City of Calgary
LRT Crossing Safety Review

Final Report

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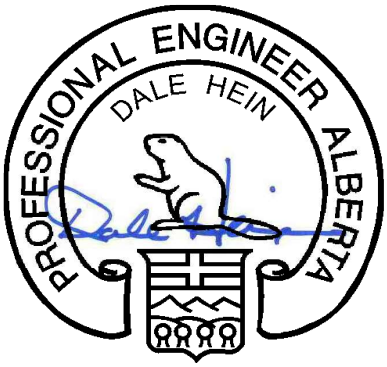

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Executive Summary

An examination of the at-grade crossing warning systems employed by Calgary Transit was performed, addressing:

- Applicable guidelines, standards and best practices;
- The rate of accidents at at-grade crossings of the LRT system;
- The adequacy of the at-grade crossing warning systems;
- Factors contributing to at-grade crossing safety issues; and
- Recommendations for improvements to address noted safety issues.

Through this examination, it was determined that the effectiveness of the at-grade crossing warning systems in Calgary is similar to that of comparable LRT systems in North America.

Calgary Transit and other LRT systems were found to have variation in the types of warning systems employed. For Calgary Transit, this variation reflects the standards employed by Calgary Transit at the time of construction; these standards have evolved over time based on experience and changes to industry best practices.

The review found that:

- Calgary Transit is employing applicable guidelines, standards and best practices in new design and has a process for capturing improvements reflected in these guidelines, standards and best practices into its own guidelines;
- The rate of accidents at at-grade crossings of the Calgary Transit LRT system is comparable to that elsewhere in North America;
- The Calgary Transit at-grade crossing warning systems are adequate to provide for the safety of motorists, cyclists and pedestrians;
- Calgary Transit is experiencing the same factors contributing to at-grade crossing safety issues as are found elsewhere in North America; and
- Calgary Transit has implemented best practices in determining the at-grade crossings needing improvements to the warning systems.

No significant deviations from applicable industry standards and best practices were noted. Opportunities to improve the safety of at-grade crossings were identified and are addressed in the report. The biggest opportunity relates to distracted walking which is an ongoing issue in the industry.

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Introduction

The report examines the at-grade crossing warning systems employed by Calgary Transit. This examination will address:

1.

- Applicable guidelines, standards and best practices;
- The rate of accidents at at-grade crossings of the LRT system;
- The adequacy of the at-grade crossing warning systems;
- Factors contributing to at-grade crossing safety issues; and
- Recommendations for improvements to address noted safety issues.

The report is intended to benchmark the effectiveness of the at-grade crossing warning systems in Calgary against comparable LRT systems in North America and will recommend best practices employed elsewhere that could result in improved crossing safety where necessary.

Calgary Transit operates a high floor light rail system of 59.9 km and 45 stations with an annual ridership of approximately 88 million (2017) and daily weekday ridership of 314,400 (Q1 2018). The systems operates primarily in a semi-exclusive alignment (type b.1 and b.2), with a non-exclusive (type c.1) right-of-way segment along 7 Avenue and two exclusive (type a) right-of-way segments on the Blue Line West LRT. There are 92 at-grade crossings of the LRT system.

In the 38 years since Calgary Transit's light rail system opened in 1981, there have been 88 total fatalities, with 42 accidental fatalities occurring at at-grade crossings. Respecting the Freedom of Information and Protection of Privacy guidelines, the yearly and location specific statistics on the number of fatalities is provided in Appendix C: Confidential Data to protect the identity of those impacted.

Applicable Regulations, Standards and Guidelines

Calgary Transit is not a federally regulated railway. Furthermore, the Railway (Alberta) Act defines a railway in a manner so that it "does not include an urban rail transit system".

2.

The documents identified in Table 2-1 are referenced as sources of best practices for the design and construction of roadway crossings of the Calgary Transit LRT system. These documents are the basis for the current Calgary Transit Guidelines shown in Table 2-2.

Table 2-1 Applicable Regulations, Standards, and Guidelines

Number	Title	Applicable Version	Short Name
American Railway Engineering and Maintenance-Of-Way Association (AREMA)			
	Communications & Signals Manual of Recommended Practice	2019	
Transport Canada			
SOR/2014-275	*Grade Crossings Regulations*	November 27, 2014	GCR
-	*Grade Crossings Standards*	January 01, 2019	GCS
G4-A	*Minimum Railway/Road Crossing Sightline Requirements for All Grade Crossings Without Automatic Warning Devices*	December 17, 2009	G4-A
Transportation Association of Canada (TAC)			
-	*Geometric Design Guide for Canadian Roads*	2017	
-	*Manual of Uniform Traffic Control Devices for Canada*	2014	
US Department of Transportation, Federal Highway Administration (FHWA)			
MUTCD	*Manual on Uniform Traffic Control Devices for Streets and Highways*	2009 Edition with Revision 1 and 2 dated May 2012	MUTCD

Table 2-2 Calgary Transit Guidelines

Number	Title	Applicable Version	Short Name
T-SP-R-0069	*LRT Crossings Review* *LRT Crossings Guidelines*	Rev. No. 01, July 2017	
	LRT Design Guidelines	Revision 2, March 2009	DGM

2.1 Transport Canada Grade Crossings Regulations and Grade Crossings Standards

The *Grade Crossing Regulations* and *Grade Crossing Standards* are applicable to at-grade crossings of federally regulated freight railways. As such, they are applicable where there is a common roadway crossing of the Calgary Transit LRT system and CN or CP track. Where the GCS is applied, the required warning time and gate descent delay may be longer than Calgary Transit has historically used elsewhere.

Elsewhere on the Calgary Transit LRT system, these documents would be considered a source of best practices. The GCR and GCS have been incorporated into the Calgary Transit guidelines applicable to at-grade crossings of the LRT System. It should be noted that Calgary Transit Specifications may exceed Transport Canada's; this is particularly true in the case of requirements for pedestrian automatic gates.

2.2 Manual of Uniform Traffic Control Devices

The *Manual of Uniform Traffic Control Devices for Canada* provides information concerning the road signage to be employed in conjunction with a roadway crossing of the Calgary Transit LRT system.

The *Manual on Uniform Traffic Control Devices for Streets and Highways* published by the Federal Highway Administration is a referenced source as Part 8 Traffic Control for Railroad and Light Rail Transit Grade Crossings specifically addresses LRT systems. The document provides guidance on the use of traffic control signals as an alternative at roadway crossings of an LRT system and treatments appropriate to pedestrians and cyclists. The traffic control signals employed in the Calgary Transit in-street alignment are based on this document.

2.3 Calgary Transit Technical Specification T-SP-R-0069

This document, dating to 2011 and officially published in 2017, provides guidance and a general overview of the technical requirements for planning and design in the layout, devices used, and signage associated with Calgary LRT road and pedestrian at-grade crossings. The document sets out guiding principles, functional planning guidelines and design guidelines.

It was noted that the decision chart provided as Appendix B identifies situations where Calgary Transit requires the installation of automatic pedestrian gates. These requirements exceed those contained in the referenced standards and guidelines and are felt to reflect a best practice being employed by Calgary Transit.

2.4 Calgary Transit LRT Design Guidelines

This document provides guidance for the design of the circuits controlling automatic crossing warning systems. The latest version was published in 2009, and was employed during the construction of the Blue Line West LRT and Red Line Tuscany Station extension. The original version was published in 2001.

2.5 Other Information Sources

The Transit Cooperative Research Program has published a number of reports concerning the impact of light rail transit on pedestrian and vehicular safety. These documents have been employed by Calgary Transit as a source of information.

Table 2-3 Other Information Sources

Number	Title	Applicable Version	Short Name
Transportation Research Board of the National Academies, Transit Cooperative Research Program (TCRP)			
TCRP Report 17	*Integration of Light Rail Transit into City Streets*	1996	TCRP Report 17
TCRP Report 69	*Light Rail Service: Pedestrian and Vehicular Safety*	2001	TCRP Report 69
TCRP Report 137	*Improving Pedestrian and Motorist Safety Along Light Rail Alignments*	2009	TCRP Report 137
TCRP Report 175	*Guidebook on Pedestrian Crossings of Public Transit Rail Services*	2015	TCRP Report 175
TCRP Research Results Digest 84	*Audible Signals for Pedestrian Safety in LRT Environments*	May 2007	TCRP Research Results Digest 84

2.6 Application of Calgary Transit Guidelines

The at-grade crossing warning devices on the Calgary Transit system reflect the standards employed by Calgary Transit at the time of construction. With experience and changes to industry best practices, these guidelines have evolved over time. This has resulted in some variation in the at-grade crossing warning devices across the system.

Calgary Transit's efforts to address some past practices are discussed later in this report. All past practices are acceptable but, in some instances, current practices are considered to improve the safety of the crossing.

It is noted that the Calgary Transit Green Line Stage 1, which is a mix of exclusive (type a) and semi-exclusive (type b.1 and b.2) alignments, is to provide flashing lights with gates for all road crossings of the LRT right-of-way and flashing lights with gates and audible devices for all pedestrian crossings.

