BRITISH COLUMBIA
The Best Place on Earth

Ministry of Transportation and Infrastructure

FINAL REPORT

PREPARED FOR THE
BC MINISTRY OF HIGHWAYS AND INFRASTRUCTURE

MOUNT LEHMAN CORRIDOR IMPROVEMENTS

BUSINESS CASE

February 2016

URBAN systems

File: 1961.0329.04

Suite 1250 - 13401-108th Ave, Surrey, BC V3T 5T3 | T: 604.682.4220

Executive Summary

Mt. Lehman Road (Mt. Lehman) between Highway 1 and Threshold Drive in Abbotsford, BC is a north-south Provincial route that accommodates local, regional and international vehicle travel. It serves as the primary access to the Abbotsford Airport - the second largest airport in the Lower Mainland after the Vancouver International Airport; and connects the movement of people and goods to the Canada/USA border crossings along the Cascade Gateway and beyond.

The location of the corridor is illustrated in **Figure 1-1**. Between Highway 1 and Simpson Road, Mt. Lehman Road is generally classified as a four-lane urban undivided arterial. South of Simpson Road, the corridor transitions to a two-lane rural undivided arterial. Through the urban section of the corridor, Mt. Lehman serves a mixture of commercial and industrial businesses, including storage, wholesale, warehousing and manufacturing. South of Simpson Road, the corridor passes through a mix of active agricultural land that is protected as Agricultural Land Reserve (ALR) and land designated for future industrial developments before leading directly into the Abbotsford Airport.

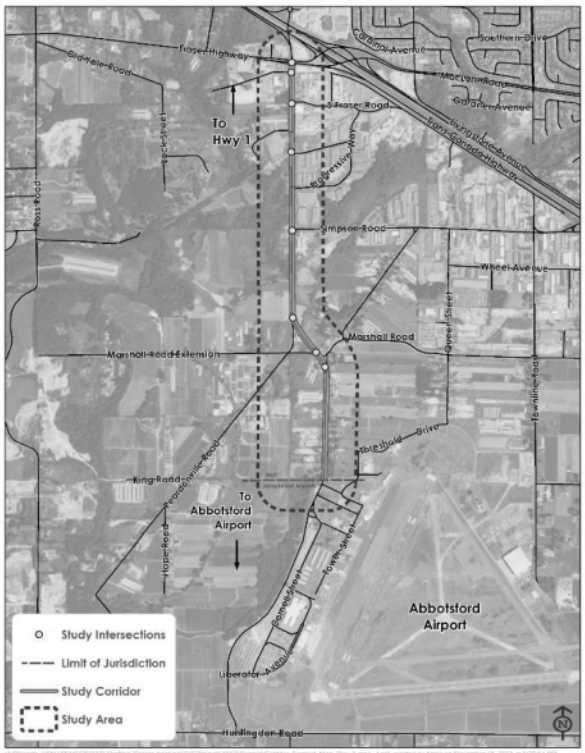


Figure ES-1: Mt. Lehman Corridor Location

In March 2015, the Province of BC issued the *B.C. on the Move*, a new transportation plan that identified a set of priorities for improving the Province's transportation network over the next 10 years. One of the priorities identified is to construct highway widening, capacity, safety and operational improvements on provincial highways throughout the Lower Mainland. Under this priority, improving the connection between Highway 1 and the Abbotsford Airport was identified as a candidate location for improvements.

In addition, the City of Abbotsford is considering two new road alignment options in the medium-term (15 years) to connect King Road, at Bradner Road, with Mt. Lehman Road at Marshall Road. This new connection will provide an important east-west connection between Abbotsford and Langley/Surrey through the 16th Avenue corridor. With this improvement, in combination with future industrial development in the southern section of Mt. Lehman Road, vehicle and truck volumes are expected to increase. Given that Mt. Lehman Road provides primary access to the Abbotsford Airport, there is an expectation for Mt. Lehman Road to be safe, efficient and reliable.

Recognizing the importance of Mt. Lehman Road to the efficient movement of people and goods and in support of the priorities set out in the *B.C. on the Move*, MoTI requested that a Business Case be completed for the corridor improvements on Mt. Lehman Road. This Business Case is intended to examine the benefits and costs of widening Mt. Lehman Road from two to four lanes between north of Simpson Road

to the airport's boundary using the Multiple Account Evaluation (MAE) methodology. The content in this document is designed to comply with Federal Business Case Guidelines.

The assessment of the existing and future mobility and safety performance and future land use changes along the corridor have identified the following constraints:

- **The mobility performance of the corridor will deteriorate as traffic demands continue to grow over the next 25 years.**
- **Corridor travel times will increase significantly due to significant intersection delays.**
- **High percentage of truck volumes contribute to delays and safety issues.**
- **Above provincial collision rates at key intersections across the corridor indicate safety problems with rear end, sideswipe and intersection/left-turn related collisions.**
- **Existing facilities for cyclists and pedestrians is limited throughout the corridor.**

Through these findings, it can be confirmed that these constraints can be mitigated through the widening of the corridor from two to four lanes from north of Simpson Road to immediately north of the Airport's boundary – approximately 1.8km in length. The widening would be supported by intersection improvements and access management along the corridor.

A Multiple Account Evaluation Summary (MAE) is provided in **Table ES-1**, including the quantitative measures used for benefit-cost evaluation and the qualitative measures of potential impacts. Key economic indicators – Net Present Value (NPV) and Benefit-Cost (B/C) Ratio, are determined for a 25-year period and reflect the base assumptions for traffic growth, discount rate and cost estimate. A sensitivity analysis of these key assumptions, are provided in **Section 5.0**. A base discount rate of 6% is used in the economic analysis and a 10% discount rate, consistent with Federal guidelines is used in the sensitivity analysis.

The improvements were found to address the issues identified in the problem definition stage as follows:

- ***Mobility*** – Mitigation of future corridor capacity and travel time issues between north of Simpson Road and south of Marshall Road by providing an additional travel lane in both directions on Mt. Lehman Road. Intersection improvements at Simpson Road and Marshall Road is also provided to mitigate projected delays and queues. The additional lanes on the corridor will also reduce the percentage of vehicles following behind slower moving vehicles – providing better passing opportunities and improving overall traffic flow.

- ***Safety*** – Mitigation of current safety issues along the corridor, such as rear end collisions at key intersections, by providing exclusive left-turn bays and improving overall traffic flow on the corridor. The upgrade of the current 2-lane rural cross section to a 4-lane urban cross section, including improved lighting along the corridor can provide some safety benefits. The increase in passing opportunities can reduce aggressive driving behaviours and in turn, reduce the risk of collisions.

Table ES -1: Multiple Account Evaluation Summary

Discount Rate = 6%	
FINANCIAL ACCOUNT	
Capital Cost (2015$)	$19.2M
Property Cost (2015$)	$0.75M
Capital Cost (PV)	$17.8M
Property Cost (PV)	$0.71M
Maintenance (PV)	$0.53M
Salvage Value (PV)	$3.7M
Total Incremental Cost	***$15.3M***
CUSTOMER SERVICE ACCOUNT	
Travel Time Savings (PV)	$25.2M
Vehicle Operating Savings (PV)	$1.5M
Safety (PV)	$1.6M
Total Incremental Benefits (PV)	***$28.3M***
SOCIAL/COMMUNITY ACCOUNT	
Noise and Visual Impacts	◑
Pollution Impacts	◕
Community Displacement	◔
Community Severance	◑
Consistency with Corridor Plans	●
ENVIRONMENTAL ACCOUNT	
Environmental	◔
Geotechnical & Archaeology	◑
Carbon Dioxide (CO2) (Tonnes/yr)	30
Nitrogen Oxide (NO) (Tonnes/yr)	3
Hydrocarbon (HC) (Tonnes/yr)	2
KEY ECONOMIC INDICATORS	
Net Present Value	**$13.0M**
Benefit-Cost	**1.9**

The proposed improvements were found to have a positive net present value of **$13.0M** and a benefit-cost ratio of **1.9**. These positive economic indicators are desired to advance the proposed improvements towards implementation; however, the indicators only form one component of the overall decision-making framework.

Mt. Lehman Road is a vital link to the Abbotsford Airport and serves as an important route for the movement of people and goods at the local, regional and international level. For these reasons, there is an expectation for Mt. Lehman Road to be efficient, safe and reliable for all users. The proposed improvements also support municipal and provincial strategies, including the City of Abbotsford's proposed King Road Connector and the Province's 10-year Transportation Plan, *B.C. on the Move*.

Key steps toward implementation would include:

- Secure funding;
- Completion of the Functional and Detailed Design;
- Finalize property acquisition;
- Completion of the procurement process

Benefits from the investment would accrue at the local, provincial and national level. Funding the proposed improvements is anticipated to be a partnership between all levels of government, including the Government of Canada, the Province of British Columbia and the City of Abbotsford. Federal cost sharing would be based on 50% of the eligible costs, which is estimated to be $7.8M. The City of Abbotsford has committed $2.0M towards project implementation. The estimated cash flow by fiscal year, including property costs, is outlined in **Table ES-2**.

Table ES-2: Project Cash Flow by Fiscal Year

s.13,s.16,s.17

The proposed improvements will be delivered by BC MoTI through Traditional Competitive Tendering and will be completed by way of a Major Works Contract set out of MoTI. The improvements are expected to be completed over 3 fiscal years, as highlighted in **Table ES.3**. Construction is expected to commence in 2016/2017 fiscal year and complete in the 2017/2018 fiscal year.

Table ES-3: Estimated Project Schedule by Fiscal Year

Activity	2015/2016	2016/2017	2017/2018
Project Design and Surveying			
Environmental Assessment			
Construction Permit			
Tender			
Start of on-site Construction			
Substantial Completion			
Project Completion			
Final Report			

Table of Contents

Appendices

Appendix A Marshall Road Intersection – Proposed Configuration

Appendix B Conceptual Design – Concept 1 & Concept 2

s.13,s.17

1.0 Introduction

Mt. Lehman Road (Mt. Lehman) between Highway 1 and Threshold Drive in Abbotsford, BC is a north-south Provincial route that accommodates local, regional and international travel and connects the movement of people and goods to the Abbotsford International Airport and the Canada/USA border crossings along the Cascade Gateway and beyond.

The location of the corridor is illustrated in **Figure 1-1**. Between Highway 1 and Simpson Road, Mt. Lehman Road is generally classified as a four-lane urban undivided arterial. South of Simpson Road, the corridor transitions to a two-lane rural undivided arterial. The posted speed across the corridor is maintained at 60km/hr.

This important corridor serves as the primary access to the Abbotsford Airport, which is located approximately 3.5km south of Highway 1 and provides a north-south link through some of Abbotsford's primary industrial and agricultural areas. South of Highway 1, Mt. Lehman Road serves a mixture of commercial and industrial businesses including a gas station, a hotel, storage, wholesale, warehousing, manufacturing and service industrial. It connects with Fraser Highway, which is a key east-west arterial that connects Abbotsford to the Township of Langley and other municipalities further east. Further south, Mt. Lehman Road connects to South Fraser Way, Great Northern Way and Progressive Way, all of which provide access to a mixed use business commercial and industrial area.

South of the industrial area, Mt. Lehman Road connects with Simpson Road, which is an east-west arterial that provides access to a larger commercial and industrial area, as well as connecting the Mt. Lehman area to the core of Abbotsford, located north of Highway 1. South of Simpson Road, Mt. Lehman Road passes through a mix of active agricultural land that is protected as Agricultural Land Reserve (ALR) and land designated for future industrial developments. Mt. Lehman then connects with Marshall Road, which connects Mt. Lehman Road to Clearbrook Road. South of Marshall Road, Mt. Lehman Road provides direct access to adjacent ALR and private properties and then leads directly into the Abbotsford Airport.

The Abbotsford International Airport is the second largest airport in the Lower Mainland after the Vancouver International Airport. The Abbotsford Airport primarily serves passenger travel and is also home to a number of aviation companies and flying schools including Cascade Aerospace, Conair Group, Coastal Pacific Aviation and Chinook Helicopters. The Fraser Valley Trade and Exhibition Centre (Tradex), which hosts a wide range of events year round, is also located at the airport

In March 2015, the Province of BC issued the *B.C. on the Move*, a new transportation plan that identified a set of priorities for improving the Province's transportation network over the next 10 years. One of the priorities identified is to construct highway widening, capacity, safety and operational improvements on provincial highways throughout the Lower Mainland. Under this priority, improving the connection between Highway 1 and the Abbotsford Airport was identified as a candidate location for improvements.

Figure 1-1: Mt. Lehman Corridor Location

In addition, the City of Abbotsford is considering two new road alignment options in the medium-term (15 years) to connect King Road, at Bradner Road, with Mt. Lehman Road at Marshall Road (see **Figure 1-2**). This new connection will provide an important east-west connection between Abbotsford and Langley/Surrey through the 16th Avenue corridor. With this improvement, in combination with future industrial development in the southern section of Mt. Lehman Road, vehicle and truck volumes are expected to increase. With this increase, roadway improvements are required to address future mobility and safety issues. Given that Mt. Lehman Road provides primary access to the Abbotsford Airport, there is an expectation for Mt. Lehman Road to be safe, efficient and reliable.

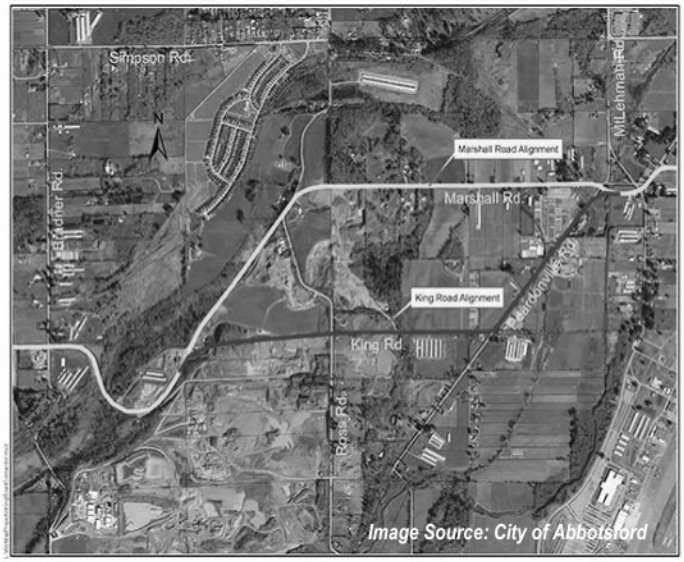


Figure 1-2: King Road Connector Road Alignment Options

Recognizing the importance of Mt. Lehman Road to the efficient movement of people and goods and in support of the priorities set out in the *B.C. on the Move*, MoTI requested that a Business Case be completed for the corridor improvements on Mt. Lehman Road.

As industrial development continues in the Mt. Lehman area, in addition to the City's proposed King Road Connector, both vehicle and truck demands on Mt. Lehman are expected to increase. The projected traffic growth and current safety deficiencies at the key intersections along the corridor would support widening the current two lane section of Mt. Lehman to four lanes. This would also be consistent with the northern section of the corridor.

The purpose of this review is to examine the benefits and costs of widening Mt. Lehman from two to four lanes between north of Simpson Road and the airport's boundary. This review also examine other safety and mobility deficiencies across the corridor and identify other improvements to address these deficiencies.

Findings outlined in this Business Case will guide further discussions between MoTI and the City of Abbotsford relative to project implementation, funding sources and potential partnerships.

2.0 Problem Identification and Definition

This section of the report examines current and future mobility and safety conditions along the Mt. Lehman corridor and identifies corridor deficiencies.

2.1 Mobility

This section highlights existing corridor conditions, including corridor characteristics, existing travel patterns, existing lane configuration, intersection locations and land uses.

2.1.1 Existing Corridor Characteristics

Within the Study Area, Mt. Lehman Road is comprised of both urban and rural roadway conditions with a posted speed of 60 km/hr. From the north, the corridor is generally urban in nature and moving towards Simpson Road, the corridor transitions from an urban arterial to rural highway conditions. The character of the corridor in the northern and southern end is illustrated in **Figure 2-1** and is described in further detail below.

North of Simpson Road

The section of Mt. Lehman Road north of Simpson Road generally consists of three to four travel lanes and is characterized with varying features that are typical of both urban and rural arterials. Mt. Lehman Road is four-lanes from Highway 1 until approximately 85m south of Great Northern Avenue. From there to Simpson Road, the corridor is reduced to three travel lanes with two northbound lanes and one southbound lane. Separated sidewalks and closed ditches are provided in the northbound direction, while in the southbound direction, the corridor includes a mix of separated sidewalks, open and closed ditches and 1.5m of paved shoulders. Existing right-of-ways (RoWs) through this section of Mt. Lehman range from 24m to 26m, with travel lanes generally 3.6m wide. Land use on the east side of the corridor is comprised mostly of industrial uses, while agricultural land uses can be found west of the corridor.

There are generally six intersections, including two signalized intersections, one roundabout and three unsignalized intersections, spaced anywhere between 70m and 270m apart, as well as over a dozen of direct accesses to adjacent industrial development and private properties. The intersections include:

- **Fraser Highway (Signalized)**. The signalized intersection with Fraser Highway generally support two travel lanes in all directions with dedicated left-turn and right-turn lanes. Fraser Highway is a major east-west arterial that connects Abbotsford to the Township of Langley and beyond.

- **Old Yale Road (Unsignalized)**. The intersection with Old Yale Road supports two travel lanes in each direction on Mt. Lehman Road with a 50m left-turn lane in the northbound direction. Old Yale Road is stop-controlled with one travel lane in each direction and the left-turn movement on Old Yale Road is restricted from 6AM – 9PM. Old Yale Road is a local road that provides access to the Shell gas station located on the southwest corner of Mt. Lehman Rd/Fraser Highway as well as industrial businesses on Old Yale Road.

- **South Fraser Way (Roundabout)**. South Fraser Way intersects Mt. Lehman Road with a dual lane roundabout. South Fraser Way is a collector providing access to the industrial area east of Mt. Lehman Rd.

- **Great Northern Avenue (Unsignalized)**. This intersection support two travel lanes in each direction on Mt. Lehman with no provision for left-turn or right-turn lanes. Great Northern Avenue is stop-controlled with one travel lane in each direction. Great Northern Avenue acts as a local service road, providing access to the industrial businesses east of Mt. Lehman Road.

- **Progressive Avenue (Unsignalized)**. The intersection with Progressive Avenue supports one travel lane in the southbound direction and two travel lanes in the northbound direction on Mt. Lehman. Turn lanes are also not provided in either direction. Progressive Avenue is stop-controlled with one travel lane in each direction and is a local road, providing access to the industrial businesses east of Mt. Lehman Road.

- **Simpson Road (Signalized)**. The signalized intersection with Simpson Road support one travel lane in each direction on Mt. Lehman Road with no provision for turn lanes. Two travel lanes are provided on Simpson Road in both directions. Simpson Road is a major arterial that provide travel between the Mt. Lehman area and the City of Abbotsford north of Highway 1.

South of Simpson Road

South of Simpson Road, the corridor transitions into rural conditions with a rural cross-section. It generally consists of two travel lanes with some passing opportunities, paved shoulders of varying widths and open ditches. Dedicated turn lanes are also not provided on this section of the corridor. The posted speed through this section is maintained at 60 km/hr. Existing right-of-ways through this section of the corridor range from 17m to 35m wide, with travel lanes generally 3.6m wide Land use on either side of the highway generally consists of single-family residential properties and agricultural lands.

There are three unsignalized intersections, spaced closely together within a 300m stretch, as well as over 35 direct accesses to adjacent industrial development and provide properties. The intersections include:

- **Mt. Lehman Rd/Peardonville Rd (Unsignalized)**. This intersection support one travel lane per direction on Mt. Lehman with no provision for left-turn or right-turn lanes. Mt. Lehman Road is stop-controlled with one travel lane in each direction and act as a collector road connecting Mt. Lehman Road to the Marshall Road extension.

