part of the Mayors Council's 10-Year Vision.

Policy/Guideline	Description	Applicability to the Project
TransLink Bus Infrastructure Design Guidelines (TransLink 2011)	Sets comprehensive guidelines related to the planning and design of transit infrastructure.	Provides guidance for bus routes and stops.
Transit Passenger Facility Design Guidelines (TransLink 2011)	Provides a consistent framework for design of transit passenger facilities and their surrounding context for the development of all new transit facilities, facility upgrades, and transit-oriented communities across the region.	Provides guidance for transit infrastructure development, design, and operations.
Municipal[1]		
SPA between TransLink and the City of Surrey (City of Surrey 2020)	Outlines the policy commitments of TransLink and the City that fall outside the direct scope of the Project but significantly affect achievement of the Project's objectives.	Outlines processes for TransLink and the City to collaborate on transportation demand management initiatives for the SLS transit corridor, including support of TransLink's Travel Smart program.
Transportation Strategic Plan (City of Surrey 2008)	Long-range planning document describing the vision, objectives, proposals, and priorities for future transportation in Surrey.	Provides the City's vision and strategic objectives for transportation planning in context of the SLS.
Design Criteria Manual (City of Surrey 2016a)	Provides design guidelines and standards for transportation and utilities in Surrey.	Guides roadway, pedestrian, and intersection design; traffic signals and controls; City utilities; and access management.
Official Community Plan (City of Langley 2021c)	Identifies strategic direction and policies for transportation in the City of Langley.	Provides strategic direction and policies for transportation for the SkyTrain extension to Langley Centre.
Master Transportation Plan (City of Langley 2014)	Sets out goals and objectives for the City of Langley's transportation network and provides guidance on priorities for developing a multi-modal transportation system.	Identifies the City's goals and objectives for SLS-related transportation planning.
Design Criteria Manual (City of Langley 2021b)	Provides design guidelines and standards for transportation and utilities in the City of Langley.	Identifies the requirements and standards for roadway, pedestrian, and intersection design, street lighting, and traffic signals and controls.
Official Community Plan (Township of Langley 2018)	Sets out strategic direction and policies for transportation in the Township of Langley.	Provides the Township's strategic direction and policies.
Township of Langley *Master Transportation Plan* (in the process of being updated, as of Spring 2022)	Sets out transportation conditions, identified problems and improvement options for the road network.	Provides the Township's plan for transportation planning in the context of the SLS.

Note:

[1] The Province will consider municipal bylaw requirements in delivery of the Project, with the intention of providing consistency with these requirements.

The Three Municipalities also follow the *Manual of Uniform Traffic Control Devices for Canada* (Transportation Association of Canada 2005), and the *Geometric Design Guide for Canadian Roads* (Transportation Association of Canada 2017). In addition, MOTI released a supplement to the *Geometric Design Guide for Canadian Roads* (Government of BC, 2021c). These documents set standards for the design and application of traffic signs, lane alignment, road configuration, and intersections.

The Project broadly aligns with federal, provincial, regional, and municipal transportation policy and plans (i.e., City of Surrey *Transportation Strategic Plan*, City of Langley *Master Transportation Plan*). The Regional Transit Strategy, *Transport 2040* (TransLink 2008) identifies the corridor for rapid transit. In 2014, the Metro Vancouver Mayors' Council confirmed the Fraser Highway corridor as a priority investment for rapid transit as part of its 10-Year Vision (TransLink 2014).and reconfirmed in TransLink's Transport 2050 plan (TransLink 2022a). The transportation plans for the Three Municipalities include policies that support improved rapid transit along Fraser Highway.

15.2 Baseline Conditions

This section describes the existing baseline conditions for transportation and access in the study area, including the road network, truck routes, parking facilities, transit services, walking and cycling infrastructure, and freight rail system. Transportation demand and travel times are assessed for different modes as is existing access for properties and key services within the study area.

15.2.1 Methodology

15.2.1.1 Desktop Review

To assess baseline conditions, a desktop review of transportation networks, policies, facilities, design and key places of origin and destination in the study area took place. Information on baseline conditions for transportation and access were obtained from TransLink, the Three Municipalities, MOTI and various industry/non-profit reports (i.e., Business Improvement Associations).

15.2.1.2 Data Sources

The assessment relied on a variety of data sources to understand baseline conditions for transportation and access in the study area, including:

- Transportation user counts (i.e., motor vehicles, cyclists, pedestrians) - sourced from the Three Municipalities. For the City of Surrey, this included intersection counts at various locations along Fraser Highway. This information was processed to provide summaries by section and year with the more detailed outputs described later within this section;
- Existing travel time data - processed from Google Maps. Travel time information is described in more detail in **Section 15.2.3**;
- Commuters by mode, and types of housing structures - sourced from Statistics Canada's 2011 and 2017 Census. Census tracts with residential populations within the study area were selected and aggregated to produce summary statistics for the study area.
- Transit data (i.e., Daily Boardings, Headways, Average Speed) - primarily sourced and summarized from TransLink's Transit Service Performance Review; and
- Motor vehicle modelling studies - prepared as part of the Project Business Case. This includes EMME modelling under both construction and operations conditions.

15.2.1.3 Interpretation and Analysis

The information and data were summarized and displayed (i.e., graphs, charts). It was then interpreted and analyzed to determine the potential interactions, effects, and mitigation measures to minimize impacts to transportation and access.

15.2.2 Description of Transportation Infrastructure

This section describes the existing conditions for all transportation infrastructure elements currently located in the study area, including the road network, truck routes, parking facilities, transit services, walking and cycling infrastructure, and the freight rail system.

15.2.2.1 Road Network

Fraser Highway is the primary corridor in the study area and is within the Three Municipalities' jurisdictions. It is classified as an arterial road and part of TransLink's Major Road Network. It has a posted speed limit of 60 km/h between Whalley Boulevard and 194 Street, except for the stretch between 168 and 182 Streets, where the posted speed limit is 70 km/h. Between 194 Street and the Langley Bypass, the posted speed limit is 50 km/h. Industrial Avenue is classified as a collector road and has a posted speed limit of 50 km/hr.

Between 138 Street and 148 Street, construction on Fraser Highway has been underway since 2021 by the City of Surrey to widen Fraser Highway and install a centre median, resulting in a four-lane road. Between 148 Street and the Langley Bypass, Fraser Highway is a four-lane, divided road with a centre median, except between 64 Avenue and 194 Street, where it is undivided. Industrial Avenue between 200 and 203 Streets is an undivided two-lane road, with angled parking access on each side of the road.

Major roads for east-west travel that intersect the study area include 96 Avenue, 88 Avenue, 64 Avenue, and the Langley Bypass (Highway 10). Key north-south routes that intersect the study area include 140 Street, 152 Street, 160 Street, 176 Street (Highway 15), 184 Street, 196 Street, 200 Street and 203 Street. The road network within the study area is shown in **Figure K15-2** (**Appendix K**: Transportation and Access Figures)**.**

15.2.2.2 Truck Routes

The Three Municipalities' Truck Route Network, which is co-managed by TransLink, designates specific roadways for truck travel to minimize adverse effects on residential neighbourhoods while maximizing favourable conditions for the trucking industry, such as promoting safety, and accommodating truck weights and volumes. Fraser Highway is a designated truck route. Other truck routes that intersect the study area include 140 Street, 96 Avenue, 152 Street, 160 Street, 88 Avenue, 176 Street (Highway 15), Production Way, the Langley Bypass, and 200 Street.

The transport of dangerous goods is permitted only on certain roads to maximize public safety. Fraser Highway is a designated dangerous goods movement route between King George Boulevard and 200 Street as are 176 Street and the Langley Bypass.

Designated truck routes and dangerous goods routes within the study area are highlighted in **Figure K15-3** (**Appendix K**: Transportation and Access Figures).

15.2.2.3 Parking

Parking, stopping, or loading is not permitted on Fraser Highway between King George Boulevard and the Langley Bypass; however, Industrial Avenue has parking and loading access on each side of the road. Additionally, throughout the study area, a substantial amount of off-street parking is available for residences and businesses with direct access to Fraser Highway and Industrial Avenue. Paid parking lots are available around King George SkyTrain Station.

15.2.2.4 Public Transit Infrastructure

As shown in **Figure K15-4** (**Appendix K**: Transportation and Access Figures), the study area is serviced by transit, including:

- The SkyTrain Expo Line at the existing King George Station;
- Bus routes servicing the Fraser Highway corridor (320, 345, 372, 395, 501, 502, 503); and
- Bus routes that pass through the study area and service nearby transit exchanges at King George, Surrey Central, Guildford, Cloverdale, Langley Centre, and Carvolth (325, 326, 335, 341, 342, 364,370, 375, 388, 531, 560, 561, 562, 563, 564, 595).

TransLink classifies Frequent Transit Network roads for corridors with transit service that runs at least every 15 minutes daily, beginning at 6:00 a.m. on weekdays, 7:00 a.m. on Saturdays, and 8:00 a.m. on Sundays, and running until 9:00 p.m. daily. The study area includes the following roads or road portions that are part of the Frequent Transit Network:

- Fraser Highway between King George Boulevard and Glover Road (the entire alignment of the SLS along Fraser Highway); and
- Portions of King George Boulevard,152 Street, Whalley Boulevard, 152 Street, 203 Street, and Glover Road where the roads intersect with Fraser Highway.

15.2.2.5 Walking and Cycling

Cycling routes and greenways in the study area are shown in **Figure K15-5** (**Appendix K**: Transportation and Access Figures) and are classified by the level of comfort they provide to users (Hub Cycling and TransLink 2019)**.** Greenways, neighbourhood bike routes, protected bike lanes, and off-street bike lanes are defined as Comfortable for Most. Bike lanes are defined as Comfortable for Some, and shared traffic and shared street lanes are defined as Comfortable for Few.

Along the alignment on Fraser Highway, cycling routes are designated as either Comfortable for Most or Comfortable for Some. The Project will upgrade cycling facilities to be separated from motor vehicle traffic (i.e., Comfortable for Most).

Section 14.2 of the Land Use chapter describes cycling and walking facilities in the study area.

15.2.2.6 Rail

Between the Langley Bypass and 200 Street, the Project crosses a single-track, at-grade, freight rail line owned by the BC Hydro. This section of rail line, the Page subdivision, forms part of the Roberts Bank rail corridor and connects the Roberts Bank container and coal terminals with the North American rail network. This section of rail line is also used by Canadian National Railway (CN) and the Southern Railway of British Columbia. Rail lines in the study area are shown in **Figure K15-3** (**Appendix K**: Transportation and Access Figures).

15.2.3 Transportation Demand and Travel Times

Fraser Highway is a major travel corridor for the Fraser Valley and connects Surrey, Langley, and Abbotsford, including Surrey City Centre, Fleetwood, North Cloverdale, West Clayton, East Clayton, Langley City, Murrayville, and Aldergrove. Fraser Highway is one of only two roads oriented northwest-to-southeast in the Fraser Valley; the other is Highway 1.

Current transportation demand in the study area is characterized as primarily motor vehicles. **Table 15-5** and **Table 15-6** summarize Statistics Canada data (Government of Canada 2012, 2017a) by mode of transport share and number of commuters in the study area[65] and in the Three Municipalities.

Table 15-5 Percentage of Commuters by Mode of Transport in 2011 and 2016

Mode of Transport	Study Area		City of Surrey, Township of Langley, City of Langley	
	2011 Trips (% of total)	2016 Trips (% of total)	2011 Trips (% of total)	2016 Trips (% of total)
Vehicle driving - car, truck, or van	80.3%	76.5%	78.6%	76.4%
Vehicle riding - car, truck, or van passenger	5.7%	6.0%	6.3%	6.5%
Public transit	9.7%	12.5%	10.7%	12.6%
Walking	2.7%	3.4%	2.8%	2.9%
Bicycle	0.2%	0.5%	0.4%	0.4%
Other	0.9%	1.1%	1.2%	1.1%

Note: Adapted from Statistics Canada (Government of Canada 2017a, 2012).

Table 15-6 Number of Commuters by Mode of Transport in 2011 and 2016

Mode of Transport	Study Area			City of Surrey, Township of Langley, City of Langley		
	2011 Trips	2016 Trips	% Change	2011 Trips	2016 Trips	% Change
Vehicle driving - car, truck, or van	40,700	45,300	+11.2%	214,900	233,900	+8.9%
Vehicle riding - car, truck, or van passenger	2,900	3,600	+22.6%	17,100	20,000	+16.7%
Public transit	4,900	7,400	+49.7%	29,400	38,700	+31.8%
Walking	1,400	2,000	+47.8%	7,700	8,900	+15.3%
Bicycle	100	300	+233.3%	1,100	1,300	+25.9%
Other	400	600	+42.7%	3,200	3,400	+5.5%
Total	**50,700**	**59,200**	**+16.8%**	**273,300**	**306,200**	**+12.0%**

Note: Adapted from Statistics Canada (Government of Canada 2017a), (Government of Canada 2012).

[65] Refers to census tracts with a residential population in the study area. The boundaries of these select census tracts may not align with the study area. Census tracts (CTs) are small, relatively stable geographic areas defined for the purpose of census-taking. Census tracts typically have a population between 2,500 and 8,000 persons.

As described in **Table 15-6,** between 2011 and 2016, the total number of individuals commuting from the study area increased by nearly 17%. For each mode of transport, the percentage increase was higher in the study area than in the Three Municipalities. By percentage change, the number of commuters by public transit, walking and bicycle, increased more than those driving, or sitting as passengers in, vehicles. Those who commuted:

- by car, truck, or van, (driver and passenger) increased by approximately 11%;
- by public transit increased by almost 50%; and
- by walking increased by almost 48%.

15.2.3.1 Motor Vehicles

According to Statistics Canada (Government of Canada 2017a), nearly 83% of commuters who live within the study area commuted by car, truck (including light trucks), or van as either a driver or a passenger. This is similar to the proportion of car, truck and van commuters in the Three Municipalities (83%) (**Table 15-6**). The census tracts on the eastern side of the study area (i.e., between 166 Street and Glover Road) had the highest share of commuters by motor vehicle, except for Langley City Centre.

According to traffic counts from the City of Surrey and the Township of Langley between 2016 and 2019, annual average daily traffic in the study area along Fraser Highway ranged from approximately 15,000 vehicles (between King George Boulevard and Whalley Avenue) to approximately 42,000 vehicles (between 84 Avenue and 164 Street) (**Figure 15-1**). Along Fraser Highway, average annual daily truck traffic ranged from 1.5% of total motor vehicles (between Whalley Boulevard and 140 Street) (representing) to 3% of all motor vehicles between 64 Avenue and 196 Street (City of Surrey 2022f).

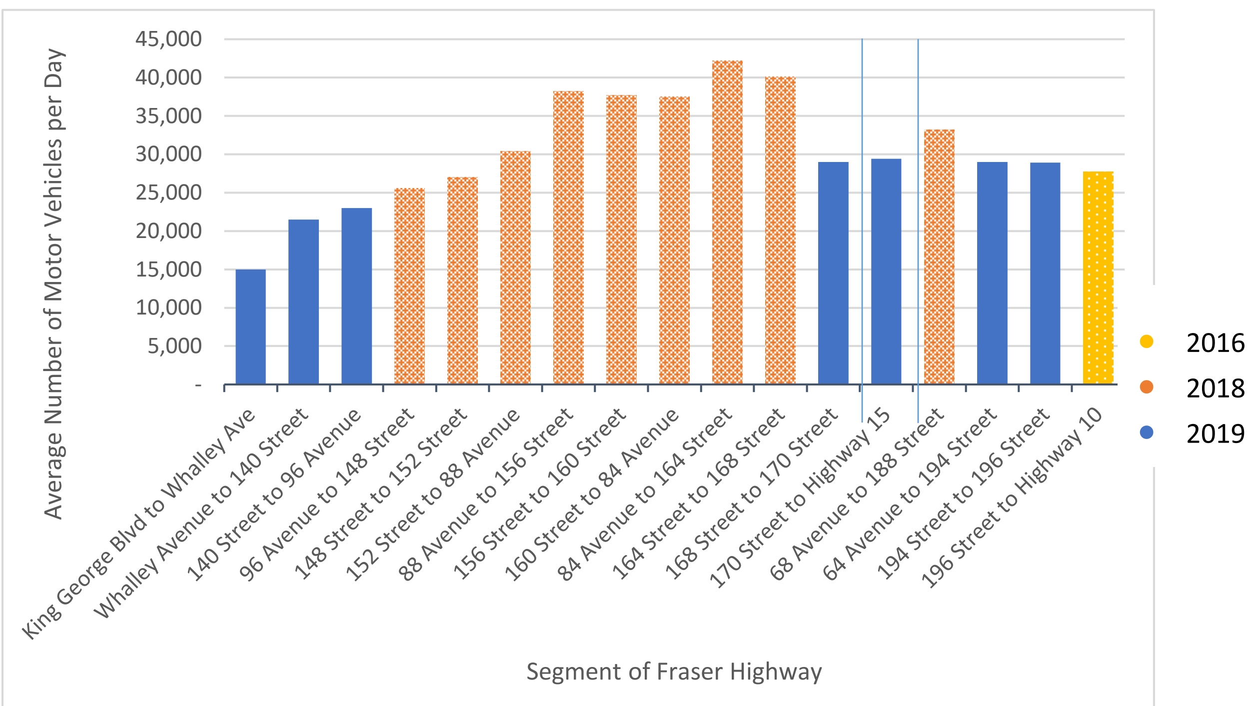

Figure 15-1 Motor Vehicle Volumes Along Fraser Highway in the Study Area

Note: Adapted from City of Surrey Traffic Data Hub (City of Surrey 2022f; Township of Langley 2016). Line indicates gap in continuity of Fraser Highway segments being displayed.

Individual intersections along Fraser Highway range from handling between 2,000 to more than 4,000 vehicles per hour (the sum of volume on all approaches) during weekday peak hours, depending on whether the intersections are minor or major. Volumes peak westbound during the morning rush hour, and eastbound during the afternoon rush hour (City of Surrey 2022f).

The intersection at Industrial Avenue and 203 Street is used by fewer motor vehicles than other intersections in the study area. During peak hours, the number of motor vehicles using the intersection may range from approximately 900 to more than 1,500. Motor vehicle volumes are generally higher going northbound in the morning rush hour entering Industrial Avenue, and higher southbound, leaving Industrial Avenue during the afternoon rush hour (City of Langley 2019b).

15.2.3.1.1 Motor Vehicle Travel Times

Travel times vary on Fraser Highway - higher during peak travel periods and lower during mid-day. As would be expected, travel times are more unreliable during peak travel periods than mid-day (**Figure 15-2**). According to the Regional Road Performance Monitoring Dashboard (TransLink 2020b), the existing 2-lane GTUF section of Fraser Highway had the highest peak hour delay , and the reason for the City of Surrey's road-widening initiative. There are also noticeable delays through Fleetwood, and as vehicles move eastbound and westbound from 176 Street.

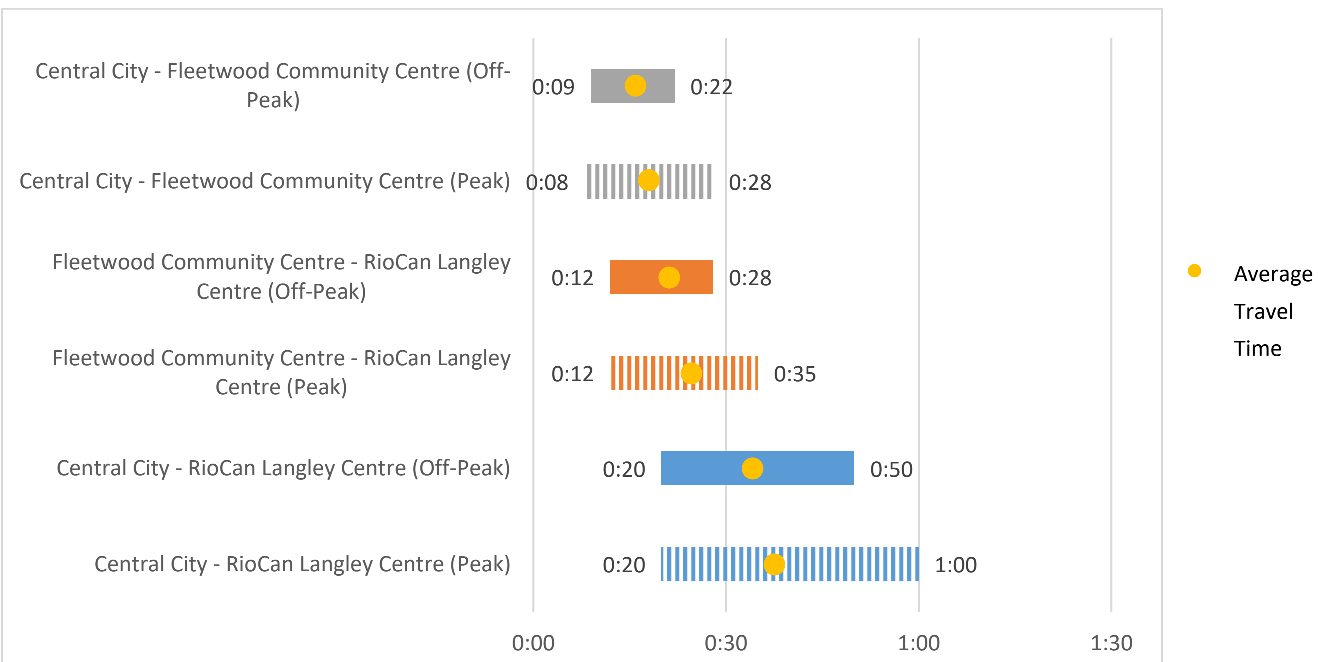

Figure 15-2 Motor Vehicle Travel Time (Range) in the Study Area

Notes: Central City refers to the mixed-use complex at 10153 King George Boulevard that houses a shopping mall, Simon Fraser University campus and an office tower complex in Surrey.
While these routes are primarily on Fraser Highway, the start and end of the routes are on other roadways.

*AM Peak was taken at 8:30 a.m., and PM Peak was taken at 5:00 p.m. for both directions and averaged. Travel time was taken for Wednesday, March 2, 2022.

** Mid-day Travel Time was taken at 12:30 p.m. for both directions and averaged. Travel time was taken for Wednesday, March 2, 2022.

15.2.3.2 Public Transit

Fraser Highway is a major transit corridor for the region. Statistics Canada transit ridership reporting for the study area in 2016 (Government of Canada 2017a) highlighted the following:

- On average, nearly 12.5% of commuters commuted by public transit in the study area;
- This share (12.6%) was similar for the Three Municipalities as a whole (**Table 15-6**);
- Transit ridership was highest in the west side of the study area (e.g., near the King George SkyTrain Station) at approximately 34% and was lowest in the east (with the exception of Langley City Centre);
- Near King George SkyTrain Station, approximately 34% of residents commuted by public transit;
- Between 148 and 164 Streets, approximately 17% of residents were transit commuters; and
- East of 176 Street, only 7% commuted by public transit.