2.7 Comparison of Regulations, Standards and Guidelines employed

The regulations, standards and guidelines employed by Calgary Transit are similar to those employed by other transit agencies.

This was determined through the review of the standards and guidance documents cited for the Edmonton Valley Line, the Minneapolis Blue Line LRT Extension and the Southern California Regional Rail Authority (Metrolink),

The few differences relate to the regulatory frame works that are applicable to the different agencies. The Transport Canada standards adopted by Calgary Transit largely mirror the US Department of Transportation guidance (such as the Federal Highway Administration's *Railroad-Highway Grade Crossing Handbook* and *Guidance on Traffic Control Devices at Highway-Rail Grade Crossings*) applicable to many US transit agencies.

It was noted that Calgary Transit's Technical Specification T-SP-R-0069 and Design Guideline Manual exceed the Transport Canada GCS (and the standards employed by other transit agencies) in the area of requirements for pedestrian automatic gates. This is considered to be an area where Calgary Transit has developed a best practice.

Crossing Committee

Calgary Transit has established a Crossing Committee to oversee the design and operation of at-grade crossings of the LRT system. This structure provides a means of examining the effectiveness of the installed warning devices, updating City of Calgary technical specifications and examining emerging best practices. The Crossing Committee consists of three groups: management, working and advisory.

3.

3.1 Crossing Working Committee

Calgary Transit's Crossing Working Committee includes representation from Calgary Transit (including Track and Way, LRT Systems, LRT Training, Operations Control Centre, Public Safety and Enforcement, and Transit Planning), Calgary Roads, Calgary Transportation Planning, Calgary Police Services, and Calgary Access Design Subcommittee. This multi-disciplinary team conducts assessments of the operation of new and existing at-grade crossings, identifying deficiencies and employing their judgement and knowledge to develop a consensus concerning recommended improvements and their relative priority. The "LRT Crossings – Field Inspection Worksheet" is employed to document this procedure.

It was noted that inviting representation from the adjacent freight rail company is desirable; Calgary Transit intents to ensure that this is done for future crossing assessments.

The Crossing Working Committee is responsible for revision of the LRT Crossing Guidelines and their incorporation via the Technical Documents Committee into the permanent Calgary Transit technical body of knowledge. They are also to establish a prioritized work plan to address crossing related issues, including a list of crossing locations of concern and proposed modifications to existing crossings.

The Crossing Working Committee conducts approximately 10 crossing assessments annually as part of identifying and addressing crossing related issues; the 2019 plan includes the conduct of 11 crossing assessments.

Early drafts of the Transport Canada GCS included a requirement that all crossings be accessed periodically, with a maximum interval between assessments of no more than 4 or 8 years. This requirement was not included in the adopted version of the GCS; railroads in Canada are expected to address the need for and frequency of crossing assessments in their Safety Management System. This results in a risk based approach to the frequency of crossing assessments which is similar to that employed in most of the United States.

Calgary Transit's Crossing Committee and the periodic safety assessment of crossings is a best practice. Canadian freight railways conduct crossing assessments in accordance with the requirements of their safety management system; typically this only happens when changes are planned or when a hazardous condition is identified.

Public Safety and Enforcement Crossing Blitz

Calgary Transit's Public Safety and Enforcement (PSE) team conducts period crossing blitz's, the most recent of which took place over 5 days in March 2019 between 0600 and 0800 at Whitehorn, Lions Park, McKnight-Westwinds, Sunnyside and 3 Street SW Stations.

4.

Issues identified during the blitz included:

- Crossing the street against the light when no vehicles were present (jaywalking);
- Complaints that lights did not work properly; and
- Crossing the tracks when the crossing warning signals were active where there were no automatic gates.

The recent addition of Second Train active and passive signage at Sunnyside was found to be effective.

There were a total of 27 warnings and 7 violation tickets issued during the blitz's.

Active enforcement is an important means of addressing at-risk behaviours that negatively impact at-grade crossing and road safety.

Customer Advisory Groups

5.1 Customer Advisor Group

The Calgary Transit Customer Advisory Group (CAG) is tasked to provide comments to CT with respect to the customer experience.

5.

The Customer Advisory Group recently examined the issues related to changing behaviour at at-grade crossings. Factors that were identified as causing people to cross when warning devices are active or against traffic signals included:

- Impatience (trying to catch a train that has just pulled into the station or that is approaching the station (visible or as indicated by PID);
- Impatience (trying to make a bus transfer);
- Impatience (excessive pedestrian wait times to cross 36 Street NE);
- Herd mentality (when one person crosses when the warning devices are active or against the light, others follow);
- Inconsistent information (false activations of warning devices, PSE allowing people to cross during stampede when warning devices are active, different information provided by traffic signals and warning devices);
- Inconsistent PSE enforcement;
- Inattention (distracted walking); and
- Complacency.

The Customer Advisory Group will also provide input to the public engagement material on the issue that Calgary Transit is currently developing strategy and content for.

5.2 Access Design Subcommittee

The Access Design Subcommittee within the City of Calgary is tasked with making recommendations on issues that relate to accessibility for people with disabilities. This includes the review of major public and private projects (properties, buildings, walkways, pathways, parks and transit facilities) to ensure the greatest level of accessibility for persons with physical, sensory and cognitive disabilities. The Access Design Subcommittee reports to Council's Advisory Committee on Accessibility.

The Access Design Subcommittee has recommended changes in Calgary Transit crossings, including the use of alternatives to swing gates and the installation of cane detectable treatments before the crossing surface.

Improvement Programs

As a result of issues identified by Calgary Transit's Crossing Working Committee, improvements have been made recently at crossings. These changes have resulted in improved compliance with the at-grade crossing warning systems.

6.

6.1 61 Ave SW (Chinook Station)

Automatic pedestrian gates were installed on the east and west sides of the center load station platform. The automatic gates replaced bedsteads, with the intent of increasing the compliance with the at-grade crossing warning system. Additional barrier channelization was provided, especially on the CP side. This has proven effective.

Figure 6-1 Chinook Station Pedestrian Crossing of Inbound LRT and CPR

6.2 Sunnyside Station

Active second train warning signs and bells were installed between tracks on the north and south end pedestrian crossings at Sunnyside Station, in conjunction with passive signs. The red indicator lights illuminate when two trains are approaching the crossing simultaneously.

While not common, the use of such active signs is not new to Calgary; the signs installed at SAIT Station were indicated as an innovative feature of the Calgary Transit system in TCRP 69. Calgary Transit has not installed active second train warning signs where pedestrian automatic gates are present. This should be considered as a further enhancement.

Figure 6-2 Second Train Warning Signage at Sunnyside Station (Calgary Transit)

6.3 26 Ave NE

The provision of simultaneous preemption of traffic signals adjacent to at-grade crossings was a common practice historically. To ensure that:

- traffic that may potentially has queued through the crossing surface is given an opportunity to clear; and
- to eliminate potential for conflicting information resulting from the operation of the at-grade crossing warning signals before the adjacent traffic signals have entered the dwell phase (red phase for conflicted traffic)

the use of advance traffic signal preemption is now preferred.

As an example of such a change, the 26 Avenue NE crossing was modified to provide 20 second advance preemption calls to the traffic signals. This change was also

completed at 8 Ave NE, 12 Ave NE and 20 Ave NE. This has also reduced the number of instances where vehicles strike gates.

Work is planned to add advance pre-emption at the remaining crossing locations along 36 St NE, with all remaining works expected to be completed prior to the end of 2019.

6.4 Whitehorn Dr NE (Whitehorn Station)

The flashing light signals for the pedestrian at Whitehorn drive have been lowered and a cantilevered signal installed so that the warning devices directly face the pedestrians. Similar changes were previously made at 61 Avenue SE (Chinook Station) and at 25 Ave SE (Erlton/Stampede Station) and found to reduce non-compliance. Additional bedsteads were also installed at Whitehorn to create overlap and better channelization. Additional warning time was provided for outbound train movements at Whitehorn.

Figure 6-3 Revised Crossing Signals at Whitehorn Station (Calgary Transit)

Figure 6-4 Revised Crossing Signals at Whitehorn Station (Calgary Transit)

Crossing Design Best Practices

7.1 Comparison to Similar LRT Systems

7.1.1 US Agencies

7.

The guidance incorporated within the US MUTCD and predecessor documents, has been the basis for design of at-grade warning systems employed by US transit agencies. The resulting treatments for road traffic are generally consistent with those employed by Calgary Transit, including:

- Flashing light signals with automatic gates; or
- Traffic control signals where LRT speeds are 55 km/h (35 mph) or less;

The US MUTCD recommends flashing light signals with an audible device for pedestrian crossings where it is determined that the sight distance is not sufficient for pedestrians to complete their crossing prior to the arrival of the LRT at the crossing or where LRT speeds exceed 55 km/h (35 mph). The treatments applied at pedestrian crossings vary greatly, with many agencies only installing passive signage only.