- **Marshall Rd Extension (Unsignalized)**. The intersection with Marshall Road Extension supports one travel lane in both directions on Mt. Lehman. Turn lanes are also not provided in either direction. Marshall Road Extension is stop-controlled with one travel lane in each direction and is a local road, providing residential and agricultural access.

- **Marshall Road (Signalized)**. The intersection with Marshall Road supports one travel lane in both directions on Mt. Lehman with no turn lanes. Marshall Road is stop-controlled at Mt. Lehman Road and is a four-lane arterial that provides east-west travel between Mt. Lehman Road and Clearbrook Road.

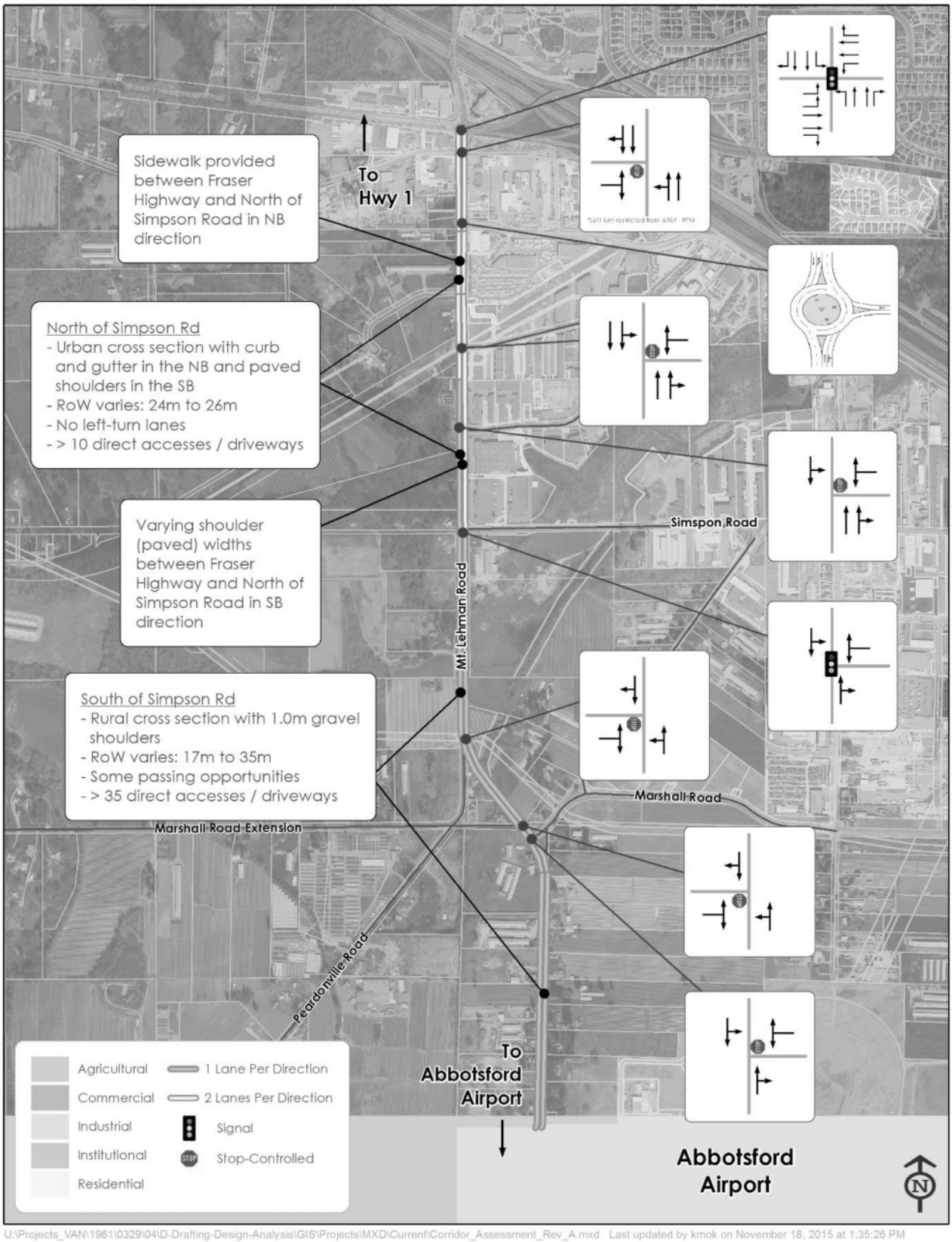


Figure 2-1: Summary of Corridor Characteristics

2.1.2 Existing Traffic Patterns and Conditions

This section examines the existing traffic patterns along Mt. Lehman relative to the daily and peak hour traffic volumes and conditions. This includes a review of corridor daily traffic volumes and traffic profiles, vehicle classification, peak directional volumes, speed profile and Google Traffic conditions. A review of the current intersection operational performance along the corridor is also provided. This review is based on historic traffic count data provided by the City of Abbotsford and daily traffic data collected by Creative Transportation Solution (CTS) between Friday, May 29th, 2015 and Friday, June 5th 2015.

Average daily traffic volumes on Mt. Lehman Road, north of Simpson Road, have increased by approximately 15% between 2009 and 2015. This growth is equivalent to a compounded annual growth rate of about 2.3% per year. **Figure 2-2** illustrates the average weekday daily traffic (AWDT) observed north of Simpson Road for the 2009 to 2015 period. Daily traffic volumes north of Simpson Road were observed to be approximately 14,000 vehicles per day under current (2015) conditions. This is an increase of over 2,000 vehicles per day from 2009.

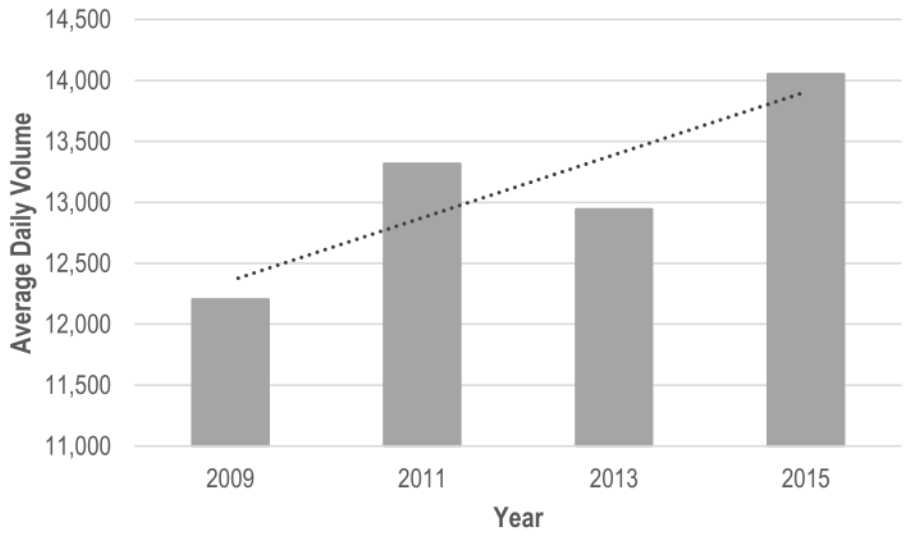


Figure 2-2: Historic Average Daily Traffic Volumes – North of Simpson Road
(Data Source: City of Abbotsford - 2009 to 2013; CTS – 2015)

Illustrated in Figure 2-3, daily volumes on Mt. Lehman are generally higher during the weekday than the weekend, especially along the north end of the corridor. North of Simpson Road, current daily volumes along the corridor are generally in the range of 14,000 vehicles per day during the weekday. Moving south towards Marshall Road, daily weekday volumes are reduced to between 5,000 and 6,000 vehicles per day. Daily volumes during the weekend are generally consistent between the northern and southern end of the corridor, with average volumes between 4,500 and 5,000 vehicles per day. These patterns support the level of expected traffic activity associated with the nature of land uses the corridor currently serves.

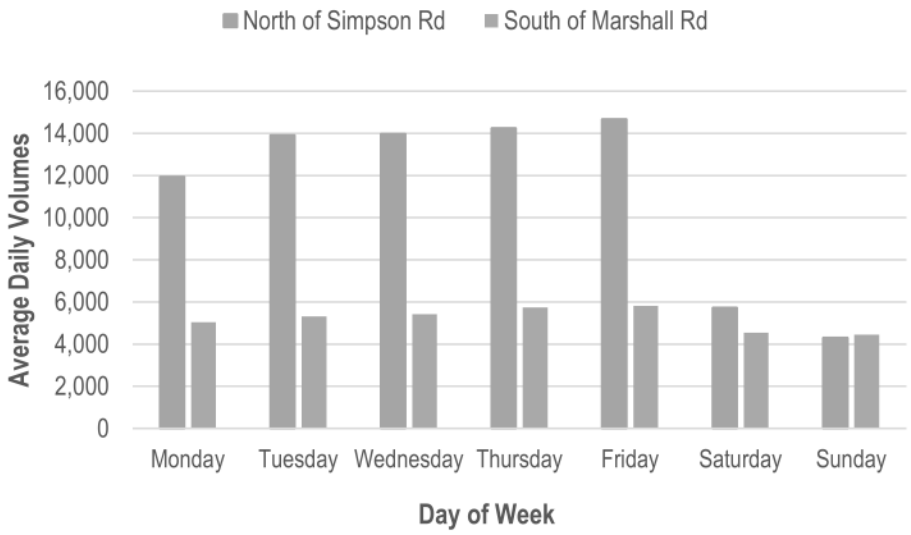


Figure 2-3: 2015 Average Daily Traffic Volumes

Daily traffic volumes on Mt. Lehman Road reach a peak during the morning between 7:00AM and 8:00AM and generally increase throughout the day towards the afternoon peak period, as illustrated in Figure 2-4. The traffic patterns also indicate that peak volumes along the northern section of the corridor are consistently two to three times higher than the southern section. North of Simpson Road, the corridor accommodates two-way volumes of approximately 1,200 vehicles per hour during the afternoon peak. Moving south towards Marshall Road, corridor volumes decreases to under 500 vehicles per hour.

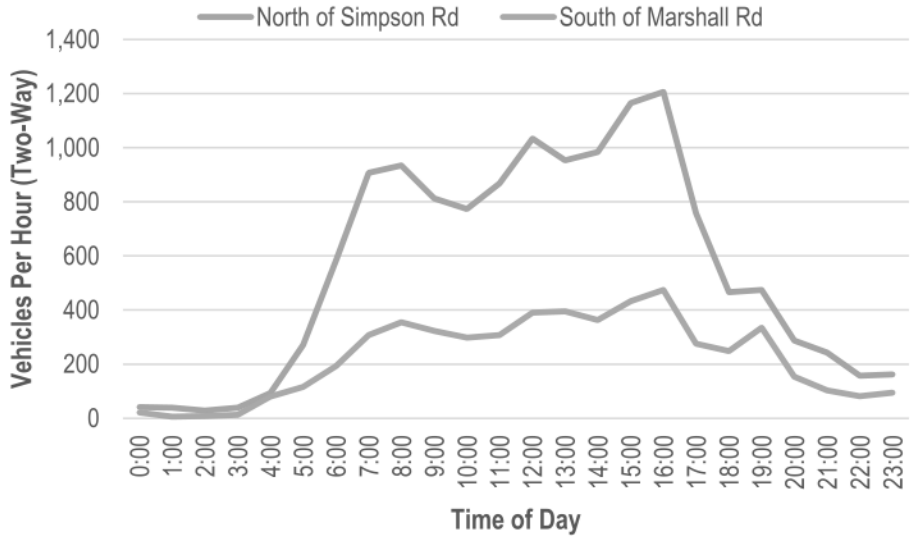


Figure 2-4: Mt. Lehman Road Two-Way Daily Traffic Profile (2015)

Peak directional traffic volumes on Mt. Lehman are generally higher in the afternoon than in the morning. **Figure 2-5** illustrates the peak directional volumes along the corridor are about 25% higher in the afternoon than in the morning. The peak direction along the northern and southern end of the corridor is generally consistent and indicates that the morning peak direction is southbound, while the afternoon

peak direction is northbound. North of Simpson Road, peak directional volumes are between 600 and 800 vehicles per hour, with the PM peak hour accommodating the highest volume (northbound direction). Towards the southern end of the corridor, peak directional volumes are in the range of 200 to 300 vehicles per hour.

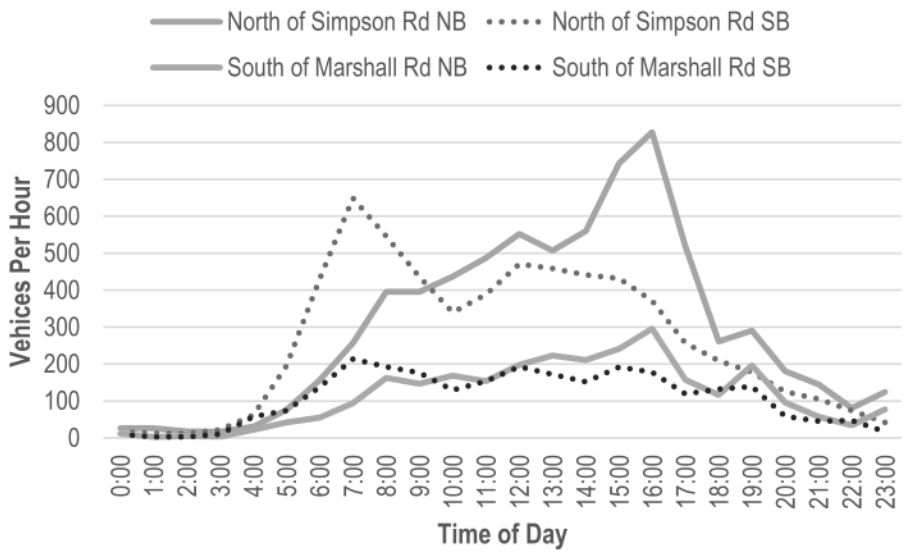


Figure 2-5: Mt. Lehman Road Directional Daily Traffic Profile (2015)

Mt. Lehman Road is considered a key truck route in the Abbotsford area. Vehicle classification counts indicate that commercial vehicles comprise of 8% to 10% of traffic through the corridor on a daily basis.

2.1.3 Existing Corridor Performance

Speed data collected along the corridor indicates that traffic generally operate above posted speeds. The average 85th percentile corridor speed collected north and south of Simpson Road range from approximately 68 km/hr to 77km/hr. This suggests that vehicles are travelling over the speed limit by almost 10 km/hr. **Table 2-1** provides a summary of the corridor speed by direction.

Table 2-1: Average 85th Percentile Speed Summary

DIRECTION	NORTH OF SIMPSON ROAD	SOUTH OF MARSHALL ROAD
Northbound	74 km/hr	70 km/hr
Southbound	68 km/hr	77 km/hr

These patterns are generally supported by the observed peak hour travel speeds along the corridor. As highlighted in **Figure 2-6**, typical weekday traffic patterns extracted from Google Traffic indicate that traffic generally moves relatively well across the corridor during peak hours throughout the day, with delays largely centered at Fraser Highway, South Fraser Way and Simpson Road. Peak directional travel times between Simpson Road and the Airport boundary is typically about 3 minutes in both the morning and afternoon periods.

Figure 2-6: Typical Weekday Peak Hour Google Traffic

Morning and afternoon peak hour traffic volumes at the key intersections were collected on June 4th, 2015 and traffic volumes at the other locations were derived based on these counts. These traffic volumes are illustrated in **Figure 2-7**. These traffic patterns indicate that Mt. Lehman Road, south of Fraser Highway carries almost 1,200 vehicles per hour in the morning and afternoon peak direction. Off-peak directional volumes are generally between 500 and 600 vehicles per hour. Moving south towards Simpson Road, peak directional volumes are reduced to approximately 600 vehicles per hour. The off-peak directional volumes in this area is between 350 and 500 vehicles per hour. South of Simpson Road, Mt. Lehman Road accommodates between 200 and 300 vehicles per hour in the morning and afternoon peak direction, with off-peak directional volumes between 150 and 200 vehicles per hour. These patterns are consistent with expectations for this area given the level and type of development in the northern and southern end of the corridor. Overall, the observed corridor volumes are within the functional capacity of an urban arterial with signalized intersections (800 vehicles per hour per lane) and rural arterial (1,000 vehicles per hour per lane).

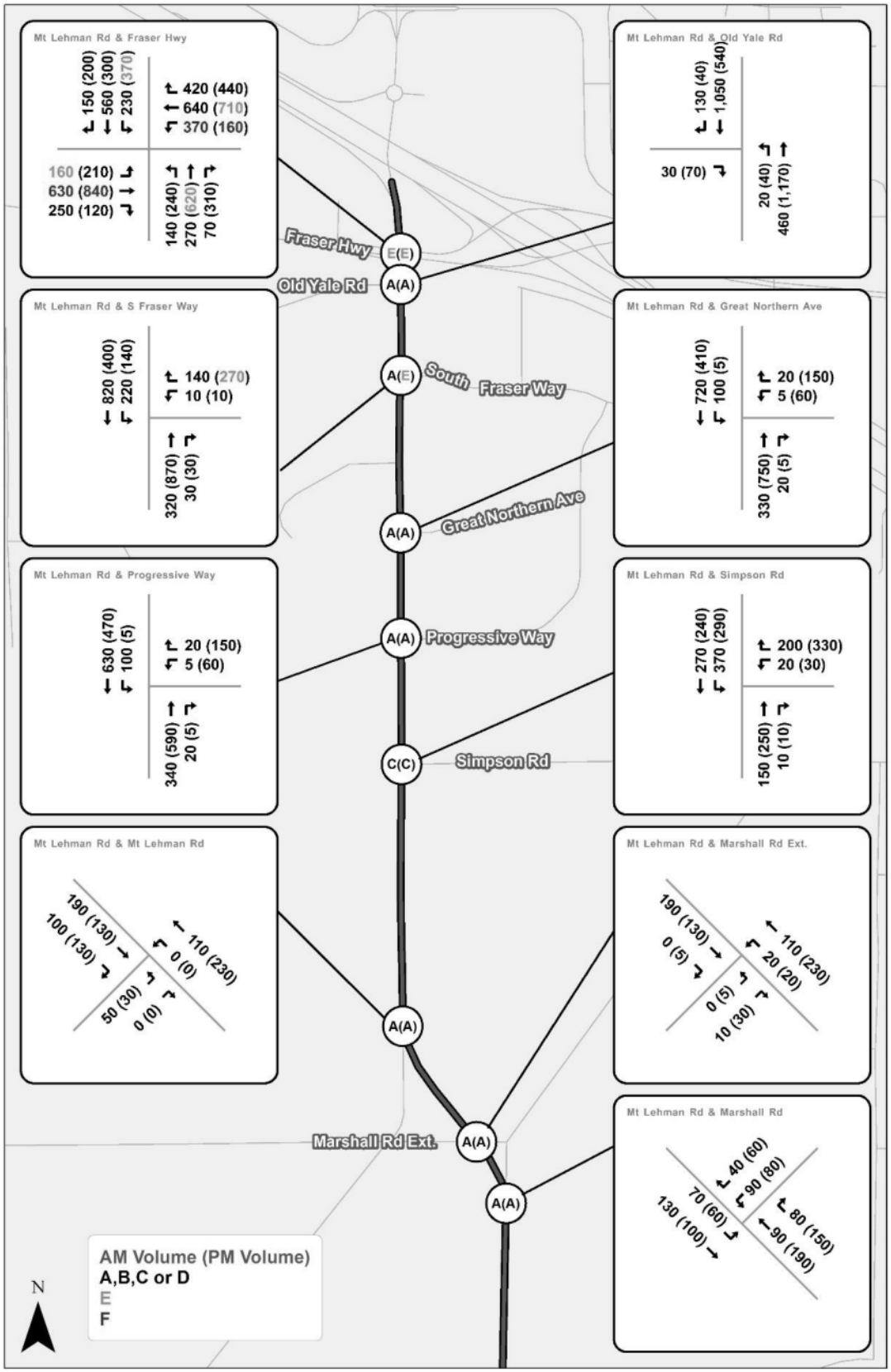


Figure 2-7: Existing (2015) Peak Hour Intersection Volumes and Level of Service

Existing (2015) morning and afternoon peak hour traffic volumes were analyzed under the existing base network using Synchro v8.0. Recognizing Synchro's limitations with roundabout analysis, SIDRA 6.1 was used to analyze the roundabout at South Fraser Way. Traffic performance measures including level of service (LOS), average vehicle delays and 95th percentile queues were reviewed.