Public transit usage of bus routes that follow the current Project alignment are summarized in **Table 15-7**. According to the 2019 Transit Service Performance Review (TransLink 2020), peak-hour headways[66] for these bus routes ranged from 30 minutes to 8.6 minutes. A review of travel times using Google Maps showed that, on average, transit travel times were longer and more unreliable during peak periods than at mid-day.

Table 15-7 Bus Ridership in the Study Area

Bus Route Name (Number) and Service Type	2019 Average Daily Boardings (Monday-Friday)	2019 AM Peak Trips (Headway) Per Hour Per Direction (Monday-Friday)*	Average Peak Travel Time (Minutes)**	Average Mid-day Travel Time (Minutes)**	2019 Trips with Over-crowding (%)	Length of Total Route and Route Along Fraser Hwy (km)***	2019 Average Speed (km/h)
Langley/Fleetwood / Surrey Central Station (320): All-day frequent service	8,050	5 (12 min.)	64 (57 – 71)	61 (58 – 63)	9%	15.5 (4.3)	23.1
King George Station/White Rock Centre (345): Basic service	3,670	3 (20 min.)	49 (46 – 51)	42 (37 – 46)	25%	20.1 (3.4)	27.2
Clayton Heights/Langley Centre (372): Standard service	620	2 (30 min.)	26 (23 – 29)	26 (23 – 29)	0%	10.9 (1.0)	23.4
Langley Centre/King George Station (395): Peak only limited service	800	4 (15 min.)	46 (45 – 47)	-	7%	19.5 (7.2)	27.6
Langley Centre/Surrey Central Station (501): Standard service	5,790	4 (15 min.)	64 (57 – 72)	59 (58 – 60)	10%	25.4 (0.4)	28.9

66 Headways are the amount of time between transit vehicle arrivals at a stop

Bus Route Name (Number) and Service Type	2019 Average Daily Boardings (Monday-Friday)	2019 AM Peak Trips (Headway) Per Hour Per Direction (Monday-Friday)*	Average Peak Travel Time (Minutes)**	Average Mid-day Travel Time (Minutes)**	2019 Trips with Over-crowding (%)	Length of Total Route and Route Along Fraser Hwy (km)***	2019 Average Speed (km/h)
Langley Centre/Surrey Central Station (502): All day frequent service	9,820	5 (12 min.)	46 (43 – 50)	44 (43 – 44)	8%	18.3 (14.4)	25.5
Aldergrove/Surrey Central Station (503): Standard service	5,050	7 (8.6 min.)	42 (36 – 51)	38	6%	29.4 (14.4)	31.0

Note: Adapted from TransLink Transit Service Performance Review (TransLink 2020).
Headway is the average interval of time between busses moving in the same direction on the same route
*AM Peak is defined between the times of 06:00 – 09:00. During Fall and Monday – Friday.
** Travel time taken for Wednesday, March 2 2022 on Google Maps. Time for bus to travel from first stop to last stop along route.
*** Route along Fraser Highway measured between Whalley Boulevard and the Langley Bypass (Highway 10)

In addition to bus routes, the western portion of the study area is also served by the Expo Line's King George Station, which ranked as the twelfth busiest SkyTrain station in 2019 with 15,210 average daily weekday boardings, as stated in TransLink's 2019 Transit Service Performance Review (TransLink 2020).

15.2.3.3 Pedestrian Traffic

Statistics Canada (Government of Canada 2017a) reported that proportions of commuters in the study area who walk to work are as follows:

- 3.4%, compared with 2.9% of commuters in the Three Municipalities as a whole (**Table 15-6**); and
- More likely to live in the west and east ends of the study area (7% between King George Boulevard and 140 Street, nearly 8% in the Township and City of Langley and 15% in Langley City Centre).

Pedestrian traffic was relatively high in the western portion of the study area due to the proximity of King George SkyTrain Station, major bus connections, healthcare facilities, and adjacent residential areas. Based on pedestrian counts in 2019 (City of Surrey 2022f); the following trends were noted for the study area:

- Approximately 2,000 pedestrians per day and approximately 140 for either the morning or evening peak hour, used the intersection at Fraser Highway and 140 Street;
- Between 400 and 1,200 pedestrians used the intersections of Fleetwood Way, 88 Avenue, and 159 Street per day; and
- Intersection counts at 194 Street ranged from 40 to 80 pedestrians per day.

15.2.3.4 Cycling

According to Statistics Canada (Government of Canada 2017a), 0.5% of commuters who lived within the study area in 2016 commuted to work by bike, compared with 0.4% of commuters in the Three Municipalities as a whole (**Table 15-6**).

Cycling usage is heaviest in the western study area, averaging 100 to 200 cyclists per day- -around King George SkyTrain Station, 140 Street and along the adjacent greenways. In comparison, usage is lowest in the central section of the study area around 170 Street, as well as at 194 Street, averaging 10 to 30 cyclists per day.

15.2.3.5 Rail

According to Transport Canada's Grade Crossing Inventory (TC 2021), approximately 11 trains per day use the section of rail line between Fraser Highway and 200 Street, over which the Project will pass.

15.2.4 Key Areas for Trip Generation, Attraction and Access

In the study area, Fraser Highway is a major northwest-southeast corridor, and Industrial Avenue provides access to local businesses and residences. Maintaining functional access to properties in the study area during construction and operation is a key priority for the Project.

In the study area, destinations or locations that attract the most trips and have relatively more or high-volume access points are designated by the Three Municipalities as Central Business District, Commercial, Town Centre, Civic Centre, Service Commercial, Transit-Oriented Core, and Designated Urban Growth. Locations expected to generate the most trips and have relatively more or high-volume access points have land use designations like Multiple Residential, Town Centre, Mid Rise Residential, Transit-Oriented Core and Transit-Oriented Residential. Additional information on land use designations and OCPs is provided in **Section 14:** Land Use.

The City of Surrey OCP designates the land use in or near the western portion of the study area (West of the GTUF) as Central Business District and Multiple Residential. The high density of commercial and residential uses in this area indicates a large number of trips are being generated and attracted in this area, for which functional access will need to be maintained. Surrey City Centre is home to nearly 27,000 residents (City of Surrey 2022a) with major employment centres including Fraser Health Authority facilities (JPOCSC and Surrey Memorial Hospital), Surrey School District head office, Surrey City Centre commercial area, and the regional RCMP headquarters.

East of the GTUF, Fraser Highway bisects the community of Fleetwood that has a current population of approximately 40,000 residents, and which is expected to grow to 84,000 by 2051 (City of Surrey 2022e). The Fleetwood Business Improvement Association represents approximately 325 businesses in the retail, food service, health and wellness, personal services, light commercial, and auto sales and service sectors. These businesses are concentrated in commercial centres around 152 Street and 160 Street intersections along Fraser Highway.

The City of Surrey OCP has designated these business concentrations as Commercial, Town Centre, or Mixed Employment. The businesses serve as key destinations in Fleetwood and are surrounded by land use designated as Urban and Multiple Residential. The Fleetwood Plan directs higher-density residential areas to be concentrated along Fraser Highway and around the future 152 Street and 160 Street stations.

Between 172 and 190 Streets, Fraser Highway bisects the communities of North Cloverdale, West Clayton, and East Clayton. According to Statistics Canada (Government of Canada 2017a), in 2016, these communities had approximately 32,000 residents. Hillcrest Village is the largest commercial centre in the area, located along Fraser Highway between 68 Avenue and 188 Street. The City of Surrey OCP has land use designated as Commercial and Multiple Residential together in select areas along Fraser Highway, surrounded by land use designated as Urban.

Between 196 Street and the Langley Bypass is the Willowbrook Shopping Centre, a major commercial facility with over 640,000 square feet of retail space and approximately 140 stores and services. In 2016, Willowbrook Shopping Centre had nearly 6 million visitors. Access to and from Willowbrook Shopping Centre is off Willowbrook Drive and westbound on Fraser Highway. The Township of Langley's OCP identifies the land use of Willowbrook Shopping Centre as Designated Urban Growth (Township of Langley 2018).

East of Willowbrook Shopping Centre, the SkyTrain alignment passes through the City of Langley neighbourhoods of Nicomekl and Douglas, with a combined residential population of approximately 16,000 (City of Langley 2019b, 2019a). Most of the employment space in the City of Langley is located within these neighbourhoods with an estimated 16,300 jobs (City of Langley 2021c). The Downtown Langley Business Association in this area represents approximately 500 shops, services, and restaurants.

The City of Langley OCP designates several land uses for this area, including Transit-oriented Core; indicating a higher density and mix of uses that is planned for the area surrounding the Langley City Station.

Key areas for trip generation and attraction in the study area are shown in **Figure K15-6** (**Appendix K**: Transportation and Access Figures).

15.2.4.1 Commercial and Residential Building Access

Buildings in the study area are predominantly low-rise structures. Single-detached houses comprise 29% of dwellings in residential population census tracts in the study area. Row houses comprise 22% of dwellings, and apartments or flats in a duplex comprise 16%. Apartment buildings fewer than five storeys comprise 26% of dwelling units, whereas 4% of dwelling units are in apartment buildings of five storeys or greater. Commercial buildings are typically low-rise, face Fraser Highway, and have off-street parking. **Table 15-8** provides an overview of the commercial and residential properties in the study area.

Table 15-8 Commercial and Residential Properties in the Study Area

Segment	Type of Properties
Whalley Boulevard to 140 Street (Fraser Highway)	Low- and mid-rise apartments and townhomes; low-rise commercial and institutional buildings
140 Street to 148 Street (Fraser Highway)	GTUF (no commercial or residential)
148 Street to 170 Street (Fraser Highway)	Low-rise townhomes, single-detached, and trailer homes; low-rise commercial and institutional buildings
170 Street to Old Yale Road (Fraser Highway)	Agricultural land, recreation facilities
Old Yale Road to 196 Street (Fraser Highway)	Low-rise apartments, townhomes, single-detached; low-rise commercial buildings
196 Street to 200 Street (Fraser Highway)	Low-rise commercial and industrial buildings
200 Street to Glover Road (Industrial Avenue)	Low-rise commercial and industrial buildings

Vehicle access to commercial properties is generally from Fraser Highway, while some properties benefit from additional access from side streets. Residential properties typically back onto Fraser Highway with access from side streets. Several single-family homes and apartment buildings rely on direct access to and from Fraser Highway. Properties with access directly to Fraser Highway may be affected during Project construction and operation.

15.2.4.2 Healthcare and Emergency Responders

Fraser Highway is a critical corridor for emergency responders, particularly for ambulance services connecting to Surrey Memorial Hospital, B.C.'s second largest hospital and its busiest emergency department. Surrey Memorial Hospital is located approximately 500 m west of the study area (at 13750 96 Avenue) and approximately 500 m south-west of the future 140 Street Station. The area around Surrey Memorial Hospital features additional health-related businesses and services. Fraser Highway is also an important route for emergency responders to access Langley Memorial Hospital, located 3.5 km east of the study area, at 22051 on Fraser Highway - just four km east of the future 203 Street Station. The 140 Street Station will be situated directly beside the JPOCSC, which provides a range of health services, including day surgery, diagnostic services, and specialized clinics.

Emergency responder facilities in or near the study area likely to rely on access to Fraser Highway are:

- RCMP headquarters for BC (E-Division) (in the vicinity of 140 Street);
- Surrey Fire Service Hall 6 (at 152 Street);
- Surrey Fire Service Hall 15 (at 64 Avenue);
- Surrey Fire Service Hall 18 (at 164 Street);
- Langley City Fire Rescue Service (at 203 Street); and
- Langley City Community Policing Office.

The location of emergency services and facilities are provided in **Figure K15-7** (**Appendix K**: Transportation and Access Figures).

15.2.4.3 Disaster Response Routes

Disaster response routes are pre-identified transportation routes for emergency responders (fire, police, ambulance, and military vehicles) to use during a disaster or emergency. Three disaster response routes pass through the study area. During construction, emergency responder access must be maintained for these routes. These disaster response routes are:

- 152 Street;
- the Langley Bypass (Highway 10); and
- 200 Street.

Municipal and provincial disaster response routes are highlighted in **Figure K15-7** (**Appendix K**: Transportation and Access Figures).

15.2.4.4 Schools, Parks, and Community Centres

Seven elementary schools and one secondary school are located in or near the study area. As these schools are set back several blocks from Fraser Highway, they do not rely on it for general access (e.g., parking lots, off-street parking, and drop-off areas). Schools west of 176 Street, as well as between 196 Street and the Langley Bypass, use Fraser Highway as a catchment boundary so students are not required to cross the busy highway. Schools within the study area are:

- Frost Road Elementary School, Surrey;
- Walnut Road Elementary School, Surrey;
- William Watson Elementary School, Surrey;
- Coast Meridian Elementary School;
- Adams Road Elementary School, Surrey;
- Hillcrest Elementary School, Surrey;
- Clayton Heights Secondary School, Surrey; and
- Douglas Park Community School, Langley.

In addition, several post-secondary campuses are located within a few kilometres of the study area, including:

- Simon Fraser University (Surrey Campus);
- Kwantlen Polytechnic University (Surrey and Langley Campuses);
- Trinity Western University (Surrey Campus); and
- Sprott Shaw College (Surrey Campus).

In 2021, the University of British Columbia also announced the acquisition of property at the corner of King George Boulevard and Fraser Highway.

The west end of the study area includes the GTUF, a large green space with important park and community amenities. Numerous smaller community parks are set back from Fraser Highway in residential areas. Parks within the study area are as follows:

- Surrey Nature Centre at Green Timbers Park;
- Barry Mather Park;
- Maple Green Park;
- Meagan Anne MacDougall Park;
- Francis Park;
- Walnut Park;
- Bonnie Schrenk Park;
- Coyote Springs Park;
- Provinceton Park;
- Clayton Park;
- Hillcrest Park;
- McIntyre Park; and
- Brooks Crescent Park.

Community centres located in the study area are as follows:

- Fleetwood Community Centre is located within the study area on 160 Street, just south of Fraser Highway and is co-located with a public library and park;
- Surrey Sports and Leisure Complex at 16555 Fraser Highway has an Olympic-sized pool, leisure pool, large weight and exercise room, fitness studio, and three full-size ice rinks, along with significant off-street parking. Primary access to this recreation facility is from Fraser Highway, with alternative access via 84 Avenue; and
- Timms Community Centre is located at 20399 Douglas Crescent and consists of a library, fitness track, gymnasium, and other amenity spaces. It is co-located with Langley City Hall.

Schools and parks located in the study area are shown in **Figure 15-8** (**Appendix K**: Transportation and Access Figures).

15.3 Project Interactions

Project activities and physical works may result in interactions with the transportation and access SE, as summarized in **Table 15-9**.

Table 15-9 Potential Project Interactions with Transportation and Access

Project Activities and Works	Change in Transportation from Baseline	Change in Access from Baseline	Change in Public Safety and Security from Baseline
Construction			
Clearing and grubbing	○	-	○
Property acquisition (including demolition)	-	-	-
Utility installation/relocation	✓	✓	✓
Use of temporary laydown areas	-	-	-
Access and traffic management	✓	✓	✓
Road widening (select locations)	✓	✓	✓
Drainage realignment (select locations)	-	-	-
Installation of SkyTrain guideway foundations	✓	✓	✓
Installation of overhead SkyTrain guideway	✓	✓	✓
Stations (foundations, structure, lighting, access, service connections, security)	✓	✓	✓
Power Propulsion Stations	-	-	-
Management of non-contaminated excavated material	-	-	-
Management of contaminated or hazardous materials	-	-	✓
Testing, commissioning, and start-up	-	-	-

Project Activities and Works	Change in Transportation from Baseline	Change in Access from Baseline	Change in Public Safety and Security from Baseline
Operation			
Operation of SLS	-	-	o
Maintenance of SLS	o	-	-

[1] *Interaction Ratings*:

– **No Interaction:** Interaction between a Project component and transportation or access is unlikely.

o **Minor Interaction:** Effects may result from an interaction, but standard measures to avoid or minimize the effects are available and understood to be effective, and any residual effects would be reduced to negligible. Interaction is not discussed further.

✓ **Interaction:** Interaction occurs and likely requires additional mitigation; carried forward and discussed in subsequent sections.

15.4 Potential Effects

This section discusses potential effects due to interactions between Project activities and the transportation network. These interactions and potential effects are summarized in **Table 15-9**.

15.4.1 Change in Transportation

The Project requires some roadway lane closures to facilitate construction activities, such as clearing and grubbing, utility work, roadway widening, foundation construction, guideway erection and station construction. Construction of new stations will involve complex foundations, and installation of mechanical systems (e.g., escalators and elevators), ancillary buildings, and PPSs, and therefore may require roadway lane closures (e.g., for delivery of materials).

The following activities may need full road closures for safety reasons or when additional access is needed:

- Removing some trees;
- Lifting segmental guideway into place between stations;
- Installing special structures (such as a superstructure needed to clear span a large intersection);
- Installing guideway rail installation; and
- Modifying streets and intersections along the alignment.

Shorter closures will likely be needed at intersections between stations when guideway segments are being lifted into place. Longer closures, potentially overnight, would take place at intersections adjacent to station locations where special structures may be required.

Where works take place concurrently, multiple roadway lane changes throughout the study area could occur. Minimal disruption to traffic flows will be a key objective during construction, however, required closures of some traffic lanes will reduce capacity on Fraser Highway and Industrial Avenue. This will likely result in traffic delays, congestion, and diversions onto alternate routes.

According to preliminary EMME traffic modelling (**Figure 15-3**), lane closures from construction may result in 2025 a.m. peak vehicle volumes[67] being on average 50% lower on Fraser Highway than they would be without the lane closures (AM Base) due to restricted capacity and users diverting to other routes.

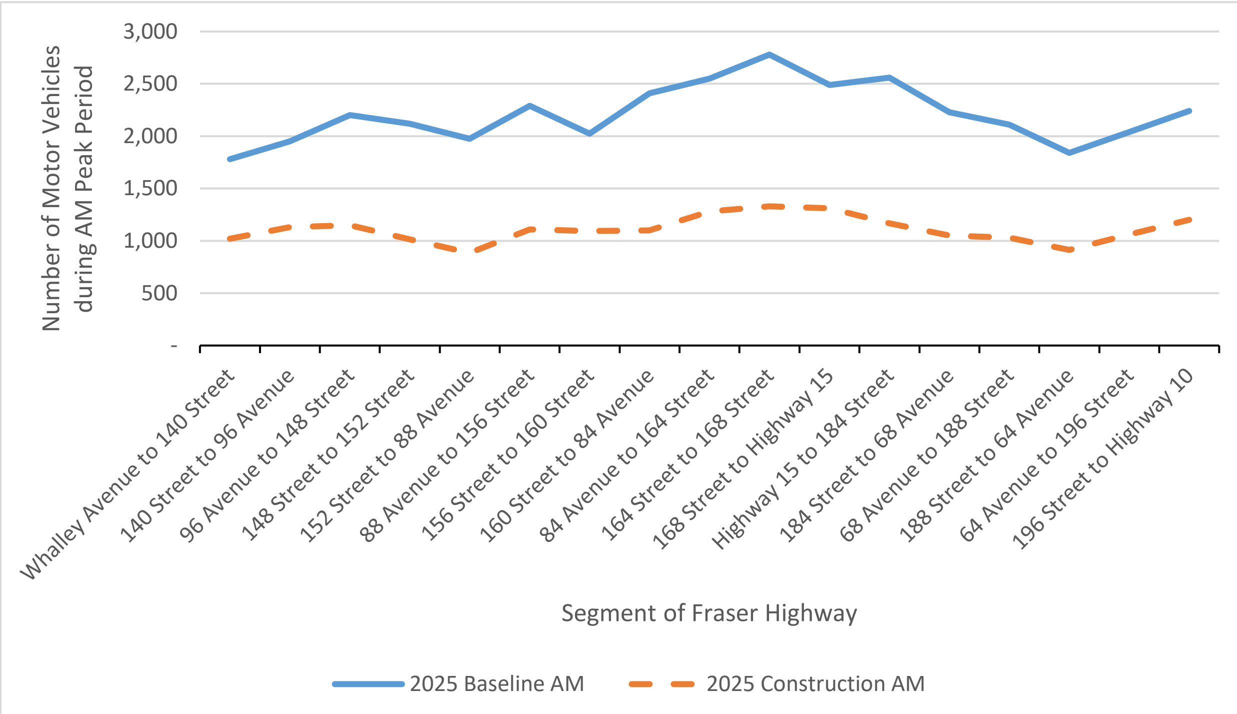

Figure 15-3 Modelled 2025 AM Peak Vehicle Volumes along Fraser Highway

Note: Adapted from (McElhanney, pers. comm., February 2022).

To ensure safety of and continued access by pedestrians and cyclists during construction, temporary closures of MUPs and bike lanes will necessitate the designation of alternative routes. For example, where overhead works are carried out for guideway or station construction, the MUP through the Serpentine Valley may be temporarily altered or closed and alternate access provided where necessary. Temporary changes could include narrowed sidewalks or detours; or closures of sidewalks, bike lanes or MUPs where space is limited (e.g., facility temporarily only on one side of the street).

Once the Project is complete, road infrastructure is, for the most part, expected to return to pre-construction conditions (i.e., similar traffic lane capacity) with some enhancements of facilities for active transportation. Some intersections may be reconfigured. According to preliminary modelling (**Figure 15-4**), once Project construction is complete and the SLS commences operation, motor vehicle volumes on Fraser Highway will be on average 3.3% lower in 2028.

67 Requirements for lane closures anticipated to be higher in 2025 than remainder of Project construction.

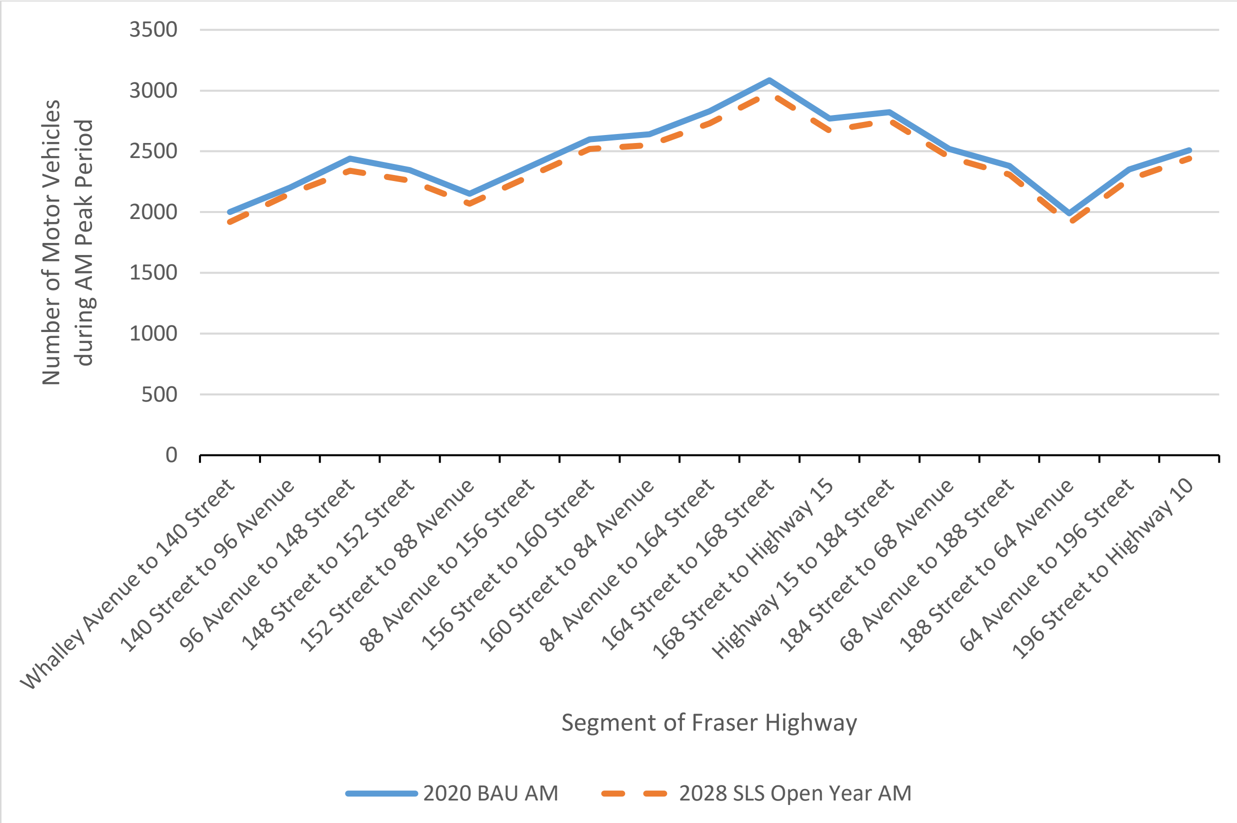

Figure 15-4 Modelled 2028 AM Peak Vehicle Volumes along Fraser Highway

Note: Adapted from (McElhanney, pers. comm., February 2022).