Figure 7-1 Passive Crossing Warning Signals (houstonpublicmedia.org)

The best practice, as identified in TCRP 69, is to apply a decision tree to determine the appropriate treatment for a pedestrian crossing of the LRT right-of-way. On this basis, additional crossing treatments are recommended to address greater levels of risk. The decision tree provided in TCRP 69 would recommend the use of pedestrian automatic gates where:

- The sight distance is not sufficient for pedestrians to complete their crossing prior to the arrival of the LRT;
- The crossing is in a school zone and the LRT speeds exceed 55 km/h (35 mph);
- There are high pedestrian activity levels, the LRT speeds exceed 55 km/h (35 mph), and either pedestrian surges occur or there is high pedestrian inattention.

As indicated in Table 7-2, there is a mix of pedestrian warning treatments in use. While many US transit agencies report the use of pedestrian automatic gates, they also report the use of swing gates and/or bedsteads (pedestrian channelization). Pedestrian automatic gates continue to only be used in special circumstances such as higher speed sections of the right-of-way.

Table 7-2 Pedestrian Control Devices by LRT System (TCRP 69)

Agency	Pedestrian Automatic Gates	Swing Gates	Pedestrian Channelization	Special Pedestrian Signs	Special Audible Devices
Baltimore	Yes		Planned		
Calgary	Yes	Yes	Yes	LRV-actuated "Danger – 2nd Train Approaching"	Yes
Dallas	Yes		Yes		
Denver	Planned		Planned		
Edmonton	Yes				Planned
Los Angeles	Yes	Yes		LRV-actuated "Second Train Approaching"	
Portland	Yes	Yes	Yes	Yes	Yes
Sacramento					Yes
Saint Louis	Yes		Yes		
San Diego			Yes		Yes
San Jose	Yes	Yes		LRV-actuated "Caution Second Train Approaching"	Planned

It is noted that, there is also a wide variety of flashing light signals for pedestrian applications employed by US transit agencies. The US MUTCD does show smaller pedestrian warning signals. The various TCRP reports have identified a variety of alternative pedestrian signals; in all instances they locate the warning signals much lower so that they are in the pedestrian's cone of vision.

Figure 7-3 "Portland Style" Pedestrian Flasher

Figure 7-4 Smaller Scale Pedestrian Flasher in Portland (Fitzpatrick)

Figure 7-5 "Minneapolis Style" Pedestrian Flasher

While consistency of the warning device design is an important factor in the ability of a person to correctly react to the information being presented, it is noted that some US agencies have a variety of warning devices in use, with the figures showing some of the variations employed in Portland as an example.

7.1.2 Edmonton Transit

The City of Edmonton's light rail system is slightly older, opening in 1978 but otherwise has many of the same challenges. ETS operates a high floor light rail system of 24.3 km and 18 stations with a daily weekday ridership of 112,805 (2017). The system operates primarily in a semi-exclusive alignment (type b.1 and b.2) including a center running semi-exclusive alignment along 111 Ave. ETS has a exclusive (type a) right-of-way segment in the downtown; Edmonton Transit does not have non-exclusive right-of-way (type c.1, c.2, c.3 or c.4). Edmonton is currently constructing their first urban integrated low floor alignment for Stage 1 (SE) of the Valley Line.

The Edmonton Transit system includes flashing lights with gates for road traffic. Typically, pedestrian traffic is address through a bell, although some crossings are equipped with barrier channelization or pedestrian automatic gates with an emergency exit swing gate. There are instances where there is not a set of warning signal lights provided for each lane of traffic.

The warning devices employed at crossings have varied over time. On the Metro Line, automatic pedestrian gates were installed at many pedestrian crossings; however, the pedestrian crossing at 106 Ave NW does not have automatic pedestrian gates.

For the Valley Line Stage 1, a Low-Floor urban LRT system Decision Tree was created and employed as the basis for RPT-20140227-SEtoW-Intersection Hazard

Analysis Report. Train speeds at most at-grade crossings of the Valley Line Stage 1 are 55 km/h or less and traffic control devices will be employed instead of flashing lights with gates and bells.

Figure 7-6 Warning Devices at 92 St NW LRT Crossing (Google)

A safety improvement program in Edmonton has been used to improve street lighting at at-grade crossings and to install pedestrian gates. Where there is more than one lane for road traffic in each direction, cantilevered warning devices are being provided.

7.2 Metro Transit

Minneapolis Metro Transit operates a high floor light rail system of 35.1 km and 37 stations with a daily weekday ridership of 71,900 (2017). The system has been in operation since 2004.

The Metro Transit system includes a mix of semi-exclusive and non-exclusive right-of-way.

Figure 7-7 Metro Crossing (metrotransit.org)

In semi-exclusive alignments, flashing lights with automatic gates and bells are provided for roadway traffic. Flashing lights are provided for pedestrian traffic where necessary. Pedestrian automatic gates are also employed. This philosophy is to continue on the proposed Blue Line extension which, while providing pedestrian flashing light signals, employs bedsteads and not pedestrian automatic gates.

Traffic signals are employed in non-exclusive alignments.

7.3 Comparison to Calgary Transit Best Practices

Except in the in-street alignment where LRT speed has been restricted to 40 km/h, the Calgary Transit Technical Specification requires:

- Flashing lights and gates for roadway crossings of the LRT system;
- Flashing lights and bells for pedestrian crossings of the LRT system;
- Swing gates or bedstead barriers for pedestrian crossings of the LRT system.

It is noted that, due to accessibility issues, bedstead barriers are preferred over swing gates except where bed steads cannot be configured as offset barriers due to space constraints.

The decision chart provided in Appendix B provides guidance concerning the appropriate treatments for pedestrian crossings of the LRT system in semi-exclusive right-of-way, including identification of situations where pedestrian automatic gates with an emergency exit swing gate are to be employed.

Calgary Transit's Technical Specifications incorporate the best practices observed in use by other agencies. These Technical Specifications require a greater use of pedestrian automatic gates than required elsewhere.

Areas where the current Calgary Technical Specifications could be improved include:

- Pedestrian refuge areas. The US MUTCD recommends that, "Where LRT tracks are immediately adjacent to other tracks or a road, pedestrian signalization should be designed to avoid having pedestrians wait between sets of tracks or between the tracks and the road." When this is not practical, adequate pedestrian refuge and additional warning signals should be provided. The size of the pedestrian refuge area must be adequate for the pedestrian volumes.
- The design of pedestrian warning signals and second train warning signals.

Both of these issues are not unique to Calgary Transit; these topics are addressed poorly by all standards reviewed. Calgary Transit has recognized these issues and is working to ensure that they addressed in new projects.

7.4 Comparison of Crossing Design Best Practices Within Calgary Transit System

The at-grade crossing warning devices on the Calgary Transit system reflect the standards employed by Calgary Transit at the time of construction. These guidelines have evolved over time as industry best practices have changed. This has resulted in the at-grade crossing warning devices across the Calgary Transit system varying.

The ongoing crossing assessment process employed by Calgary Transit provides a means of ensuring that, within the limits of available funding, action is taken to improve the safety of at-grade crossings.

It was noted that there are fewer accidents at at-grade crossings equipped with pedestrian automatic gates, however, the data sample size is small. It is generally accepted that at-grade crossings with flashing lights and automatic gates are safer than crossings with only flashing lights.

Crossing Assessments

Calgary Transit identified 7 crossings for assessment as part of the LRT Crossing Safety Review. The crossings are summarized in Table 8-1.

8. The crossings represent a mix of different crossing types across the Red Line, Blue Line and 7 Avenue. As the crossings were built at different times, as part of the original LRT segment and during subsequent extensions, the crossings have been built to different standards applicable at the time of construction.

Table 8-1 Crossings Assessed

Line Segment	Crossing Location	Crossing Type
NW	Lions Park West End Pedestrian Crossing	Pedestrian
NE	Saddletowne Station South Pedestrian Crossing	Pedestrian
NE	Whitehorn Drive	Mixed
S	162 Ave S	Mixed
S	61 Ave SW (Chinook Station)	Mixed
NE	12 Ave NE at 36 St NE	Mixed
7 Ave	7 Ave S at 3 St SE	Mixed

8.1 Lions Park West End Pedestrian Crossing

The Lions Park west end pedestrian crossing is equipped with flashing lights with bells and swing gates. The crossing allows pedestrian movements between side load platforms. There is heavy pedestrian traffic due to the North Hill shopping center.

8.1.1 This location has a significant number of near miss reports.Adherence to Minimum Industry Standards

This location conforms to the practices appropriate for a pedestrian crossing on a semi-exclusive alignment.

It should be noted that the swing gates are now felt to create accessibility issues for people in wheelchairs. The user must pull the gate towards themselves and maneuver past the gate.

Figure 8-2 Lions Park West End Pedestrian Crossing

8.1.2 Noted Safety Issues

The flashing light signals are mounted at greater than 8 feet above the top of rail. While appropriate from the perspective of reducing vandalism, this location places the warning devices above the normal cone of vision for pedestrians.