The overall performance of a roadway is typically measured by the delays experienced at major intersections, commonly refer to as Level of Service (LOS). LOS is calculated based on current intersection turning movement volumes. The LOS assigned to a signalized intersection can range between LOS "A" and "F". LOS "A" through "C" generally indicate that the intersection experiences very minimal delays during the peak hour, whereas LOS "F" suggests either the delays are significant (greater than 50 seconds/vehicle for unsignalized intersections) and/or the traffic demand is greater than the available capacity. For planning purposes, a LOS "D" is generally considered acceptable for overall intersection operations. LOS worse than "D" may be acceptable for individual movements with lower traffic volumes or with lower priority with respect to overall network performance.

The current corridor mobility performance are generally considered to be within acceptable levels of service. **Figure 2-7** illustrates that the intersections are generally operating at LOS "D" or better, with the exception at Fraser Highway. Fraser Highway is currently operating at LOS "E", with some key movements operating at capacity with longer delays. It is also worth noting that the 95th percentile queue lengths at Simpson Road can reach between 150m to 170m during the peak hours, however, the overall performance is considered to be acceptable (LOS "C"). Individual movements at the remaining intersections are generally operating with minimal to modest delays. These patterns are also supported by the Google Traffic observations illustrated in **Figure 2-6**.

2.1.4 Future Base Conditions (2040 Horizon)

Over the next 25 years, growth in the local, regional and international economies will continue to place increased pressure on the corridor and local area connections. Based on historic population data obtained from BC Stats, population in the Abbotsford area have grown by about 1.0% per year over the past 10 years and is projected to continue growing at this rate over the next 25 years.

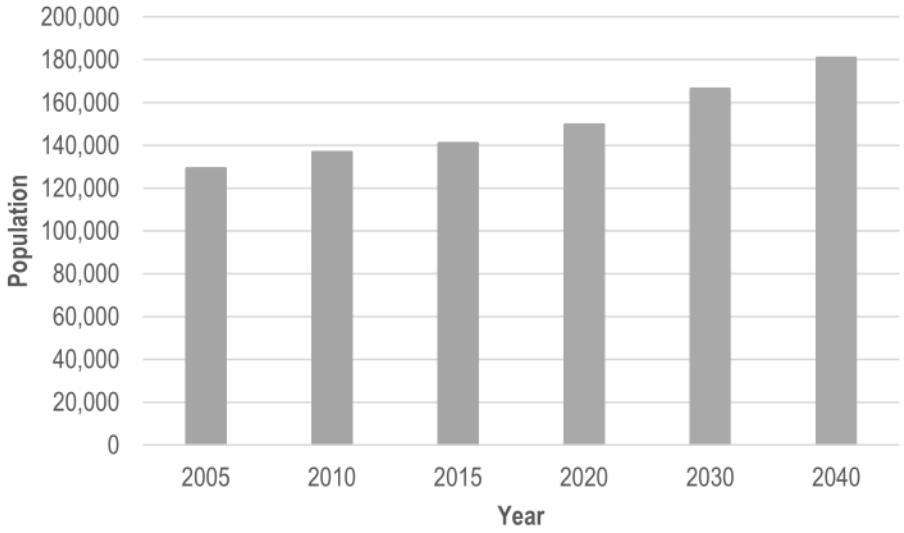


Figure 2-8: Abbotsford Area Population Projection (Data Source: BC Stats)

As previously identified, historic growth on Mt. Lehman Road appears to have increased by approximately 2.3% per year between 2009 and 2015. A review of the City's travel demand model (EMME), which was developed as part of the City's 2007 Transportation Master Plan, indicate that peak directional volumes across the corridor will increase by 650 and 850 vehicles per hour over the next 25 years, while off-peak directional volumes will generally increase by about 300 vehicles per hour. These patterns suggest that traffic volumes along certain segments of the corridor will generally, at a minimum, double from today. More growth is expected south of Marshall Road as the majority of industrial development is expected to occur around this area, in addition to the planned east-west connection between King Road and Marshall Road. Modest growth is expected north of Marshall Road, with most of the traffic heading south towards the Marshall Road area. These trends are aligned with development around the Mt. Lehman area, as the area north of Marshall Road is already largely developed. The rate of traffic growth is generally aligned with the overall growth in the Mt. Lehman area.

Future (2040) morning and afternoon peak hour traffic volumes were analyzed under the future base network, which includes the existing road network in addition an upgraded Marshall Road intersection as a result of the King Road Connector. Marshall Road will become a four-legged signalized intersection, with two travel lanes provided through the intersection on Mt. Lehman. Dedicated left-turn lanes are also provided on Mt. Lehman. The proposed configuration of the Marshall Road intersection is provided in **Appendix A**. **Figure 2-9** illustrates the forecast intersection volumes and level of service.

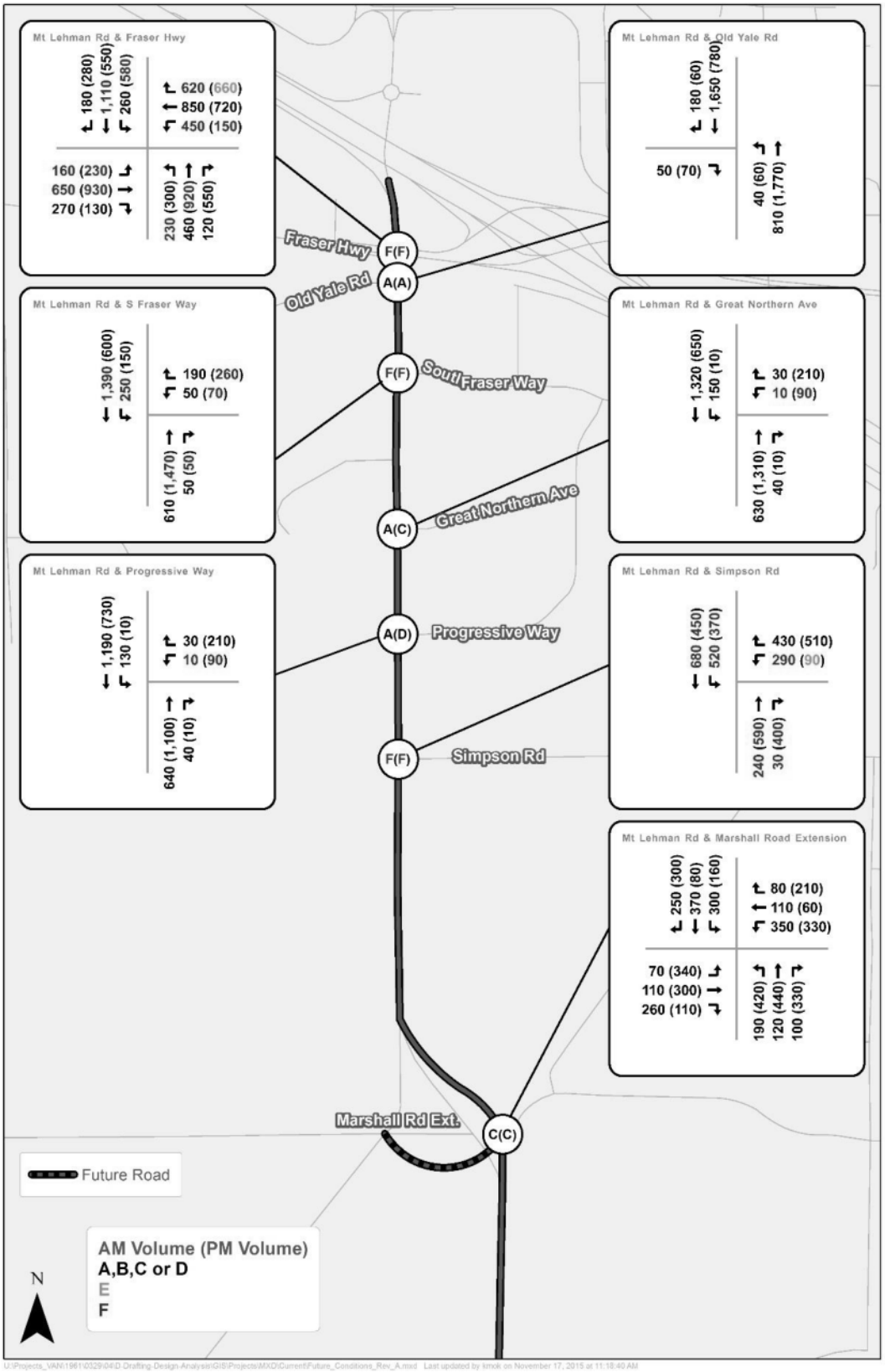


Figure 2-9: Future (2040) Intersection Volumes and Level of Service

Based on the City's travel demand model projections, peak directional volumes south of Fraser Highway is projected to increase from about 1,200 vehicles to 1,800 vehicles per hour during the morning and afternoon peak hours. This increase is carried through towards Simpson Road, with peak directional volumes increasing from about 600 vehicles to 1,200 vehicles per hour. South of Simpson Road, Mt. Lehman Road will accommodate approximately 900 to 1,000 vehicles per hour in the morning and afternoon peak direction – this is an increase of about 700 to 750 vehicles from today. Larger growth is expected in the south due to the new King Road/Marshall Road connection, as well as proposed development. These projected corridor volumes are expected to reach or exceed the current corridor capacity.

The future condition analysis indicates that maintaining the existing corridor configuration in the long-term, with the exception of the Marshall Road realignment, will result in failing level of service with significant delays and extensive queues at the key intersections along the corridor. As illustrated in **Figure 2-9**, these intersections include Fraser Highway, South Fraser Way and Simpson Road. Key turning movements at these locations will also operate with significant delays and longer queues. These delays will inherently increase the corridor travel times.

Travel time information obtained from Google Traffic indicate that it takes typically about 3 minutes to travel between Simpson Road and the airport boundary during the peak periods today. With the projected traffic growth over the next 25 years, peak directional travel time is expected to increase anywhere from 4 to 11 minutes. **Table 2-2** provides a comparison of the peak directional travel time under existing and future base conditions.

Table 2-2: Existing and Future Base Peak Directional Travel Time Comparison

Time Period	Travel Time (Minutes)		
	Existing Base	Future Base	Change in Travel Time
AM Southbound	3.0	6.9	+3.9
PM Northbound	3.0	13.7	+10.7

2.1.5 Abbotsford International Airport (YXX)

Over the past decade, the annual number of passengers travelling through Abbotsford Airport, have increased by over 100,000 passengers. This is shown in **Figure 2-10**. In 2014, the airport served over 475,000 passengers and airport authorities have indicated plans to expand air services to accommodate one million passengers by 2020.

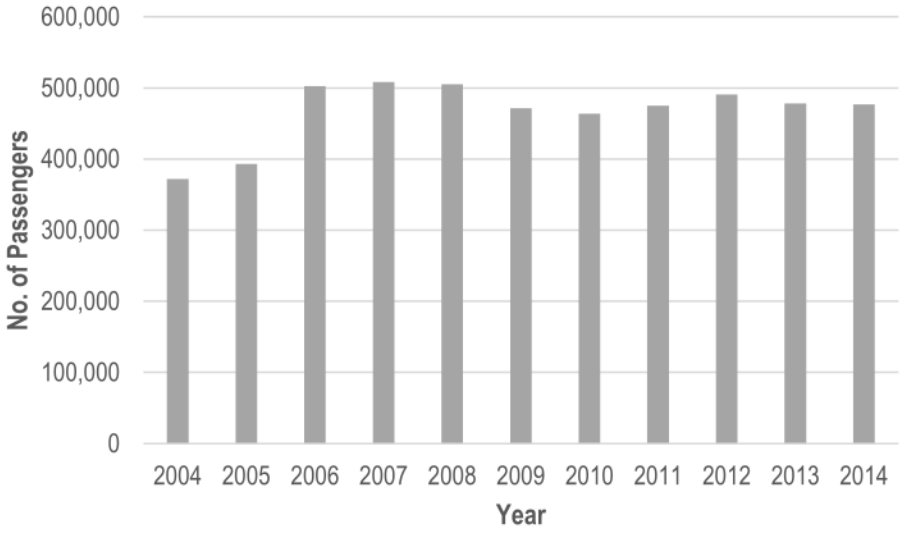


Figure 2-10: Total Number of Airport Passengers (2004 to 2014)

The airport currently provide daily domestic scheduled services and seasonal international services. By the end of June 2015, the airport will operate nine flights per day. Peak airport activity typically occurs between 8:00AM and 10:45AM, with three flights arriving and departing during this time period.

There are currently 14 airport staff, with approximately 1,400 field employees. Future development plans within the airport's land would increase the number of employees and vehicle trips to the area, including a new 120,000 ft^2 hanger space, a multi-modal logistic park, an 8.5acres business park and potential for a hotel if passenger levels reach one million. However, timing of these developments will depend on overall airport growth. Due to the uncertainty around the timing of development, the future projections noted in **Section 2.1.5** do not account for development on airport land.

Mt. Lehman Road is the primary gateway corridor to the airport. Discussions with airport authorities indicate that a majority of concerns from travellers are related to the airport's entrance. The lack of lighting and minimal airport signage, in addition to the rural setting, often cause some confusion for drivers and subsequently questioning their sense of direction. There is certainly a desire from the airport to improve the airport's gateway and enhance the corridor with improved landscaping, lighting and informational/directional signs.

2.2 Safety

Historical collision patterns recorded by ICBC between 2009 and 2013 were obtained from the City of Abbotsford and summarized for the following locations along Mt. Lehman Road:

- Fraser Highway
- Old Yale Road
- South Fraser Way
- Great Northern Avenue
- Progressive Way
- Simpson Road
- Marshall Road/Peardonville Road
- Marshall Road

Between 2009 and 2013, 80 to 120 collisions were reported on the corridor annually, as illustrated in **Figure 2-11**. Since 2009, the total number of collisions have increased by about 50%. Approximately 60% of the collisions resulted in property damage, while the remaining 40% resulted in injury. No fatalities were reported during this time period.

Figure 2-11: Total Collisions by Severity (2009 to 2013)

Figure 2-12 illustrates the distribution of collisions by intersection and show that the majority of collisions reported occurred at the busiest locations on the corridor. Approximately 70% of the collisions reported occurred at Fraser Highway, while 20% of the collisions occurred at South Fraser Way.

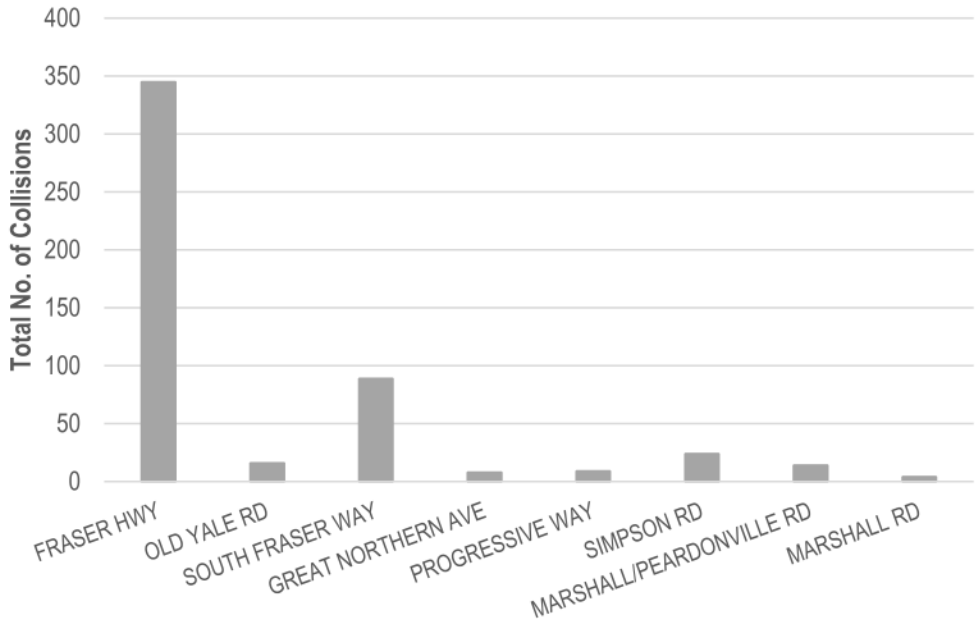


Figure 2-12: Total Number of Collisions by Intersections (2009 to 2013)

As illustrated in **Figure 2-13**, rear end, side impact and conflicted occurrences account for approximately 85% of the collisions reported between 2009 and 2013.

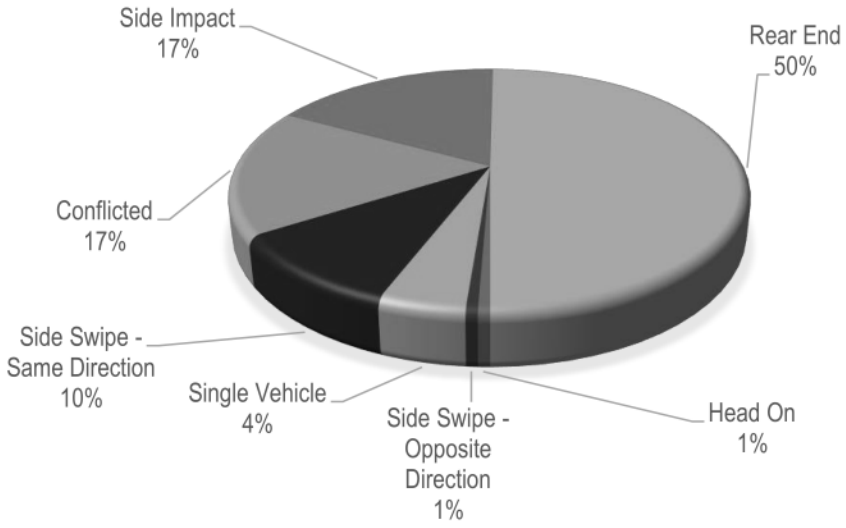


Figure 2-13: Primary Occurrence of Historic Collisions (2009 to 2013)

Safety performance indicators, including intersection collision rates, critical collision rates and collision severity index were calculated for each location and compared to provincial benchmarks for similar facilities. **Figure 2-14** illustrates that the intersection collision rates experienced along Mt. Lehman Road generally exceed the provincial average for similar facilities. Additionally, higher than critical collision rates can be experienced at Fraser Highway, South Fraser Way, Simpson Road and Marshall/Peardonville Road. These patterns suggest that higher collision rates can be attributed to higher traffic activity.