15.4.2 Change in Access

Changes may be required to access points, such as residential and commercial driveways, to facilitate temporary Project construction activities, including clearing and grubbing, utility work, roadway widening, foundation construction, guideway erection, and station construction. Access may also be affected for safety reasons related to overhead works during guideway or station construction.

Column placement, guideway foundations and stations may require temporary or permanent changes for some properties to parking facilities, traffic flow and access. Where Project activities temporarily or permanently affect access, it may necessitate a relocation or reduction in the quantity, quality, and width of access points (limiting to and from movements). As SkyTrain is grade-separated, permanent access effects are expected to be limited and would occur only at locations with permanent ground-level infrastructure (e.g., stations).

No street parking is available on Fraser Highway, but there is a significant amount of access to commercial properties underneath the future guideway alignment. Access to street parking and loading along Industrial Avenue will be temporarily affected, and parking spaces will be temporarily unavailable during construction of the foundations, guideway, and station access.

15.4.3 Change in Public Safety and Security

Project activities are anticipated to result in changes to road conditions, such as driver distractions, constrained roadways, and increased congestion during construction. Conditions for pedestrians and cyclists (e.g., temporary detours, MUP / sidewalk closures) may also affect individual safety during construction. As public safety is a key Project consideration, changes to mobility, travel time reliability, and access along the corridor will need to be carefully planned in the development of mitigation measures.

During Project operation, the areas around station locations will require focused attention to ensure that safety and security is paramount, including access for emergency service providers, which is further described in the mitigation measures section.

15.5 Mitigation Measures

Mitigation measures to avoid or minimize Project-related effects to transportation and access during the design, construction and operation phases are listed below. Specific mitigation measures, the potential effect(s) they address, and the mitigation objectives they target, are summarized in **Table 15-10.** For transportation and access, the relevant stages to implement mitigation are during design (denoted as "D"), construction (denoted as "C") and operation (denoted as "O").

Content from this section will be incorporated into the CEMP Framework (see the TOR for additional description of this document). As its name implies, the Framework document will provide detailed guidance for the content of the Project Co's CEMP and transportation management documentation. In addition to mitigation and performance objectives, the CEMP Framework will describe best practices intended to meet the performance objectives, required content for each sub-plan and details on roles and responsibilities for Project Co's key team members.

15.5.1 Design Mitigation

Mitigation M15.D-1 RCD Optimization

The performance objective of this mitigation measure is to avoid or reduce unnecessary effects on transportation and access through careful planning, route selection, and facility design. Many potential areas of conflict can be avoided by taking an anticipatory approach to Project design.

The Project team has incorporated the following design measures into the RCD to reduce or avoid disturbance to transportation networks and property access:

- The guideway is elevated to minimize effects on existing transportation networks and allows for uninterrupted access to property;
- The elevated guideway is largely contained within existing municipal ROWs designated for transportation; and
- The placement of guideway foundations, stations and other infrastructure was designed to minimize transportation and access effects.

15.5.2 Construction Mitigation

Mitigation M15.C-1 Traffic Management Plan

A TMP for Project construction will be developed to include performance objectives that ensure roadway land closures meet Project and Three Municipalities requirements, and that stakeholders and the public are informed of construction activities to enable knowledge-based travel decisions in advance of any significant closures or detours. The TMP should consider the needs of various road users, including transit drivers, emergency service providers, delivery services, and pedestrians and cyclists of all ages and abilities and incorporate their feedback where possible. The TMP should also meet relevant environmental requirements (e.g., idling reduction measures), as described in **Section 7** Air Quality and Greenhouse Gases**.**

The TMP should include:

- Traffic Control Plans (TCPs) for all construction activities that may have an effect on traffic, including each lane closure to ensure safe travel through Project work sites and on-site worker safety. Special attention should be paid to:
    - Access Management Plans to properties in close proximity to Project construction, such as business and residential properties. Access Management Plans should identify site-specific effects, including access points and parking, and potential mitigation measures that will be developed in consultation with property and business owners.
    - Pedestrian and cyclist TCPs should be developed in consultation with the Three Municipalities and other relevant stakeholder groups to minimize effects.
- An Incident Management Plan that describes:
    - response procedures for unplanned events and incidents, and
    - how emergency vehicles and personnel access to or through the site will be facilitated;
- A Public Information Plan that describes:
    - procedures to notify TransLink and its operating agencies, Three Municipalities' emergency services, media, stakeholders, adjacent property owners, and the travelling public of any scheduled or unscheduled activities affecting traffic, and
    - use of portable dynamic message signs along the Project alignment and more broadly, as needed, to inform the public.
- A Bus Management Plan that describes:
    - how all bus routes will be accommodated;
    - how bus operations will be prioritized;
    - potential effects to bus routes and proposed mitigation measures;
    - how and where bus stops will be relocated; and
    - associated pedestrian access, transfer, and waiting areas.
- A Construction Truck Management Plan that describes truck staging areas and access routes for the delivery of construction materials (e.g., precast concrete segments, structural steel, steel piles and caissons, ready-mix concrete, equipment) and the removal of waste materials.

In addition, traffic count data at intersections along Fraser Highway should be reviewed and analyzed on a regular basis to support traffic management planning.

Mitigation M15.C-2 TransLink Bus Operations Management Plan

This plan will identify all bus routes in need of change during Project construction, how bus operations will be modified, how and where bus stops will be relocated, and the associated pedestrian access, transfer, and waiting areas. Note: this Plan is separate from the Contractor Bus Management Plan in the TMP and is developed by Coast Mountain Bus Company (CMBC), TransLink's bus operations subsidiary.

Mitigation M15.C-3 Construction Staging Plans

An important component of transportation and access during construction is the development of Construction Staging Plans. These will be developed by Project Co and should include consultation with emergency service providers and other key stakeholders. The plans should identify the following:

- site-specific effects of construction activities that occupy physical locations along the alignment;
- timing and duration of such events (including any night-time activities and lane closures);
- plans for access (both short term or long term, as relevant);
- specifics of detours for vehicles, cycling and pedestrians; and
- associated mitigation measures.

15.5.3 Operation Mitigation

Mitigation M15.O-1 Changes to Business and Residential Access and Parking

As above for construction (M15.C-4) and as a component of the TMP, the Access Management Plan should identify site-specific effects, including access points and parking, as well as potential mitigation measures that will be developed in consultation with property owners during Project operation.

Where changes to access are permanent, additional discussions with property owners, TransLink, and the relevant municipality will occur to explore traffic flow on the property, the quality of the accesses, and the potential for permanent signage to direct the public to the new access locations.

Mitigation M15.O-2 Safety and Security at New Stations

During operation, TransLink will work closely with emergency service providers, including informing them of all emergency procedures in and around the new stations. This includes ensuring that all station activities, including operation and maintenance, do not restrict emergency routes and/or the development of alternate routes, as required. Prioritization of emergency responder needs will be factored into operation and maintenance activities through consultation with emergency service providers.

Passenger and cyclist safety within the stations will be managed using similar measures already in place at existing SkyTrain stations, including provision of security personnel and security surveillance.

15.5.4 Summary of Proposed Mitigation

Mitigation measures for the design, construction and operation phases of the Project are summarized in **Table 15-10**. They will be developed and implemented by Project Co, except for M15.C-2 and M15.O-2, which will be developed and implemented by TransLink.

Table 15-10 Summary of Potential Project Effects and Mitigation Measures for Transportation and Access

Potential Effect	Mitigation Number	Mitigation Objective	Project Phase	Environmental Management
Change in Transportation from baseline	M15.D-1	Design to avoid transportation impacts through planning, route selection and facility design.	Design	Design Criteria
	M15.C-1	Develop and implement a TMP. Identify any impacts from construction noise.	Construction	TMP
	M15.C-2	Develop and implement a Bus Operations Management Plan.		
Change in Access from baseline	M15.D-1	Design to avoid or reduce effects on access through careful planning, route selection and facility design.	Design	Design Criteria
	M15.C-3	Develop and implement a Construction Staging Plan.	Construction	CEMP – Transportation Access Communications Plan
	M15.O-1	Develop and implement an Access Management Plan	Operation	
Change in Public Safety and Security from baseline	M15.O-2	Maintain functional mobility and access at stations. Manage passenger and cyclist safety at stations.	Operation	TransLink best practices

15.6 Discussion

Project-related effects that remain following the implementation of appropriate mitigation measures are discussed below.

15.6.1 Change in Transportation

During Project construction, trips for all transportation users may be temporarily affected throughout the study area by lane closures, sidewalk closures, reduced lane widths and detours. Multiple temporary changes will occur throughout the study area during construction and likely result in delays, congestion and diversions onto alternate routes. Temporary effects will differ based on the location, scope and duration of the construction work.

Project operation may result in permanent changes to the transportation network for all users. These may include changes to roadways (i.e., additions of new vehicle turning lanes), parking, pick-up/drop-off areas, sidewalks, off-street cycling facilities, and bus routes.

To mitigate effects of Project construction and operation on transportation users, a series of measures will be developed, coordinated, and delivered. The TMP should ensure that stakeholders and the public are informed of Project construction activities and can adjust their travel plans accordingly. It should also ensure that roadway lane closures meet the requirements of both the Project and the Three Municipalities. The TCPs need to ensure closures are planned and implemented efficiently. TCPs specific to pedestrians and cyclists can help minimize effects on users of all ages and abilities and facilitate safe passage through sites. The Bus Management Plan will identify impacts to bus routes and mitigation measures (e.g., identifying how and where bus stops will be relocated).

Identified mitigation measures should help to limit long-term adverse effects during construction and operation pertaining to potential changes to roadway profile, vehicle volumes, vehicle travel times, transit operation and pedestrian and cycling facilities. These changes are discussed in more detail below.

15.6.1.1 Change in Roadway Profile

During construction, motor vehicle lanes on Fraser Highway and Industrial Avenue will be affected. Construction of stations and the elevated guideway will likely be sequenced concurrently with activities in several construction zones taking place simultaneously. Effects on transportation users should be limited to the localized construction area. Roadway lane closures and pedestrian and cyclist detours will be required to facilitate construction work, but mitigation measures should help to minimize effects.

Once the Project is complete, the roadway profile is, for the most part, expected to return to pre-construction conditions (i.e., similar traffic lane capacity).

15.6.1.2 Change in Vehicle Volume

Lane closures, detours, and additional construction vehicles may result in Project-related congestion and disruptions for motor vehicles in the study area. As a result, drivers may choose to take alternative routes. According to preliminary modelling (**Figure 15-3**), lane closures from construction may result in 2025 a.m. peak vehicle volumes averaging 50% lower on Fraser Highway than without the lane closures (AM Base) due to restricted capacity and users diverting to other routes.

During operation, the Project will see a reduction in travel times and an increase in transit capacity, which is expected to attract some drivers to rapid transit. This mode shift, would, in turn, help to improve traffic operations for buses, private vehicles, and commercial vehicles servicing businesses along the alignment. According to preliminary modelling (**Figure 15-4**), once Project operation commences, motor vehicle volumes on Fraser Highway will average 3.3% lower in 2028 than 2020.

15.6.1.3 Change in Vehicle Travel Times

During construction, motor vehicle travel times along Fraser Highway and through the study area will likely be affected. Identified mitigation measures should provide more predictability by providing up-to-date information on lane closures and detours. Advance notice on lane closures will allow road users to make informed travel choices and help minimize their travel times.

During operation, the Project should result in improved truck and motor vehicle operations on Fraser Highway. For example, people travelling by car from Fleetwood to Surrey Central, travel times are forecast to decrease from 24 minutes to 22 minutes (McElhanney 2022).

15.6.1.4 Change in Transit Operation

Bus routes cross the study area and link to transit exchanges at King George, Surrey Central, Guildford, Cloverdale, Langley Centre, and Carvolth as well as associated commercial and community facilities. These routes will be affected by roadway and sidewalk changes related to Project construction. The Bus Management Plan, developed in coordination with bus operators and stakeholders, should provide a comprehensive approach to minimizing effects on transit users, routes, and usage, and provide an opportunity for ongoing consultation and improvement.

During operation, the SLS will reduce travel times and increase transit capacity, which will attract a portion of existing drivers to rapid transit. This mode shift, in turn, will help to improve operations for buses that will service the SLS. For example, from Fleetwood to Surrey Central, transit travel times are forecast to improve from 41 minutes to 20 minutes. In addition, travel time from Fleetwood to Langley Centre would improve from 37 minutes to 23 minutes (McElhanney 2022).

Overall, the Project improves transit travel times significantly. In some circumstances, transit travel times become comparable to, or even faster than, those made by car. Transit will overtake the car as the quickest way to travel from Fleetwood to Surrey Central. A trip from Fleetwood to downtown Vancouver is forecast to be half an hour shorter on the SkyTrain (63 minutes) than by auto (90 minutes) (McElhanney 2022). With the SLS in operation, travel time savings for auto trips and buses will improve as more people choose to use SkyTrain, freeing up road capacity.

15.6.1.5 Change in Pedestrian and Cycling Facilities

With the effective implementation of appropriate mitigation measures and proactive planning, cyclists and pedestrians are not expected to be significantly affected by construction or to experience negative impacts related to safety. During operation, the SLS will integrate seamlessly with pedestrian and cyclist routes. The Project will provide like-for-like, and in some cases improved, pedestrian and cycling facilities. Sidewalks and off-street bike lanes will be added to several sections of Fraser Highway, including off-street bike lanes between 148 and 152 Streets. The Project will also result in new cycle parking facilities at SkyTrain stations, including bike racks at every station, and bike parkades at the 166 Street and 203 Street Stations. Space provided at 152 Street and 184 Street Stations will accommodate future bike parkades.

15.6.2 Change in Access

Changes may be required to access points, such as residential and commercial driveways, to facilitate Project construction activities. Guideway foundations, columns, and stations may require permanent changes to parking facilities, traffic flow, and access on some properties. Other changes, for example, to accommodate construction access, will be temporary. As SkyTrain is grade-separated, permanent access effects are expected to be limited and occur only at locations with permanent ground-level infrastructure (e.g., stations).

To mitigate the effects of Project construction and operation on access, a series of mitigation measures will be developed, coordinated, and delivered. The Access Management Plan should identify site-specific effects (e.g., to access points and parking) and mitigation measures, developed in consultation with property and business owners. Mitigation measures may include relocated or temporary access points, alternative parking arrangements, public information notices, suggested routing, and wayfinding signage. Access management should minimize disruptions, provide predictability, and maintain public awareness that businesses and services remain open during construction. The Project will work to maintain equivalent functional access to properties.

Where changes to access are permanent, additional discussions with property owners, TransLink and the relevant municipality will occur to explore traffic flow on the property, the quality of the access, and the potential for permanent signage to highlight new access locations.

Identified mitigation measures will help to maintain access during construction to properties, parking and are discussed in more detail below.

15.6.2.1 Change in Access to Residential, Institutional, and Commercial Properties

During construction, temporary access changes for residential, institutional, and commercial properties within the study area will likely be required, particularly for areas fronting station and elevated guideway. Recommended mitigation measures, such as maintaining established access, or securing alternate access will minimize the duration and frequency of disruptions.

Permanent changes to residential, institutional, and commercial driveways and access points are anticipated to be limited to only those locations directly obstructed by guideway columns or station infrastructure. Project Design should minimize any potential permanent effects, but if required, modified or alternative access points should be developed during Project construction. Intersection movements that were in place prior to construction will generally be reinstated following construction unless new alternatives are developed with the Three Municipalities.

15.6.2.2 Change in Access to Parking

No street parking is available on Fraser Highway, but there is currently a significant amount of access to commercial and residential properties underneath the future guideway alignment. For example, parking and loading access in some Project areas will be temporarily unavailable during construction of the foundations, guideway, and stations. Recommended mitigation measures should minimize the duration and frequency of disruptions at all affected sites.

15.6.3 Change in Public Safety and Security

Modified road conditions during Project construction may result in unexpected navigation challenges, constrained roadways, and increased congestion during construction. Conditions for pedestrians and cyclists (e.g., temporary detours, MUP or sidewalk closures) may also affect safety for individuals during construction, due to changes to mobility, travel time reliability and access. Such changes will be factored into mitigation identified in the TMP. Identified mitigation measures should help limit long-term effects.

During operation, TransLink will work closely with emergency service providers, including informing them of all emergency procedures in and around the new stations, maintaining emergency routes and/or the development of alternate routes, as required. Prioritization of emergency responder needs will be factored into operation and maintenance activities through consultation with emergency service providers.

Passenger and cyclist safety within the stations will be managed using similar measures already in place at existing SkyTrain stations, including provision of security personnel and security surveillance.

15.7 Conclusion

Fraser Highway is a major urban transportation corridor that connects the City of Surrey, Township of Langley, and City of Langley, serving both local and regional transit users, those who walk and cycle, the goods movement sector, and drivers. The corridor facilitates sees commuters accessing key areas of commerce as well as healthcare hubs such as Surrey Memorial Hospital and the JPOCSC. Industrial Avenue also provides critical access for local businesses and residents in the City of Langley. As such, the corridor is key to the movement of people and goods both locally and regionally.

During Project construction, temporary impacts to the transportation and access SE will occur due to changes to active transportation and road infrastructure. To maintain acceptable levels of transportation, access, and safety along the alignment during construction, several key mitigations are required, including the creation of a TMP, Access Management Plan, and site-specific TCPs. These plans will be developed in coordination with the Three Municipalities, emergency services, potentially affected businesses, and adjacent residents. The plans will focus on providing a level of predictability and maintaining access and mobility for all transportation users.

The mitigations will help to minimize effects on transportation and access during construction, but some effects cannot be fully mitigated. For example, travel times during construction are forecast to be longer than normal, temporary barriers may impede the visibility of businesses, and there will be changes to existing pedestrian routes and parking. The Project anticipates extensive and ongoing coordination between the Province, Project Co, TransLink, the Three Municipalities, First Nations, key stakeholders and the public to help inform plans and mitigate effects. This will help to keep people and goods moving, maintain access to services, and allow businesses to continue to operate throughout construction. Project-related construction effects that are expected to remain after implementation of mitigation are summarized in **Table 15-11**.

During Project operation, TransLink will implement mitigation measures that are in line with existing practices for the SkyTrain system, such as incident management, station and system security, and access management. Project-related effects that remain after the application of mitigation for operation are characterized in **Table 15-12**.

Overall, the Project will bring about numerous benefits, both locally and regionally, by improving transportation options and supporting planned growth and economic development. Once in service, reliable transit travel times, increased transit capacity, better active transportation infrastructure will help to create mode shift south of the Fraser River, which will reduce VKTs along Fraser Highway.

Table 15-11 Summary of Potential Effects Remaining After Mitigation for Transportation and Access - Construction

Potential Effect	Criterion	Rating	Rationale for Rating
Change in transportation from baseline	Magnitude	Moderate	During Project construction, travel patterns and times are likely to be affected by transportation changes that include lane closures, sidewalk closures, reduced lane widths and detours. These changes will likely result in travel delays, congestion, as well as diversions onto alternate routes. Recommended mitigation measures will help limit to these effects, but there will still be impacts to road users.
	Geographic Extent	Low	During construction, there will be transportation effects to commuters passing through the study area due to the localized nature of the construction (e.g., lane closures resulting in delays, detours, etc.).
	Duration	Short-term	Changes to the roadway profile to facilitate construction (i.e., lane closures, sidewalk closures, reduced lane widths) will only occur at site-specific locations .
	Frequency	Common	During construction, activities could occur simultaneously along the alignment. The frequency of effects will differ based on location, scope, and duration of construction works.
	Reversibility	Reversible	Changes in transportation (i.e., transit operations, pedestrian routing, number of vehicle lanes) and resulting effects during construction will be temporary and cease at completion of construction.
Change in access from baseline	Magnitude	Low	To facilitate construction activities, changes will be required to some property access points, affecting associated access for residential, institutional, and commercial properties, as well as areas for parking. The Project will work to maintain equivalent functional access to properties, and the Access Management Plan should identify site-specific effects and potential mitigation measures.
	Geographic Extent	Negligible	Changes in access to some properties and parking will occur at the site level
	Duration	Short-term	The changes to access points and resulting effects on property and parking access during construction, should be short-term. The recommended mitigation measures are expected to minimize the duration of disruptions.
	Frequency	Uncommon	Changes in access is expected to be limited to properties that front construction areas for the station and elevated guideway. Mitigation measures should minimize the frequency of disruptions.
	Reversibility	Reversible	Temporary changes to access will be reversed once construction is complete.

Potential Effect	Criterion	Rating	Rationale for Rating
Change in public safety and security from baseline	Magnitude	Low	During Project construction, access to all properties for emergency services will be maintained. Emergency vehicles will be prioritized through construction zones and alternative routes will be identified well in advance to minimize effects on response times.
	Geographic Extent	Low	During Project construction, effects on access and response times for emergency service providers would be limited to the study area. The recommended mitigation measures should limit effects on access or response times.
	Duration	Short-term	During Project construction, effects on access and response times for emergency service providers would be limited to the short-term, or construction period. The recommended mitigation measures should limit effects on access or response times.
	Frequency	Uncommon	The recommended mitigation measures should limit any effect on access or response times.
	Reversibility	Reversible	Any change to access and response time for emergency service providers would be reversible, following construction. However, the recommended mitigation measures should limit any effect on access or response times during construction.

Notes:

1. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance, and high (exceedance of criteria or threshold). Generally, magnitude is measured in terms of the proportion of the SE affected within the assessment area (for biophysical SE), or the degree within the interaction area relative to the range of natural or historic (in the case of human environment SE) variation.
2. The duration of an effect may be short-term (i.e., within the construction phase), medium term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (permanent) (i.e., extending past the life of the Project).