Two minor issues were noted with the existing warning devices. The top hinge on the center swing gate on North (East) side is broken. Gate still somewhat operable but does get stuck. The crossing sign for northward direction is present but extremely faded.

8.1.3 Recommended Enhancements

The addition of active second train warning devices should be considered. The replacement of swing gates with pedestrian automatic gates should be considered.

8.2 Saddletowne Station South Pedestrian Crossing

The Saddletowne south end pedestrian crossing is equipped with flashing lights with bells and swing gates. The crossing allows pedestrian movements between a center load platform and the adjacent infrastructure. There is heavy pedestrian traffic due to this being a terminus station.

This location has a significant number of near miss reports.

The warning devices for the inbound and outbound tracks operate independently.

Figure 8-3 Saddletowne South End Pedestrian Crossing

8.2.1 *Adherence to Minimum Industry Standards*

This location conforms to the practices appropriate for a pedestrian crossing on a semi-exclusive alignment.

It should be noted that the swing gates are now felt to create accessibility issues for people in wheelchairs. The user must pull the gate towards themselves and maneuver past the gate.

8.2.2 *Noted Safety Issues*

The flashing light signals are mounted at 8 feet or more above the top of rail. While appropriate from the perspective of reducing vandalism, this location places the warning devices above the normal cone of vision for pedestrians.

One minor issue was noted with the existing warning devices. One of the swing gates remained open and would not return to closed position on its own..

8.2.3 *Recommended Enhancements*

The replacement of swing gates with pedestrian automatic gates should be considered.

8.3 Whitehorn Drive Mixed Crossing

The Whitehorn Drive crossing is equipped with flashing lights with bells and automatic gates for road traffic. Flashing lights with bells and bedsteads are provided for pedestrian traffic movements to the center load platform. There is heavy pedestrian traffic during rush hour.

This location has a significant number of near miss reports. Information concerning pedestrian fatalities is found in Appendix C: Confidential Data.

The pedestrian flashing light signals have been lowered and extra cantilever assemblies have been installed.

Figure 8-4 Whitehorn Drive Crossing

8.3.1 Adherence to Minimum Industry Standards

This location conforms to the practices appropriate for a pedestrian crossing on a semi-exclusive alignment.

8.3.2 Noted Safety Issues

The crossing operation is not split for inbound and outbound train movements; the resulting nuisance operation of the warning system on the non-active track creates the impression that the warning devices are not functioning correctly, leading pedestrians to being accustom to crossing the track while warning devices are operating.

Refuge areas between the traffic on 36 St NE and the LRT alignment are narrow.

8.3.3 Recommended Enhancements

Pedestrian automatic gates would be desirable but additional space would be required.

Pedestrian compliance with traffic and at-grade crossing warning signals would benefit from splitting the operation of the at-grade crossing warning signals so that the inbound and outbound tracks operate independently. PSE has noted that pedestrians are ignoring the warning signals, resulting in an undesirably high number of near miss reports. This operation would be similar to that at 25 Ave SE (Erlton/Stampede Station). Changes are planned as soon as funding is available.

8.4 162 Ave SW Mixed Crossing

The 162 Ave SW crossing is equipped with flashing lights with bells and automatic gates for road traffic. Flashing lights with bells and bedsteads are provided for pedestrian traffic movements; the bedstead in the NW quadrant is located between the LRT alignment and the CP.

This location does not have a significant number of near miss reports. Pedestrian traffic is light. Information concerning pedestrian fatalities is found in Appendix C: Confidential Data.

Figure 8-5 162 Ave SW Crossing

8.4.1 *Adherence to Minimum Industry Standards*

This location conforms to the practices appropriate for a pedestrian crossing on a semi-exclusive alignment.

8.4.2 *Noted Safety Issues*

The flashing light signals for pedestrians are mounted at greater than 8 feet above the top of rail. While appropriate from the perspective of reducing vandalism, this location places the warning devices above the normal cone of vision for pedestrians. The sharing of flashing light signals for road traffic and pedestrians further complicates this issue and results in the placement of the warning signal in NE quadrant being 4.5 meters from the center of sidewalk.

On the north sidewalk, bedstead barriers are present but there is evidence that cyclist and pedestrians bypassing them. Additional barriers or fencing are required.

8.4.3 *Recommended Enhancements*

The addition of active second train warning devices should be considered. The replacement of bedsteads with pedestrian automatic gates should be considered.

8.5 61 Ave SE (Chinook Station) Mixed Crossing

The 61 Ave SE crossing is equipped with flashing lights with bells and automatic gates for road traffic. Flashing lights with bells and bedsteads are provided for pedestrian traffic movements on the north side of the road. Flashing lights with bells and pedestrian automatic gates are provided fore pedestrian traffic movements on the south side of the road, adjacent to the station platform.

This location does not have a significant number of near miss reports. Pedestrian traffic is heavy adjacent to the Chinook station, accessing into the station platform. Information concerning pedestrian fatalities is found in Appendix C: Confidential Data.

The pedestrian warning devices on the south side of 61 Ave for the inbound and outbound tracks operate independently.

Figure 8-6 61 Ave SE Crossing

8.5.1 Adherence to Minimum Industry Standards

This location conforms to the practices appropriate for a pedestrian crossing on a semi-exclusive alignment.

8.5.2 Noted Safety Issues

The flashing light signals for pedestrians are mounted at greater than 8.5 feet above the top of rail. While appropriate from the perspective of reducing vandalism, this location places the warning devices above the normal cone of vision for pedestrians. Aligning lights downward is not affective.

Signal Masts C&D are missing the "2" tracks signs.

8.5.3 Recommended Enhancements

An additional warning signal should be added in NW quadrant for pedestrian traffic.

8.6 12 Ave NE at 36 St NE Mixed Crossing

The 12 Ave at 36 St NE crossing is equipped with flashing lights with bells and automatic gates for road traffic. Flashing lights with bells and bedsteads are provided for pedestrian traffic movements. There is moderate pedestrian due to the Canadian Tire and McDonalds shopping area.

Information concerning pedestrian fatalities is found in Appendix C: Confidential Data.

Pedestrians are routed to a single side of 12 Ave NE.

8.6.1 Adherence to Minimum Industry Standards

This location conforms to the practices appropriate for a pedestrian crossing on a semi-exclusive alignment.

8.6.2 Noted Safety Issues

Westward pedestrians must cross four lanes before getting to track and there is no refuge point until after crossing both tracks. No crossbuck or 2 tracks sign visible for westbound pedestrians while in crosswalk.

Gate for southbound left turn lane to eastbound across track is parallel with track (not perpendicular to the road) and does not substantially block the lane.

8.6.3 Recommended Enhancements

It is recommended that the lane arrangement for 36 St NE be revised to provide a pedestrian refuge area in the SE quadrant. This has been previously estimated as $150,000.

8.7 7 Ave S at 3 St SE Mixed Crossing

The 3 Street SE crossing is located directly east of City hall building and has the New Centre library and Bow Valley College buildings in close proximity. For this reason and the proximity to the revitalized East Village, there is heavy pedestrian traffic year-round. The location consists of;

- Red and Blue Lines entering and existing downtown
- A road crossing (3rd Street East) which crosses both the Red Line and the Blue Line. This crossing is controlled by traffic lights.

- A pedestrian crossing on the west side of 3rd Street which crosses both the Red Line and the Blue Line. This crossing is controlled by traffic lights and walk/don't walk indicators.
- A pedestrian crossing on the east side of 3rd Street which crosses the Blue Line. This crossing is controlled by traffic lights and walk/don't walk indicators.
- A pedestrian crossing slightly east of 3rd Street which crosses the Red Line, near the library. This crossing is protected by a warning system consisting of walk/don't walk indicators, swing gates and a bell.

Figure 8-7 7 Ave at 3 St SE Library Pedestrian Crossing

This crossing is located at the eastward extent of the in-street limits.

There are a high number of near miss reports concerning this crossing.

8.7.1 Adherence to Minimum Industry Standards

This location conforms to the practices appropriate for a low speed line segment operated on a line-of-sight basis. Additional treatments beyond the normal pedestrian type signals used along 7 Ave, including swing gates and bell, are provided for the pedestrian crossing of the Red Line near the library. Sightlines to approaching Red Line trains are restricted by track geometry and the tunnel portal.

It should be noted that the swing gates are now felt to create accessibility issues for people in wheelchairs. The user must pull the gate towards themselves and maneuver past the gate. This is a concern at this and other locations where swing gates are employed.