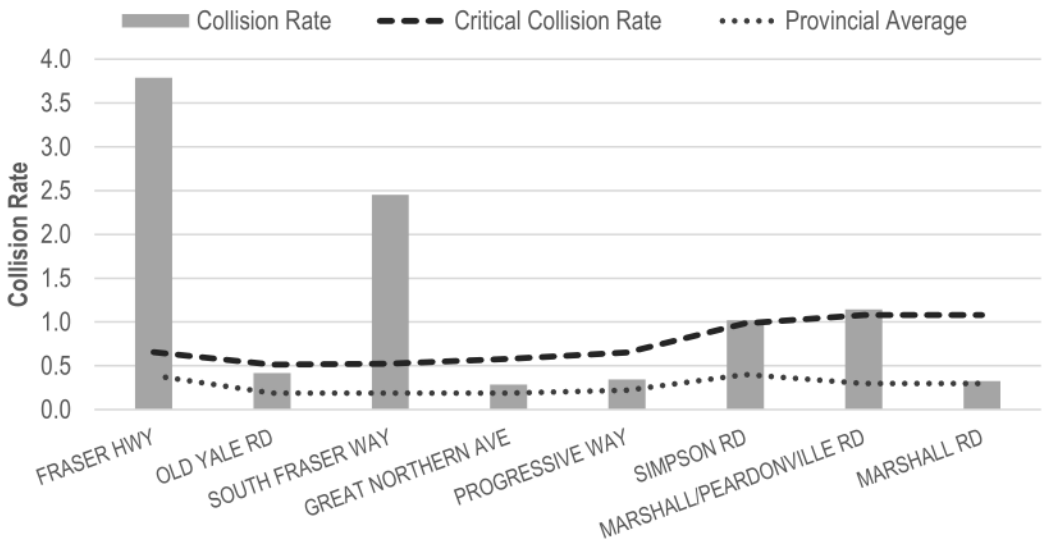


Figure 2-14: Collision Rate Indicators

The collision severity index provides a clear indication of the types of collisions that occur along the study corridor. **Figure 2-15** illustrates that the severity of collisions at key locations generally result in fewer injuries and/or fatalities than similar facilities located elsewhere in the province, with the exception of the Marshall/Peardonville Road intersection. In other words, the collisions are less severe than the provincial average.

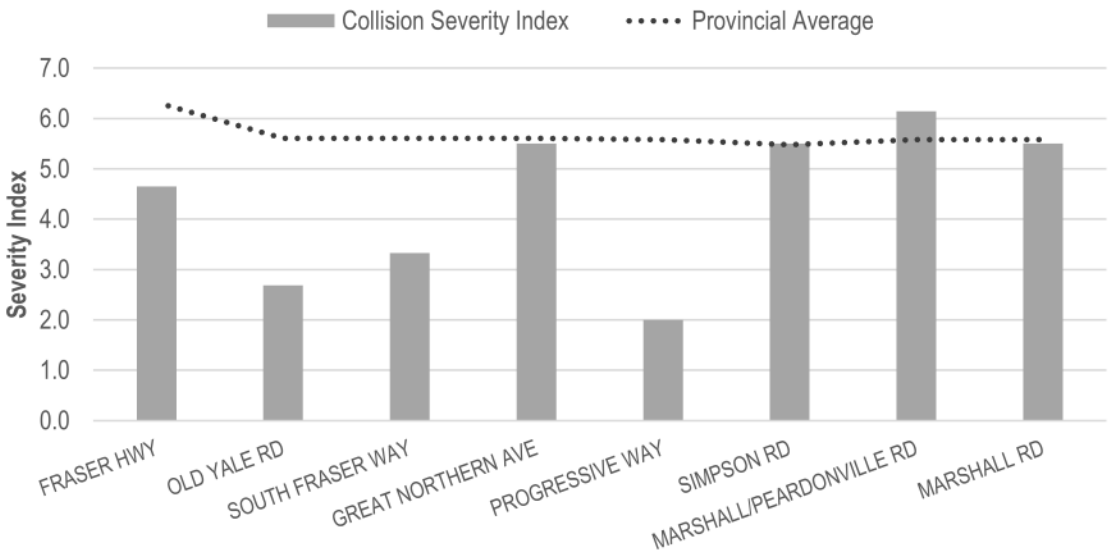


Figure 2-15: Collision Severity

For intersections that had collision rates higher than both the provincial average and critical collision rates, safety patterns were examined in detail to identify specific safety issues. The intersections include Fraser Highway, South Fraser Way, Simpson Road and Marshall Road/Peardonville Road. A summary of the review is further described below.

Fraser Highway

A total of 345 incidents were reported at this location between 2009 and 2013, with 40% of the collisions resulting in injury and the remaining resulting in property damage. Over 50% of the collisions were classified as rear-end collisions and approximately 20% were reported as sideswipe collisions. The time of day patterns are very similar to the traffic profile along the corridor, with over 30% of the collisions occurring during the afternoon peak period (3PM to 6PM). These patterns are typical of urban intersections with higher traffic activity.

South Fraser Way

A total of 89 incidents were reported at this location between 2009 and 2013, with 25% of the collisions resulting in injury and the remaining resulting in property damage. Approximately 60% of the collisions were classified as sideswipe collisions and approximately 30% were reported as rear end collisions. The time of day patterns are very similar to the traffic profile along the corridor, with about 30% of the collisions occurring during the afternoon peak period (3PM to 6PM). The higher percentage of sideswipe collisions can be attributed to driver confusion and potentially, deficiencies with the current roundabout geometry. Based on a desktop review, the roundabout appears to have little deflection. The combination of faded pavement marking, heavy vehicles and little deflection could impact the natural path of vehicles entering the roundabout.

Simpson Road

A total of 24 incidents were reported at this location between 2009 and 2013, with 50% of the collisions resulting in injury and the remaining resulting in property damage. Approximately 30% of the collisions were classified as rear end collisions and approximately 40% were reported as sideswipe or off-road collisions. The time of day patterns are very similar to the traffic profile along the corridor, with about 30% of the collisions occurring during the afternoon peak period (3PM to 6PM). These patterns could be a result of slower moving vehicles through the intersection, as well as the lack of turn lanes.

Marshall Road/Peardonville Road

A total of 14 incidents were reported at this location between 2009 and 2013, with almost 60% of the collisions resulting in injury and the remaining resulting in property damage. Approximately 35% of the collisions were classified as intersection and left-turn related collisions and approximately 20% were reported rear end collisions. The time of day patterns are very similar to the traffic profile along the corridor, with over 30% of the collisions occurring during the afternoon peak period (3PM to 6PM). The higher percentage of intersection and left-turn related collisions could be attributed to the skewed intersection design, which may reduce the sightlines for vehicles turning.

2.3 Problem Definition Summary

The Mt. Lehman corridor is a vital north-south link for the movement of people and goods in the Abbotsford area. The assessment of the existing and future mobility and safety performance and future land use changes along the corridor have identified the following constraints:

- **The mobility performance of the corridor will deteriorate as traffic demands continue to grow over the next 25 years.** Current travel demands are generally within the functional capacity of the corridor, with most intersections currently operating with LOS D or better during the morning and afternoon peak hours. As development continues in the area, traffic volumes on the corridor is expected to increase by as much as 800 vehicles per hour in the peak direction – this would require an additional lane of traffic to accommodate. Without improvements to the corridor, the projected travel demands will exceed the current corridor capacity, with key intersections operating with significant delays and failing conditions.

- **Corridor travel times will increase significantly due to significant intersection delays.** It typically takes about 3 minutes to travel between Simpson Road and the airport boundary during the peak periods today. With the projected traffic growth over the next 25 years, peak directional travel time is expected to increase by as much as 11 minutes.

- **High percentage of truck volumes contribute to delays and safety issues.** Trucks travelling on Mt. Lehman account for approximately 8% to 10% of the corridor volumes. Increased truck activity can be excepted as industrial development continues in the area in combination with the anticipated King Road Connector, leading to greater intersection delays as trucks generally occupy more space and longer acceleration times at intersections. The percent time-following behind slower moving vehicles may also increase due to the lack of passing opportunities. This can often result in driver frustration that leads to poor decisions making, aggressive driving and risky passing manoeuvres.

- **Above provincial collision rates at Fraser Highway, South Fraser Way, Simpson Road and Marshall Rd/Peardonville Rd** indicate a safety problem with rear end, sideswipe and intersection/left-turn related collisions. Although these patterns are typical for the urban intersections, the lack of turn lanes along the corridor could attribute to the rear-end collisions.

- **Existing facilities for cyclists and pedestrians is limited throughout the corridor.** The corridor north of Simpson Road provides a 1.5m paved shoulder in the southbound direction and paved sidewalks in the northbound direction. South of Simpson Road, the shoulders are of varying widths and have no other dedicated pedestrian or cyclist accommodation.

3.0 Concept Development and Evaluation

This section examines potential long-term improvement concepts to address the key mobility and safety challenges described and summarized in **Section 2.0**. The improvements include widening the corridor from two to four lanes from Simpson Road to the Airport's boundary in addition to supporting intersection improvements.

3.1 Concept Development

Based on the existing conditions assessment, the Mt. Lehman corridor is approaching the capacity of a two-lane roadway, with some cross movements operating near capacity during the PM peak hour. In addition, safety concerns at key intersections have been identified. As growth continues in the area, in addition to the new King Road connector, projected traffic volumes will exceed the current corridor capacity, with key intersections operating under failing levels of service. Through these findings, it can be confirmed that these issues can be mitigated through the widening of the corridor from two to four lanes from north of Simpson Road to immediately north of the Airport's boundary – approximately 1.8km in length. The widening would be supported by intersection improvements and access management along the corridor, including:

- **Fraser Highway** - provide a second westbound left-turn lane. This improvement would reduce the westbound left-turn delays and queues.

- **South Fraser Way** - convert roundabout to a conventional T-intersection with a southbound left-turn lane. This improvement is expected to reduce the projected delays on South Fraser Way and address some of safety issues with sideswipe collisions.

- **Simpson Road** - provide dual southbound left-turns to accommodate the projected turn volumes.

- **Marshall Road/Peardonville Road** - close intersection to consolidate access around the Marshall Road intersection.

- **Marshall Road Extension** - close intersection to consolidate access around the Marshall Road intersection.

- **Marshall Road** - convert to a 4-legged signalized intersection with provision for left-turn lanes as per the King Road Connector concept. This intersection will also support the closure of the Marshall Road/Peardonville Road and the Marshall Road Extension intersections.

Although intersection improvements were identified to mitigate the projected failing conditions at the intersections with Fraser Highway and South Fraser Way, MoTI have indicated that this Business Case would primarily focus on the corridor widening and intersection improvements between north of Simpson Road and the Airport's boundary, as these improvements were considered a priority in the Province's 10-Year Transportation Plan (BC on the Move). The improvements identified at Fraser Highway and South Fraser Way would be considered at a later time through future corridor review. To this end, the concepts explored are centered on four-laning the corridor and the supporting intersection improvements.

Through discussions between MoTI and City of Abbotsford, it was agreed that the corridor would be widened based on the Ministry's typical urban 4-lane cross section as shown in **Figure 3-1**.

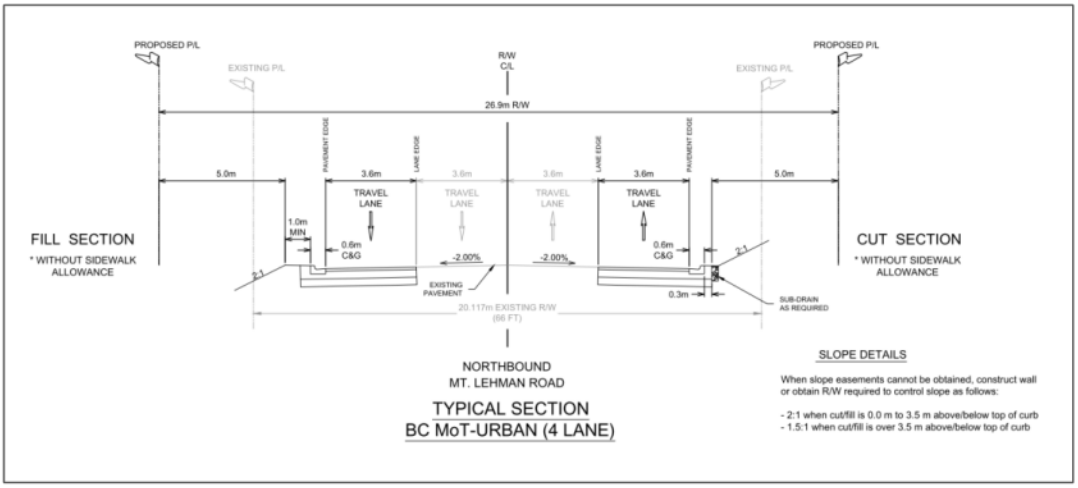


Figure 3-1: BC MoTI Typical Urban (4-Lane) Cross Section

The cross-section shown above would require approximately 27m of right-of-way and this can be accommodated within the existing right-of-way between Simpson Road and about 400m north of Marshall Road. From this point until the Airport's boundary, the right-of-way along the corridor is reduced to 20m or less, which mean that property takes would be required to accommodate the widening. In order to understand and mitigate the number of property takes, two concepts of the widening were developed and reviewed. The proposed improvements are illustrated in **Figure 3-2** and further described below. Conceptual design drawings for each concept is provided in **Appendix B**.

Concept 1 – Existing Centreline

In Concept 1, the current roadway alignment is maintained and the corridor is widened by providing an additional lane on either side of Mt. Lehman between north of Simpson Road to the airport's boundary. The posted speed along the corridor is also maintained at 60km/hr. Mt. Lehman Road is widened from two to four travel lanes through each of the intersections. At Simpson Road, dual southbound lanes are also provided by a protected signal phase.

The intersection improvements at Marshall Road is built on the concept developed by the City of Abbotsford as part of the King Road Connector project, which considers a new road alignment connecting King Road at Bradner Road, with Mt. Lehman Road at Marshall Road. This concept provides two travel lanes on Mt. Lehman with the provision of left-turn lanes. Marshall Road crosses Mt. Lehman with two travel lanes in each direction. With the new King Road Connector, access on Mt. Lehman at the intersections with Mt. Lehman/Peardonville Road and Marshall Road Extension is removed.

Approaching the airport's boundary, a dropped lane in the southbound direction and a merge lane in the northbound direction is provided to tie the proposed widening to the existing two-lane roadway on the airport side.

In Concept 1, properties on both sides of the corridor are impacted, primarily in the area south of Marshall Road. Property takes on the northwest quadrant of the intersection with Simpson Road is also required to accommodate the widening with the dual southbound left-turn lanes.

Sidewalks and improved street lighting are also provided. Sidewalks are provided in the vicinity of Simpson Road, while south of Simpson Road will be protected for sidewalks and constructed as development occurs.

Concept 2 – Modified Centreline

In Concept 2, the proposed corridor and intersection improvements are identical to Concept 1, with the exception of the alignment south of Marshall Road. South of Marshall Road, the current alignment on Mt. Lehman is shifted towards the east to avoid property impacts on both sides of the corridor. In this regard, only the properties on the east side of Mt. Lehman are impacted.

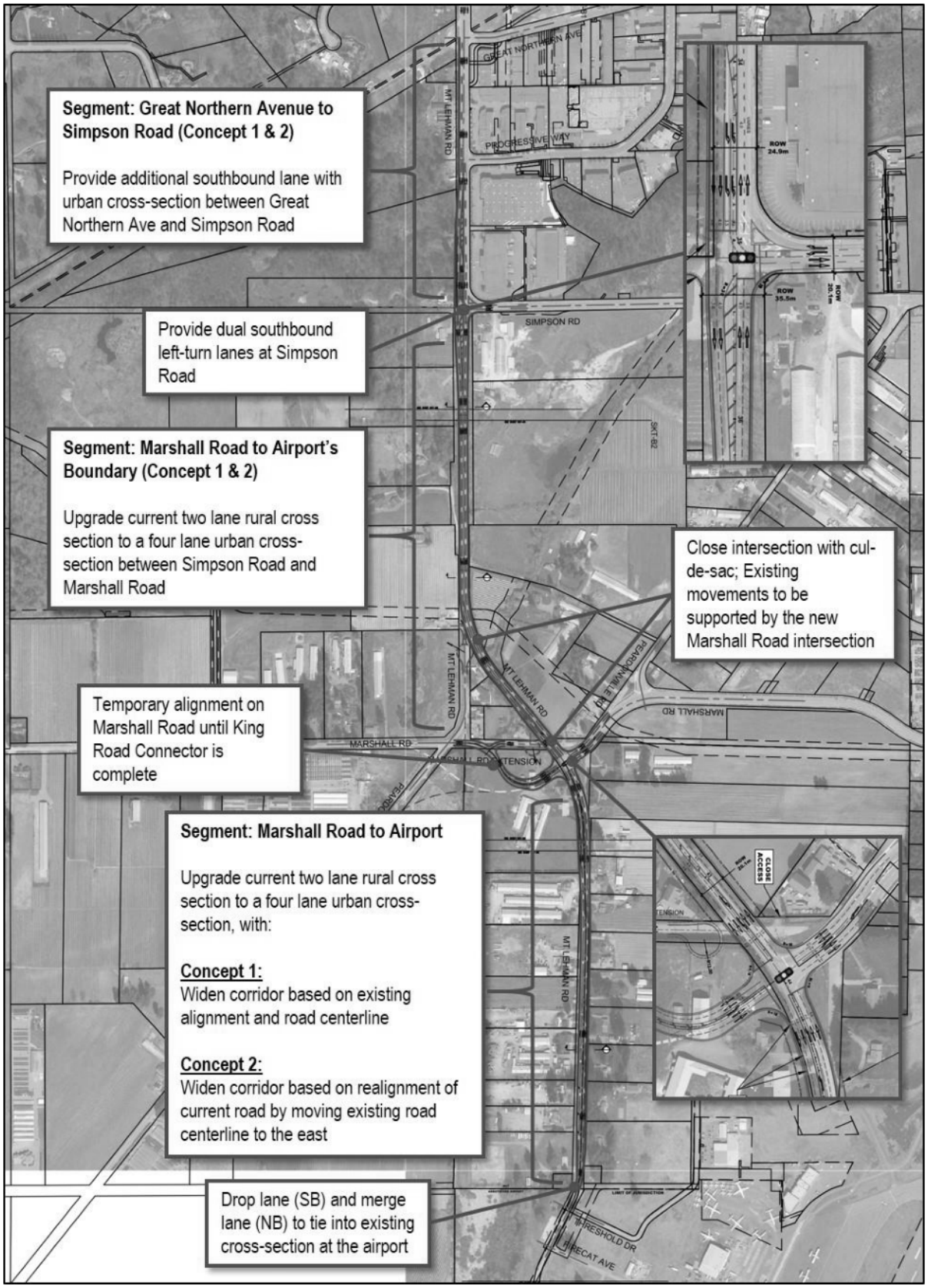


Figure 3-2: Proposed Improvements

URBAN systems

3.2 Concept Evaluation

The proposed corridor widening and intersection improvements were found to provide significant travel times savings across the corridor. Travel time information obtained from Google indicate that it takes typically about 3 minutes to travel between Simpson Road and the Airport boundary during the peak periods. With the projected traffic growth over the next 25 years, peak directional travel time is expected to increase anywhere from 4 to 11 minutes. This is primarily due to significant intersection delays projected at Simpson Road and Marshall Road. The corridor and supporting intersection improvements would provide approximately 4 minutes of travel time savings under the future peak hours, as summarized in **Table 3-1**.

Table 3-1: Future Corridor Peak Directional Travel Time Savings

Time Period	Travel Time (Minutes)		
	Future Base	Future Improved	Improved Travel Time Savings
AM Southbound	6.9	2.6	-4.2
PM Northbound	13.7	9.4	-4.3

The intersection upgrades at Simpson Road would improve the projected intersection level of service from LOS F to LOS C. Key movements at this intersection would generally operate at a LOS D or better. The operations at the Marshall Road intersection would generally remain the same as future base conditions, however, the queues on Mt. Lehman Road would be reduced due to the additional lane capacity approaching the intersection.