Table 15-12 Summary of Potential Effects Remaining After Mitigation for Transportation and Access - Operation

Potential Effect	Criterion	Rating	Rationale for Rating
Change in transportation from baseline	Magnitude	High	Effect is positive. During Project operation, the roadway profile is expected to return to pre-construction functionality (i.e., similar lane profile) with minor changes expected in station areas. A low level of effects can be expected for drivers. The Project should result in travel time improvements and higher capacity for transit users on Fraser Highway, as well as like-for-like, or in some cases improved, pedestrian and bike routes. A high level of benefits is expected for pedestrians and cyclists.
	Geographic Extent	Regional	Effect is positive. During Project operation, transit users travelling in the study area and across the region will experience significant benefits, including reduced travel times between Downtown Vancouver and Langley Centre.
	Duration	Permanent	Effect is positive. Project operation will bring about changes and resulting benefits to the roadway profile, transit operations and pedestrian and cycling facilities that will be permanent.
	Frequency	Continuous	Effect is positive. Project operation will bring about changes and resulting benefits that are ongoing into the future (e.g., new transit, cycling and walking facilities, turning lanes)
	Reversibility	Permanent	Effect is positive. Project operation will bring about changes and resulting benefits to transportation (e.g., transit operations, pedestrian routing, number of vehicle lanes) that will be permanent.
Change in access	Magnitude	Low	Permanent changes to residential, institutional, and commercial driveways and access points are anticipated to be limited to only those locations directly obstructed by guideway columns or station infrastructure. Where resulting effects may be permanent, additional discussions with property owners, TransLink and the relevant municipality will occur.
	Geographic Extent	Negligible	Changes in access to some properties and parking will occur at the site level.
	Duration	Permanent	If access points are to be obstructed by guideway columns or station infrastructure, then these changes, resulting effects and mitigation measures will be permanent when Project operation begins.
	Frequency	Continuous	Permanent impacts are expected for changes in access points due to obstruction by guideway columns or station infrastructure. However, Project design should minimize any potential permanent effects, and modified or alternative access points should be developed, as required.
	Reversibility	Permanent	Permanent changes may be expected for access points that are obstructed by guideway columns or station infrastructure. Resulting effects should be limited with effective application of recommended mitigation measures.

Potential Effect	Criterion	Rating	Rationale for Rating
Change in public safety and security from baseline	Magnitude	Negligible	During Project operation, TransLink will work closely with emergency service providers, including making them aware of all emergency procedures in and around new stations. Safety and security measures in and around stations will be implemented in line with current practice on the SkyTrain system.
	Geographic Extent	Negligible	During operation, effects would be limited to the site or station level. Recommended mitigation measures and existing SkyTrain operating procedures should minimize effects.
	Duration	Continuous	During operation, effects would be permanent and ongoing. Recommended mitigation measures and existing SkyTrain operating procedures should minimize effects.
	Frequency	Uncommon	The recommended mitigation measures should limit effects on access or response times.
	Reversibility	Permanent	During operation, effects would be permanent Recommended mitigation measures and existing SkyTrain operating procedures should minimize effects.

Notes:

1. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance, and high (exceedance of criteria or threshold). Generally, magnitude is measured in terms of the proportion of the SE affected within the assessment area (for biophysical SE), or the degree within the interaction area relative to the range of natural or historic (in the case of human environment SE) variation.
2. The duration of an effect may be short-term (i.e., within the construction phase), medium term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (permanent) (i.e., extending past the life of the Project).

16 Visual Landscape

16.1 Introduction

The Project alignment is adjacent to residential, commercial, civic, and institutional areas. These areas are composed of single-family homes, townhomes, commercial plazas, institutions (such as hospitals and educational facilities) and public areas. Accordingly, there will be changes to views from some properties because of with the presence of the elevated SkyTrain guideway, stations, and related road works. In addition, access changes around some stations could permanently change the view from adjacent properties.

This assessment identifies areas and representative locations along the alignment where the visual presence of Project infrastructure will be most evident and where recommended mitigation measures will be of benefit to the visual landscape. This Visual Landscape Assessment (VLA) focuses on how the Project infrastructure, siting, layout, massing, materials, and height may affect the views, general visibility, and aesthetics in surrounding communities.

16.1.1 Project Features Relevant to Visual Landscape

Key features of the Project Description (**Section 2**) relevant to the VLA include those that are intrinsic to the RCD, such as its alignment and elevated components. The Project will generally follow the existing transportation corridor on Fraser Highway, which except for GTUF and the Serpentine Valley, is an urbanized environment. During development of the RCD, a key factor in refinement of the alignment design was proximity to adjacent land uses (see **Figure 2-1**).

The Project's permanent above-ground built structures are the key items discussed in this VLA. These include the SkyTrain stations, elevated guideway and support columns, and the standalone PPS. RCD documents define the typical dimensions of these structures, which helped to inform this visual assessment. There may be more substantial changes to the visual landscape in some locations due to the presence of elevated structures.

The permanent RCD footprint is shown in **Figure B1-1 Appendix B:** Project Description Figures. The VLA focuses on the permanent footprint areas are associated with the physical infrastructure essential to Project operation (e.g., stations, SkyTrain overhead guideway and support columns, and PPSs). Final design, particularly regarding guideway column locations, may differ from the RCD and will be confirmed during detailed design by Project Co.

The main components and typical dimensions of the Project's permanent above-ground structures assessed for visual landscape effects are summarized in **Table 16-1**.

Table 16-1 Summary of Main Components and Typical Dimensions

Component	Dimensions
Eight New SkyTrain stations	
Platform length	82.5m
Platform width	3.0 m or greater per side (where applicable
Height from roadway to platform	7.30 m – 13.5 m
Concourse, stairs, escalators, and ancillary rooms	vary from station to station
Guideway and Support Columns	
Total length	16 km
Typical span	39.0 m
Typical width	7.6 m
Typical design clearance	5.1 m from roadway to the underside of structure
Minimum driveway clearance	4.7 m from roadway to underside of structure
Standalone PPS	
Typical length	30.0 m
Typical width	10.0 m
Typical height	Approx. 2.5 m
Additional buffers, fencing, parking, and utility rooms	Vary from station to station

16.1.2 Selection as a Screening Element

Visual landscape was selected as an SE based on engagement with First Nations, stakeholders and the public, due to the potential for Project-related changes in views from residential neighbourhoods and public areas as well as views to natural landforms This assessment focuses on visual landscape effects that stem from the Project's permanent built structures, and thus does not include temporary changes during construction.

The selection of Review Indicators for the VLA is based on the information requirements in the TOR, as determined by the geographical location and representative street-level viewpoints within and near the Project site, and a review of potential Project-related effects. The potential effects, Review Indicators, and selection rationale are summarized in **Table 16-2**.

Table 16-2 Selection of Review Indicators

Potential Effect	Review Indicator(s)	Rationale for Selection
Change in existing view conditions due to presence of stations, guideway and PPS	Change in views within the study areas from the following representative locations: • Residential neighbourhoods • Civic and institutional establishments • Public Areas	Changes to existing view conditions from the representative locations due to the Project's presence. Desire to maintain visual quality of built environment.

16.1.3 Spatial Boundaries and Temporal Boundaries

This section presents details on the spatial and temporal boundaries for the Project.

16.1.3.1 Spatial Boundaries and Viewpoint Selection

Study locations and viewpoints were selected to represent potential changes to existing landscapes in residential, civic, institutional, and public spaces due to presence of stations, elevated guideway and support columns, and PPS infrastructure. The VLA focused on the study locations that are considered representative of different sensitive receptors (i.e., that exhibit various land uses and visual contexts along the Project alignment). A **study location** is a geographic reference area of a future station or guideway location from adjacent areas within a 300 m radius of the Project centerline. The study locations are represented as an orthographic map image with overlaid graphics of the Project design in 2D CAD plan and selected viewpoint locations as view cone symbols. A **viewpoint location** is the eye-level origin point visual representation of the existing and Project conditions. The **existing conditions** are represented as street-level photographs. Lastly, the **Project conditions** are represented as three-dimensional models (3D models), in reference to the current RCD design, that are superimposed into the existing conditions' photographs using graphic visualization rendering.

16.1.3.2 Temporal Boundaries

As the VLA assesses only permanent infrastructure and no decommissioning is anticipated, the only temporal boundary considered is Project operation. For this assessment, the operation phase is 25 years.

16.1.4 Regulatory and Policy Context

No local, provincial, or federal legislation is in place governing impacts to the visual landscape of a project.

16.2 Methods

16.2.1 Methods Guidance

Table 16-3 outlines documents that guided the assessment of the Project's potential visual impacts. In the absence of directly applicable provincial guidance, the VLA used a combination of best practice methods. The Visual Impact Assessment Guidebook (Government of BC, 2001) outlines the procedures of fieldwork and the application of the Visual Quality Objectives. Although the guidelines were developed for the forestry sector, many of the same principles can be applied to urban settings. In addition, the Project & Environmental Review: Guidelines – View and Shade Impact (VFPA, 2015) outlines selection criteria and methods relevant to assessment of proposed infrastructure.

Table 16-3 Summary of Key Policies and Guidelines

Guidelines / Standards	Responsible Agency	Applicability to the Project
Visual Impact Assessment Guidebook (Government of BC 2001)	FOR	Outlines site visit and documentation considerations and procedures as well as visual landscape assessment methodologies and techniques to render images and present other graphics.
A Guide to Visual Quality Objectives (Government of BC 2013a)	FOR	Highlights possible alterations of views to the affected natural forested landscapes (timbered areas).
Visual Landscape Inventory: Procedures and Standards Manual (Government of BC 1997)	FOR	Presents the technical fieldwork procedures and standards to conduct a visual landscape inventory to inform the assessment of a project's visual effects.
Project & Environmental Review: Guidelines – View and Shade Impact (VFPA 2015)	Vancouver Fraser Port Authority	Informs the selection of the study locations, identifies general considerations of a project's context, and provides mitigation measures for affected communities.

16.2.2 Baseline Conditions

Baseline conditions on and adjacent to the alignment were documented in orthographic photos and satellite images of study locations as well as street-level photographs taken in spring 2020, fall 2021, and spring 2022. The following reports, drawings, plans and other information required complete this assessment were provided by the Project team:

- RCD Workbook;
- Public engagement reports;
- Digital files for drawings and 3D models of the proposed guideway and stations;
- Elevation drawings of the guideway segments; and
- Landscape architectural plans and model reference documents for proposed stations.

The selection criteria for the study locations and viewpoints were established based on the following:

- Representative of multiple locations along the Project alignment where similar effects may be experienced;
- Residential areas near the Project footprint where view quality and neighbourhood character may be affected by the proposed infrastructure;
- Recreational trails and public areas;
- Main roadways near the Project footprint with high traffic volumes;
- Institutional and community buildings with potential views to the Project infrastructure; and
- High-use public spaces with potential views to the Project infrastructure.

Table 16-4 describes the selected study locations for viewpoints and the rationale for their selection. Study locations were reviewed with the Project team to confirm selection.

Table 16-4 Representative Study Locations, Descriptions, and Selection Rationale

No.	Study Location[1]	Figure	Elevated Structure Description	Rationale for Location Selection	Receptors Considered
1	140 Street SkyTrain Station	**Figure 16-2**	Station platform above Fraser Highway, southeast of the 140 Street intersection	Station to be situated immediately south of JPOCSC, west of GTUF, and northeast of residential areas	Public area Residential area Civic and Institutional area
2	Guideway at GTUF	**Figure 16-7**	Guideway above Fraser Highway at 96 Avenue intersection with GTUF trail	Guideway has a median alignment at this location and intersects a public trail	Public area
3	152 Street Station	**Figure 16-10**	Station north of Fraser Highway and west of 152 Street and guideway transitions to north side of Fraser Highway	Station to be situated near residential areas	Residential area
4	Guideway near 159 Street	**Figure 16-14**	Guideway north of Fraser Highway between 158 Street and 159 Street	Guideway to be situated south of residential area at a lower than typical elevation.	Residential area
5	Guideway near Serpentine River + PPS 170	**Figure 16-17**	Guideway south of Fraser Highway with a nearby standalone PPS	Guideway and PPS located in farmed valley near the Serpentine Valley.	Public area
6	Guideway near Old Yale Road	**Figure 16-19**	Guideway transitions from the south side to the median of Fraser Highway	Guideway to the north of residential area at a lower than typical elevation due to elevation change	Residential area
7	184 Street Station	**Figure 16-24**	Station north of Fraser Highway and west of 184 Street	Station to be situated near residential areas	Residential area
8	190 Street Station	**Figure 16-28**	Station north of Fraser Highway and northwest of 64 Avenue	Station to be situated adjacent to residential area with an urban trail south of Fraser Highway.	Public area Residential area
9	Guideway near 64 Avenue	**Figure 16-30**	Guideway alignment north of Fraser Highway	Guideway to be situated near residential areas	Residential area
10	196 Street Station	**Figure 16-33**	Station north of Fraser Highway	Station to be situated northeast of residential areas and high pedestrian and vehicular traffic volume	Public area Residential area
11	203 Street Station	**Figure 16-35**	Station east of 203 Street near Industrial Avenue	Station to be situated near residential area.	Residential area

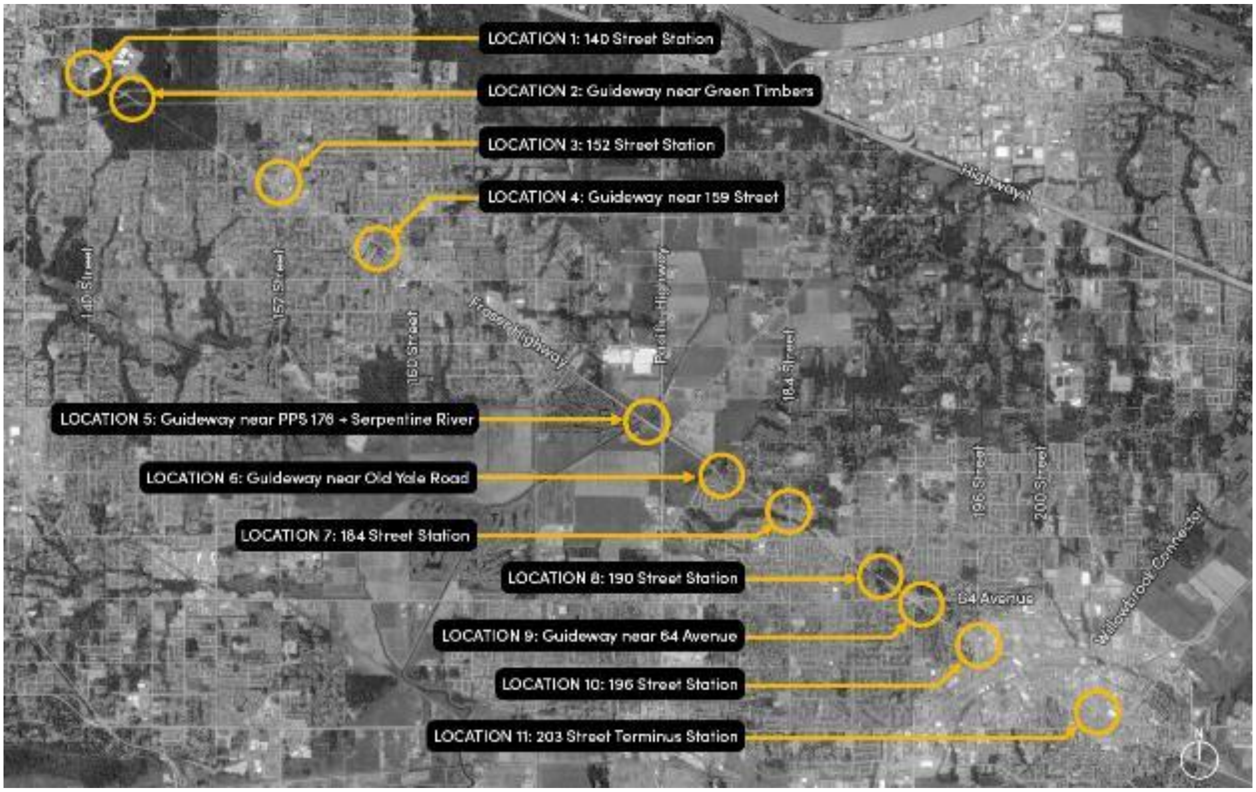

Figure 16-1 Project Study Locations for Visual Landscape Assessment

In April 2020, September 2021, and February 2022 site visits included inspections of adjacent properties and surrounding areas from publicly accessible vantage points. The site visits were used to:

- Review existing conditions of the selected locations;
- Identify the viability of the suggested viewpoints; and
- Propose additional or alternative viewpoint options in the neighbouring vicinities, if required.

A shortlist of 25 viewpoints across 11 locations were confirmed for the VLA, which considered public and stakeholder comments, constraints and potential impacts and options of the Project's fully obscuring elements. See **Table 16-5** for the description and rationale for each viewpoint.

Table 16-5 Selected Viewpoints, Description, and Selection Rationale

Viewpoint Identified	Figure	Description	Rationale for Viewpoint Selection
1-A	**Figure 16-3**	Looking southeast from Fraser Highway (westbound) near residential apartments	View from residential complex northwest of the proposed 140 Street Station
1-B	**Figure 16-4**	Looking southeast from the intersection of Fraser Highway (westbound) and 140 Street	View from a busy transit intersection
1-C	**Figure 16-5**	Looking south from 140 Street near JPOCSC	View near JPOCSC area north of the proposed 140 Street Station
1-D	**Figure 16-6**	Looking east from the intersection of Fraser Highway (eastbound) and 140 Street	View from new residential building southwest of the proposed 140 Street Station
2-A	**Figure 16-8**	Looking north from Fraser Highway (eastbound) near PPS-96	View from asphalt trail that connects north and south GTUF trail near intersection with 96 Avenue
2-B	**Figure 16-9**	Looking west from GTUF trail (east side)	View from public trail through a natural forested area
3-A	**Figure 16-11**	Looking east from Fraser Highway (eastbound) near residential areas at 151 Street	View from residential areas (mostly single-family homes with some properties being redeveloped)
3-B	**Figure 16-12**	Looking south from a commercial parking lot near residential areas at 91 Avenue	View from residential complex directly north of the proposed 152 Street Station
3-C	**Figure 16-13**	Looking southwest from 152 Street near Mr. Lube and Surrey Fire Service Hall 6	View from residential areas near 152 Street and north of Frasier Highway
4-A	**Figure 16-15**	Looking southeast from Fraser Highway (westbound) near 158 Street	View from residential townhomes directly north of the elevated guideway
4-B	**Figure 16-16**	Looking northwest from Fraser Highway (eastbound) near 159 Street	View from residential townhomes south of FH
5-A	**Figure 16-18**	Looking southeast from Fraser Highway (westbound) near PPS-176	View from nearby publicly accessible area east of Serpentine River
6-A	**Figure 16-20**	Looking north from Old Yale Road (west end) near Fraser Highway (eastbound)	View from a public urban trail and residential townhomes south of FH
6-B	**Figure 16-21**	Looking north from Old Yale Road (east end) near Fraser Highway	View from a public urban trail and residential townhomes south of FH
6-C	**Figure 16-22**	Looking east from Old Yale Road (east end) near Fraser Highway	View from public urban trail and residential townhomes south of FH
6-D	**Figure 16-23**	Looking west from 108 Street near Fraser Highway	View from residential areas north of FH
7-A	**Figure 16-25**	Looking east from Fraser Highway (eastbound) west of 184 Street	View from residential areas south of FH
7-B	**Figure 16-26**	Looking west from 184 Street near Fraser Highway (westbound)	View from residential townhomes north of FH and adjacent to an urban trail south of FH
7-C	**Figure 16-27**	Looking north from 184 Street (northbound) south of Fraser Highway	View from residential areas south of FH

Viewpoint Identified	Figure	Description	Rationale for Viewpoint Selection
8-A	**Figure 16-29**	Looking east from Fraser Highway near an urban trail	View from residential areas and urban trail south of FH
9-A	**Figure 16-31**	Looking east from Fraser Highway (eastbound) northwest of 64 Avenue intersection	View from residential townhome complex
9-B	**Figure 16-32**	Looking east from Fraser Highway (eastbound) southeast of 64 Avenue intersection	View to residential areas from a bus stop
10-A	**Figure 16-34**	Looking east from Fraser Highway (eastbound) east of 196 Street	Views from residential apartment complex
11-A	**Figure 16-36**	Looking southeast from Industrial Avenue (eastbound) at the 203 Street intersection	Views from residential building
11-B	**Figure 16-37**	Looking northwest from proposed 203 Street station at Industrial Avenue intersection	Views from the proposed station entrance/exit

16.2.3 Methodology for Assessing Change to the Visual Landscape

The Project RCD Workbook was the key technical reference document used for developing the two-dimensional plans and elevation line work. This and other information sources were used to characterize existing (baseline) visual landscape information and details (see **Section 16.2**). Once the Project team verified the 3D models, renderings were developed to depict the Project superimposed on the existing visual landscape. Digital data from the RCD renderings and layout were used to model change from existing conditions.

Renderings were developed for study locations and viewpoints as follows:

- The 3D models were verified to fully coincide with computer-aided drawings before initiating the view assessment;
- Two-dimensional linework of the Project was overlaid onto orthographic images of Google Earth to geo-reference the proposed physical locations and identify the Project's alignment; and
- 3D models of stations and guideways[68] were referenced to the accuracy of the RCD Workbook's plans and elevations with its length, width, height, site layout, and massing.
- The reference materials guided the accuracy of digital renderings by superimposing the proposed structure on the existing conditions' street-level photographs, using graphic visualization software (Adobe Photoshop).

16.3 Results

Photographs of existing conditions and renderings of Project infrastructure as per the RCD are presented for Location 1 to Location 11 in a series of figures (**Figure 16-2** through **Figure 16-36**) A plan view of each study location is then followed by street-level photos of existing conditions and renderings of proposed conditions.

[68] Subsequent to modelling of the guideway, BCRTC indicated a requirement for fall protection to be installed along the entire length of guideway, similar to existing fall protection along portions of the existing SkyTrain system (e.g., near stations). The fall protection is not imaged in the renderings.