8.7.2 Noted Safety Issues

It was noted that:

- Many pedestrians were disregarding the warning system installed on the pedestrian crossing on the Red Line near the library. (possibly partially account of the nuisance warning reported below)
- There was significant nuisance warning by the warning system on the pedestrian crossing near the library. Specifically, nuisance warning was observed when;
    - Northbound, Red Line trains approached.
    - Eastbound, Red Line and Blue Line trains approached, when switch was lined for the Red Line.
    - Randomly while trains had left the crossing and were trailing away from the crossing.
    - Randomly, while no trains were in the vicinity.
- Some short warning time events (as short as 7 seconds) were observed on Northbound trains from Red Line on the crossing near the library.
- Irregular warning times observed on crossing near library on Eastbound trains going to Red Line. Warning times varied from 30 to 50 seconds. Likely caused by passengers loading in the station.

No irregularities were observed with the traffic lights on 3 Street SE.

8.7.3 Recommended Enhancements

The design of the pedestrian crossing of the Red Line near the library should be reviewed to determine the cause of nuisance operations and short warning time events associated with the bell. The investigation of this problem is ongoing, with further work to determine the root cause planned during the May maintenance shut down.

Once this issue has been addressed, the ongoing issues related to pedestrians disregarding the warning system should be reviewed. Without the nuisance operation, it is anticipated that these issues will be reduced. The use of swing gates and the bell at the pedestrian crossing of the Red Line near the library exceeds what is installed along 7 Ave.

At the other end of 7 Ave, the 11 Street SW crossing also has additional warning devices. The pedestrians on the west side of the street are controlled by flashing lights with bells and automatic gates and all crossings east of that location are controlled by Traffic Signals. While local characteristics associated with the location of the station result in greater complexity at 3 Street SE, the installation of flashing lights, bells &

automatic gates for the pedestrian crossing near library may ultimately be found to be appropriate.

Among the concerns with the installation of additional warning devices is the potential to confuse pedestrians crossing the Blue line on east side of 3 Street SE. Closing this crossing or the addition of flashing lights, bells and automatic gates for the pedestrians on east side of 3 Street SE may be appropriated. Barriers to channel pedestrians towards the crossing point may be appropriate.

In contemplating any of these changes, consideration of pedestrian delay is important as this is a driver of undesirable pedestrian behavior.

8.7.4 Other Issues

While looking at the approaches for the 3 St SE crossing, it was noticed that there is a pedestrian crossing located just west of 4th Street East that only has some channelization; there are no pedestrian signals or crossing warning signals provided. The adjacent road crossing has flashing lights with bell and gates and the pedestrian crossing on the east side of the road has bedsteads. We recommend that this pedestrian crossing be assessed and warning devices added as appropriate.

Figure 8-8 7 Ave at 4 St SE Pedestrian Crossing

This issue has also been identified by Calgary Transit and Calgary Roads. The addition of flashing lights with pedestrian automatic gates, bells and second train warning signs is under review. The addition of cantilevered flashing light signals and bedstead barriers is currently being considered as a nearer term improvement.

Accident and Incident Rates

9.1 Baseline Accident Data

Statistics Canada *Table 13-10-0156-01 Death by cause, Chapter XX: External causes of morbidity and mortality (V01 to Y89)* summarizes the causes of death in Canada.

9. On the basis of this data, most recently published for the calendar year 2016, it is possible to develop an average annual individual risk of death.

Table 9-1 Annual Individual Risk of Death

Cause	2000 Deaths	2016 Deaths	2000 Average Annual Individual Risk of Death	2016 Average Annual Individual Risk of Death
Transport Accident	3120	2075	101.7	59.0
Railway Accidents	104	40	3.4	1.1
Pedestrian Collision with Train or Railway Vehicle	32	16	1.0	0.5
Assault	453	390	14.8	11.1
Intentional Self Harm	3605	3974	117.5	113.1
Lightening	3	2	0.1	0.06

The data indicates that in 2016 an average of 59 people in a population of 1 million died to a transportation accident, of which only 1.1 people in a population of 1 million died due to a railway accident. The rate of death due to a pedestrian collision with a train or railway vehicle was 0.5 per 1 million population.

The average annual individual risk of death due to assault and intentional self harm were one and two orders of magnitude greater respectively.

Although there has been a statistically significant decrease in transport accidents, all other causes listed would be viewed as unchanged during the period between 2000 and 2016.

9.2 Calgary Transit Accident and Incident Data

In 2017, the analysis of accidents that had occurred to date since 1981 indicated that they were distributed as:

- 6.8% due to collision of LRV with a car;
- 4.1% due to collision of LRV with a cyclist;
- 89% due to collision of LRV with a pedestrian.

The fatal injuries were distributed as:

- Accidental 66.2%
- Intentional self-harm 31.1%

Accidental fatalities at at-grade crossings were attributed to human error factors including intoxication, distracted walking and noncompliance with safety measures.

The 18 fatal accidents involving Calgary Transit between 2015 and 2018 would result in an average annual individual risk of death of 3.62 in 1 million, well below the average annual individual risk of death due to transport accidents. When the incidents of intentional self harm are excluded, the average annual individual risk of death is 2.2 in 1 million.

There were 10 fatal injuries at crossings within the Calgary Transit system, amounting to a average annual individual risk of death of 2.08 in 1 million. While this is above the national rate for pedestrian collision with train or railway vehicle, this is not unexpected given the greater number of potential interactions resulting from the train frequency in a light rail system (200 or more crossing events per day) versus a heavy rail system (typically 25 crossing events per day).

For the period between 2015 and 2018, Calgary Transit had:

- 4.5 fatal injuries per year (all causes)
- 2.75 fatal injuries per year (excluding those due to intentional self-harm);
- 2.5 fatal injuries per year at crossings;
- 0.03 fatal injuries per crossing per year.

All fatal injuries occurred in semi-exclusive right-of-way.

For the period between 2016 and 2018, there were 83 collisions not resulting in fatal injuries, an average of 27.6 per year. 37 of these collisions or an average 12.3 per year, occurred in the downtown.

9.3 Comparison of Accident and Incident Rates Within Calgary Transit System

The number of accidents involving fatalities and collisions are insufficient to draw a conclusion concerning the need for safety improvements at any given location. It was noted that the West LRT portion of the Blue line has had no fatal accidents or collisions during the period for which data was provided. This indicates that the City's current standards are effective.

Calgary Transit tracks near miss events.

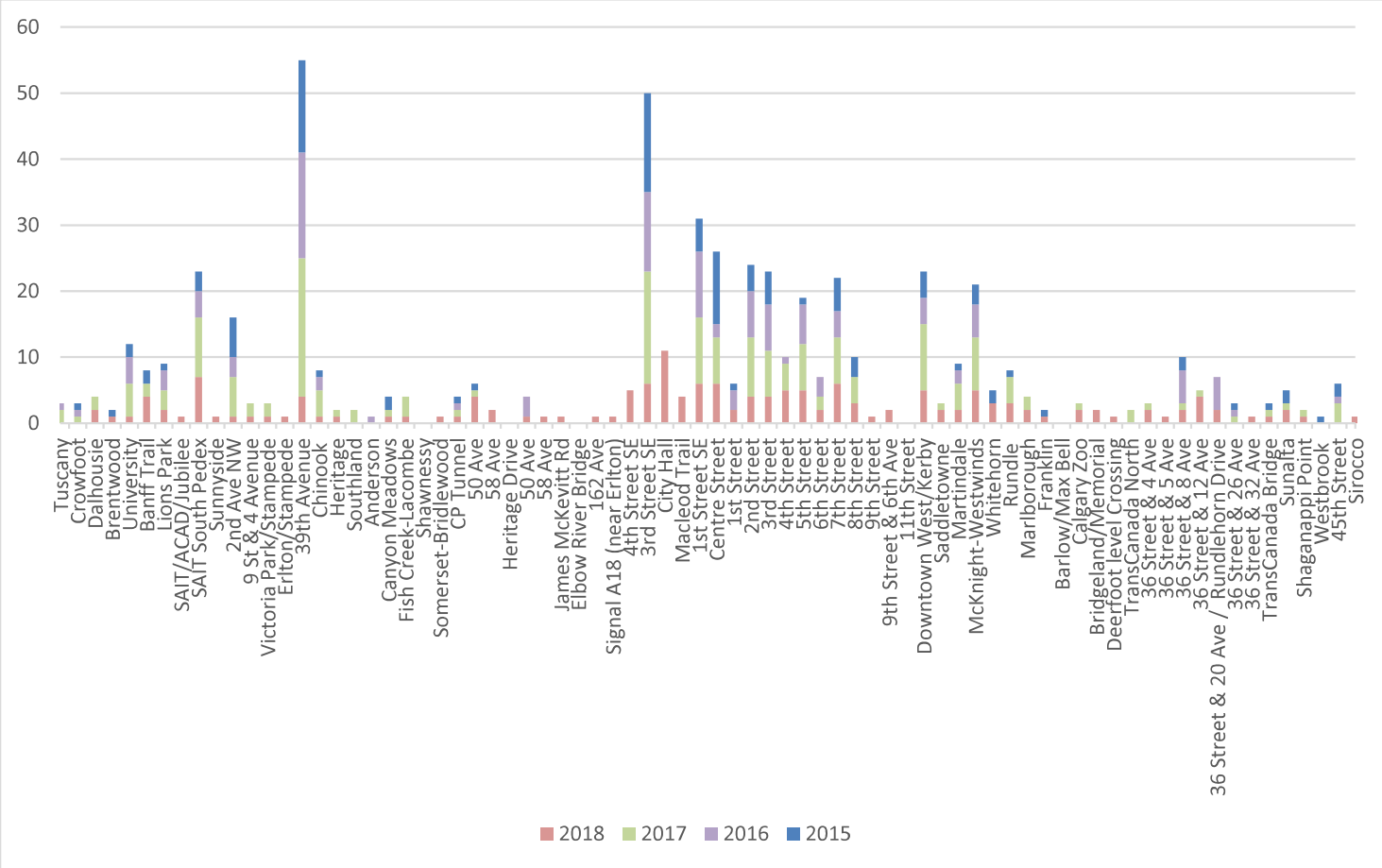

Figure 9-2 LRT Near Miss Events 2015-2018 (Calgary Transit)