3.3 Preferred Concept

s.13,s.17

4.0 Multiple Account Evaluation

This section describes the evaluation of the costs, benefits, impacts and risks of the preferred improvement concept based on a Multiple Account Evaluation (MAE) approach consistent with the BC Provincial Business Case Guidelines. The MAE methodology is intended to capture both the quantifiable measures of project cost and direct project benefits, in addition to more qualitative measures of direct project benefits, as well as wider scale in direct benefits. Within the MAE, the quantitative measures are monetized over a 25-year period using a 6% discount rate to determine the Net Present Value (NPV) and Benefit-Cost (B/C) Ratio. For this assignment, a MAE was completed for the Preferred Concept described above using the following accounts:

- **Financial**
  - Project Costs (construction, engineering, property)
  - Maintenance (annual and periodic rehabilitation)
  - Salvage Value
- **Customer Service**
  - Mobility (travel time and vehicle operating cost savings)
  - Safety (collision reductions)
- **Social/Community**
- **Environmental**
- **Economic**
  - Net Present Value
  - Benefit-Cost Ratio

4.1 Financial Account

The financial account represents the discounted life-cycle costs over 25 years. These include the initial investment (construction, property acquisition, engineering and project management), annual maintenance and rehabilitation costs, and the salvage value at the end of the project's life cycle. In order to represent common dollars, the Present-Value (PV) method is typically used to discount future costs. A discount rate of 6% was assume for this evaluation, as is consistent with the Provincial Business Case guidelines.

- **Project Costs**. Class D cost estimate were prepared based on the concept developed and refined with MoTI. The capital costs for the proposed improvements, including construction, engineering and project management is estimated to be **$19.2M** and are highlighted in **Table 4-1**. A 40% contingency was included in the cost estimate. Property costs were estimated to be **$750,000**, as provided by MoTI. Further details on project costs and property take are provided in **Appendix C**.

Table 4-1: Estimated Project Costs

Cost	Cost Estimate (2015$)
Construction	$12.5M
Engineering and Project Management	$1.7M
Contingency (40%)	$5.0M
Property Acquisition	$0.75M
TOTAL (2015$)	**$20.0M**

- **Maintenance.** Annual maintenance costs are calculated using values as described in the *Default Values for Benefit Cost Analysis In British Columbia 2012*. The annual maintenance of new roads is estimated to be approximately $3,839 per lane kilometre, while periodic rehabilitation costs which assume hot mix paving once every 15 years are estimated to be $110,000 per lane kilometre. The discounted maintenance cost over 25 years is estimated to be **$530,000**.

- **Salvage Value**. The salvage value represents the investment at the end of the analysis period. In this case, the salvage value was assumed to be 20% of the total construction cost (including contingency) and is estimated to be **$3.7M**.

4.2 Customer Service Account

The customer service account represents the cost to the roadway users over the project's life cycle. This includes travel time and vehicle operating costs, and collisions accrued and discounted over 25 years. Improvements to the corridor that result in improved mobility and safety can be compared to the financial account of the project.

Benefits in the customer service account identify benefits to roadway users, but also reflect improvements to local, regional, and provincial connectivity because they reflect the reduced travel time and lower collision costs experienced by these trips.

- **Mobility.** As noted in Section 1 of this report, the Mt. Lehman corridor within the study area serve important, local, regional and international mobility and economic roles. Reduction in travel time along the corridor will have positive effects on the larger network. Mobility benefits to vehicles travelling through the study area were determined based on the change in average delays between the existing and future base versus the improved condition under the same time horizons. The widening of the corridor from two to four lanes, in combination with intersection improvements provide additional capacity on the corridor. Intersection delays are also reduced as a result of the addition of turn lanes. Which all serve to improve overall performance on the corridor.

  Travel time benefits were calculated separately for private vehicles and trucks along the corridor using the assumed travel time costs for automobiles and trucks as summarized in **Table 4-2**. Projected 25-year travel time savings are estimated to be **$25.2M** in 2015 dollars (based on a discount rate of 6%).

Table 4-2: Value of Travel Time

Vehicle/Driver Type	Value ($ per hour)
Automobile	$15.94
Single Unit Truck	$46.03
Combination Truck	$53.30

Vehicle operating costs can be assumed to decrease due to reduced vehicle idling and improved traffic flow and the corresponding improvement in fuel efficiency. Vehicle operating cost savings were determined to be **$1.5M** over 25 years. The total mobility benefits from the improvements, including travel time savings and vehicle operating cost savings, were determined to be **$26.7M** over 25 years.

It is worth noting that the travel time benefits noted above are incurred after project completion and do not account for the potential offsets to travel time during construction due to traffic disruption. The disruption to travel time during construction would only be temporary and should be managed through a traffic management plan.

- **Safety**. The Collision Prediction Model (CPM), a spreadsheet tool developed by BC MoTI, was used to estimate the potential safety benefits as a result the corridor and intersection improvements. Using a combination of collision modification factors (CMFs) for BC and from the Highway Safety Manual, the CPM was used to evaluate and compare the safety benefits.

  The largest reduction in collisions was found to be provided by implementing left-turn lanes at Simpson Road and the signal intersection upgrade at Marshall Road.

  The value of various collisions (by severity), as described in the *Default Values for Benefit Cost Analysis In British Columbia 2012* is summarized in **Table 4-3**.

Table 4-3: Cost of Collisions to Society

Severity Type	Value ($ per hour)
Fatal	$6,385,999
Injury	$135,577
Property Damage	$11,367

The proposed improvements are expected to reduce the collision frequency by as much as 25% along the corridor. Discounted to present value at 6%, the total safety benefits over 25 years were determined to be approximately **$1.5M**.

4.3 Social/Community

The social/community account evaluates the potential effect of the roadway improvement on community and social values. These are generally qualitative measures but are considered in combination with the more quantifiable economic indicators. Factors that are typically considered include:

- Noise, Visual and Pollution Impacts – exposure and magnitude;
- Community Displacement – Property takes, partial and full; and
- Community Severance – the 'barrier effect' of the highway on local and pedestrian traffic.

When evaluating competing options, these factors are usually considered using a single qualitative measure of low, moderate or high impact, with low being the most desirable and high being the least desirable. However, in this case, only one option is being evaluated and therefore comparative measures such as these are not as useful. For this reason, social/community impacts will be discussed as they relate

to the existing conditions and evaluated based on their estimated positive, neutral or negative impact to key stakeholders.

Table 4-4: Summary of Socio-Community Accounts

Account	Impact
Noise and Visual	**Neutral** – Both noise and visual impacts are expected to remain relatively the same as today with the proposed improvements.
Pollution	**Modest Benefit -** The proposed improvements are expected to reduce vehicle stops, delays and the number of vehicles idling with the corresponding reduction in vehicular emissions.
Community Displacement	**Modest Impact** - Approximately 20 partial property takes are required to accommodate the widening.
Community Severance	**Neutral** - The proposed improvements do not substantially impact community connections or create additional barriers.

4.4 Environmental & Geotechnical

The environmental account is intended to identify any significant environmental impacts resulting from the proposed improvements. This is not intended to replace an environmental assessment, if required, but only as a qualitative measure of potential impact. In addition, qualitative measures of reduced greenhouse gas (GHG) emissions have also been included.

- **Environmental**. While a detailed environmental assessment has not been conducted in the context of this project, there are a number of anticipated environmental impacts that would need to be addressed and mitigated. The Mt. Lehman area is situated on the Abbotsford-Sumas Aquifer, which is an underground water storage used by over 100,000 people in BC and Washington. The aquifer is easily contaminated as the water table is relatively close to the surface. There is also a creek that runs across Mt. Lehman, which is likely home to a number of habitats, wildlife and fish species. Additionally, there is a gas line that runs across Mt. Lehman, immediately north of Marshall Road. Finally, there will be some impact to the Agricultural Land Reserve (ALR), as the area south of Marshall Road is largely designated as ALR and is also where most of the property takes are required to accommodate the widening. Appropriate mitigation measures will be required to minimize these impacts, whether during construction and/or implemented in the roadway design. For these reasons, modest impacts are expected for the environmental account. It is recommended that a detailed environmental assessment be completed should the project advances forward to the next phase of design.

- **Geotechnical and Archeological**. Geotechnical and archeological impacts were not reviewed as part of this Business Case. It is recommended that a detailed geotechnical and archeological assessment be completed should the project advances forward to the next phase of design.

- **Greenhouse Gas (GHG) Emissions**. Vehicle emissions and fuel consumption impacts were estimated using BC MoTI's ShortBen methodology. For the proposed improvement, estimated outputs

over 25 years are summarized in **Table 4-5**. GHG emissions were found to decrease over the 25-year period with the proposed improvement.

Table 4-5: Vehicle Emissions Savings

Vehicle Emissions	GHG Savings (Tonnes per Year)
Carbon Dioxide (CO_2)	30
Nitrogen Oxide (NO	3
Hydrocarbon (HC)	2

4.5 Economic Development

This account addresses the **Provincial/Federal** benefits of the proposed project. Since local benefits (including some economic benefits) are typically captured qualitatively in the social / community account, they are not considered here. In addition, according to federal benefit-cost methodology, economic impacts derived from transportation projects such as improved private business opportunities, are excluded from consideration. Given that the source of these benefits is captured by reduced travel time, vehicle operating costs, and collision costs in the customer service account, the inclusion of additional economic benefits that arise from spending those savings would be counted twice. For this reason, the 'multiplier effect' of secondary economic benefits is not included in the benefit-cost evaluation of this project. While these secondary economic benefits are excluded from the strict benefit-cost equation, they do represent potential benefits to the provincial/national economy and can be included as a qualitative measure of project viability.

4.6 Multiple Account Evaluation Summary

A summary of all Multiple Account Evaluation accounts is provided in **Table 4-6**. These include both quantitative measures used for the economic evaluation of the project and qualitative measures of direct project benefits and wider scale indirect benefits. Key economic indicators such as, Net Present Value (NPV) and Benefit-Cost Ratio (B/C), are included for a 25-year period and reflect the assumptions for traffic growth as highlighted in **Section 2.0**. The costs reported in the table below has been discounted to present value (PV) using a 6% discount rate.

The proposed improvements will result in positive economic indicators, with a net present value of $13.0M and a B/C ratio of 1.9, and support project advancement. As discussed previously, Mt. Lehman serves as the primary access to the Abbotsford Airport, as well as a north-south link through some of the primary industrial and agricultural areas in the Mt. Lehman area. Improvements to the arterial roadway will result in overall benefits to the local, provincial and national economy. The anticipated social and economic benefits are also aligned with the objectives of the corridor plans.

When evaluating any type of transportation improvement project at a strategic/planning level, such as in this case, there is a level of uncertainty inherent in the results. The calculation of financial costs and benefits related to the project rely upon numerous assumptions, estimations, and secondary sources. While all assumptions made as part of this review were based on the best information available at the time, there will always be a certain level of risk with the results presented.

Table 4-6: Multiple Account Evaluation Summary

Discount Rate = 6%	
FINANCIAL ACCOUNT	
Capital Cost (2015$)	$19.2M
Property Cost (2015$)	$0.75M
Capital Cost (PV)	$17.8M
Property Cost (PV)	$0.71M
Maintenance (PV)	$0.53M
Salvage Value (PV)	$3.7M
Total Incremental Cost	***$15.3M***
CUSTOMER SERVICE ACCOUNT	
Travel Time Savings (PV)	$25.2M
Vehicle Operating Savings (PV)	$1.5M
Safety (PV)	$1.6M
Total Incremental Benefits (PV)	***$28.3M***
SOCIAL/COMMUNITY ACCOUNT	
Noise and Visual Impacts	◑
Pollution Impacts	◕
Community Displacement	◔
Community Severance	◑
Consistency with Corridor Plans	●
ENVIRONMENTAL ACCOUNT	
Environmental	◔
Geotechnical & Archaeology	◑
Carbon Dioxide (CO2) (Tonnes/yr)	30
Nitrogen Oxide (NO) (Tonnes/yr)	3
Hydrocarbon (HC) (Tonnes/yr)	2
KEY ECONOMIC INDICATORS	
Net Present Value	**$13.0M**
Benefit-Cost	**1.9**

● Significant Benefit ◕ Modest Benefit ◑ Neutral ◔ Modest Impact ○ Significant Impact

5.0 Sensitivity Analysis

In order to consider the risks and uncertainties inherent in this type of evaluation appropriately, a sensitivity analysis was conducted. This approach considers a range of uncertainty for key factors in the project assessment. The result is that the conclusions reached can be tested for resiliency against potentially changed economic conditions. For this assignment, sensitivity analyses were conducted for several key variables including discount rates, traffic growth and cost estimates.

5.1 Discount Rates

To convert future project related costs and benefits to a common present value for comparison, a discount rate was used in the benefit-cost evaluation. This rate is typically set to reflect the rate of inflation, and is therefore subject to changes depending on overall economic circumstances. In this type of evaluation the discount rate is of particular importance for future benefits (mobility and safety). However, project costs are also affected where future costs must also be discounted to represent present value. According to the *BC Ministry of Transportation's Benefit-Cost Guidebook*, a discount rate of 6% should be used for Provincial benefit cost evaluation. This value has been used for the original analysis presented above. On the other hand, the *Transport Canada – Guide to Benefit-Cost to Analysis* indicates that a rate of 10% is appropriate for federal business cases. Consequently, in order to test the sensitivity of the results of this evaluation, the benefit-cost analysis was also calculated using the 10% discount rate as preferred by Transport Canada, and an additional 8% rate for comparison. The results of the analysis are summarized in **Table 5-1**.

Table 5-1: Discount Rate Sensitivity

Account	Discount Rate		
	6%	8%	10%
FINANCIAL ACCOUNT			
Discounted Project Cost	$18.5M	$18.0M	$17.6M
Maintenance	$0.53M	$0.42M	$0.34M
Construction Salvage Value	($3.7M)	($3.6M)	($3.5M)
Total Costs (PV)	***$15.3M***	***$14.8M***	***$14.4M***
CUSTOMER SERVICE ACCOUNT			
Travel Time	$25.2M	$18.9M	$14.5M
Vehicle Operating	$1.5M	$1.1M	$0.86M
Safety	$1.6M	$1.1M	$0.80M
Total User Benefits (PV)	***$28.3M***	**$21.1M**	**$16.1M**
KEY ECONOMIC INDICATORS			
Net Present Value	**$13.0M**	**$6.3M**	**$1.7M**
Benefit-Cost Ratio	**1.9**	**1.4**	**1.1**

This analysis indicates that the key economic indicators are sensitive to a reasonable variation in discount rate. As expected, the economic indicators are improved with reduced discount rate assumptions. The key

indicators remain positive with a discount rate assumption of 10% - resulting in a NPV of $1.7M and a B/C ratio of 1.1.

5.2 Traffic Growth

The estimate of mobility and safety benefits is heavily dependent on traffic volumes and the projection of future traffic conditions at the end of the forecast horizon. In order to test the sensitivity of travel time benefits to modified traffic growth assumptions, a +/- 20% in traffic volumes were evaluated against the base condition. The results of the sensitivity analysis are summarized in **Table 5-2**.

This analysis indicates that traffic growth rate affects the magnitude of customer service benefits over 25 years. As expected, an increased growth rate assumption results in increased economic indicators. Reducing projected traffic volumes by 20% still results in a very positive NPV of $4.4M and a B/C ratio of 1.3. Increasing traffic volumes by 20% produces significant customer service benefits, resulting in a NPV of $18.9M and a B/C ratio of 2.2.

Table 5-2: Traffic Growth Sensitivity

Account	Traffic Growth		
	-20%	Base	+20%
FINANCIAL ACCOUNT			
Discounted Project Cost	$18.5M	$18.5M	$18.5M
Maintenance	$0.53M	$0.53M	$0.53M
Construction Salvage Value	($3.7M)	($3.7M)	($3.7M)
Total Costs (PV)	***$15.3M***	***$15.3M***	***$15.3M***
CUSTOMER SERVICE ACCOUNT			
Travel Time	$16.8M	$25.2M	$30.9M
Vehicle Operating	$1.7M	$1.5M	$1.4M
Safety	$1.2M	$1.6M	$1.9M
Total User Benefits (PV)	***$19.7M***	***$28.3M***	***$34.2M***
KEY ECONOMIC INDICATORS			
Net Present Value	**$4.4M**	**$13.0M**	**$18.9M**
Benefit-Cost Ratio	**1.3**	**1.9**	**2.2**

5.3 Project Cost Estimates

While estimated project costs are based on the best engineering data available and a reasonable contingency, but without detailed engineering, the magnitude of potential risks may not be completely captured. In this case, a +/- 25% in cost estimates and property costs are analysed and summarized in **Table 5-3**.

This analysis indicates that the key economic indicators are sensitive to a reasonable variation in the cost estimate. As expected, the economic indicators are improved with a reduced cost estimate assumption, while increasing the cost estimates by 25% still yield positive indicators – a NPV of $9.3M and a B/C ratio of 1.5.

Table 5-3: Project Cost Estimate Sensitivity

Account	Project Costs		
	-25%	Base	+25%
FINANCIAL ACCOUNT			
Discounted Project Cost	$13.8M	$18.5M	$23.1M
Maintenance	$0.53M	$0.53M	$0.53M
Construction Salvage Value	($2.8M)	($3.7M)	($4.6M)
Total Costs (PV)	***$11.6M***	***$15.3M***	***$19.0M***
CUSTOMER SERVICE ACCOUNT			
Travel Time	$25.2M	$25.2M	$25.2M
Vehicle Operating	$1.5M	$1.5M	$1.5M
Safety	$1.6M	$1.6M	$1.6M
Total User Benefits (PV)	***$28.3M***	***$28.3M***	***$28.3M***
KEY ECONOMIC INDICATORS			
Net Present Value	**$16.7M**	**$13.0M**	**$9.3M**
Benefit-Cost Ratio	**2.4**	**1.9**	**1.5**

6.0 Potential Risks

In addition to the sensitivity analysis, it is important to identify potential risks to project cost and schedule. Some of the risks that have been identified are summarized in **Table 6-1** along with the potential impacts and mitigation measures.

Table 6-1: Potential Risks and Mitigation Measures

Potential Risks	Risk Description	Possible Impact	Probability of Risk	Level of Impact	Mitigation Measures
Traffic Management	Construction activities may restrict access to local roads, driveways and private properties	Local traffic and business impacts	Possible	Moderate	Access management mitigated through a Traffic Management Plan during construction
Environmental	Harm to endangered plant or wildlife species Disruption to existing pipeline	Schedule Impacts	Possible	High	Conduct detailed environmental assessment prior to ground breaking and monitor during construction
Geotechnical	Settlement of subgrade	Schedule Impacts	Unlikely	Moderate	Conduct geotechnical assessment prior to ground breaking and monitor during construction
Archaeological	An archaeological find is discovered during construction	Schedule Impacts	Unlikely	High	Conduct archaeological impact assessment prior to ground breaking and monitor during construction
s.13,s.17					
First Nations Consultation	Not Applicable – The proposed improvements are not located within existing Indian Reserves				

7.0 Advancement of Provincial & Federal Transportation Strategies and Plans

Mt. Lehman Road between Highway 1 and Threshold Drive in Abbotsford, BC serves as a key link to trade and tourism on a local, regional and international context. It serves local and regional travel through its direct connection with adjacent commercial and industrial businesses, as well as connections to key east-west arterials that connects Abbotsford to the Township of Langley and other municipalities further east. Not only is Mt. Lehman Road the primary access to the Abbotsford Airport, it also connects the movement of people and goods to the Canada-USA land border crossings across the Cascade Gateway.