16.3.1 Location 1: 140 Street Station and Viewpoints

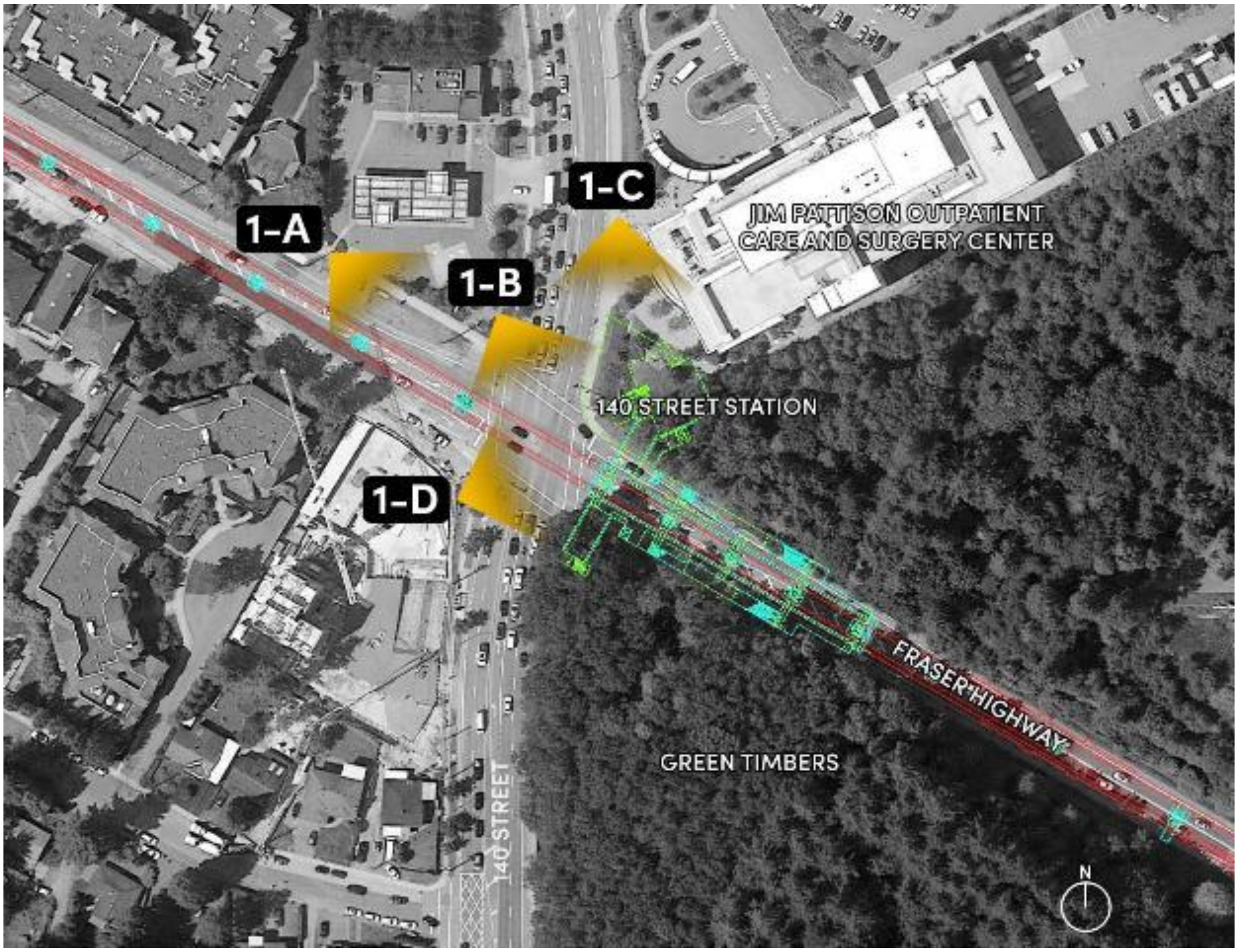

Figure 16-2 Location 1: 140 Street Station and Viewpoints

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-3 Viewpoint 1-A: Representation of 140 Street Station Looking Southeast from Fraser Highway

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-4 Viewpoint 1-B: Representation of 140 Street Station Looking Southeast at 140 Street and Fraser Highway

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-5 Viewpoint 1-C: Representation of 140 Street Station Looking South at 140 Street Near the JPOCSC

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-6 Viewpoint 1-D: Representation of 140 Street Station Looking East at 140 Street and Fraser Highway

16.3.2 Location 2: Guideway along Fraser Highway and viewpoints

Figure 16-7 Location 2: Guideway Along Fraser Highway in the GTUF Showing Viewpoints

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-8 Viewpoint 2-A: Representation of Guideway Looking North Along Fraser Highway Near 96 Avenue

Existing Conditions

Project Conditions

Notes: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-9 Viewpoint 2-B: Representation of Guideway Looking West from the GTUF Trail

16.3.3 Location 3: 152 Street Station and Viewpoints

Figure 16-10 Location 3: 152 Street Station Showing Viewpoints

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-11 Viewpoint 3-A: Representation of 152 Street Station Looking East Along Fraser Highway

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles tentative for relocated.

Figure 16-12 Viewpoint 3-B: Representation of 152 Street Station Looking West Near Residential Properties

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-13 Viewpoint 3-C: Representation of 152 Street Station Looking South Along 152 Street

16.3.4 Location 4: Guideway along Fraser Highway near 158 Street and Viewpoints

Figure 16-14 Location 4: Guideway Along Fraser Highway near 158 Street Showing Viewpoints

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-15 Viewpoint 4-A: Representation of Guideway Looking Southwest from 158 Street and Fraser Highway

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-16 Viewpoint 4-B: Representation of Guideway Looking Northeast from 159 Street and Fraser Highway

16.3.5 Location 5: Guideway at Fraser Highway Near Serpentine River and Viewpoints

Figure 16-17 Location 5: Representation of Guideway at Fraser Highway near Serpentine River Showing Viewpoint

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-18 Viewpoint 5-A: Representation of Guideway Looking Southwest Along Fraser Highway near the Serpentine River Bridge

16.3.6 Location 6: Guideway at Fraser Highway and Viewpoints

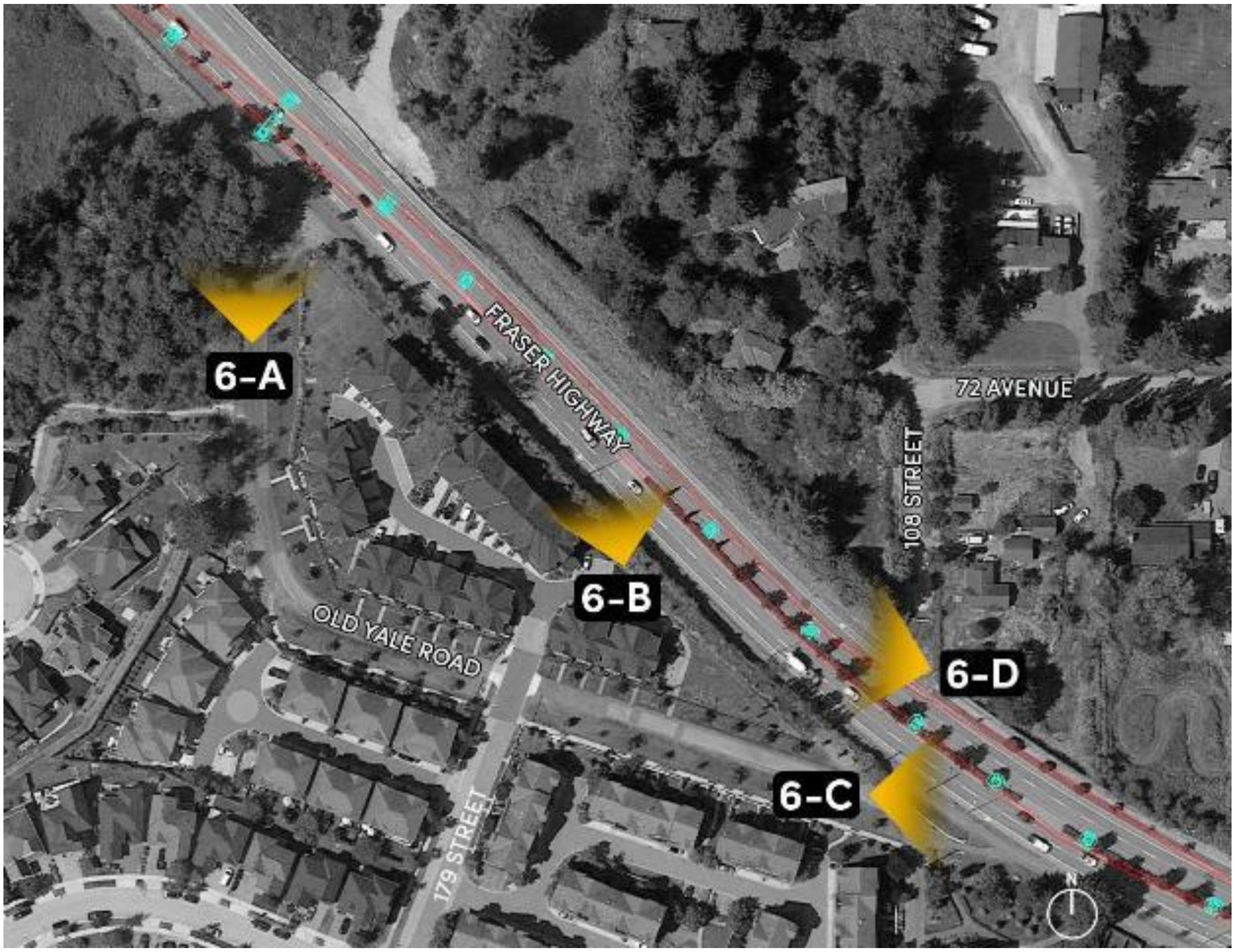

Figure 16-19 Location 6: Guideway at Fraser Highway Showing Viewpoint

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-20 Viewpoint 6-A: Representation of Guideway Looking North Along Old Yale Road near Fraser Highway

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-21 Viewpoint 6-B: Representation of Guideway Looking Northwest Old Yale Road and Fraser Highway

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-22 Viewpoint 6-C: Representation of Guideway Looking East along Old Yale Road and Fraser Highway

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-23 Viewpoint 6-D: Representation of Guideway Looking West Along Fraser Highway near 108 Street

16.3.7 Location 7: 184 Street Station at Fraser Highway and Viewpoints

Figure 16-24 Location 7: 184 Street Station at Fraser Highway Showing Viewpoint

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-25 Viewpoint 7-A: Representation of Guideway Looking Northeast Along 184 Street and Fraser Highway

Existing Conditions

Project Conditions

Note: Proposed roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-26 Viewpoint 7-B: Representation of Guideway Looking West Along 184 Street and Fraser Highway

Existing Conditions

Project Conditions

Note: Proposed roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-27 Viewpoint 7-C: Representation of Guideway Looking North Along 184 Street and Fraser Highway

16.3.8 Location 8: 190 Street Station at Fraser Highway and Viewpoints

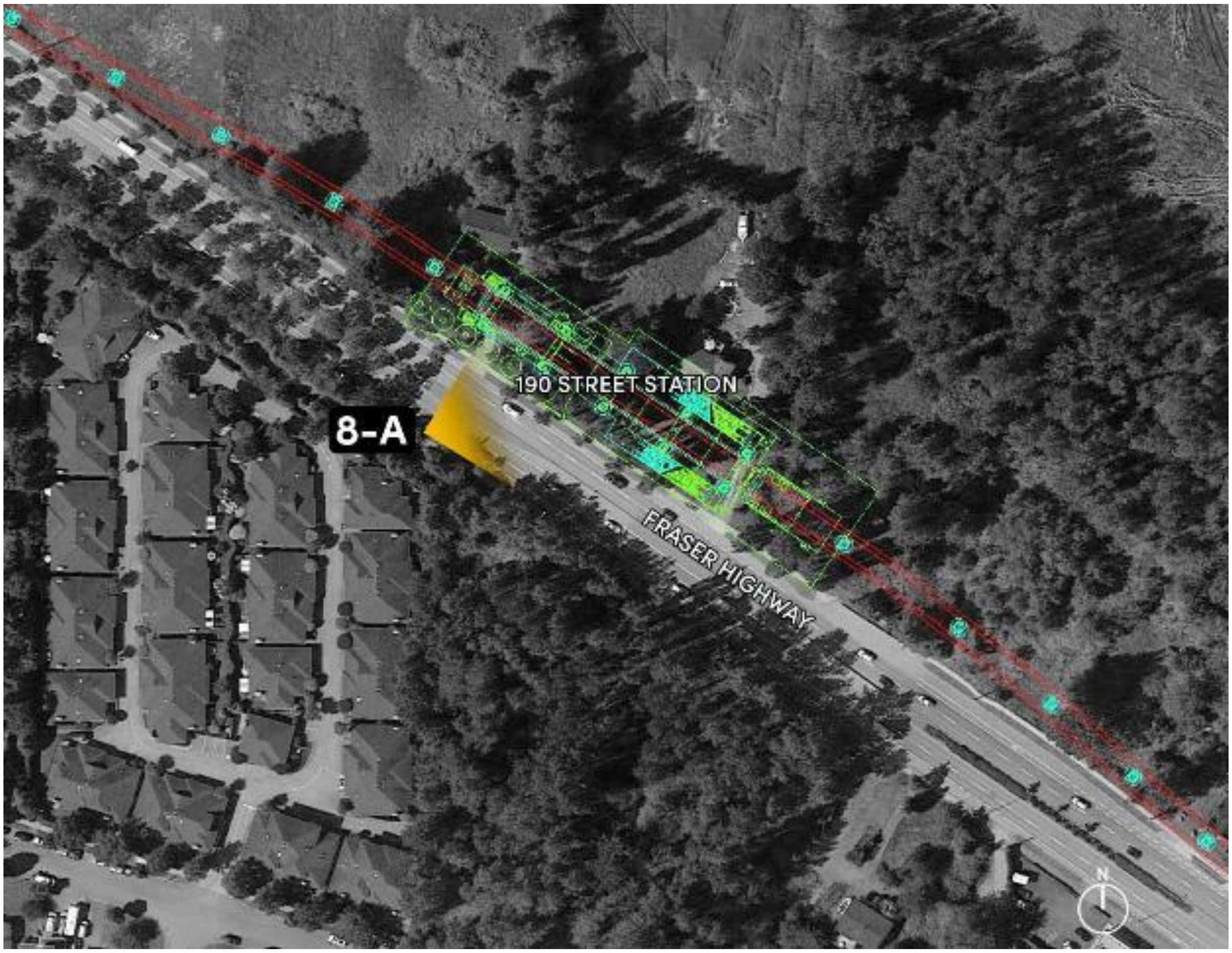

Figure 16-28 Location 8: 190 Street Station at Fraser Highway Showing Viewpoint

Existing Conditions

Project Conditions

Note: Proposed roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-29 Viewpoint 8-A: Representation of 190 Street Station Looking East Along Fraser Highway

16.3.9 Location 9: Guideway at Fraser Highway near 64 Avenue and Viewpoints

Figure 16-30 Location 9: Guideway at Fraser Highway near 64 Avenue Showing Viewpoint

Existing Conditions

Project Conditions

Note: Proposed roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-31 Viewpoint 9-A: Representation of Guideway Looking Southeast along Fraser Highway West of 64 Avenue Intersection

Existing Conditions

Project Conditions

Note: Proposed roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-32 Viewpoint 9-B: Representation of Guideway Looking East Along Fraser Highway East of 64 Avenue Intersection

16.3.10 Location 10: 196 Street Station and Viewpoints

Figure 16-33 Location 10: 196 Street Station Showing Viewpoint

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-34 Viewpoint 10-A: Representation of 196 Street Station Looking Southeast Near 196 Street

16.3.11 Location 11: 203 Street Station and Viewpoints

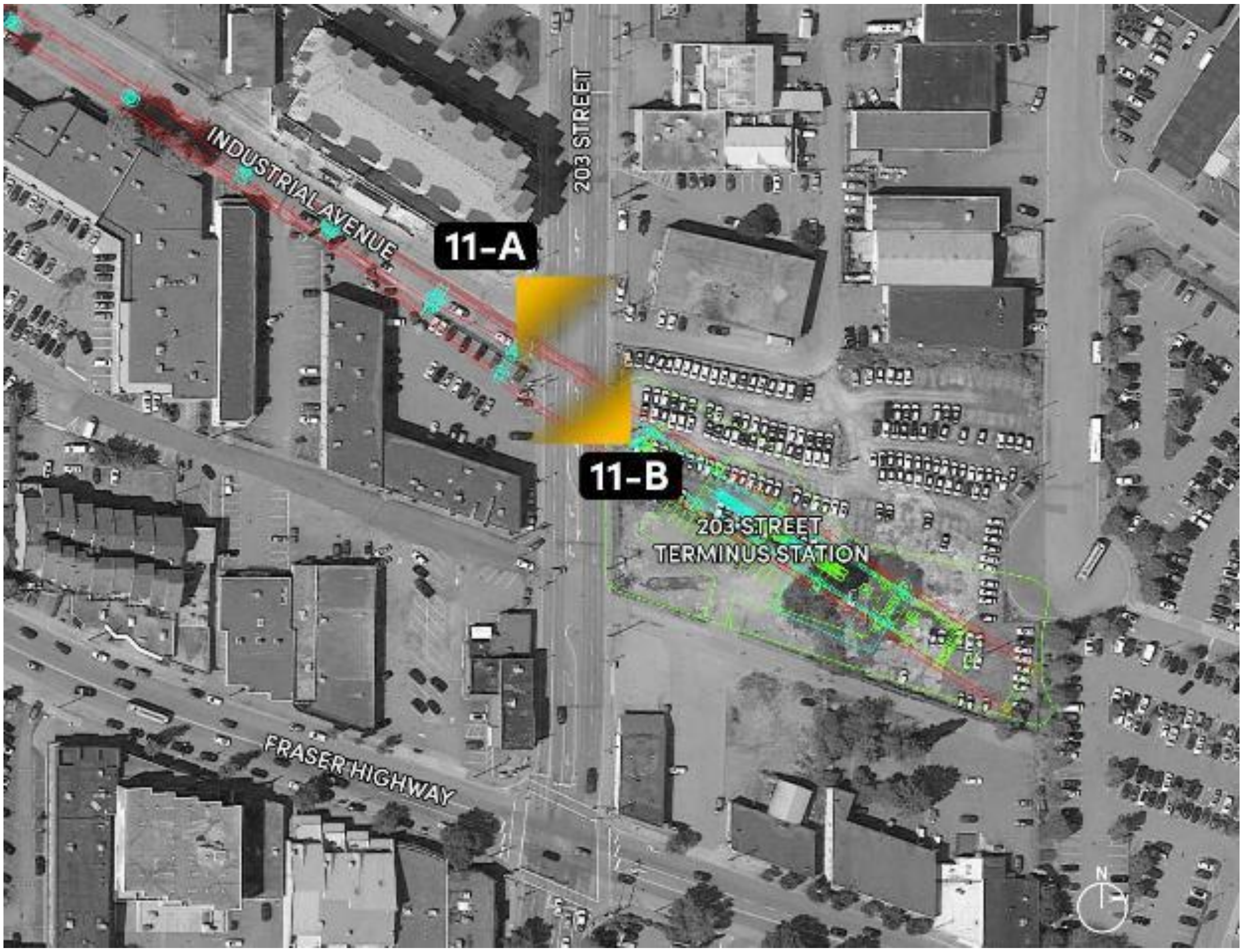

Figure 16-34 Location 11: 203 Street Station Showing Viewpoints

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-35 Viewpoint 11-A: Representation of 203 Street Station Looking Southwest at 203 Street and Industrial Avenue

Existing Conditions

Project Conditions

Note: Future roadway and sidewalk design are not shown in graphics. Existing utility poles may be relocated.

Figure 16-36 Viewpoint 11-B: Representation of 203 Street Terminus Station Looking Northeast at 203 Street and Industrial Avenue

16.4 Project Interactions

Table 16-6 summarizes potential interactions between permanent Project infrastructure and the visual landscape. The single effect (Change in views) has been further refined in the table to address identified Review Indicators. While visual impacts may occur during the Project's construction phase, they will be temporary and are not considered in this review.

Table 16-6 Project Potential Interactions with Visual Landscape

Project Components	Changes in views
SkyTrain Stations	✓
Overhead SkyTrain guideway and associated support columns	✓
PPS (standalone)	✓

Note:

Interaction Rating:

✓ **Interaction**: interaction that will likely require additional mitigation; carried forward and discussed in subsequent sections.

16.5 Mitigation Measures

This section presents mitigation measures recommended to minimize or integrate the Project's visual effects to views in surrounding communities, residential neighbourhoods, and public areas. Mitigation measures are sub-divided into two categories to address the stations and the guideway, which comprise the Project's major physical components. Mitigation is also categorized according to the stage of Project development. For the VLA, the two relevant stages for implementing mitigation are during design (denoted as "D") and operation (denoted as "O").

Where applicable, content from this section will be incorporated into the Project's CEMP Framework (see the TOR for an additional description of this document). As its name implies, the Framework document will provide detailed guidance for the content of the Project Co's CEMP. In addition to mitigation and performance objectives, the CEMP Framework will describe best practices intended to meet the performance objectives and required content for each sub-plan. The CEMP Framework will also include details on roles and responsibilities for Project Co's key team members.

16.5.1 Design Mitigation Measures

Mitigation 16.D-1 Use Contemporary, high-quality, durable materials

Where applicable, the use of durable, high-quality, and low-maintenance materials in SkyTrain station construction and finishing surfaces may provide attractive visual assets for the surrounding community. Moreover, the use of robust design standards and contemporary and proportionate materials, where feasible, to construct the stations may mitigate potential visual effects of the new infrastructure on the character of the adjacent neighbourhood, (**Figure 16-37**).

Thoughtful use of high-quality materials such as timber, glass, metal, and concrete in a design that corresponds with the surrounding neighbourhood's scale and character can help create a positive perception of new SkyTrain stations and related infrastructure.

Figure 16-37 Following Established Precedents – Using Durable, High-quality, Low-maintenance Materials for Lincoln Station, Coquitlam, BC

Mitigation 16.D-2 Integrate and enhance public realms in station design

Incorporating public spaces and streetscapes into station design will help to integrate new infrastructure into the fabric of the surrounding community. Spaces to gather, socialize and engage in other forms of passive recreation should be incorporated, where possible, to offer social and aesthetic benefits. For example, the 140 Street Station will be located at the westernmost entry and exit point of the GTUF; therefore, the station's plaza should consider the context of this natural area.

In addition, selecting surface materials and furnishings that are visually interesting and textured, that complement one other, and include a cohesive palette of colours and textures, can also help to create an identifiable, lively sense of place that invites action and community connection (**Figure 16-38**). First Nations and public art in plaza areas can enhance the station's sense of community and local identity.

Elements of placemaking may include integrating culture, history, and nature into the site by selecting materials, furnishings, and public art. In the above image, the site's proximity to the Fraser River is reflected in the water feature and integrated fish cut-outs as paving accents.

Figure 16-38 Following Established Precedents – Interactive Plaza Space at Marine Gateway, Vancouver, BC

Mitigation 16.D-3 Design publicly accessible areas for safety and wayfinding

Open areas or plazas that are attractive not only helps to create a sense of community, but also enhances safety by providing clear sight lines at SkyTrain stations to the street from multiple vantage points. Appropriate lighting and open sightlines create a safe and welcoming experience in public spaces, both during the day and at night. In terms of wayfinding and accessibility, different station elements can also provide effective levels of hierarchy and directionality to guide pedestrians and improve flow. Consideration of sightlines is also important to ensure privacy in adjacent residential areas through visual screening and careful design. By incorporating features at the relevant locations - such as pavement typologies and markings, signage, integrated public art, First Nations cultural recognition, and combinations of stairs and ramps, collectively - the station design can help guide and accommodate people of all ages and abilities (**Figure 16-39**).