This data shows:

- A high occurrence rate of near miss events in the area of non-segregated alignment in the downtown;
- A low rate of occurrence along the West LRT segment of the Blue Line
- A high rate of events at University Station, SAIT/ACAD/Jubilee Station South pedestrian crossing, 2 Avenue NW, 39 Avenue, McKnight-Westwinds Station and 36 Street at 8 Avenue NE;
- 80 percent of reported near miss events involved pedestrians.

9.4 Edmonton Transit Accident and Incident Data

For the years 2016 to 2018, Edmonton reported 25 major incidents (an average of 8.3 per year) and 315 near miss events (an average of 105 per year). There were an average of 2.3 instances annually of individuals being struck by a train.

Given the differences in the data reported, the frequency of individuals being struck by a train is the only common point within the Calgary Transit and Edmonton Transit data. Edmonton Transit's fatal accident rate is approximately half that of Calgary Transit's, however, their system is approximately half the size of Calgary's. As such, the frequency of individuals being struck by trains in both cities is very similar.

The most common near miss cause related to pedestrians and vehicles disregarding warning devices (29%).

9.5 Metro Transit Accident Data

Minneapolis Metro Transit experienced 6 pedestrian collisions, of which 3 were fatal, during the 31 day period between December 4, 2015 to January 3, 2016. Of these collisions, 4 involved pedestrians, one involved a cyclist and one involved a person on a mobility device. The consistent theme that emerged was ignoring active warning devices. During the 12 month period between January 4, 2015 and January 3, 2015, they experienced 14 LRT pedestrian collisions.

The subsequent year, between January 4, 2016 and January 3, 2017, they experienced 7 LRT pedestrian collisions. There was also a reduction of 235 close call reports. The accident reduction was attributed to an outreach program and a variety of engineering initiatives. The engineering initiatives included:

- Installation of alternating flashing train headlamps, with the fleet now 66% equipped;
- Low mounted Train Approaching signals at station entrances that flash when a train is approaching;
- Fencing extensions;
- Maintaining bell operation when the automatic gates are in the down position; and
- Active advance warning signage on a bike path.

Metro Transit, which is significantly smaller than Calgary Transit, has a higher rate of collisions with pedestrians than Calgary Transit.

9.6 Comparison to Other Similar LRT Systems

The TCRP has published 3 reports addressing vehicle and pedestrian safety in Light Rail systems. The earliest report, TCRP 17, was published in 1996 and the most recent, TCRP 137, was published in 2009.

TCRP 69 summarizes data from 11 agencies for the period up to 1996, including Calgary Transit and Edmonton Transit. Calgary transit had an Average Annual Total Accidents of 12.2 compared with an industry average of 20.9.

Calgary Transit had an Average Annual Accidents per LRT Crossing-Year of 0.26 for semi-exclusive alignment types b.1 and b.2, compared to the average of 0.17 for all 11 agencies and 0.21 for Edmonton Transit.

Calgary Transit had an Average Annual Accidents per LRT Crossing-Year of 0.55 for non-exclusive and semi-exclusive alignment types b.3 and b.4, compared to the average of 0.54 for all 11 agencies. While non-exclusive and semi-exclusive right-of-way types b.3 and b.4 account for an average of 23% of the total LRT right-of-way, they account for an average of 87% of the accidents.

Calgary Transit's performance in terms of annual accidents per LRT crossing matched the industry average in areas other than semi-exclusive right-of-way types b.1 and b.2 where CT's performance was found to be worse than the industry average.

Table 9-3 Summary of Accident Experience at LRT Crossings Through 1996 (TCRP 69)

Agency	Average Annual Total Accidents	Semi-Exclusive Right-of-Way, Types b.1 & b.2 (above 55 km/h)			Semi-Exclusive & Non-Exclusive Right-of-Way, Types b.3, b.4, b.5, c.1, c.2, & c.3 (below 55 km/h)		
		Average Annual Accidents	Average Annual LRT Crossing-Years	Average Annual Accidents per LRT Crossing-Year	Average Annual Accidents	Average Annual LRT Crossing-Years	Average Annual Accidents per LRT Crossing-Year
Baltimore	29.8	0.8	18	0.04	29.0	21	1.38
Calgary	12.2	5.1	20	0.26	7.1	13	0.55
Dallas	6.0	2.0	22	0.09	4.0	14	0.29
Denver	34.0	0.5	2	0.25	33.5	29	1.16
Edmonton	1.7	1.7	8	0.21			
Los Angeles	50.7	10.7	28	0.38	40.0	56	0.71
Portland	20.8	0.1	4	0.03	20.7	74	0.28
Sacramento	20.5	2.2	14	0.16	18.3	62	0.30
Saint Louis	0.5	0.5	11	0.05			
San Diego	28.5	5.9	43	0.14	22.6	42	0.54
San Jose	25.2	0.2	3	0.07	25	59	0.42
Average	**20.9**	**2.7**	**16**	**0.17**	**18.2**	**34**	**0.54**

TCRP 137 summarizes data from 23 US agencies for the period of 2002 through 2007. Key takeaways from the report include:

- 44.8% of collisions occurred on non-exclusive right-of-way, 20.1% of collisions occurred on semi-exclusive right-of-way, 11.8% of collisions occurred on exclusive right-of-way, and 24.1% of collisions occurred on unclassified right-of-way;
- An average of 0.073 collisions per crossing occurred.
- An average of 2.32 collisions per million vehicle revenue miles occurred.
- An annual average of 59 fatal injuries occurred (or 2.68 fatalities per agency), with 80% involving pedestrians.
- An annual average of 404 injuries occurred (or 18.36 injuries per agency), with 65% involving motor vehicles and 29% involving pedestrians.

Table 9-4 Ratio of Collisions (TCRP 137)

Agency	Annual Average 2002-2007			Annual Average 2002-2006		
	Collisions	Number of Crossings	Ratio	Collisions	Million Vehicle Revenue Miles	Ratio
Bi-State Development Agency	1	24	0.042	1	4.85	0.2
Dallas Area Rapid Transit	12	98	0.121	14	5.01	2.8
Denver Regional Transportation District	4	39	0.090	3	3.74	0.8
Hillsborough Area Regional Transit Authority	2	21	0.095	2	0.08	24.0
King County Department of Transportation – Metro Transit Division	8	14	0.571	8	0.04	194.7
Los Angeles County Metropolitan Transportation Authority	20	104	0.106	21	7.29	2.9
Maryland Transit Administration	5	52	0.090	5	2.20	2.0
Massachusetts Bay Transportation Authority	4	65	0.059	4	5.72	0.7
Memphis Area Transit Authority	2	62	0.024	2	0.38	4.0
Metro Transit	3	45	0.067	3	1.28	2.3
Metropolitan Transit Authority of Harris County, Texas	23	68	0.331	24	0.71	34.1
New Jersey Transit Corporation	1	88	0.011	1	1.90	0.5
New Orleans Regional Transit Authority	1	238	0.006	2	0.63	2.4
Niagara Frontier Transportation Authority	2	8	0.250	2	0.78	2.6
Port Authority of Allegheny County	4	44	0.083	4	1.67	2.2
Sacramento Regional Transit District	9	104	0.090	10	2.90	3.6
San Diego Trolley, Inc.	5	96	0.052	4	7.24	0.6
San Francisco Municipal Railway	19	351	0.055	19	5.51	3.5
Santa Clara Valley Transportation Authority	2	119	0.017	2	2.30	0.8
The Greater Cleveland Regional Transit Authority	8	22	0.356	9	0.96	9.2
Tri-County Metropolitan Transportation District of Oregon	11	128	0.087	12	6.11	2.0
Utah Transit Authority	6	72	0.081	6	2.63	2.3
Average	**152**	**1862**	**0.073**	**147.5**	**63.51**	**2.32**

Table 9-5 Severity and Type of Collision 2002-2007 (TCRP 137)