The Province's 10-year transportation plan, *B.C. on the Move*, established a series of short-term, medium-term and longer-term priorities focused on moving goods and people in safe and reliable manner, growing the economy, connecting and strengthening communities and maximizing collaboration and investment with partners, including First Nations, and local, regional and federal government, as well as the private sector. In this plan, the Mt. Lehman Road corridor was identified as a candidate location for improving the connection between Highway 1 and the Abbotsford Airport.

The proposed four-laning of Mt. Lehman is also aligned with other Provincial and Federal transportation strategies. A number of these strategies support transportation improvements to provide safe, efficient and reliable movement of people and goods, as well as advancement of partnering relationships as they relate to transportation investments. These Provincial and Federal strategies include:

- ***Opening Up BC – A Transportation Plan for British Columbia (Provincial)*** **-** the Province of British Columbia's *Opening Up BC – A Transportation Plan for British Columbia* identifies the need to improve the safety and reliability of existing transportation systems, free up the movement of goods, and expand transportation infrastructure to meet the needs of a growing population. This initiative also supports partnering relationships for transportation investments.

- ***Partnering for the Future – A Transportation Vision for Canada (Federal)*** – In addition to *Opening Up BC – A Transportation Plan for British Columbia*, this Federal strategy also supports the advancement of partnering relationships as they relate to transportation investment. The continued expansion of cost-sharing initiatives between the Government of Canada and the Province of British Columbia is supported by both levels of government as an effective means to ensuring continued economic growth and quality of life improvements for all Canadians.

- ***New Building Canada Plan (Federal)*** - The New Building Canada Plan is a long-term infrastructure plan that builds on the Government of Canada's unprecedented investments in infrastructure. This Plan support infrastructure projects that foster economic growth, job creation and long-term prosperity. Thus, Mt. Lehman Corridor would be would be consistent with federal transportation strategies and may be eligible for specific federal funding sources.

8.0 Corridor Performance Measures

As part of the Province's commitment to accountability under the Capital Asset Management Framework (CAMF), MoTI is expected to measure and report on the performance of its completed capital project. To support this commitment, performance measures must be developed for the recommended option at the planning and programming stage of a project. Actual performance then needs to be measured and reported on post-construction[1].

For this project, performance measures were developed for Customer Service and Social/Community accounts identified in **Section 4.0** and are summarized in **Table 8-1**.

Table 8-1: Performance Measure Summary

Strategic Objective	Performance Measure	Method of Measurement
Customer Service – Mobility	Maintain acceptable levels of service and highway capacity.	TomTom historical traffic data; Ongoing data collection program.
Customer Service – Safety	Reduce collision frequencies by 25% and reduce collision rates and severities to below provincial averages.	Collision data from the Ministry's Collision Infrastructure System.
Social/Community	Minimize residential takings.	Follow up with project management team to confirm.

[1] *Guidelines for Preparing MoTI Business Cases, Appendix 6, Performance Measures for MoTI Business Case (November, 2015)*

9.0 Project Implementation and Recommendations

This Business Case is intended to examine the benefits and costs of widening Mt. Lehman Road from two to four lanes between north of Simpson Road to the airport's boundary. The improvements were found to address the issues identified in the problem definition stage as follows:

- ***Mobility*** – Mitigation of future corridor capacity and travel time issues between north of Simpson Road and south of Marshall Road by providing an additional travel lane in both directions on Mt. Lehman Road. Intersection improvements at Simpson Road and Marshall Road is also provided to mitigate projected delays and queues. The additional lanes on the corridor will also reduce the percentage of vehicles following behind slower moving vehicles – providing better passing opportunities and improving overall traffic flow.

- ***Safety*** – Mitigation of current safety issues along the corridor, such as rear end collisions at key intersections, by providing exclusive left-turn bays and improving overall traffic flow on the corridor. The upgrade of the current 2 lane rural cross section to a 4-lane urban cross section, including improved lighting along the corridor can provide some safety benefits. The increase in passing opportunities can reduce aggressive driving behaviours and in turn, reduce the risk of collisions.

The proposed improvements were found to have a positive net present value of **$13.0M** and a benefit-cost ratio of **1.9**. These positive economic indicators are desired to advance the proposed improvements towards implementation; however, the indicators only form one component of the overall decision-making framework.

Mt. Lehman Road is a vital link to the Abbotsford Airport and serves as an important route for the movement of people and goods at the local, regional and international level. For these reasons, there is an expectation for Mt. Lehman Road to be efficient, safe and reliable for all users. The proposed improvements also support municipal and provincial strategies, including the City of Abbotsford proposed King Road Connector and the province's 10-year Transportation Plan, *B.C. on the Move*.

Key steps toward implementation would include:

- Secure funding;
- Completion of the Functional and Detailed Design;
- Finalize property acquisition;
- Completion of the procurement process

Benefits from the investment would accrue at the local, provincial and national level. Funding the proposed improvements is anticipated to be a partnership between all levels of government, including the Government of Canada, the Province of British Columbia and the City of Abbotsford. Federal cost sharing would be based on 50% of the eligible costs, which is estimated to be $7.8M. The City of Abbotsford has committed $2.0M to the proposed improvements. The estimated cash flow by fiscal year, including property costs, is outlined in **Table 9-1**.

Table 9-1: Project Cash Flow by Fiscal Year

Costs	2015/2016	2016/2017	2017/2018	Total
A: Non-Eligible Costs				
Project Management	$27,400	$483,900	$591,200	$1,102,500
Engineering	$39,200	$755,600	$780,200	$1,575,000
Property Acquisition	$18,600	$731,400	$0	$750,000
Environmental	$12,500	$287,500	$200,000	$500,000
Administration & Other	$11,700	$271,700	$189,100	$472,500
Non-Eligible Costs Sub-Total	***$109,400***	***$2,530,100***	***$1,760,500***	***$4,400,000***
B: Eligible Costs				
Construction/Contingency	$43,700	$1,005,200	$699,300	$1,748,200
Engineering External	$346,900	$7,964,700	$5,540,200	$13,851,800
Eligible Costs Sub-Total	***$390,600***	***$8,969,900***	***$6,239,500***	***$15,600,000***
Project Total	**$500,000**	**$11,500,000**	**$8,000,000**	**$20,000,000**
Level of Contribution				
Provincial Contribution	***$71,000***	***$5,466,00***	***$4,663,000***	***$10,200,000***
Municipal (Abbotsford) Contribution	***$178,000***	***$1,428,000***	***$394,000***	***$2,000,000***
Federal Contribution	***$251,000***	***$4,606,000***	***$2,943,000***	***$7,800,000***

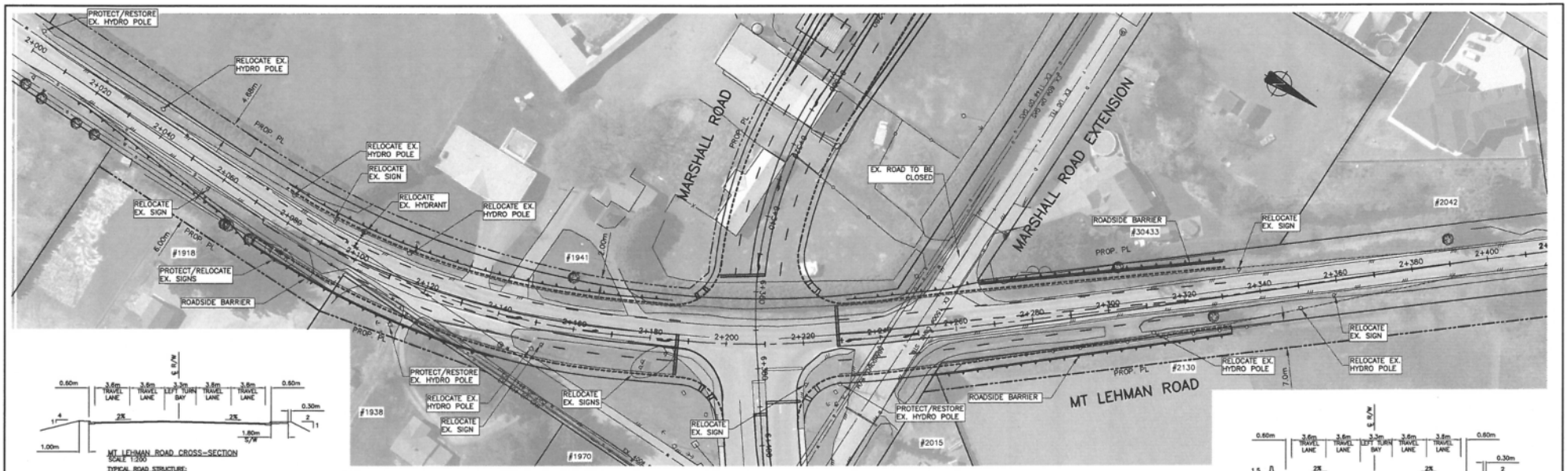
The proposed improvements will be delivered by BC MoTI through Traditional Competitive Tendering and will be completed by way of a Major Works Contract set out of MoTI. The improvements are expected to be completed over 3 fiscal years, as highlighted in **Table 9.2**. Construction is expected to commence in 2016/2017 fiscal year and complete in the 2017/2018 fiscal year.

Table 9-2: Estimated Project Schedule by Fiscal Year

Activity	2015/2016	2016/2017	2017/2018
Project Design and Surveying			
Environmental Assessment			
Construction Permit			
Tender			
Start of on-site Construction			
Substantial Completion			
Project Completion			
Final Report			

Appendix A

Marshall Road Intersection – Proposed Configuration

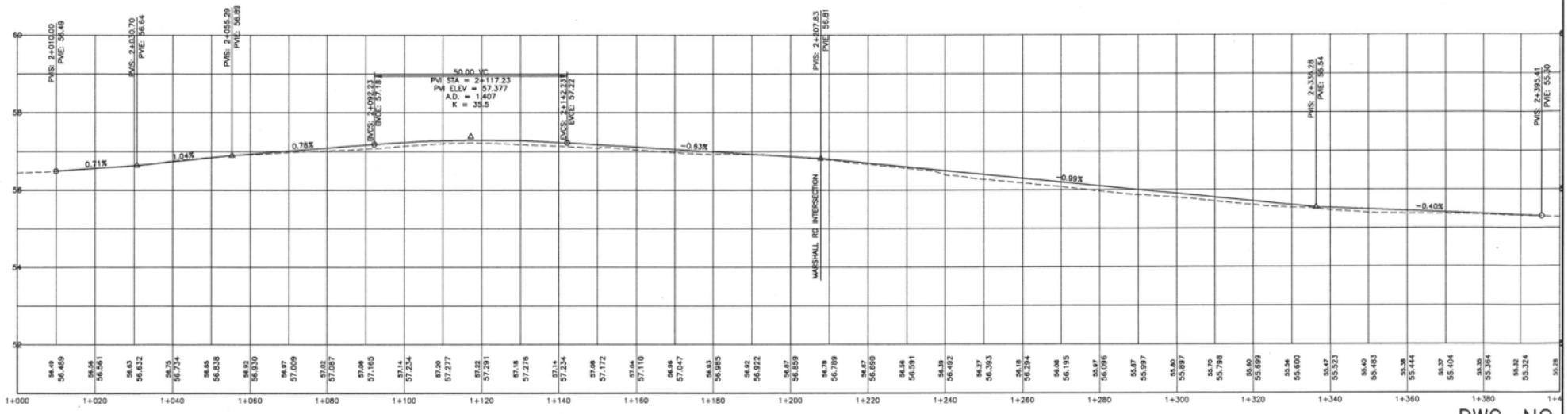


MT LEHMAN ROAD CROSS-SECTION
SCALE 1:200

TYPICAL ROAD STRUCTURE:
100mm – ASPHALT
150mm – 25mm CBC (PER MOTI)
150mm – 75mm CBC (PER MOTI)
300mm – SELECT GRANULAR SUB BASE (SGSB)
TO MOTI STANDARDS.

MT LEHMAN ROAD CROSS-SECTION
WITH ROAD SIDE BARRIER
SCALE 1:200

TYPICAL ROAD STRUCTURE:
100mm – ASPHALT
150mm – 25mm CBC (PER MOTI)
150mm – 75mm CBC (PER MOTI)
300mm – SELECT GRANULAR SUB BASE (SGSB)
TO MOTI STANDARDS.



GRID NO. C5 DISCIPLINE SHEET NO. 6 OF 16 COA DWG. NO. DWG. NO.

LOCATION FOR GAS, ELECTRICAL, TEL, & CABLE UTILITIES TO BE VERIFIED

FILE LOCATION

FRAME REV. 2010 06 07

ENGINEER:

ISL Engineering and Land Services

SUITE 301, 20338 – 65 AVENUE
LANGLEY, BRITISH COLUMBIA, V2Y 2X3
(604) 530-2286 FAX: (604) 530-1132

NO.	DATE	BY	REVISIONS	DF	TECH	EM ENG.
1	2014 09 03	DF	PRELIMINARY SUBMISSION			

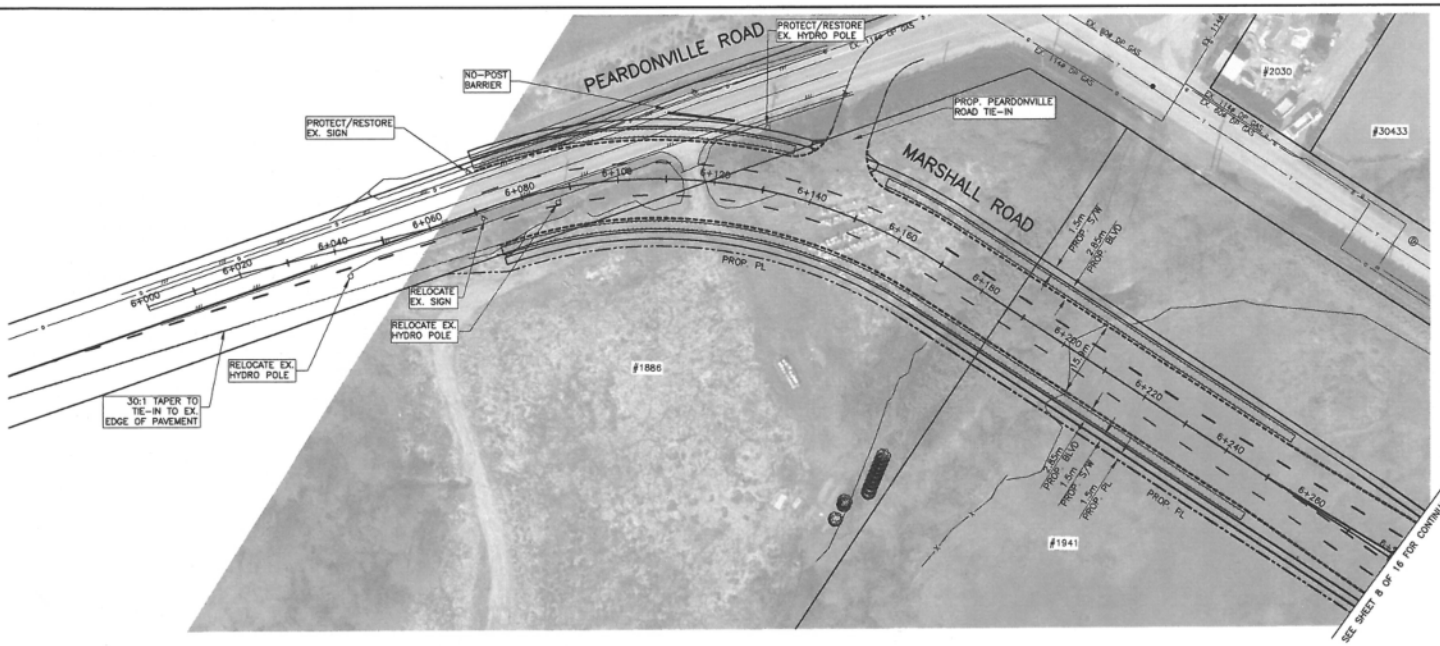
DATE:	2014 09 03
DRAWN:	DF
DESIGN:	EM
SCALE HOR.	1 : 500
SCALE VER.	1 : 50

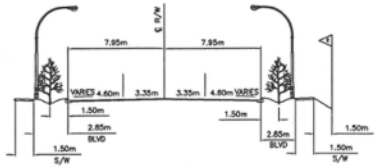
PROJECT SHEET NUMBERS: 6 OF 16
COA CONTRACT NUMBER: 00000
COA SAP NO.: 00000

ABBOTSFORD

MT LEHMAN ROAD
STA. 1+000 TO 1+400
ULTIMATE DESIGN PLAN AND PROFILE

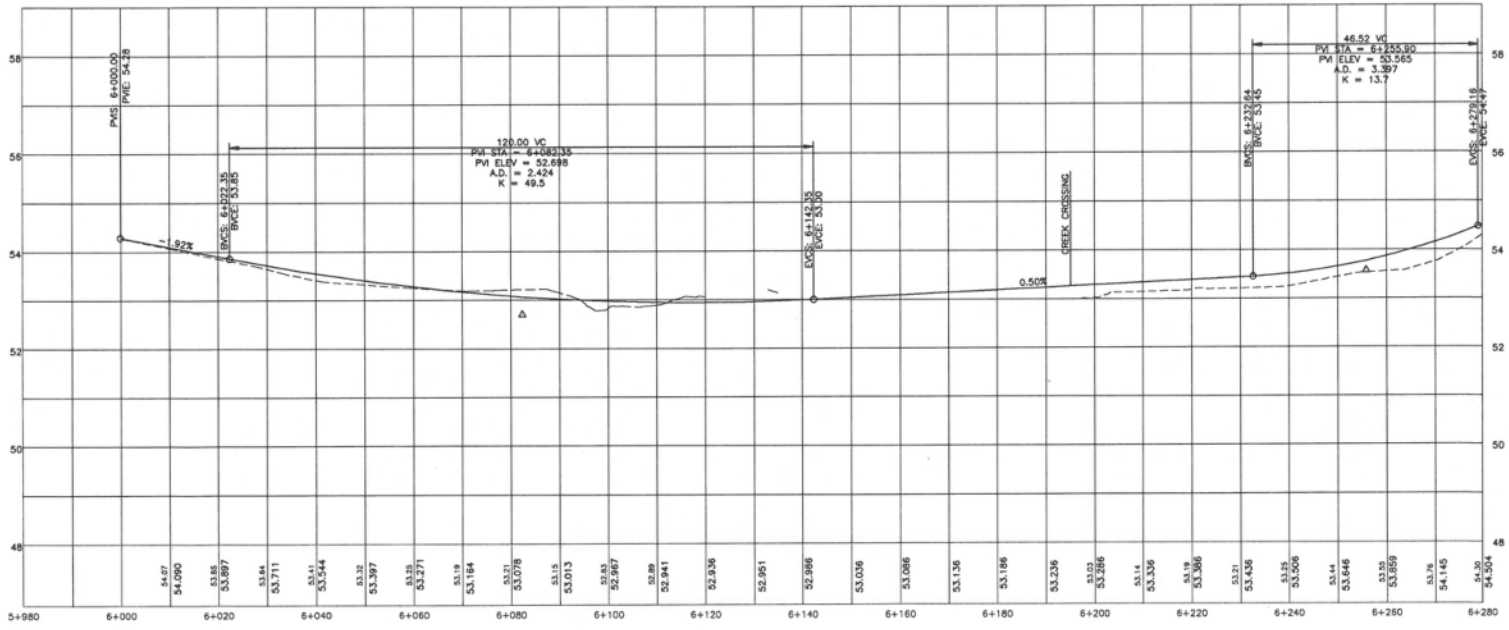
CONSULTANT PROJECT NO.: 31209
CONSULTANT DWG. NO.: 31209-C-8





MARSHALL ROAD CROSS-SECTION
SCALE 1:200

TYPICAL ROAD STRUCTURE:
50mm FINISHED COURSE ASPHALT
50mm BASE COURSE ASPHALT
100mm MINUS 19mm CRUSHED GRAVEL BASE
350mm PITRUN SAND AND GRAVEL SUBBASE
TO MMCD STANDARDS.