Cohesive with the architectural intent, adding legible pavement markings surrounding the SkyTrain station can help guide people to their intended destinations such as commercial establishments, civic facilities, public parks, and residential neighbourhoods.

Figure 16-39 Following Established Precedents – Paving Patterns at Lincoln Station, Coquitlam, BC

Mitigation 16.D-4 Add visual interest and buffering elements around built structures

Where space is available and clearance requirements are met, vegetative elements, such as trees or shrubs, as well as First Nations and public art helps to soften the visual effect of highly visible and expansive SkyTrain station walls (**Figure 16-40**).

Using existing trees helps to visually buffer one side of the station as shown in the image above. The new planting bed and added vegetation help soften the look of the station's building edges.

Figure 16-40 Following Established Precedents – Using Existing Trees and Planting Additional Vegetation Around Coquitlam Central Station, Coquitlam, BC

Mitigation 16.D-5 Preserve views to natural landforms and public landmarks

Designing stations to preserve existing view corridors from SkyTrain platforms to regional landmarks or natural landscapes (e.g., North Shore mountains, Coast Mountain Ranges, and Mount Baker) can maintain connections with a community's natural features (**Figure 16-41**).

Maintaining views from station platform levels provides regional context and strengthens the station's sense of place.

Figure 16-41 Following Established Precedents – North Shore Mountain Views from Renfrew SkyTrain Station, Burnaby, BC

Mitigation 16.D-6 Add visual buffering elements adjacent to residential areas

Protecting and preserving existing trees and planting new trees along roadways and boulevards or in nearby open spaces, can help to buffer views of elevated guideways and infrastructure from the street level and neighbouring residential areas and maintain privacy, where needed. The incorporation of First Nations and public art motifs into guideway structures adds visual interest to guideway infrastructure.

Protecting and preserving existing trees along the guideway and planting new trees where possible will help buffer the view of the guideway infrastructure from street level and neighbouring residential areas.

Figure 16-42 Following Established Precedents – Tree Buffers Along the Guideway Near Joyce-Collingwood SkyTrain Station, Vancouver, BC

Mitigation 16.D-7 Integrate visual buffering elements adjacent to public parks and greenways

Using existing trees and green spaces and planting additional trees, shrubs, and natural plants helps to soften the appearance of elevated guideways and PPS and retain buffer zones. Other visual elements, such as motifs imprinted on guideway columns, can provide a sense of place, community identity and add interest. In addition, establishing buffer zones around the Project facilitates the planting of additional trees. A detailed review of this option is recommended, including discussions with the three municipalities (**Figure 16-43**).

Opportunities exist to install planting beds or vertical vegetative screens around the SkyTrain's guideway columns.

Figure 16-43 Following Established Precedents – Vegetation integrated with support columns Near Aberdeen Station, Richmond, BC

Mitigation 16.D-8 Preserve and reinforce visual buffering elements adjacent to natural forested areas

Where possible, retaining trees in spaces around the guideway and stations, and within public areas will help to buffer the visual impact of the elevated guideway and PPS. Existing trees that need to be removed will be replaced in accordance with arborist recommendations and with municipal input (see Mitigation **M11.C-2** in **Section 11** Vegetation and Wildlife Resources).

Mitigation 16.D-9 Preserve views to natural landforms and public landmarks

Where possible, preserving existing views to natural landforms and public landmarks will help to mitigate the visual effects of elevated guideways and provide opportunities for new scenic viewpoints for SkyTrain passengers. Elevated guideways offer unique viewing opportunities to mountains to the north (e.g., the Garibaldi Range), south (e.g., Mount Baker), and other natural and man-made regional landmarks (**Figure 16-44**). It is important to ensure that any recommended buffering elements do not impede these views.

The SkyTrain guideway provides unobstructed views of the North Shore mountains.

Figure 16-44 Following Established Precedents – Guideway Views to the North Shore Mountains

16.5.2 Operation Mitigation Measures

Mitigation 16.O-1 Maintain aesthetics and visual buffering elements at stations and along the guideway

As is current practice for the SkyTrain system, regular cleaning and maintenance of stations supports a positive site aesthetic. Frequent maintenance, such as custodial cleaning, litter and graffiti removal around the stations, and regular upkeep for all vegetative buffers will promote a positive visual experience at new stations during their operation.

Trees planted as visual buffering elements may grow to obstruct station elements and consequently interfere with wayfinding, views to natural landforms and SkyTrain station safety and operation. As such, regular maintenance of plantings is recommended to prevent overgrowth within station and plaza areas, and to ensure public and operational safety (in line with TransLink's standards for the existing system) while promoting the enjoyment of the surrounding landscape. Routine assessments for hazard trees along the guideway, and selection of tree species that conform with arborist prescriptions for height and site suitability should limit maintenance requirements and service disruptions due to track intrusions (see Mitigation **M11.C-2** in **Section 11** Vegetation and Wildlife Resources).

16.5.3 Summary of Proposed Mitigation

The mitigation measures recommended in this assessment will help to integrate the new SkyTrain stations and guideway infrastructure into surrounding neighbourhoods while creating safe, welcoming public spaces that may be enjoyed year-round. **Table 16-7** summarizes recommended mitigation measures for each Review Indicator.

Table 16-7 Summary of Potential Project Effects and Mitigation Measures for Visual Landscape

Potential Effect	Mitigation Number	Mitigation Measure	Project Phase	Environmental Management
Design Mitigation Measures to SkyTrain Stations				
Change to Views (Effects of new stations from residential, civic, institutional public areas)	M16.D-1	Use contemporary, high-quality, and durable materials	Design	Design Criteria
	M16.D-2	Integrate public realm in station design		
	M16.D-3	Design publicly accessible areas for safety and wayfinding		
	M16.D-4	Add visual buffering elements around built structures		
	M16.D-5	Preserve views to natural landforms and public landmarks		

Potential Effect	Mitigation Number	Mitigation Measure	Project Phase	Environmental Management
Design Mitigation Measures to the Elevated Guideway and PPS				
Changes to Views (Effects of guideway from residential, civic, institutional and public areas)	M16.D-6	Add visual buffering elements adjacent to residential areas	Design	Design Criteria
	M16.D-7	Add visual buffering elements adjacent to public parks and plaza areas (guideway and standalone PPS)		
	M16.D-8	Add visual buffering elements adjacent to natural areas (guideway and standalone PPS)		
	M16.D-9	Preserve views to natural landforms and public landmarks along guideway		
Operational Mitigation Measures for the Stations and the Guideway				
Changes to Views (Potential decline in visual value)	M16.O-1	Regularly clean and maintain stations. Regularly maintain vegetation and additional visual buffering elements along the guideway and at stations.	Operation	Existing TransLink Procedures

16.6 Discussion

A total of 11 study locations (see **Figure 16-1** and **Table 16-4**) were selected to visually characterize existing and future conditions on the alignment. The study locations are intended to be representative of similar site contexts along the alignment so that recommended mitigation can be applied broadly in typical situations.

The VLA predicts that the Project will directly affect views from residential neighbourhoods, civic and institutional establishments, and public spaces. The mitigation measures described in **Section 16.5** provide options that can be incorporated into the Project scope to minimize the effects.

The following discussion items outline the changes to views for each Review Indicator. The representative study locations were used to develop mitigation measures for visual landscape impacts that would be applicable throughout the Project alignment.

16.6.1 Changes to Views from Residential Neighbourhoods

16.6.1.1 Views Changed by Presence of Skytrain Stations

SkyTrain stations may be built in various site conditions and in differing topography. Where stations will be located within residential neighbourhoods, there may be changes to surrounding views and conditions or that impact privacy; or changes to views to natural landforms.

In locations where a SkyTrain station is designed and built to the minimum required height, there may be some impacts on residential privacy. To the extent feasible, this effect has been addressed in the RCD and will be a key consideration as design progresses. When a station will be taller than the adjacent residential areas, vegetation buffers could be used to minimize visual and privacy impacts. Planting additional trees, adding other visual barriers, and installing public and First Nations art, could help to further buffer these areas and preserve privacy (see Mitigation M16.D-4). Wherever possible, the design and orientation of the stations should encourage the preservation of views of Mount Baker, Garibaldi Range, and North Shore Mountains from residential areas (see Mitigation M16.D-5). The use of contemporary materials would increase the visual value of the stations, adding to the aesthetic from adjacent residential areas (see Mitigation M16.D-1). Wherever possible, trees requiring removal should be replaced to provide a visual buffer from residential sightlines (see Mitigation M16.D-8).

Operational mitigation measures at stations will preserve the positive effects to the views from residential or public areas. Regular maintenance, such as cleaning, will retain the intended visual appearance of the station as will annual upkeep of vegetative buffers. Vegetation pruning should be considered as needed preserve views to natural landforms (see Mitigation M16.O-1).

16.6.1.2 Views Changed by Presence of the Guideway and Support Columns

In some residential areas, the elevated guideway may affect privacy or existing views to natural landforms. To the extent feasible, this effect has been addressed in the RCD and will be a key consideration as design progresses. Street trees, vegetative buffers, and First Nations and public art could be used to provide aesthetic treatments along the guideway and as visual buffers for residences (see Mitigation M16.D-6). Where support columns are directly adjacent to residential areas, the design should consider visual buffers, such as larger trees and vegetative screens, if sufficient space exists to align with BCRTC vegetation management requirements (see **Section 18.6**). Additional visual buffers or aesthetic treatments of columns can minimize the appearance of guideway support columns from residential areas (see Mitigation M16.D-7).

Where possible, sightlines to any natural landforms should be protected and the vegetative buffers that mitigate visual privacy concerns should not obstruct existing views. Therefore, site planning and landscape design should be considered when implementing mitigation measures for privacy and landform view preservation. In addition, the Project design can consider a clear sightline along the guideway segments that cross over major north-south arterial roads (see Mitigation M16.D-9).

16.6.2 Changes to Views from Civic and Institutional Establishments

16.6.2.1 Views Changed by Presence of Skytrain Stations

Design at stations should visually connect the station with the context of the surrounding area. The station plazas will be visible from high-circulation areas, such as the station entry and publicly accessed roadways and paths. Design of station plazas present significant opportunities to reflect the area’s cultural, historical or natural context (see Mitigation M16.D-2). Intuitive wayfinding should be designed to help pedestrians safely navigate to nearby destinations and transit exchanges (see Mitigation M16.D-3).

16.6.3 Changes to Views from Public Spaces

16.6.3.1 Views Changed by Presence of Skytrain Stations

Several stations are located along Fraser Highway with existing commercial areas that experience high volumes of car and foot traffic. Stations are expected to constitute a key aesthetic focus for these commercial areas and provide opportunities to introduce user-friendly wayfinding in the surrounding plazas (see Mitigation M16.D-3). Visual clarity around the stations will help users to navigate through these spaces and promote pedestrian safety. Where public plazas may be visible from nearby residential areas, planting additional trees and public art could help to buffer these areas and preserve resident privacy (see Mitigation M16.D-6).

16.6.3.2 Views Changed by Presence of the Guideway and Support Columns

The alignment along Fraser Highway transitions between the north, median, and south sides of the existing roadway. Some of the elevated guideway and support columns will be visible in public areas, such as from GTUF trails Serpentine Valley, and adjacent MUPs.

Where possible, sightlines to existing vegetation should be protected, and additional vegetative buffers should avoid obstructing existing views to the natural landforms, to the extent possible. In addition, detailed design could consider a clear sightline along the guideway segments that cross over major north-south arterial roads (see Mitigation M16.D-9). Additional visual buffers can help to soften the appearance of the guideway support columns viewed from greenways and MUPs (see Mitigation M16.D-7). Where vegetative buffers are proposed and retained, routine pruning, and tree maintenance is recommended to preserve views to the natural landforms (see Mitigation M16.O-1).

16.6.3.3 Views Changed by Presence of Standalone PPS Structures

The proposed PPS-96 and PPS-176 will be standalone electrical structures located in the municipal ROW. However, their locations adjacent to GTUF and in the Serpentine Valley may impact views of green spaces due to the required siting, width, length, and height for these structures. Design and operational mitigations are recommended to integrate the structures into the natural landscapes of the surrounding public areas. Replacing trees, adding plantings and other visual treatments following PPS construction would provide a visual buffer between the structure and the adjacent greenways and MUPs (see Mitigation M16.D-7 and Mitigation M16.D-8). Regular maintenance of PPS-96 and PPS-176 is recommended to keep the structures and surrounding areas clear of graffiti and litter (see Mitigation M16.O-1).

16.7 Conclusions

The Project will result in changed views from some residential neighbourhoods, civic and institutional establishments, and public spaces. The study locations used in this VLA are representative of different land uses and visual contexts, and the proposed mitigation measures are applicable along the alignment at relevant locations. Potential Project-related effects on views include:

- Changes to views at most station locations are expected to affect sightlines from residential, institutional and / or public areas. Project design should consider key recommended mitigation measures, such as use of contemporary and high-quality materials for stations, integrating the public realm of stations, intelligent use of wayfinding and adding visual buffering such as vegetation;
- Changes to views from residential areas due to the presence of the guideway, support columns and standalone PPS call for mitigation to improve surrounding visual quality and maintain privacy. Where these structures are proximal to residential receptors (e.g., 25 m or less), the Project design should incorporate key measures (such as vegetative or other visual barriers) to the extent feasible; and
- Changes to views due to the standalone PPS at 96 Avenue (adjacent to GTUF) will result in a substantial change to the existing natural landscape so the design for this facility should consider visual buffers that integrate with the surrounding native vegetation.

The recommended mitigation measures should be applied, based on site-specific contexts, to integrate Project infrastructure into the surrounding community. Based on the approach outlined above, the recommended mitigation measures will help to balance visual landscape effects with aesthetic contributions. Through detailed design, measures should be considered that preserve views of the natural landforms, buffer views of structures and offer additional visual buffering for areas where privacy is affected. **Table 16-8** summarizes potential effects remaining after the application of mitigation measures.

Many of the recommended measures are already in place on existing SkyTrain infrastructure. If well-designed, well-integrated, and regularly maintained, the Project can contribute positive visual benefits to sensitive receptors. Therefore, the overall impact of change to the visual landscape is anticipated to be low.

Table 16-8 Potential Effects Remaining After Mitigation for Visual Landscape Assessment

Potential Effect	Criterion	Rating	Rationale for Rating
Changes to Views from Residential Neighbourhoods	Magnitude[1]	Low	Some residential areas adjacent to stations and guideway structures are affected, particularly at locations with direct views to Project infrastructure. Changes of views to surrounding natural landforms would be minor.
	Geographic Extent	Low	Visual impacts from nearby residential areas will be limited to line of sight. While study locations are selected as representative sites of this visual assessment, views from most residences in nearby communities outside the Project footprint will be unaffected.
	Duration[2]	Permanent	This SE focuses on the Project's permanent built structure. Therefore, the changes in views will be permanent.
	Frequency	Continuous	
	Reversibility	Permanent	
Changes to Views from Civic and Institutional Sites	Magnitude[1]	Low	Changes in views from civic and institutional establishments to surrounding natural landforms are minimal.
	Geographic Extent	Low	Visual impacts from civic and institutional establishments will be limited to line of sight. While study locations are selected as VLA representative sites, most nearby establishments outside the Project footprint will be unaffected with the view changes.
	Duration[2]	Permanent	This SE focuses on the Project's permanent built structure. Therefore, the changes in views will be permanent.
	Frequency	Continuous	
	Reversibility	Permanent	

<table>
<tr><th>Potential Effect</th><th>Criterion</th><th>Rating</th><th>Rationale for Rating</th></tr>
<tr><td rowspan="5">Changes to Views from Public Spaces</td><td>Magnitude[1]</td><td>Moderate</td><td>Changes in views from public areas with line of sight to Project infrastructure, particularly in publicly accessible trails and paths, is moderate. Where applicable, additional visual buffers are recommended to minimize impacts to views.</td></tr>
<tr><td>Geographic Extent</td><td>Moderate</td><td>Some public areas, such as GTUF and the MUP in the Serpentine Valley, will have views and lines of sight affected by the elevated infrastructure. While study locations are selected as VLA representative sites, the majority of the nearby public areas outside the Project footprint will be unaffected with the view changes.</td></tr>
<tr><td>Duration[2]</td><td>Permanent</td><td rowspan="3">This SE focuses on the Project’s permanent built structure. Therefore, the changes in views will be permanent.</td></tr>
<tr><td>Frequency</td><td>Continuous</td></tr>
<tr><td>Reversibility</td><td>Permanent</td></tr>
</table>

Notes:

1. Magnitude may be defined as negligible (undetectable or unmeasurable), low (detectable within standards), moderate (detectable approaching exceedance, and high (exceedance of criteria or threshold). Generally, magnitude is measured in terms of the proportion of the SE affected within the assessment area (for biophysical SE), or the degree within the interaction area relative to the range of natural or historic (in the case of human environment SE) variation.
2. The duration of an effect may be short-term (i.e., within the construction phase), medium term (i.e., the length of the construction phase), long-term (i.e., extending into the operation phase), or very long-term (permanent) (i.e., extending past the life of the Project).

17 Environmental Management during Construction

17.1 Introduction

This section describes the approach to environmental management during Project construction to mitigate effects, as identified in the ESR, on the natural, built, and social environment in the vicinity of the SLS. Environmental management for construction must consider how the Project will be procured and delivered. The plan for procurement involves multiple contracts consisting of a three-way scope split for guideway, stations, and systems and trackwork. During procurement, the CEMP Framework and the DBSS (Government of BC 2019c) will provide key guidance to prospective bidders on the environmental management requirements. Each of the three successful proponents, (Project Co) will be responsible for the design, construction, testing, and commissioning of their respective contracts.

This section considers the regulatory and policy context for environmental management and provides an overview of the CEMP Framework that will support the Project's compliance with environmental requirements. This Framework will be a key instrument in environmental management and will form a portion of Project requirements. As its name implies, the CEMP Framework will guide the minimum content for Project Co's CEMP. **Figure 17-1** illustrates the progression of environmental management from the ESR to the CEMP.

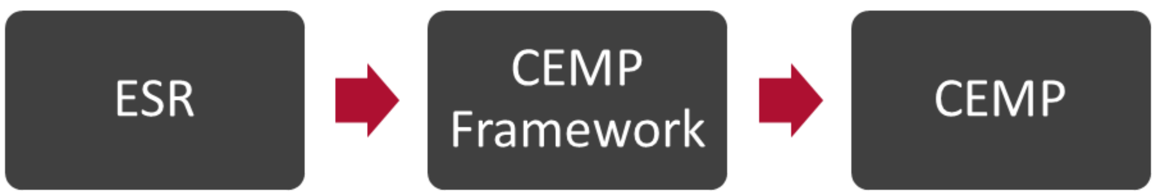

Figure 17-1 Construction Environmental Management flow chart

17.2 Project Interactions with Screening Elements

The ESR evaluates interactions that could occur between each SE and Project activities or physical works – summarized in **Table 17-1** - and where these interactions likely require additional mitigation. The following sections discuss the approach to environmental management during Project planning, design, and construction and where each interaction will be addressed in a CEMP component plan.

Table 17-1 Summary of Interactions Between Screening Elements and Project Construction

Project Activities and Physical Works	Air Quality and Greenhouse Gases (GHG)	Noise and Vibration	Contaminated Sites	Fisheries and Aquatics	Vegetation and Wildlife Resources	Archaeology and Heritage	Agricultural Land	Land Use	Transportation and Access	Visual Landscape[1]
Clearing and grubbing	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
Property acquisition, including demolition of inert building materials	✓	✓	✓	-	✓	o	✓	✓	o	-
Relocation of overhead BC Hydro transmission lines	✓	✓	-	-	-	o	-	✓	✓	-
Utility installation/relocation	✓	✓	✓	o	o	✓	✓	✓	✓	-
Use of temporary laydown areas	-	o	-	o	o	✓	✓	✓	o	-
Access and traffic management	o	o	-	-	o	-	-	✓	✓	-
Roadwork widening (select locations)	✓	✓	o	o	o	✓	o	✓	✓	-
Drainage realignment (select locations)	✓	✓	o	✓	o	✓	✓	✓	o	-
Installation of SkyTrain guideway foundations	✓	✓	✓	o	✓	✓	✓	✓	✓	✓
Installation of overhead SkyTrain guideway	✓	✓	-	-	✓	-	✓	✓	✓	✓
Stations (foundations, structure, lighting, access, service connections, security)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Power propulsion substations	✓	✓	✓	-	✓	✓	✓	✓	✓	-
Management of non-contaminated excavated material, including excavation	✓	✓	-	o	✓	✓	✓	✓	o	-
Management of contaminated or hazardous materials	✓	✓	✓	o	✓	✓	✓	o	o	-
Testing, commissioning, and start-up	o	o	-	-	-	-	-	o	-	-
Operating and/or fuelling heavy equipment during construction activities	✓	✓	o	-	-	-	-	-	-	-

Notes:

– **No Interaction:** Interaction between a Project component and the SE is unlikely.

○ **Minor Interaction:** Effects may result from an interaction, but standard measures to avoid or minimize the effects are available and understood to be effective, and any residual effects would be reduced to negligible.

✓ **Interaction:** Interaction occurs and likely requires additional mitigation.

[1] Visual and shading assessment only covers presence of completed Project, not construction effects

17.3 Linkage between Interactions and CEMP Component Plans

Based on the interactions identified in **Table 17-1,** environmental guidance documents (e.g., DBSS), professional experience with other transportation projects in BC and the scope defined in the ESR's TOR, **Table 17-2** identifies the key considerations for environmental management planning during construction for each Project activity and physical work. Mitigation for each of these key considerations should be detailed in the applicable component plan of Project Co's CEMP.

Table 17-2 Environmental Management Considerations for Project Construction

Project Activities and Physical Works	Key Considerations for Construction Environmental Management												
	Agricultural lands	Air quality and dust control	Archaeology and heritage	Hazardous and waste management	Construction Water Management	Contaminated Site	Erosion and sediment control	Fish and fish habitat	Noise, lighting and vibration control	Site restoration	Spills and Emergency Response	Transportation and access [2]	Vegetation and wildlife
Clearing and grubbing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
Demolition	✓	✓	✓	✓		✓	✓		✓			✓	✓
Relocation of overhead BC Hydro transmission lines	✓	✓	✓						✓			✓	✓
Operating and/or fueling heavy equipment	✓	✓		✓		✓			✓		✓	✓	
Utility installation/relocation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Use of temporary laydown areas including stockpiling material	✓	✓			✓		✓		✓	✓	✓	✓	✓
Roadwork widening (select locations)	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
Drainage realignment (select locations)	✓		✓		✓		✓	✓					✓
Installation of SkyTrain guideway foundations and PPS	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓
Installation of overhead SkyTrain guideway									✓		✓	✓	
Stations (foundations, structure, access, utilities, security)	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Testing, commissioning, and start-up					✓[1]				✓[1]	✓[1]			✓[1]

Notes:

1. Effectiveness monitoring of mitigation installed during construction.
2. Transportation and access management will be described in a standalone TMP, separate from the CEMP.

17.4 Construction Environmental Management Plan Framework

This section describes the CEMP Framework that will guide the environmental management requirements and procedures to be included in Project Co's CEMP to avoid or limit Project-related effects of construction. Key aspects of environmental management identified in **Table 17-3** are addressed in this section.