Agency	Fatalities				Injuries			
	Total	With Motor Vehicle	With Person	With Cyclist	Total	With Motor Vehicle	With Person	With Cyclist
Bi-State Development Agency					5	1	3	
Dallas Area Rapid Transit	5		5		28	20	8	
Denver Regional Transportation District	1		1		13	9	4	
Hillsborough Area Regional Transit Authority	1		1		1	1		
King County Department of Transportation – Metro Transit Division					2	1	1	
Los Angeles County Metropolitan Transportation Authority	18	1	13	4	63	41	18	4
Maryland Transit Administration	3				11	9	1	
Massachusetts Bay Transportation Authority	1				21	5	12	1
Memphis Area Transit Authority					2	2		
Metro Transit	4	2	2		7	5	2	
Metropolitan Transit Authority of Harris County, Texas					65	54	11	
New Jersey Transit Corporation					1	1		
New Orleans Regional Transit Authority					3	2		
Niagara Frontier Transportation Authority					1		1	
Port Authority of Allegheny County					4	4		
Sacramento Regional Transit District	2		2		21	12	5	4
San Diego Trolley, Inc.	10		10		19	11	7	1
San Francisco Municipal Railway	5				66	33	27	2
Santa Clara Valley Transportation Authority	4	2	1	1	5	3	2	
The Greater Cleveland Regional Transit Authority	4	1	3		10	10		
Tri-County Metropolitan Transportation District of Oregon	1		1		39	26	12	1
Utah Transit Authority	2		1	1	17	11	3	3
Average	**2.68**	**0.27**	**2.14**	**0.27**	**18.36**	**11.86**	**5.32**	**0.73**

The Calgary Transit's 4.5 fatal injuries per year for the period between 2015 and 2018 is better than the industry average of 9.8 accidents per year reported with TCRP 137.

The Calgary Transit average of 2.5 fatal injuries per year at crossings is approximately the same as the industry average of 2.14 pedestrian fatalities per year.

Evolving Issues

10.1 Distraction

10. Distraction has emerged as an issue contributing to accidents and incidents, to such an extent that distracted driving has been addressed legislatively under the Alberta Traffic Safety Act. The number of distracted driving convictions has declined from 27,417 in 2015 to 23,546 in 2018.

The Office of the Chief Coroner for Ontario's *Pedestrian Death Review: A Review of All Accidental Pedestrian Deaths in Ontario from January 1st, 2010 to December 31st 2010* found that, as a causal factor in these deaths, distraction may have been a factor in approximately 20% of occurrences. This includes using a cell phone, MP3 player, a mobile device, pushing a shopping cart, walking a dog, or riding a skateboard. While the report recommended a "complete streets" approach to pedestrian safety, there were no recommendations in the report to directly address pedestrian distraction.

For Calgary Transit, distracted walking has also been an issue. At at-grade crossings of the LRT alignment, distractions can lead to a reduction in the effectiveness of the installed warning equipment. In addition, noise cancelling headphones can negate the benefits of audible warning devices.

Potential solutions need to address providing information within the pedestrian's cone of vision. Vertically, the cone of vision is 10 degrees below the horizontal eye position of a standing individual. Color can be differentiated in the range from +25 to -30 degrees from the horizontal eye position.

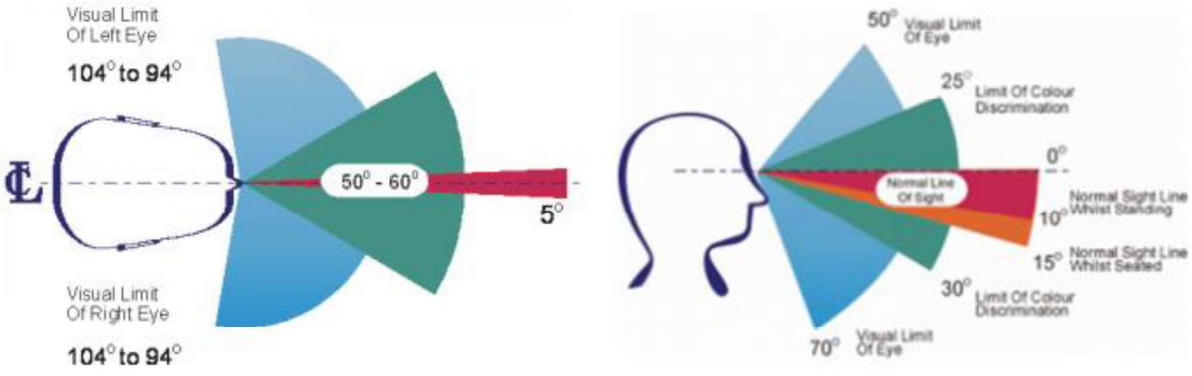

Figure 10-1 Cone of Vision (epd.gov.hk)

Solutions include mounting warning devices lower. Alternative treatments have been employed elsewhere as shown in Figure 10-2 and Figure 10-3. The example treatments place LED lights in barriers or in the pavement. While these solutions would be problematic due to Calgary's climatic conditions, they have the potential to address placement of warning information in the pedestrian's cone of vision.

It would also be possible to install gate lights on top of swing gate posts.

Figure 10-2 Non-traditional Warning Lights – YYC Airport Link (GEC Architecture)

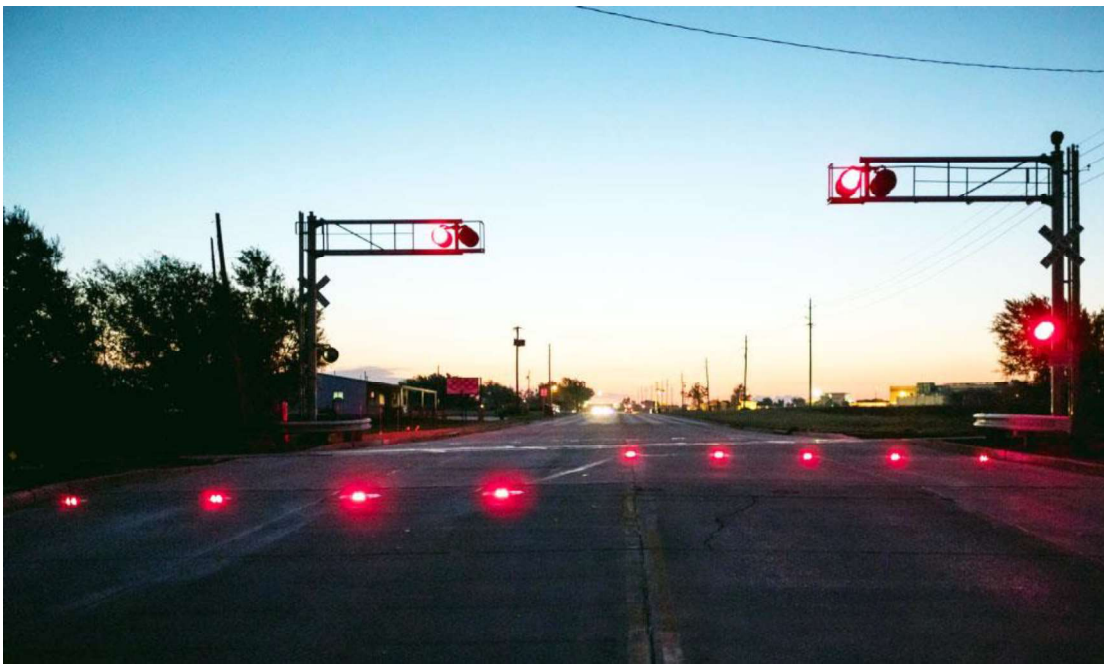

Figure 10-3 Warning Lights Set in Pavement (LightGuard TraxAlert™)

10.2 Accessibility

Accessibility issues center around the following:

- Crossing angle – A crossing angle of between 70 and 120 degrees has a lower risk of the wheels of an assistive device being impeded by the flangeway gap than a crossing that is angled beyond these limits;
- Flangeway gap – The GCS and the Americans with Disabilities Act Accessibility Guidelines (ADAAG) specify limits that the flangeway gap is to be maintained within;
- ADA tactile strip – The ADAAG and the City of Calgary Access Design Standards recommend the use of a cane detectable and high contrast tactile tile before the crossing surface.

There has been an increasing focus on the issues associated with building assessible infrastructure and, especially, transportation infrastructure. The current Calgary Technical Specifications address these issues.

With the exception of emergency exit gates (which you push to open) installed in conjunction with pedestrian automatic gates, the use of swing gates in new crossings is now considered undesirable from an accessibility perspective. Swing gates must be pulled open and cannot cost effectively be powered due to provide accessible access.

10.3 Vehicles Turning onto the LRT Right-of-Way

There have been numerous incidents of vehicles turning onto the LRT right-of-way. This is seen to be an issue of distraction, with drivers sometimes being confused by GPS directions and turning onto the track instead of the adjacent road. In 2017, Long Island Railroad (LIRR) recorded 29 reports of cars on tracks. In Toronto, there have been several incidents of vehicles turning onto the alignment of the new Eglinton Crosstown LRT line.