GRID NO. C5 DISCIPLINE SHEET NO. 7 OF 18 COA DWG. NO. DWG. NO.

LOCATION FOR GAS, ELECTRICAL, TEL, & CABLE UTILITIES TO BE VERIFIED

FILE LOCATION:
FRAME REV. 2010 06 07

ENGINEER:
ISL Engineering and Land Services
SUITE 301, 20338 – 65 AVENUE
LANGLEY, BRITISH COLUMBIA, V2Y 2X3
(604) 530-2288 FAX: (604) 530-1132

NO.	DATE	BY	REVISIONS	TECH	ENG.
1	2014 09 03	DF	PRELIMINARY SUBMISSION	DF	EM

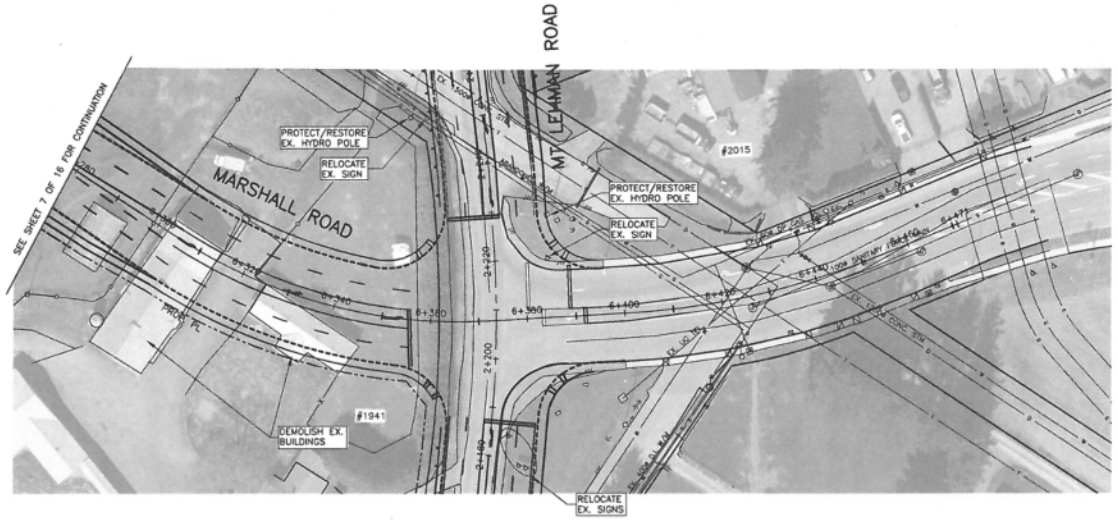
DATE:	2014 09 03
DRAWN:	DF
DESIGN:	EM
SCALE HOR.	1 : 500
SCALE VER.	1 : 50

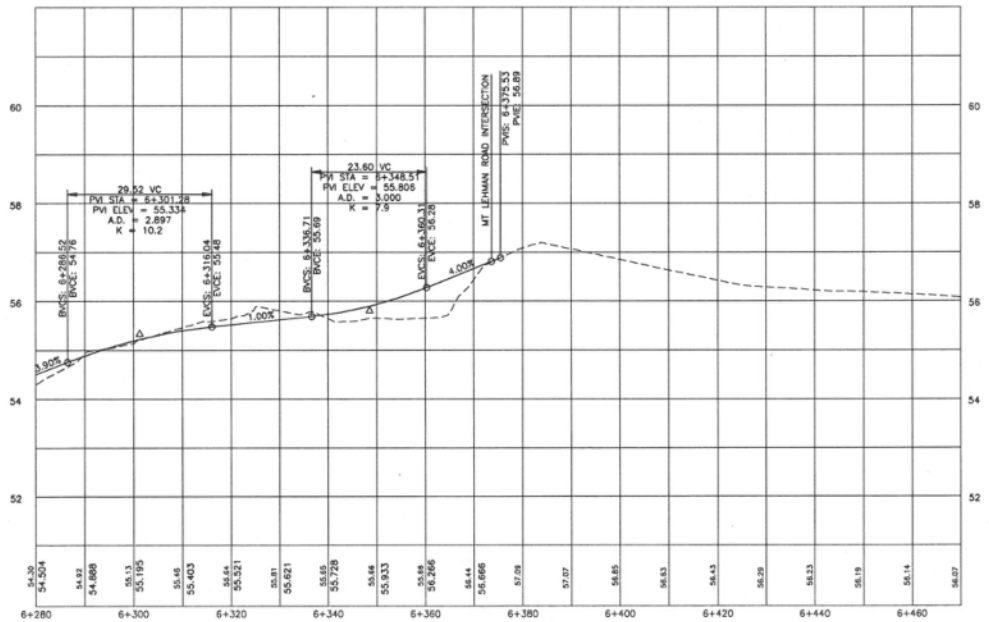
PROJECT SHEET NUMBERS:	9 OF 18
COA CONTRACT NUMBER:	00000
COA SAP NO.:	00000

ABBOTSFORD

MARSHALL ROAD
STA. 6+000 TO 6+280
ULTIMATE DESIGN PLAN AND PROFILE

CONSULTANT PROJECT NO.: 31209
CONSULTANT DWG. NO.: 31209-C-9





DWG. NO.

GRID NO. C5 DISCIPLINE SHEET NO. 8 OF 16 CDA DWG. NO.

LOCATION FOR GAS, ELECTRICAL, TEL, & CABLE UTILITIES TO BE VERIFIED

FILE LOCATION

FRAME REV. 2010.06.07

ENGINEER:

ISL Engineering and Land Services

SUITE 301, 20338 – 65 AVENUE
LANGLEY, BRITISH COLUMBIA, V2Y 2N3
(604) 530-2288 FAX: (604) 530-1132

NO.	DATE	BY	REVISIONS	TECH	ENG
1	2014 09 03	DF	PRELIMINARY SUBMISSION	DF	EM

DATE:	2014 09 03
DRAWN:	DF
DESIGN:	EM
SCALE HOR.	1 : 500
SCALE VER.	1 : 50

PROJECT SHEET NUMBERS: 10 OF 18

CDA CONTRACT NUMBER: 00000

CDA SAP NO.: 00000

ABBOTSFORD

MARSHALL ROAD
STA. 6+280 TO 6+460
UTLIMATE DESIGN PLAN AND PROFILE

CONSULTANT PROJECT NO.: 31209

CONSULTANT DWG. NO.: 31209-C-10

Appendix B

Conceptual Design – Concept 1 & Concept 2

NOTE: THIS DRAWING IS TO BE CONSIDERED CONCEPTUAL ONLY AND IS INTENDED TO PROVIDE INTERNAL GUIDANCE ON DEVELOPMENT APPLICATIONS. DETAILED ROAD GEOMETRY AND REQUIREMENTS TO BE CONFIRMED AS PART OF FUTURE DETAILED DESIGN.

BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

#	Date	Issue / Revision	App

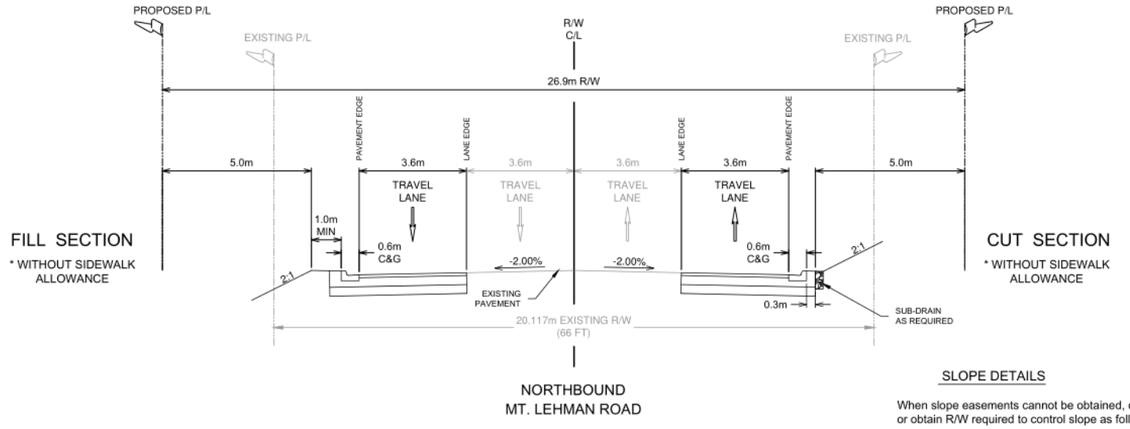
ISSUED FOR CONCEPTUAL
September 24, 2015
urbansystems.ca

URBAN systems
Scale 0 50 1:5000 250m
[HALF SIZE]
Quality Control by — U. Systems
Designed by — U. Systems
Drawn by — U. Systems

MT. LEHMAN RD
SKT-DRAFT- MoT- URBAN- OPT 1
EXISTING CENTERLINE

Sheet Number		1 of 5
Project Number	Drawing Number	Revision
1961.0329.04 OVERVIEW		----

U:\Projects_VAN\1961\0329\04\D-Drafting-Design-Analysis\CADD\CURRENT\SKETCHES\SKT-19610329O4- MoT- URBAN- OPT 1.dwg, OVERVIEW, 2015-09-24 09:39 am srath

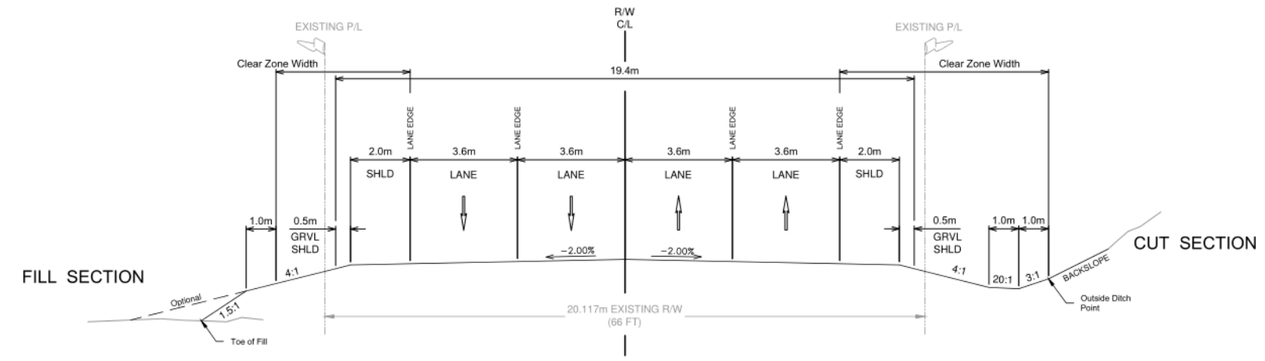


TYPICAL SECTION
BC MoT-URBAN (4 LANE)

SLOPE DETAILS

When slope easements cannot be obtained, construct wall or obtain R/W required to control slope as follows:

- 2:1 when cut/fill is 0.0 m to 3.5 m above/below top of curb
- 1.5:1 when cut/fill is over 3.5 m above/below top of curb



TYPICAL SECTION
BC MoT RAU (4 LANE)

DESIGN VEHICLE: WB-20
DESIGN SPEED: 60 km/h

U:\Projects_VAN\1961\0329\04\D-Drafting-Design-Analysis\CADD\CURRENT\SKETCHES\SKT-1961032904- MoT- URBAN- OPT 1.dwg, TYPICAL, 2015-09-24 09:39 am srath

NOTE: THIS DRAWING IS TO BE CONSIDERED CONCEPTUAL ONLY AND IS INTENDED TO PROVIDE INTERNAL GUIDANCE ON DEVELOPMENT APPLICATIONS. DETAILED ROAD GEOMETRY AND REQUIREMENTS TO BE CONFIRMED AS PART OF FUTURE DETAILED DESIGN.

BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

#	Date	Issue / Revision	App

ISSUED FOR CONCEPTUAL
September 24, 2015
urbansystems.ca

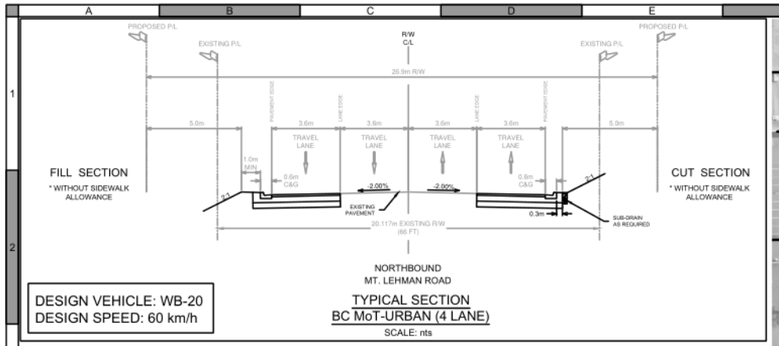
URBAN systems

Scale 0 1 1:100 5m
[HALF SIZE]

Quality Control by U. Systems
Designed by U. Systems
Drawn by U. Systems

MT. LEHMAN RD
SKT-DRAFT- MoT- URBAN- OPT 1
EXISTING CENTERLINE

Sheet Number 2 of 5
Project Number 1961.0329.04
Drawing Number TYPICAL
Revision ----



U:\Projects_VAN\1961\0329\04\D-Drafting-Design-Analysis\CADD\CURRENT\SKETCHES\SKT-1961032904- MoT- URBAN- OPT 1.dwg, SKT-A1, 2015-09-24 09:39:39 am srath

ATTENTION
This drawing is prepared for the sole use of BC Ministry of Transportation. No representations of any kind are made by Urban Systems Ltd. or its employees to any party with whom Urban Systems Ltd. does not have a contract.

NOTE:
BASE INFORMATION, INCLUDING ALL CADASTRAL, LEGAL, AND TOPOGRAPHIC DETAILS WERE PROVIDED BY VARIOUS SOURCES. NO WARRANTY TO THE ACCURACY, RELIABILITY, OR COMPLETENESS OF THIS DATA IS PROVIDED AND SHOULD BE CONFIRMED AS AND WHERE REQUIRED FOR USE

NOTE: THIS DRAWING IS TO BE CONSIDERED CONCEPTUAL ONLY AND IS INTENDED TO PROVIDE INTERNAL GUIDANCE ON DEVELOPMENT APPLICATIONS. DETAILED ROAD GEOMETRY AND REQUIREMENTS TO BE CONFIRMED AS PART OF FUTURE DETAILED DESIGN.

A1 A2 A3

LEGEND
DRIVEWAY CONSTRUCTION
APPROX. PROPERTY TAKE

BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

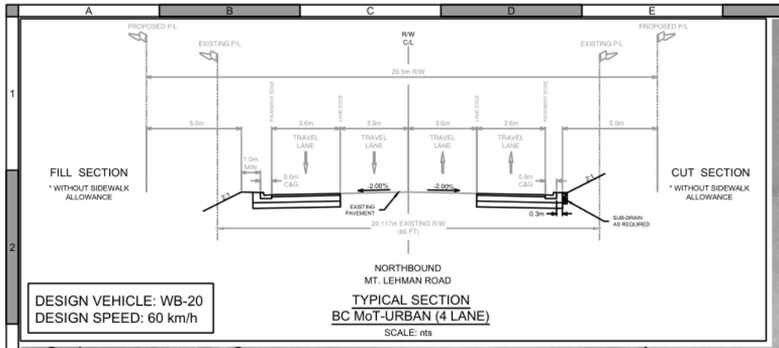
#	Date	Issue / Revision	App

ISSUED FOR CONCEPTUAL
September 24, 2015
urbansystems.ca

URBAN systems
Scale 0 10 1:1000 50m
[HALF SIZE]
Quality Control by U. Systems
Designed by U. Systems
Drawn by U. Systems

MT. LEHMAN RD
SKT-DRAFT- MoT- URBAN- OPT 1
EXISTING CENTERLINE

Sheet Number		3 of 5
Project Number	Drawing Number	Revision
1961.0329.04	SKT-A1	----



U:\Projects_VAN\1961\0329\04\D-Drafting-Design-Analysis\CADD\CURRENT\SKETCHES\SKT-1961032904- MoT- URBAN- OPT 1.dwg, SKT-A2, 2015-09-24 09:40 am srath

ATTENTION
This drawing is prepared for the sole use of BC Ministry of Transportation. No representations of any kind are made by Urban Systems Ltd. or its employees to any party with whom Urban Systems Ltd. does not have a contract.

NOTE:
BASE INFORMATION, INCLUDING ALL CADASTRAL, LEGAL, AND TOPOGRAPHIC DETAILS WERE PROVIDED BY VARIOUS SOURCES . NO WARRANTY TO THE ACCURACY, RELIABILITY, OR COMPLETENESS OF THIS DATA IS PROVIDED AND SHOULD BE CONFIRMED AS AND WHERE REQUIRED FOR USE

NOTE: THIS DRAWING IS TO BE CONSIDERED CONCEPTUAL ONLY AND IS INTENDED TO PROVIDE INTERNAL GUIDANCE ON DEVELOPMENT APPLICATIONS. DETAILED ROAD GEOMETRY AND REQUIREMENTS TO BE CONFIRMED AS PART OF FUTURE DETAILED DESIGN.

A1 A2 A3

LEGEND
DRIVEWAY CONSTRUCTION
APPROX. PROPERTY TAKE

BRITISH COLUMBIA
Ministry of Transportation and Infrastructure

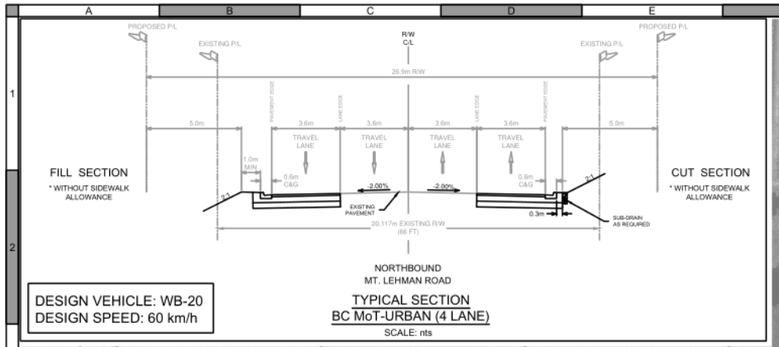
#	Date	Issue / Revision	App

ISSUED FOR CONCEPTUAL
September 24, 2015
urbansystems.ca

URBAN systems
Scale 0 10 1:1000 50m
[HALF SIZE]
Quality Control by U. Systems
Designed by U. Systems
Drawn by U. Systems

MT. LEHMAN RD
SKT-DRAFT- MoT- URBAN- OPT 1
EXISTING CENTERLINE

Sheet Number		4 of 5
Project Number	Drawing Number	Revision
1961.0329.04	SKT-A2	----



DESIGN VEHICLE: WB-20
DESIGN SPEED: 60 km/h

TYPICAL SECTION
BC MoT-URBAN (4 LANE)
SCALE: nts

U:\Projects_VAN\1961\0329\04\D-Drafting-Design-Analysis\CADD\CURRENT\SKETCHES\SKT-1961032904- MoT- URBAN- OPT 1.dwg, SKT-A3, 2015-09-24 09:40 am srath

ATTENTION
This drawing is prepared for the sole use of BC Ministry of Transportation. No representations of any kind are made by Urban Systems Ltd. or its employees to any party with whom Urban Systems Ltd. does not have a contract.