Review of the draft CEMP Framework by First Nations and feedback from public engagement has provided opportunities for input to this key environmental management document. During procurement, contract bidders will be expected to outline their environmental management approach for the work and demonstrate alignment with the CEMP Framework. Each successful proponent (Project Co) will be responsible for all delegated aspects of environmental management during Project design and construction.

Key elements of the CEMP Framework are as follows:

- Required content for the CEMP and the component plans;
- Project-related activities and physical works, and associated interactions with SEs;
- Performance objectives and measures to meet legislative and Project requirements;
- Roles, responsibilities, and reporting relationships for key environmental personnel;
- Applicable construction mitigation measures and considerations for adaptive management;
- Component plans (each signed off by an AQP[69]);
- A detailed description of how environmental monitoring will be carried out for each component plan, including parameters, schedule of routine monitoring, and designated AQP (s);
- A detailed description of how awareness and training for environmental work will be carried out for each component plan, including key topics, cultural awareness, scheduling, content, and routine refreshers; and
- Approaches to evaluate implemented mitigation measures.

Based on the identified Project activities, legislative requirements, DBSS (Government of BC 2019c), experience from other transportation projects in B.C., results of the ESR and environmental management considerations identified in **Table 17-3**, the CEMP Framework should include the following CEMP component plans to manage the Project's environmental effects:

- Agricultural Land Management Plan;
- Air Quality and Dust Control Plan;
- Archaeological and Heritage Management Plan;
- Construction and Demolition Waste Management Plan;
- Construction Water Management Plan (for surface and groundwater);
- Contaminated Soil and Excavated Materials Management Plan;
- Erosion and Sediment Control Plan (including for clearing and grubbing);

69 Appropriately Qualified Professional (AQP) is defined by the DBSS as follows: an applied scientist or technologist specializing in a relevant applied science or technology including, but not necessarily limited to, archaeology, agrology, forestry, biology, engineering, erosion and sediment control, geomorphology, geology, hydrology, hydrogeology or landscape architecture. An AQP must be recognized in British Columbia with the appropriate professional organization, registered and in good standing, and acting under that organization's Code of Ethics and subject to disciplinary action by that organization. He or she must also be someone who, through demonstrated suitable education, experience, accreditation and knowledge directly related and relevant to the level and responsibilities of the particular matter, may be reasonably relied on to provide advice within his or her area of expertise and experience.

- Fish and Fish Habitat Plan;
- Hazardous Materials Management Plan;
- Noise and Vibration Management Plan;
- Site Restoration Plan;
- Spill and Emergency Response Plan (including incident reporting); and
- Vegetation and Wildlife Management Plan (including invasive species).

The CEMP Framework will also include drawings showing Environmental Constraints, including Environmentally Sensitive Areas, sensitive receptors and other environmental features (e.g., APECS) that will need to be considered during construction. Environmentally Sensitive Areas include fish-bearing watercourses and high value wildlife habitat.

The CEMP Framework will require that each component plan include the following information:

- Purpose, scope and objectives;
- Roles and responsibilities;
- List of applicable licences, permits, and approvals required and obtained for the Project;
- Cross-references to other linked component plans, including training requirements to ensure effective implementation of the CEMP;
- Mitigation measures and contingency procedures;
- Monitoring and reporting requirements in relation to Project requirements, defined performance objectives and for assessing the efficacy of mitigation measures; and
- Provisions for adaptive management.

Relevant component plans, such as those for management of erosion and sediment and noise and vibration, will demonstrate how Project works and activities avoid or minimize adverse effects to Environmentally Sensitive Areas and sensitive receptors. Other component plans will include general and emergency contacts for protocols that deal with chance finds or emergency management.

The CEMP and its component plans will be developed by the respective Project Co prior to construction, will conform with Project requirements (including all relevant legislative requirements and the DBSS), and will reflect the final Project design and its associated construction means and methods. The CEMP will guide environmental management of the Project by providing construction managers and onsite personnel with requirements, responsibilities, and mitigation measures. It is expected that the CEMP will adapt or refine mitigation measures identified in the ESR and combine them with other approaches and practices, as needed, to optimize mitigation of potential Project-related effects. This approach will allow for the selection of mitigation measures that are appropriate and effective in the context of the Project's final design and construction methods. The CEMP will include chance find protocols for archaeology and contamination and identify anticipated requirements for environmental procedures to address site-specific activities in the vicinity of ESAs, APECs and sensitive receptors.

The proposed objectives and minimum requirements for each CEMP component plan are listed in **Table 17-3** below.

Table 17-3 Proposed Objectives and Minimum Requirements for CEMP Component Plans

Component Sub-plan	Proposed Objective	Minimum Requirements[1]
Agricultural Land Management Plan	Avoid or limit effects from Project-related activities in the vicinity of land and drainages in agricultural use	Describe and implement measures to: • Adhere to relevant regulatory and/or permit requirements • Identify mitigation measures to avoid or reduce the potential effects on agricultural land and drainage resulting from Project activities, including soil and invasive species management • Describe key performance objectives, best management practices and monitoring requirements that will be implemented to conform with permit requirements and address potential Project-related effects on agricultural land and drainage during construction
Air Quality and Dust Control Management Plan	Avoid or limit effects from Project-related common air contaminants (e.g., SO_2, inhalable PM) and GHG emissions (e.g., carbon dioxide, methane) during Project construction.	Describe and implement measures to: • Specify relevant regulatory and/or permit requirements • Identify mitigation measures to avoid or reduce the potential effects on air quality and dust resulting from Project activities • Describe key performance objectives, best management practices, and monitoring requirements that will be implemented to limit potential Project-related effects on air quality during construction
Archaeological and Heritage Management Plan	Limit potential Project-related effects on archaeological and heritage resources by completing necessary AIA and monitoring. Provide Project personnel with a framework to identify archaeological sites and artifacts, and heritage resources.	• Conduct remaining AIA and monitoring of subsurface investigations to minimize the potential for archaeological chance finds that could delay construction activity Adhere to the CFP that: • Describes the types of archaeological and heritage sites that occur in the Lower Mainland • Outlines steps to follow if a suspected archaeological or heritage site is located during construction • Outlines a plan to communicate with participating First Nations if an archaeological site is identified

Component Sub-plan	Proposed Objective	Minimum Requirements[1]
Construction Waste Management Plan	Manage construction-related waste to protect soil and water quality, wildlife, aquatic environments, and the public from Project-related waste, in a manner that is consistent with the EMA and DBSS.	Describe and implement measures to: • Reduce construction waste, such as best practices typically used in urban development projects for recycling and beneficial reuse of materials • Manage construction-related waste in a way that avoids effects on environmental and social values • Store and dispose of construction materials, manage food waste that may attract wildlife, and re-use non-hazardous construction materials, in accordance with best practices
Construction Water Management Plan	Manage construction-related surface and groundwater water to protect water quality, aquatic environments, and the public in accordance with the WSA, the *Environmental Management Act,* and Project requirements.	Describe and implement measures to: • Manage surface water to minimize potential for generation of sediment and release of deleterious substances and conform with permit and other regulatory requirements • Identify measures for management of groundwater, including that from potentially contaminated sources • Identify contingency measures to address stormwater, extreme weather, temporary work shutdowns and chance finds of contaminated water
Contaminated Site Management Plan	Manage contaminated sites in compliance with the CSR under EMA and DBSS.	Describe and implement measures to: • Identify locations of known and potential contaminated sites, and remediation procedures for working in and near known and potentially contaminated sites • Outline contingency procedures for encounters with a contaminated site or if an accidental release occurs during construction, and describe testing and reporting requirements • Properly manage fill materials used in construction of the Project • Identify, classify, and manage fill material used for construction of the Project • Inspect, track, store, and re-use imported or transferred fill materials on site • Avoid or reduce the potential effects of contaminated soil and water that may be produced from Project activities • Report and document the origin, destination, and quality of materials brought to the site
Environmental Awareness and Training Plan	Provide Project personnel with training opportunities to enhance their environmental awareness as it relates to the Project.	• List the required training types (e.g., site orientation, specific to environmentally sensitive areas, CFPs, including objectives and target audiences. • Provide a timeline that states when specific types and frequency of training that will be offered, including that for cultural awareness. • Provide an outline of training materials and content to be covered in each training type.

Component Sub-plan	Proposed Objective	Minimum Requirements[1]
ESC Plan	Identify construction activities that could lead to soil erosion and discharge of sediment-laden water into municipal stormwater systems and watercourses and identify ways to manage and minimize erosion and discharges to aquatic environments and stormwater infrastructure.	Describe and implement measures to: • Avoid or reduce potential Project-related effects of erosion and sedimentation and identify BMPs and mitigation measures to avoid or reduce clearing and grubbing. • Identify high risk areas of the Project site (e.g., ESAs) and provide proactive ESC measures. • Specify ESC monitoring requirements. • Describe performance objectives and sampling requirements of relevant performance objectives such as conformance with applicable water quality standards and guidelines
Fish and Fish Habitat Plan	Identify regulatory requirements and permit conditions regarding the protection of fish and fish habitat, and have the Project meet the identified requirements and conditions.	Describe and implement measures to: • Protect fish habitat, including detailed characterization of watercourses, use of reduced risk timing windows, fish salvage methods, and linkages to other environmental management plans to prevent potential introduction of deleterious materials. • Avoid or reduce potential Project effects to fish and fish habitats during construction, and outline mitigation and enhancement for aquatic habitats that will be affected by the Project. • Monitor water quality for compliance with the Fisheries Act, the federal Water Quality Guidelines for the Protection of Aquatic Life, the WSA, and the City of Surrey's Sanitary Sewer Regulation and Charges By-law.
Noise and Vibration Management Plan	Limit or reduce effects on the local community and sensitive receptors from Project-related noise and vibration levels that exceed identified thresholds during construction, such as during site preparation and ROW construction.	Describe and implement measures to: • Avoid or reduce the potential Project effects of noise and vibration • Specify Project-specific noise and vibration targets and thresholds (e.g., that may result in damage to buildings or human and sensitive equipment receptors), described in the ESR • Schedule construction activities and document hours, equipment inspection and maintenance requirements • Support the Province's public outreach program, including noise and vibration monitoring. • Monitor pre- and post-construction noise and vibration levels to regularly verify levels at key locations and enable comparison with specific thresholds

Component Sub-plan	Proposed Objective	Minimum Requirements[1]
Site Restoration Plan	Plan for and demonstrate: • Project consistency with tree replacement requirements • Site vegetation and restoration • Post-construction efficacy monitoring	Describe and implement measures to: • Adhere to specified planting ratios and other requirements for tree replacement • Restore and revegetate areas that will be disturbed by the Project (e.g., temporary footprint areas) • Reflect site restoration requirements of relevant provincial and federal environmental permits • Specify effectiveness monitoring to achieve planting survival targets
Spill and Emergency Response Plan	Reduce or limit the potential for an accident or malfunction caused by Project-related activities and equip Project personnel with emergency response procedures including incident reporting and follow-up to relevant regulatory agencies.	Describe and implement measures to: • List materials and equipment that will be stored on site (e.g., spill abatement materials, clean-up kits, survival kits) to support emergency response activities. • Identify mitigation measures to avoid or reduce the potential effects of spills resulting from Project activities. • Describe roles and responsibilities and training requirements for onsite personnel. • Describe spill response procedures and spill reporting requirements.
Vegetation and Wildlife Management Plan	Avoid or limit Project-related effects on wildlife, wildlife habitat, and vegetation (e.g., boulevard trees, plant species at risk), particularly during site preparation, and prevent the long-term spread and establishment of invasive or noxious plants.	Describe and implement measures to: • Limit effects on known wildlife habitat features and sensitive habitats and to prevent the spread of invasive and noxious plants. • Manage any invasive wildlife or plants (including noxious plants) or species at risk that may be discovered during construction. • Limit risk of injury or mortality of wildlife and reduce disturbance in sensitive areas. • Avoid or reduce potential Project effects on vegetation and wildlife. • Use sensitive timing windows for wildlife. • Secure relevant permits for wildlife salvage and relocation.

A standalone TMP will address temporary Project-related effects on local traffic by maintaining the safe and efficient movement of goods and traffic, well-connected street networks, as well as access to residential and non-residential properties, community amenities, and emergency services. Minimum requirements include measures to:

- Demonstrate adherence to provincial and municipal traffic management requirements;
- Consider and accommodate all road users (e.g., drivers, cyclists, and pedestrians of all abilities) in design and construction insofar as reasonably possible; and
- Avoid or reduce potential Project effects on transportation and access through the development and implementation of:
    - a Construction Staging Plan;
    - a TMP, including component plans for traffic controls, incidents, public information, truck routing, bus operations and access; and
    - consultation with business and property owners.

17.5 Regulatory and Policy Context for Environmental Management

Key federal and provincial legislation that may apply to Project activities for environmental management during construction are summarized in **Table 17-4**. The Province will work with municipalities to define requirements for construction. International, federal, provincial and local government policies and guidelines that could be relevant to Project activities are summarized in **Table 17-5**. Compliance with all applicable environmental licences, permits, and approvals will be monitored during construction. Project construction will consider environmental constraints defined for the Project, such as environmental timing windows for instream works.

Table 17-4 Summary of Key Legislation and Regulations for Environmental Management

Policy/Guidance	Responsible Agency	Relevant Aspects of Legislation	Applicability to the Project	Relevant SE
Federal				
Fisheries Act, RSC 1985, c. F-14 (last amended on 2019-08-28)	DFO	Provides a framework for fisheries management and conservation and protection of fish and fish habitat, including by preventing pollution. The agency determines the type of approval required through proponent-submitted Requests for Project Review.	Project construction has the potential to disrupt or alter fish habitat, depending on final design and construction methodology.	Fisheries and Aquatics
Migratory Birds Convention Act, SC 1994, c. 22	ECCC	Protects various species of migratory birds. This Act prohibits the disturbance, destruction, or removal of a nest or related shelter or egg of a migratory bird, or possession of a live migratory bird, or a carcass, nest, or egg of a migratory bird. Requires Migratory Birds Damage or Danger Permit.	Project construction may directly (i.e., habitat removal or mortality) or indirectly (i.e., sensory disturbance, habitat degradation) affect individual, or nests of, migratory birds protected by the MBCA.	Vegetation and Wildlife
Species At Risk Act, SC 2002, c. 29	ECCC	Protects wildlife species at risk in Canada. Manages species of special concern to prevent them from becoming threatened or endangered. Effects to protected species on federal land may require SARA Permit.	Project activities may affect designated species. Species listed on Schedule 1 of SARA have informed the scope of the wildlife SE.	Vegetation and Wildlife; Fisheries and Aquatics
Provincial				
BC Local Government Act, RSBC 2015, c. 1	Ministry of Municipal Affairs (MUNI)	Primary legislation for municipalities and regional districts.	Metro Vancouver and the Three Municipalities are regulated, and certain responsibilities are delegated under this Act.	Archaeology and Heritage; Land Use; Agricultural Use
Environmental Management Act (EMA)	ENV	EMA prohibits the introduction of waste into the environment in a way that will cause pollution, except in accordance with a regulation, permit, approval, or code of practice issued under the Act.	Excavation dewatering and discharge to a receiving environment, such as a watercourse, may be required. Waste will be generated by the Project.	Air Quality and GHG; Contaminated Sites; and Fisheries and Aquatics

Policy/Guidance	Responsible Agency	Relevant Aspects of Legislation	Applicability to the Project	Relevant SE
EMA CSR	ENV	The CSR sets out requirements for site remediation in BC. Schedule 2 of the Contaminated Sites Regulations defines industrial activities that have the potential to cause site contamination. Soil to be relocated under the Contaminated Soil Relocation Agreement	Surplus soil may be generated or contaminated soil encountered during construction. Soil to be relocated offsite may need a Contaminated Soil Relocation Agreement or disposal at a licensed facility. Chance finds of contaminated materials could occur during Project construction or associated utility works.	Contaminated Sites
EMA HWR	ENV	Addresses the handling and disposal of hazardous wastes. Requires Transport Licence.	The HWR addresses the proper handling and disposal of hazardous wastes.	Contaminated Sites
EMA Petroleum Storage and Distribution Facilities Storm Water Regulation, BC Reg. 168/94	ENV	Applies to every petroleum storage and distribution facility in BC. Requires Fuel Storage Registration.	Petroleum Storage and Distribution Facilities Storm Water Regulation applies to every petroleum storage and distribution facility, which is defined as “a facility, other than an oil refinery, situated at one location that stores petroleum in tanks.”	Contaminated Sites
EMA Spill Reporting Regulation, BC Reg. 187/2017	ENV	Outlines the spill reporting requirements.	Project activities could result in spills to ground or to local watercourses.	Contaminated Sites
Heritage Conservation Act, RSBC	FOR	Encourages and facilitates the protection and conservation of heritage property. Administers Heritage Inspection Permit and Heritage Investigation Permit.	The Project may need to conduct additional archaeological inspections or investigations depending on construction methodology.	Archaeology and Heritage
Integrated Pest Management Act, SBC 2003, c. 58 Integrated Pest Management Regulation, BC Reg. 604/2004	FOR	Regulates classes of pesticides. Administers Integrated Pest Management Regulation Licence.	Pesticides may be used to manage noxious weeds or invasive plants during Project activities.	Vegetation and Wildlife

Policy/Guidance	Responsible Agency	Relevant Aspects of Legislation	Applicability to the Project	Relevant SE
Riparian Areas Protection Act, SBC 1997, c.21 Riparian Areas Protection	FOR	Requires local governments to protect riparian areas during development including stream features, functions, and conditions essential to maintaining stream health. Municipalities must adhere to the RAPR unless they have equivalent or better legislation for streamside protection. Requires RAPR Assessment Report Submission.	Project activities will occur within streamside protected areas of local watercourses.	Fisheries and Aquatics
Waste Management Act, RSBC 1996, c. 482	ENV	Regulates solid waste and recyclable material. Requires Permit or Approval.	Project activities may introduce waste, such as air contaminants, into the environment.	Contaminated Sites
WSA, SBC 2914, c. 15	FOR	Changes in and about a stream may be made only with an approval under the WSA and Water Sustainability Regulation, or notification, as applicable. Requires Changes in and about a Stream Change Approval Application or Notification and Temporary Use Permit.	Project activities may include complex works (e.g., water diversions, channel relocation/removal) and temporary diversion of groundwater for non-domestic use.	Fisheries and Aquatics
Weed Control Act, RSBC 1996, c. 487	FOR	Regulates invasive and noxious plant species on provincial Crown and private lands. Noxious weeds (listed in Schedule A of the Weed Control Regulation) must be controlled by land managers to prevent their spread.	Project construction activities could introduce or spread noxious plant species. Designated noxious weeds found in the Project area include Japanese knotweed (*Reynoutria japonica*) and Canada thistle (*Cirsium* spp.).	Vegetation and Wildlife
Wildlife Act, RSBC 1996, c. 488	FOR	Protects at-risk wildlife species from direct harm or harassment, including nesting birds and active nests (i.e., occupied by a bird or its egg(s)) and nests of certain species (e.g., bald eagles) year-round. Regulates the collection of species for inventory and research. Requires *Wildlife Act* Permit and Scientific Fish Collection Permit.	Project activities may affect protected species as well as habitat features of select species that are afforded year-round protection in the province on non-federal lands (e.g., bald eagle and great blue heron nests). Fish salvage or sampling may be required.	Vegetation and Wildlife

Table 17-5 Relevant Policies and Guidance for Construction Environmental Management

Policy/Guidance	Responsible Agency	Relevant Aspects of Policies and Guidelines	Potential Applicability to the Project	Relevant SE
International				
Code of Practice for Noise and Vibration Control on Construction and Open Sites	British Standards Institute	Outlines a code of practice for noise and vibration control at construction sites.	Project activities will result in noise and vibration impacts during construction.	Noise and Vibration
Environmental Noise Guidelines for the European Region	World Health Organization	Presents information on the effects of nighttime noise on human health.	Project activities will result in noise impacts during construction.	Noise and Vibration
Transportation and Construction Vibration Guidance Manual	CalTrans	Highlights guidance and criteria to assess vibration effects from transportation projects.	Project activities will result in vibration impacts during construction.	Noise and Vibration
Transit Noise and Vibration Impact Assessment Manual	United States FTA	Describes procedures and criteria to predict and assess noise and vibration effects from public transportation projects, including rapid rail transit.	Project activities will result in noise and vibration impacts during construction.	Noise and Vibration
Federal				
Fish and Fish Habitat Protection Policy Statement	DFO	Outlines the regulatory aspects of the DFO’s Fisheries Protection Program.	Project construction activities have the potential to affect fish and fish habitat.	Fisheries and Aquatics
Measures to Protect Fish and Fish Habitat	DFO	Conserves and protects fisheries and aquatic ecosystems.	Project construction activities have the potential to affect fish and fish habitat.	Fisheries and Aquatics
Standards and Codes of Practice	DFO	Specifies procedures, practices, or standards for avoiding death of fish or harmful alteration, disruption, or destruction of fish habitat.	Project construction activities may require pumping of water in fish-bearing streams.	Fisheries and Aquatics
Water Quality Guidelines for the Protection of Aquatic Life	CCME	Provides science-based benchmark for a nationally consistent level of protection for aquatic life in Canada.	Project construction activities have the potential to result in changes in water quality.	Vegetation and Wildlife

Policy/Guidance	Responsible Agency	Relevant Aspects of Policies and Guidelines	Potential Applicability to the Project	Relevant SE
Provincial				
Archaeological Impact Assessment Guidelines	FOR, Archaeology Branch	Outlines procedures for archaeological resource assessment, review and permitting.	The Project's ground-altering activities could affect archaeological and or heritage resources. The Project has an HCA permit and is reporting on AIA.	Archaeology and Heritage
AOA as General Land Use Planning Tools – Provincial Standards and Guidelines	FOR, Archaeology Branch	Outlines Provincial AOA standards.	The Project has undertaken an AOA to assess potential effects on archaeological and heritage resources, and appropriate management of these resources.	Archaeology and Heritage
BC Water Quality Guidelines	ENV	Outlines guidelines, including for aquatic life, agriculture, and drinking water.	Uncontaminated surface water or groundwater dewatered and discharged to a surface water-receiving environment must meet the BC Water Quality Guidelines.	Fisheries and Aquatics
Best Management Practices for Amphibian and Reptile Salvages in British Columbia	FOR	Summarizes the most current information on BMPs for amphibian and reptile salvages in BC and permitting requirements.	Project construction activities have the potential to interact with amphibians, e.g., red-legged frogs in North Creek.	Vegetation and Wildlife
Found Human Remains Policy	FOR, Archaeology Branch	Provides guidelines for handling human remains that may be protected under the HCA.	Project development will require ground-altering activities, which could affect archaeological resources.	Archaeology and Heritage
Regional				
Greater Vancouver Regional District NRDE Emission Regulation Bylaw	Metro Vancouver	Controls and prevents discharge of air contaminants from non-road diesel equipment.	The Project will require the use of non-road diesel equipment for construction.	Air Quality and GHG
Greater Vancouver Sewerage and Drainage District (GVS&DD) Sewer Use Bylaw	Metro Vancouver	Controls direct or indirect discharge of waste into sewers and drains connected to GVS&DD Sewage Facility via Waste Discharge Permits.	Discharge of excavation water to a Greater Vancouver sewer or drain may be required.	Fisheries and Aquatics; and Contaminated Sites
Indigenous Archaeology and Heritage Permits	Indigenous Community	Archaeological sites in BC are protected under the HCA and may not be altered or changed in any manner without a permit.	The Project has followed best practice for Indigenous engagement and archaeology process; Indigenous-specific heritage and archaeology permits are in place for the Seyem' Qwantlen (Kwantlen First Nation), Stó:lō Research and Resources Management Centre (Stó:lō Nation), Katzie First Nation and xʷməθkʷəy̓əm (Musqueam Indian Band).	Archaeology and Heritage

18 Environmental Management during Operations

Existing operational practices for SkyTrain lines follow robust management and mitigation measures. The policies, procedures, and practices that are currently in place for Metro Vancouver's SkyTrain system have been developed and implemented by TransLink's operating agency, BCRTC. For over 30 years, TransLink and BCRTC have worked together to continually update and improve their operations with both external and in-house expertise. This legacy knowledge and experience with the SkyTrain system will benefit the Project by continuing with an established and successful environmental management approach.

BCRTC maintains and operates two SkyTrain lines in Metro Vancouver: the Expo and Millennium Lines,[70] and as such, will maintain and operate the future SLS extension (of the Expo Line), including its environmental management systems and procedures. The following sections describe the elements that are likely to require ongoing management during SLS operation.

18.1 General Practices

In accordance with applicable regulatory and legislative requirements as well as TransLink and BCRTC best practices for environmental management and mitigation, the following measures are recommended:

- Air quality and dust control − Reduce air contaminants by adhering to Metro Vancouver requirements for non-road diesel engines; monitor and control fugitive dust emissions from operations and maintenance activities; utilize low volatile products to reduce evaporation of volatile deleterious substances;
- Fuel, chemicals, and material storage and the handling of hazardous materials − Develop site-specific plans and ensure appropriate training for all personnel mandated under the Workplace Hazardous Materials Information System and other applicable legislation;
- Solid and liquid waste − Reduce usage and dispose of materials in accordance with legislative requirements and best practices (i.e., develop site-specific waste management plans and ensure appropriate training for all personnel);
- Water and sediment management − Reduce environmental impacts by implementing surface and stormwater management strategies, including ensuring water quality thresholds are achieved and implementing rainwater management infrastructure;
- Snow accumulations − Ensure public safety and reliability during winter maintenance; and
- Vegetation and wildlife management – Implement existing program that prevents and manages unwanted vegetation and invasive species, including monitoring and controlling invasive or noxious weed infestations and minimizing accidental intrusions onto the tracks.

Prior to the start of SLS operation, BCRTC will review and update operational guidance documents to manage any newly identified environmental risks.

[70] BCRTC manages the contracted service agreement with InTransit BC for the operation and maintenance of the Canada Line. BCRTC also operates and maintains the West Coast Express commuter rail service.

18.2 Electromagnetic Fields

Based on a review of comparable EMF assessments for advanced light rail transit projects, including Broadway Subway Project, there are no anticipated adverse effects from EMF interference with specialized equipment or human health. Sensitive medical equipment, such as MRI machines at the JPOCSC (located approximately 50 m from the Project), and emitted EMFs will be attenuated to levels that will not interfere with these types of equipment. The EMF frequency and intensity produced by the Project are below the acute reference levels indicated by International Commission on Non-ionizing Radiation Protection for occupational exposures. Project-related equipment will meet the applicable regulations and standards to maintain electromagnetic compatibility and mitigate the potential for electromagnetic interference. The assessment conducted for Broadway Subway Project is available at:

https://www.broadwaysubway.ca/app/uploads/sites/626/2020/08/Environmental-and-Socio-Economic-Review-December-2019-Main-Report.pdf.

18.3 Noise and Vibration

It is expected that noise levels will increase over baseline conditions due to the SLS and associated bus operation, with potential impacts predicted for some areas with residential receptors (see **Section 8** Noise and Vibration). Following noise monitoring by Project Co to determine effectiveness of the implemented design, BCRTC may conduct additional monitoring if operational noise levels exceed the expected levels or based on public feedback. Noise will be managed by BCTRC in accordance with current practices. TransLink has been conducting noise assessments and developing mitigation to address existing operations. Additional information on the SkyTrain Noise Study Phase Two Technical Report (2022) is available at www.translink.ca.

The relatively straight alignment of the guideway and elevated Project design will avoid vibration effects at most locations along the alignment. However, vibration levels are predicted to exceed general guidance criteria from the Federal Transit Administration at some existing residential receptors. These locations should be considered in final design and potentially in post-construction monitoring to determine whether mitigation is warranted.

Recommended noise and vibration mitigations during operation include the use of preventative maintenance practices, including rail grinding, friction modifiers, regular inspections, and others to reduce or avoid rail corrugation and surface defects, and maintain an optimal state.

18.4 Effectiveness Monitoring and Reporting

The ESR's identification of potential effects was based on models and pre-construction assumptions; these could change prior to or during construction. The ESR recommends effectiveness monitoring both to verify the determinations of this ESR and the performance of recommended mitigation. Mitigation measures, such as those for noise mitigation and vegetation plantings for site restoration, may require a limited program of effectiveness monitoring by Project Co to document conformance with Project requirements and assess whether measures are functioning as intended or designed. If effectiveness monitoring indicates that mitigation is not achieving conformance with Project requirements, further actions and monitoring will occur. If effectiveness monitoring confirms that the mitigation is effective, monitoring will cease unless determined necessary by the operating agency. Project Co will be required to document the monitoring, its results and any adaptive management measures taken.

18.5 Spill Response Procedure

BCRTC has well-established spill response procedures for the existing Expo and Millennium SkyTrain stations and guideways. The Spill Response Procedure for the SLS will adhere to current practices to prevent, report, and respond to environmental spills and minimize environmental impacts. Current mitigation measures to prevent spills and maintain water quality include oil separators and grease interceptors at stations and directing guideway drainage to swales or inground infiltration. Where the Project footprint may interact with fish-bearing watercourses (e.g., in the vicinity of 140 Street Station and the Serpentine River crossing), measures to prevent discharge of deleterious substances, including hazardous materials, may be required.

BCRTC maintains a detailed inventory of any potentially hazardous materials and their material safety data sheets. Possible spills or exposure can occur from the following:

- Hydraulic brake line fluid from trains as well as rail-borne maintenance equipment;
- Diesel fuel from rail-borne maintenance equipment;
- Biodegradable glycol (ethylene glycol) used to spray power rails during winter freezing conditions;
- Grease;
- Precision Clean Multi-Purpose Cleaner Degreaser for pressure washing side plates, guideway, and switch rods; and
- Herbicides (glyphosate) for noxious weed control.

If a significant spill occurs, BCRTC will contact its contracted spill responder to assist in cleanup, visual inspection of the affected area, and spill reporting to the BC Ministry of Environment and Climate Change Strategy, in accordance with the EMA Spill Reporting Regulation. All spills of hazardous materials will be reported internally and cleaned up, regardless of quantity.

18.6 Vegetation

As part of its Environmental Management System Program, BCRTC will manage unwanted vegetation, tree growth, and noxious weeds for the Project footprint. BCRTC manages invasive and noxious species on their lands as per the BC *Weed Control Act*. Vegetation up to 10 m from the SLS guideway will be routinely assessed to prevent guideway intrusions, in accordance with arborist recommendations and as required. Vegetation outside of a 10 m buffer may be managed to maintain visibility, reduce hazards, or improve aesthetics. Arborist reporting will occur approximately every three years to assess tree conditions along the SLS alignment.

18.7 Wildlife

Interactions with birds or urban wildlife may occur during SkyTrain operation. For example, if bird nests or animal dens are observed within the Project footprint or any adjacent lands that would be affected by Project operation, BCRTC will assess and determine the appropriate course of action.

The risk of bird injury from window strikes at stations may be reduced by employing bird-friendly glazing (see **Section 11** Vegetation and Wildlife Resources). Following assessment by Project Co to determine effectiveness of the implemented design and whether bird or bat strikes could be a significant issue, BCRTC may implement additional surveys to determine the need for additional mitigation. Key areas to assess during initial Project operation are at stations or where habitat is adjacent to both sides of the guideway (e.g., GTUF and Serpentine Valley areas).

19 Summary and Conclusions

This section of the ESR summarizes key findings and describes how these findings will be used to avoid or minimize potential effects, as discussed in **Sections 7** to **16**. This section also presents next steps for First Nations, public, and stakeholder engagement.

19.1 Key Findings: Project Effects and Mitigation

The key findings regarding the potential Project effects and recommended mitigation for each SE are summarized in **Table 19-1**.

Table 19-1 Summary of Potential Effects and Proposed Mitigation

Screening Element	Review Indicator	Potential Effects and Proposed Mitigation	Summary of Effects Remaining After Mitigation

Air Quality and Greenhouse Gases (GHG)	• Change in emissions of CACs relative to baseline
	• Change in emissions of GHGs relative to baseline
		• During construction, the use of best management practices is recommended to minimize CAC and GHG emissions:
		  • Use electric-powered equipment over other fossil fuels where feasible, or use Tier 4 and higher diesel equipment
		  • Conduct regular inspections and maintenance on all equipment and enforce equipment idling restrictions
		  • Use high-volume fly ash concrete or other low carbon alternatives where feasible
		  • Apply water for dust generating activities during dry periods
		  • Minimize traffic delays to the extent practicable
		• During operation, the Project is expected to reduce emissions of CAC and GHG due primarily to the transportation mode shift from buses and vehicles (powered by internal combustion engines) to the electrically powered SkyTrain system
			• Construction-related emissions of CACs are expected to be minor relative to existing conditions, and continuous for up to 10 hours per day. The changes in concentration of CACs are expected to be localized to the LSA and effects are fully reversible after completion of construction
			• Construction-related emissions of greenhouse gases (GHG) are expected to be minor relative to existing conditions and continuous, lasting up to 10 per day. GHG emissions are global in nature and can persist for hundreds of years in the atmosphere, but are partially reversible and will be offset by air quality improvements within 3 years of Project operation
			• During operation, the Project will have a positive effect on air quality and GHGs

Noise and Vibration	• Noise levels during construction and operation
	• Vibration levels during construction and operation
		• Detailed modelling of potential noise and vibration levels for Project construction predicts temporary effects due to the use of heavy equipment in proximity to residences and if impact piling occurs
		• During construction, recommended mitigation measures in urban and commercial areas to minimize noise and vibration effects include the need to:
		  • Install piles using drilling or other low vibration techniques
		  • Provide advance notification, limit construction activities to daytime hours where possible and follow a complaint management process to receive and track feedback
		  • Conduct noise and vibration monitoring for areas with potential impacts, and use temporary noise barriers or other mitigation, where indicated.
		• During operation, noise and vibration may be perceptible at select locations without further mitigation. Monitoring is recommended following commissioning to inform the need for further mitigation such as noise barriers and/or rail dampers.
			• It is expected that, with effective implementation of Project design and recommended mitigation measures, effects from noise and vibration during operation and construction are anticipated to be negligible or low in magnitude and geographic extent
			• During construction, noise effects will be limited to hours of operation and localized to areas of activity.
			• During operation, receptors located near pocket track or alignment transitions may perceive noise when trains are operating.
			Noise effects are anticipated to be below relevant noise quality criteria. Similarly, vibration effects are anticipated to be below thresholds for building cosmetic damage during construction and below perceptibility during operation.

Screening Element	Review Indicator	Potential Effects and Proposed Mitigation	Summary of Effects Remaining After Mitigation
Contaminated Sites	• Historical Schedule 2 activities or known contamination recorded at acquired properties • Encountering contaminants prior to or during construction • Contamination remaining following construction	• 113 APECs were identified and assigned a risk ranking of low, medium, or high-risk, based on the likelihood of the operation of concern causing contamination. The identified APECs include 17 high-risk and 47 medium- risk sites. • In the absence of pre-characterization, risks to the Project schedule due to chance finds of contaminated soil and groundwater during construction can be partially mitigated through the development of a Contaminated Site Management Plan as part of the CEMP. • Recommended mitigation for potential environmental liabilities associated with property acquisitions consist of the completion of due diligence investigations and development of remediation estimates for property transfer negotiations. • Completion of a Phase I and/or Phase II ESA at each of the identified properties to assess the presence of potential contamination related to the APECs is recommended prior to the acquisition of properties.	• It is expected that, with effective implementation of recommended mitigation, effects associated with environmental liabilities will be low in magnitude and geographic extent, could be long-term for a limited number of sites, and there will be an improvement over existing conditions following remediation • Effects for contaminated soil and groundwater management during construction will be low in magnitude and geographic extent, short-term, uncommon in occurrence and there will be an improvement over existing conditions following remediation • With effective implementation of mitigation measures, the exposure risk to human health or ecological receptors during and following construction would be low in magnitude and geographic extent, short-term, rare in frequency and there will be an improvement over existing conditions following remediation • Potential effects can be reduced by implementing the recommended mitigation measures, but they may not be entirely resolved prior to construction.
Fisheries and Aquatics	• Change in water quality and fish habitat presence, structure, and access • Change in fish and egg mortality	• The Project is not anticipated to result in permanent or temporary changes to instream fish habitat. Based on the RCD, the Project effects on riparian habitat are anticipated to be a permanent change of 2,253 m^2 and a temporary change of 11,900 m^2 within legislated stream setbacks. • During Project construction, standard erosion prevention and sediment control practices, as well as spill response plans, and properly implemented best management practices are expected to be sufficient to prevent introduction of deleterious substances. • If instream works are required, measures such as isolating work areas from streamflow, and salvage of fish and amphibians from work areas are recommended to minimize the potential for fish mortality.	• With effective implementation of Project design and recommended mitigation, effects on Fisheries and Aquatics are anticipated to be low in magnitude. • Effects are expected to be temporary, reversible, and will be offset by riparian planting. Habitat function is anticipated to return to existing condition or better within 5 years of replanting.

Screening Element	Review Indicator	Potential Effects and Proposed Mitigation	Summary of Effects Remaining After Mitigation
Vegetation and Wildlife	Changes in: • occurrence or locations of species of management concern • spatial extent of ecological communities at risk • habitat availability or suitability for species of management concern • spatial extent of vegetated areas and number of trees • Potential for injury or mortality to wildlife from construction and operation	• Project construction may interact with species of management concern, alter the abundance and quality of wildlife habitat, or otherwise adversely affect some species. Habitat for species at risk is limited in the Project study area. Recommended mitigation includes conducting clearing outside of the bat roosting and breeding bird seasons and conducting species at risk salvages). • Approximately 1,650 trees are located in the Project footprint (temporary and permanent), primarily east of 148 Street. An arborist's survey is recommended to confirm tree removal and replacement requirements • No Project-related effects are expected on sustainability of biodiversity • TransLink best practices will be implemented during operation to mitigate potential impacts • Post-construction monitoring is recommended to confirm effectiveness of mitigation for vegetation plantings in environmentally sensitive areas and wildlife impacts for stations and guideway areas	With application of recommended mitigation, Project construction and operation effects on wildlife and vegetation are anticipated to be temporary and reversible, and Project operation effects likely to be negligible.
Archaeology and Heritage	• Areas of designated high archaeological potential that may be affected • Number and description of archaeological sites with the potential to be altered • Number and description of heritage sites with the potential to be altered	• 17 AOIs and two Management Areas were identified in the Project footprint. Systematic shovel testing in accessible AOI locations identified an archaeological site not previously registered • 12 previously recorded or designated heritage sites are located within 1 km of the Project area, 3 of which overlap with the proposed Project footprint • Additional AIA work is recommended as well as monitoring of AOIs that are currently inaccessible. • Where feasible, the Project will avoid disturbing known archaeological sites. If site avoidance is not feasible and impacts to identified archaeological sites will be mitigated through site-specific measures and in accordance with the HCA, provincial guidance, and associated permitting. Where needed, new mitigation measures will be developed through discussion with regulators, First Nations and landowners.	• With effective implementation of recommended management and mitigation measures, impacts to archaeological and heritage resources are anticipated to be negligible in magnitude, and low in geographical extent. • Effects are expected to be short-term, reversible, and will be informed by pre-construction archaeological assessments.

Screening Element	Review Indicator	Potential Effects and Proposed Mitigation	Summary of Effects Remaining After Mitigation
Agricultural Land	• Alignment with provincial and municipal agricultural land use designations • Change in area of agriculturally designated land and in agricultural use • Change in land infrastructure and sensory conditions	• The Project traverses ALR in the Serpentine Valley, which includes extensive water management infrastructure and several non-ALR agricultural parcels along Fraser Highway in Surrey. • Project design measures to locate the Project within the existing Fraser Highway ROW have eliminated the need for permanent property acquisitions in the ALR. • The Project will temporarily and permanently require non-ALR lands in agricultural use along Fraser Highway in Surrey. • Engaging with agricultural operators prior to and during construction should help to identify potentially affected agricultural infrastructure and help manage potential effects. • Management plans in the CEMP will prevent potential soil quality effects in adjacent lands resulting from sedimentation and hazardous materials.	• With the implementation of recommended management and mitigation measures, the magnitude of effects to agricultural lands are anticipated to be low for designated lands and high for non-designated lands. These effects are anticipated to be low in geographical extent. • Effects to designated lands are expected to be short term and reversible. Effects to non-designated lands are expected to be non-reversible and permanent. • Most land in agricultural use temporarily required for construction will likely be returned to a similar function following construction. Therefore, overall, this effect is assessed as low.

Land Use	• Alignment with local and regional government land use policies
	• Changes to residential, commercial, and industrial properties
	• Change in area and features of parkland
		• The Project will require some land outside road ROWs that is currently designated and zoned for other uses. It is expected that in the Three Municipalities, permanent changes to land use due to the Project will be 10.1 ha
		• The OSPA, SPA and other agreements, which provide for robust planning, should help to manage and avoid effects due to changes in land use plans while accommodating anticipated growth during Project operation
		• Identified mitigations measures include minimizing the Project footprint, engaging with properties owners, businesses, and communities, and managing disturbance during construction
		• Measures to maintain the function of recreational features during construction and restore like-for-like functionality to these features following construction are anticipated to mitigate effects to recreational uses
		• During construction, alternatives for access along and around the alignment will be available
		• During operation, access points will be restored, or permanent alternatives will be available
			• With implementation of identified design measures and mitigation, the overall effects to:
			  • Low for residential and commercial land uses due to the fact that Project footprint outside of ROWs is relatively small, although some parcels may not be able to continue their current use
			  • Minimal for industrial land due to the fact that affected lands are localized to City of Langley parcels designated for transit use and their use during construction is not expected to preclude existing uses
			  • Low for recreational land uses as impacts are avoided or reduced with mitigation and limited to construction

Screening Element	Review Indicator	Potential Effects and Proposed Mitigation	Summary of Effects Remaining After Mitigation
Transportation and Access	• Change in transportation from baseline (i.e., number of lanes, vehicle volume, travel times) • Change in access to parking and residential, institutional, and commercial properties • Change to emergency services, safety, or security	• During construction, temporary impacts to the transportation and access are expected due to the requirement of sidewalk and roadway closures. • Collaboration between the Province, Project Co, TransLink, the Three Municipalities, First Nations and stakeholders will mitigate effects, keep people and goods moving, maintain access to services, and allow businesses to operate throughout construction. • Project operation will benefit key commerce and residential areas and healthcare hubs by improving transportation options, capacity and access while supporting planned growth and economic development. • Recommended mitigations during construction include: managing traffic to minimize disruption to all road users; providing public notifications of construction details and impacts well in advance and maintaining functional access to properties through extensive and ongoing communication and cooperation between the Province, the Project Co, and stakeholders (e.g., businesses and property owners). • Recommended mitigation measures for construction includes provision of equivalent functional access to properties and minimizing any change to access and response times for emergency providers. • Standard SkyTrain procedures for public safety and security will be implemented during Project operation.	• The Project's TMP, including specific sub-plans to manage access, public information, incidents, and traffic control, will help minimize effects on transportation and access during Project construction, but some disruption is still likely to occur. • Effects will primarily be localized to users travelling through the review area and will be reversed following completion of the construction period. • During operation, Project effects to transportation and access are anticipated to be positive with improved facilities for transit users, pedestrian, and cyclists. Permanent changes may be expected for access points that are obstructed by guideway columns or station infrastructure.
Visual Landscape	• Change of views to surrounding communities, residential neighbourhoods, and public areas	• Assessment of select study locations predicts that the Project will directly affect views from some residential and public areas. • For commercial areas, public and recreational trails, effects are anticipated to be minor to minimal. Mitigation is recommended for select residential areas. • Careful design measures will help to preserve views of the natural landforms, buffer views of structures and consider additional visual buffering for areas where privacy is a primary concern. • Recommended mitigations to integrate the Project into the existing area include: integrating and enhancing public realms in station design, using visual buffers, incorporating architectural finishes and landscaping at stations, and preserving views, where possible.	• With effective implementation of Project design and recommended mitigation, effects on the visual landscape are anticipated to be low in magnitude, and geographic extent, and permanent in duration for residential, civic and institutional receptors. • It is expected that effects to receptors in public spaces will be moderate in magnitude, and geographic extent but otherwise similar to other receptors.

19.2 Conclusions

The Province's understanding of potential Project-related effects on natural and human receptors has been informed by comprehensive engagement with First Nations, stakeholders, and the public. Input and feedback on areas of interest from these groups are described and considered in this ESR report.

In general, Project-related effects to SEs during construction can be avoided or limited with effective implementation of mitigations identified in **Section 17 Environmental Management during Construction** through design measures, management plans, and best practices. It is anticipated that sustainable functioning of natural systems within the Project footprint will be maintained. Construction-related effects to the human environment, including changes to archaeological resources, land use, visuals, noise level, air quality, and transportation and access will be temporary and mitigated to the best extent possible.

Once in operation, the Project will provide a fast, frequent and reliable rapid transit option south of the Fraser as well as improved regional connectivity. The SLS will attract new riders, improve regional access to housing, health services, jobs, post-secondary education and support economic development and livability. By encouraging mode shift from private vehicles to electrically powered SkyTrain, the Project is forecast to reduce VKT and GHG emissions and to be beneficial for air quality. The Project effects during operation on the assessed SEs will be generally positive, with the implementation of mitigation identified in **Section 18** Environmental Management during Operation.

19.3 Next Steps

This ESR process has identified key mitigation measures to avoid or limit Project construction effects that will be summarized in the CEMP Framework. The CEMP Framework document provides details of performance objectives and identifies the minimum environmental management requirements of Project Co's CEMP to avoid or limit Project-related adverse environmental effects during construction. The Province will oversee Project Co's implementation of the CEMP and review environmental management plans.

Once complete, Project infrastructure will be operated by BCRTC on behalf of TransLink. BCRTC will implement existing environmental management practices used elsewhere on the SkyTrain system coupled with additional Project-specific requirements, including mitigation for addressing noise levels and monitoring the presence of invasive plant species during operation.

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Section 8 Noise and Vibration

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