NOTE:
BASE INFORMATION, INCLUDING ALL CADASTRAL, LEGAL, AND TOPOGRAPHIC DETAILS WERE PROVIDED BY VARIOUS SOURCES . NO WARRANTY TO THE ACCURACY, RELIABILITY, OR COMPLETENESS OF THIS DATA IS PROVIDED AND SHOULD BE CONFIRMED AS AND WHERE REQUIRED FOR USE.

NOTE: THIS DRAWING IS TO BE CONSIDERED CONCEPTUAL ONLY AND IS INTENDED TO PROVIDE INTERNAL GUIDANCE ON DEVELOPMENT APPLICATIONS. DETAILED ROAD GEOMETRY AND REQUIREMENTS TO BE CONFIRMED AS PART OF FUTURE DETAILED DESIGN.

A1 A2 A3

LEGEND
DRIVEWAY CONSTRUCTION
APPROX. PROPERTY TAKE

BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

#	Date	Issue / Revision	App

ISSUED FOR CONCEPTUAL
September 24, 2015
urbansystems.ca

URBAN systems

Scale 0 10 1:1000 50m
[HALF SIZE]

Quality Control by	U. Systems
Designed by	U. Systems
Drawn by	U. Systems

MT. LEHMAN RD
SKT-DRAFT- MoT- URBAN- OPT 1
EXISTING CENTERLINE

Sheet Number		5 of 5
Project Number	Drawing Number	Revision
1961.0329.04	SKT-A3	----

U:\Projects_VAN\1961\0329\04\D-Drafting-Design-Analysis\CADD\CURRENT\SKETCHES\SKT-19610329004- MoT- URBAN- OPT 2.dwg, FULL VIEW, 2015-09-24 09:53 am srath

ATTENTION
This drawing is prepared for the sole use of BC Ministry of Transportation. No representations of any kind are made by Urban Systems Ltd. or its employees to any party with whom Urban Systems Ltd. does not have a contract.

NOTE:
BASE INFORMATION, INCLUDING ALL CADASTRAL, LEGAL, AND TOPOGRAPHIC DETAILS WERE PROVIDED BY VARIOUS SOURCES . NO WARRANTY TO THE ACCURACY, RELIABILITY, OR COMPLETENESS OF THIS DATA IS PROVIDED AND SHOULD BE CONFIRMED AS AND WHERE REQUIRED FOR USE

NOTE: THIS DRAWING IS TO BE CONSIDERED CONCEPTUAL ONLY AND IS INTENDED TO PROVIDE INTERNAL GUIDANCE ON DEVELOPMENT APPLICATIONS. DETAILED ROAD GEOMETRY AND REQUIREMENTS TO BE CONFIRMED AS PART OF FUTURE DETAILED DESIGN.

BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

#	Date	Issue / Revision	App

ISSUED FOR CONCEPTUAL
September 24, 2015
urbansystems.ca

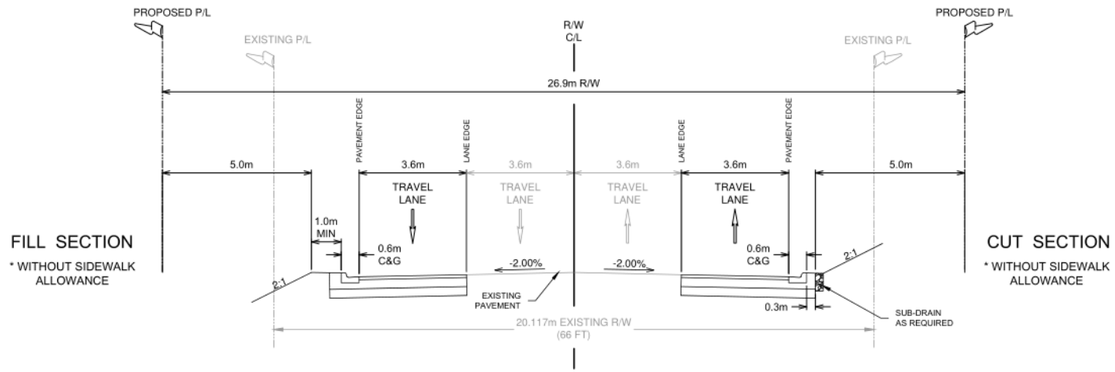
URBAN systems

Scale 0 50 1:5000 250m
[HALF SIZE]

Quality Control by	U. Systems
Designed by	U. Systems
Drawn by	U. Systems

MT. LEHMAN RD
SKT-DRAFT- MoT- URBAN- OPT 2
MODIFIED CENTERLINE

Sheet Number		1 of 6
Project Number	Drawing Number	Revision
1961.0329.04	FULL VIEW	----

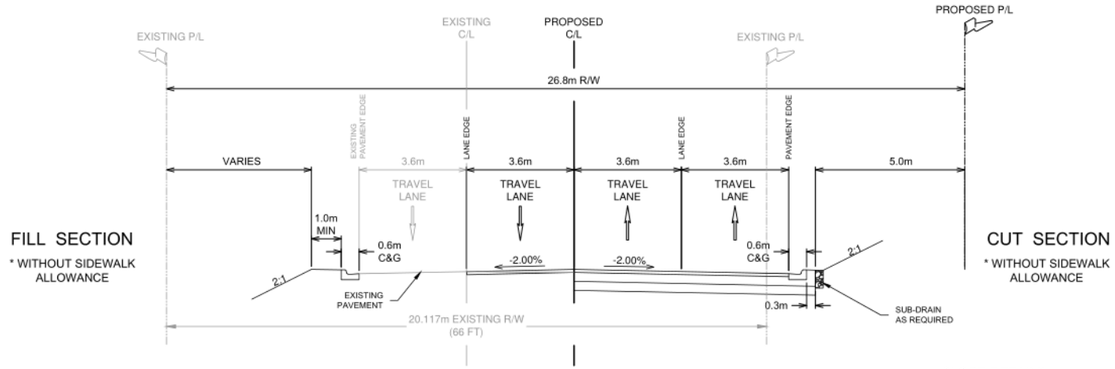


TYPICAL SECTION
BC MoT-URBAN (4 LANE)

SLOPE DETAILS

When slope easements cannot be obtained, construct wall or obtain R/W required to control slope as follows:

- 2:1 when cut/fill is 0.0 m to 3.5 m above/below top of curb
- 1.5:1 when cut/fill is over 3.5 m above/below top of curb



TYPICAL SECTION
BC MoT-URBAN (4 LANE)
MODIFIED CENTERLINE

SLOPE DETAILS

When slope easements cannot be obtained, construct wall or obtain R/W required to control slope as follows:

- 2:1 when cut/fill is 0.0 m to 3.5 m above/below top of curb
- 1.5:1 when cut/fill is over 3.5 m above/below top of curb

DESIGN VEHICLE: WB-20
DESIGN SPEED: 60 km/h

NOTE: THIS DRAWING IS TO BE CONSIDERED CONCEPTUAL ONLY AND IS INTENDED TO PROVIDE INTERNAL GUIDANCE ON DEVELOPMENT APPLICATIONS. DETAILED ROAD GEOMETRY AND REQUIREMENTS TO BE CONFIRMED AS PART OF FUTURE DETAILED DESIGN.

BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

#	Date	Issue / Revision	App

ISSUED FOR CONCEPTUAL
September 24, 2015
urbansystems.ca

URBAN systems

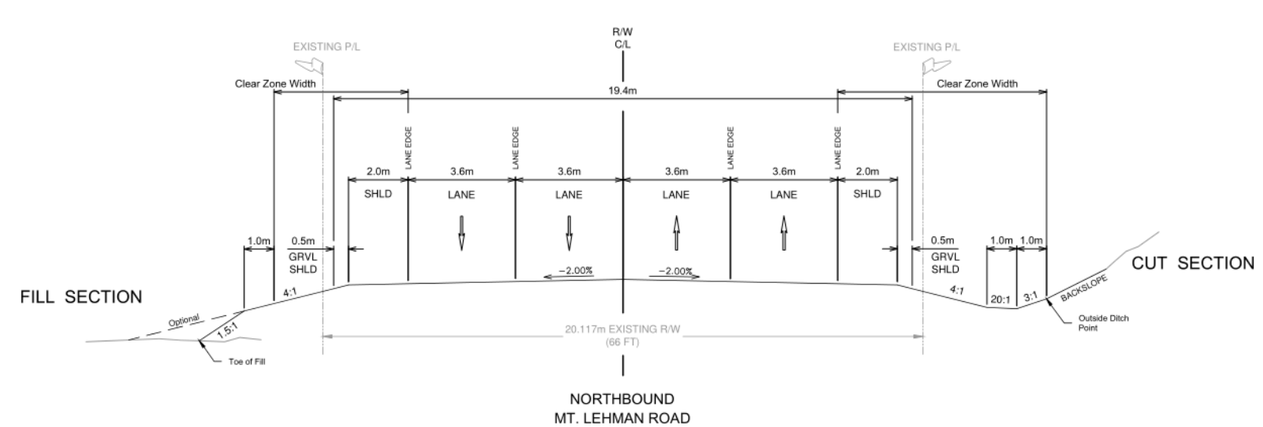
Scale 0 1 1:100 5m
[HALF SIZE]

Quality Control by U. Systems
Designed by U. Systems
Drawn by U. Systems

MT. LEHMAN RD
SKT-DRAFT- MoT- URBAN- OPT 2
MODIFIED CENTERLINE

Sheet Number 2 of 6
Project Number 1961.0329.04
Drawing Number TYPICAL-1
Revision ----

U:\Projects_VAN\1961\0329\04\D-Drafting-Design-Analysis\CADD\CURRENT\SKETCHES\SKT-1961032904- MoT- URBAN- OPT 2.dwg, TYPICAL, 2015-09-24 09:53 am srath



TYPICAL SECTION
BC MoT RAU (4 LANE)

DESIGN VEHICLE: WB-20
DESIGN SPEED: 60 km/h

U:\Projects_VAN\1961\0329\04\D-Drafting-Design-Analysis\CADD\CURRENT\SKETCHES\SKT-1961032904- MoT- URBAN- OPT 2.dwg, TYPICAL (2), 2015-09-24 09:53 am srath

ATTENTION
This drawing is prepared for the sole use of BC Ministry of Transportation. No representations of any kind are made by Urban Systems Ltd. or its employees to any party with whom Urban Systems Ltd. does not have a contract.

NOTE:
BASE INFORMATION, INCLUDING ALL CADASTRAL, LEGAL, AND TOPOGRAPHIC DETAILS WERE PROVIDED BY VARIOUS SOURCES . NO WARRANTY TO THE ACCURACY, RELIABILITY, OR COMPLETENESS OF THIS DATA IS PROVIDED AND SHOULD BE CONFIRMED AS AND WHERE REQUIRED FOR USE

NOTE: THIS DRAWING IS TO BE CONSIDERED CONCEPTUAL ONLY AND IS INTENDED TO PROVIDE INTERNAL GUIDANCE ON DEVELOPMENT APPLICATIONS. DETAILED ROAD GEOMETRY AND REQUIREMENTS TO BE CONFIRMED AS PART OF FUTURE DETAILED DESIGN.

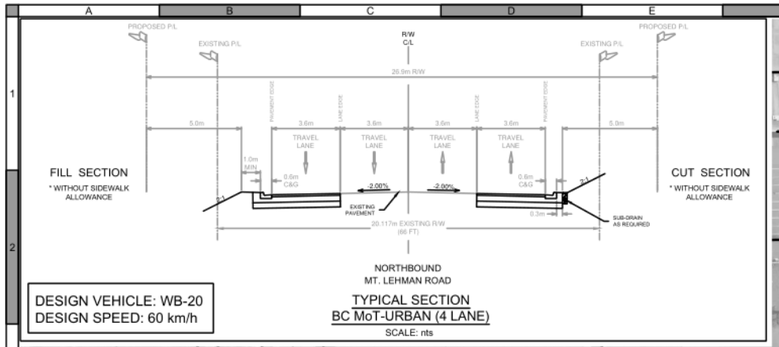
BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

#	Date	Issue / Revision	App

ISSUED FOR
CONCEPTUAL
September 24, 2015
urbansystems.ca

URBAN systems
Scale 0 1 1:100 5m
[HALF SIZE]
Quality Control by U. Systems
Designed by U. Systems
Drawn by U. Systems

MT. LEHMAN RD
SKT-DRAFT- MoT- URBAN- OPT 2
MODIFIED CENTERLINE
Sheet Number 3 of 6
Project Number Drawing Number Revision
1961.0329.04 TYPICAL-2 ----



U:\Projects_VAN\1961\0329\04\D-Drafting-Design-Analysis\CADD\CURRENT\SKETCHES\SKT-1961032904- MoT- URBAN- OPT 2.dwg, SKT-B1, 2015-09-24 09:53 am srath

NOTE: THIS DRAWING IS TO BE CONSIDERED CONCEPTUAL ONLY AND IS INTENDED TO PROVIDE INTERNAL GUIDANCE ON DEVELOPMENT APPLICATIONS. DETAILED ROAD GEOMETRY AND REQUIREMENTS TO BE CONFIRMED AS PART OF FUTURE DETAILED DESIGN.

B1 B2 B3

LEGEND
DRIVEWAY CONSTRUCTION
APPROX. PROPERTY TAKE

BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

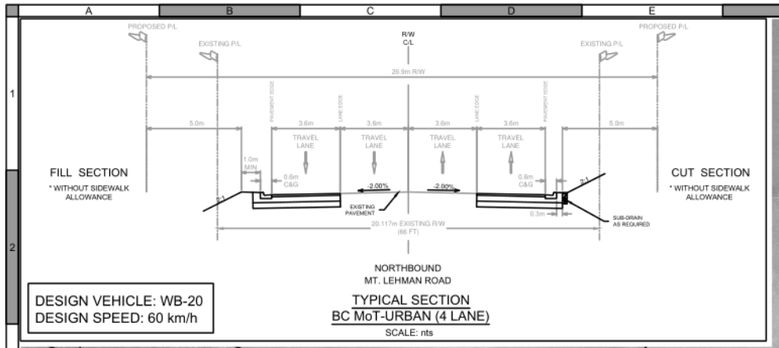
#	Date	Issue / Revision	App

ISSUED FOR CONCEPTUAL
September 24, 2015
urbansystems.ca

URBAN systems
Scale 0 10 1:1000 50m
[HALF SIZE]
Quality Control by U. Systems
Designed by U. Systems
Drawn by U. Systems

MT. LEHMAN RD
SKT-DRAFT- MoT- URBAN- OPT 2
MODIFIED CENTERLINE

Sheet Number			4 of 6
Project Number	Drawing Number		Revision
1961.0329.04	SKT-B1		----



DESIGN VEHICLE: WB-20
DESIGN SPEED: 60 km/h

ATTENTION
This drawing is prepared for the sole use of BC Ministry of Transportation. No representations of any kind are made by Urban Systems Ltd. or its employees to any party with whom Urban Systems Ltd. does not have a contract.

NOTE:
BASE INFORMATION, INCLUDING ALL CADASTRAL, LEGAL, AND TOPOGRAPHIC DETAILS WERE PROVIDED BY VARIOUS SOURCES . NO WARRANTY TO THE ACCURACY, RELIABILITY, OR COMPLETENESS OF THIS DATA IS PROVIDED AND SHOULD BE CONFIRMED AS AND WHERE REQUIRED FOR USE.

NOTE: THIS DRAWING IS TO BE CONSIDERED CONCEPTUAL ONLY AND IS INTENDED TO PROVIDE INTERNAL GUIDANCE ON DEVELOPMENT APPLICATIONS. DETAILED ROAD GEOMETRY AND REQUIREMENTS TO BE CONFIRMED AS PART OF FUTURE DETAILED DESIGN.

LEGEND
B1 B2 B3
DRIVEWAY CONSTRUCTION
APPROX. PROPERTY TAKE

BRITISH COLUMBIA
Ministry of Transportation and Infrastructure

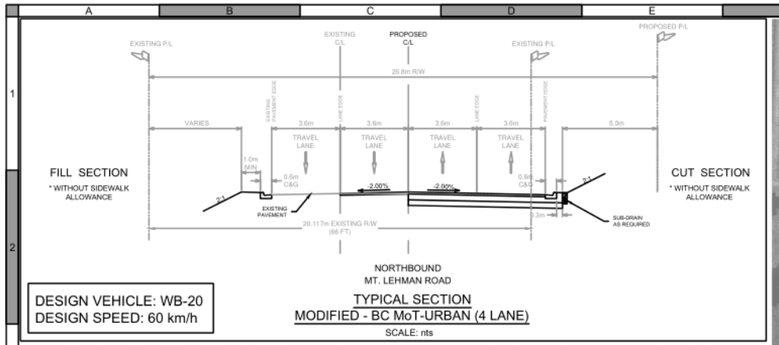
#	Date	Issue / Revision	App

ISSUED FOR CONCEPTUAL
September 24, 2015
urbansystems.ca

URBAN systems
Scale 0 10 1:1000 50m
[HALF SIZE]
Quality Control by U. Systems
Designed by U. Systems
Drawn by U. Systems

MT. LEHMAN RD
SKT-DRAFT- MoT- URBAN- OPT 2
MODIFIED CENTERLINE
Sheet Number 5 of 6
Project Number 1961.0329.04
Drawing Number SKT-B2
Revision ----

U:\Projects_VAN\1961\0329\04\D-Drafting-Design-Analysis\CADD\CURRENT\SKETCHES\SKT-1961032904- MoT- URBAN- OPT 2.dwg, SKT-B2, 2015-09-24 09:54 am srath



DESIGN VEHICLE: WB-20
DESIGN SPEED: 60 km/h

ATTENTION
This drawing is prepared for the sole use of BC Ministry of Transportation. No representations of any kind are made by Urban Systems Ltd. or its employees to any party with whom Urban Systems Ltd. does not have a contract.

NOTE:
BASE INFORMATION, INCLUDING ALL CADASTRAL, LEGAL, AND TOPOGRAPHIC DETAILS WERE PROVIDED BY VARIOUS SOURCES . NO WARRANTY TO THE ACCURACY, RELIABILITY, OR COMPLETENESS OF THIS DATA IS PROVIDED AND SHOULD BE CONFIRMED AS AND WHERE REQUIRED FOR USE

NOTE: THIS DRAWING IS TO BE CONSIDERED CONCEPTUAL ONLY AND IS INTENDED TO PROVIDE INTERNAL GUIDANCE ON DEVELOPMENT APPLICATIONS. DETAILED ROAD GEOMETRY AND REQUIREMENTS TO BE CONFIRMED AS PART OF FUTURE DETAILED DESIGN.

B1 B2 B3

LEGEND
DRIVEWAY CONSTRUCTION
APPROX. PROPERTY TAKE

BRITISH COLUMBIA
Ministry of Transportation and Infrastructure

#	Date	Issue / Revision	App

ISSUED FOR CONCEPTUAL
September 24, 2015
urbansystems.ca

URBAN systems
Scale 0 10 1:1000 50m
[HALF SIZE]
Quality Control by U. Systems
Designed by U. Systems
Drawn by U. Systems

MT. LEHMAN RD
SKT-DRAFT- MoT- URBAN- OPT 2
MODIFIED CENTERLINE

Sheet Number		6 of 6
Project Number	Drawing Number	Revision
1961.0329.04	SKT-B3	----

U:\Projects_VAN\1961\0329\04\D-Drafting-Design-Analysis\CADD\CURRENT\SKETCHES\SKT-1961032904- MoT- URBAN- OPT 2.dwg, SKT-B3, 2015-09-24 09:54 am srath

Page 65 to/à Page 70

Withheld pursuant to/removed as

s.13;s.17