LIRR has employed extended roadway markings, flexible, four-feet high reflective delineators and additional reflective devices to better alert drivers. that they should not make a turn onto the tracks. LIRR has also partnered with Waze to alert motorists using the app that they are approaching a grade crossing.

Figure 10-4 Crossing Edge Markings on LIRR (Huntington NOW)

Within Calgary, this issue is most evident along 7 Avenue SE and SW and 36 Street NE. Calgary Transit is coordinating improvements to street lighting and is examining the installation of delineators.

In the case of 7 Avenue, each intersection is bounded by clearly marked crosswalks, with overhead signage indicating that turns onto 7 Avenue are not permitted (RB-15 Turns Prohibited Sign). Due to busses and emergency vehicles employing 7 Avenue, it is not possible to square off the corners of the intersection to further discourage turning movements.

Figure 10-5 7 Ave at 7 St LRT Signage (Google)

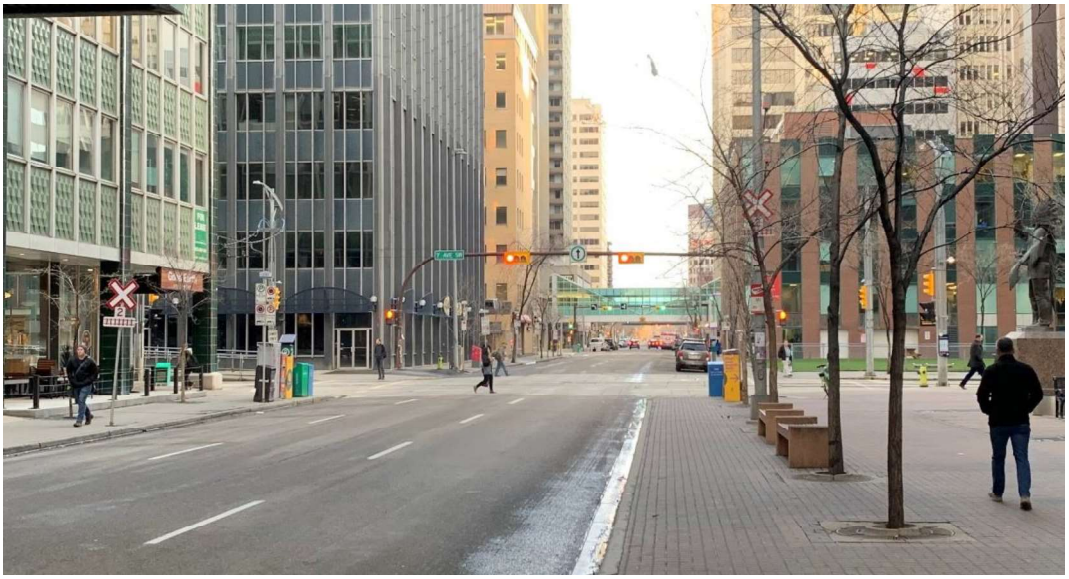

Figure 10-6 7 Ave at 6 St LRT Signage

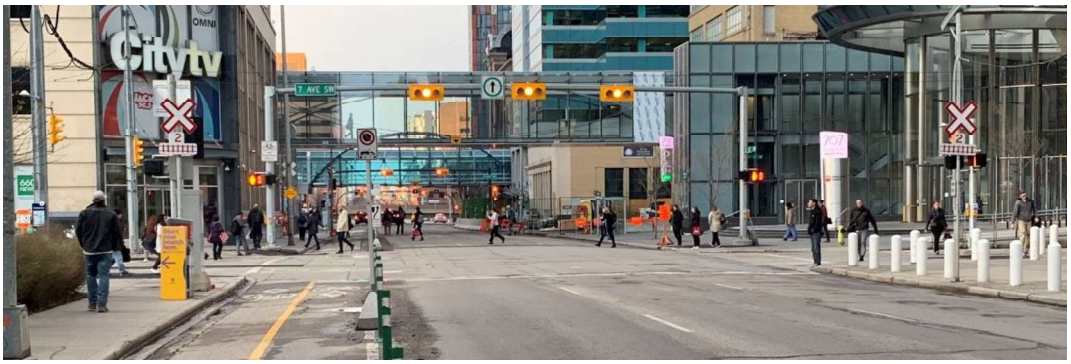

Figure 10-7 7 Ave at 5 St LRT Signage

The LRT crossing signage near 7 Avenue is inconsistent (both in terms of the signs employed and placement) and should be standardized. Signage is missing for the cycle tracks in one direction (opposing direction to road traffic). Calgary Transit and Calgary Roads have conducted a review of signage for the LRT system in downtown and have developed a plan to address this issue.

10.4 Deaths Due to Intentional Self Harm on the ROW

In 2016, there were 3974 instances of death due to intentional self-harm in Canada, amounting to an average annual individual risk of death of 113.1 in 1 million. During the same year, 79 deaths were reported as a result of the individual jumping or lying before a moving object (accounting for an average annual individual risk of death of 2.25 in 1 million); eliminating the deaths that occurred in heavy rail environments (based on Transportation Safety board of Canada data), the remaining 32 deaths likely all occurred in light rail and subway environments (an average annual individual risk of death of 0.91 in 1 million).

The 7 fatal events involving intentional self-harm involving Calgary Transit between 2015 and 2018 would result in an average annual individual risk of death of 1.4 in 1 million, in line with national trends.

To supplement the access prohibited signs, Metrolinx (GO Transit) now posts mental health helpline numbers at points of access to the ROW, including at the end of station platforms. The effectiveness of such signs is currently not known.

Figure 10-8 Mental Health Helpline (Metrolinx)

10.5 Noise

Railroad crossing bells are designed to emit sound on a 180 degree plain. This can negatively impact neighboring homes and businesses. Calgary Transit employs “soft tone” adjustable bells and adjusts the sound output. Other agencies have tried shutting off the bell when gates are in the down position. Metro Transit, which only provides gates for road traffic typically, has recently changed this policy. As bells are a pedestrian warning device and may be the only indication of an approaching train to an individual with a visual impairment, bells should ring when the warning signals for the crossing are active.

Audible devices other than railroad bells are being investigated for use on the Green Line, with the intent of providing a more focused warning, similar to “chirpers” that are employed with traffic signals.

Recommendations for Future Improvements

11.1 Ongoing Calgary Transit Improvements

The following improvements are being made by Calgary Transit as budgets permit. These initiatives should be continued on a risk based basis as funding permits.

11.

11.1.1 Split Warning Phases at Center Load Station Platforms

The warning systems at pedestrian crossings at the end of center load station platforms should operate independently so as to provide warning only when required. This eliminates unwanted warning device operation which leads to a perception that the warning devices do not function correctly.

This will be made a requirement for the Green Line Stage 1.

11.1.2 Second Train Warning Signage

Second train warning signage should be provided at crossings where there is the potential for two trains to pass within the limits of the crossing approach.

For the Green Line Stage 1, active blank-out signs, similar to those employed in Portland, are being recommended.

Figure 11-1 Active Blankout Second Train Warning Sign

The use of second train warning signage is intended to supplement the current Calgary Transit practice of training drivers to pass each other while in the crossing surface.

11.1.3 Height of Pedestrian Warning Signals

The installation of pedestrian warning signals should be reviewed to ensure that they are installed in the normal code of vision of pedestrians. This is particularly critical due to the issues surrounding distraction.

For Stage 1 of the Green Line, pedestrian warning signals are required to be installed so that the light is at a 2.3 to 2.6m (7.5 to 8.5') above the crown of the sidewalk or pathway. This is at the lower end of the range for warning signals (normally 2.3 to 2.9m) and is intended to improve signal conspicuity.

It is understood that this change will increase the potential for vandalism and the need for maintenance activities.

11.1.4 *Pedestrian Automatic Gates*

As indicated in MUTCD Section 8C.05, situations where the sight distance is not sufficient for pedestrians and bicyclists to complete their crossing prior to the arrival of the LRT traffic at the crossing warrant the installation of active warning devices. The minimum acceptable pedestrian sighting time is 10 seconds per Transport Canada G4-A 'Minimum Railway/Road Crossing Sightline Requirements for All Grade Crossings Without Automatic Warning Devices'. This allows for sufficient time for a pedestrian to cross the tracks between points of safety prior to arrival of the train and is shown in Table 11-2. The variable distance travelled by the train during this time is shown as a function of train speed in Figure 11-3, with a sight distance of greater than 223m required when the train is travelling at 80 km/h.

Table 11-2 Minimum Pedestrian Sight Distance & Minimum Stopping Sight Distance

LRT Speed (km/h)	LRT Speed (m/s)	Minimum Pedestrian Sight Distance (m)	Minimum LRT Stopping Sight Distance (m)
25	6.9	69	46
30	8.3	83	58
35	9.7	97	76
40	11.1	111	87
45	12.5	125	107
50	13.9	139	130
55	15.3	153	154
60	16.7	167	181
65	18.1	181	210
70	19.4	195	240
75	20.8	209	273
80	22.2	223	307

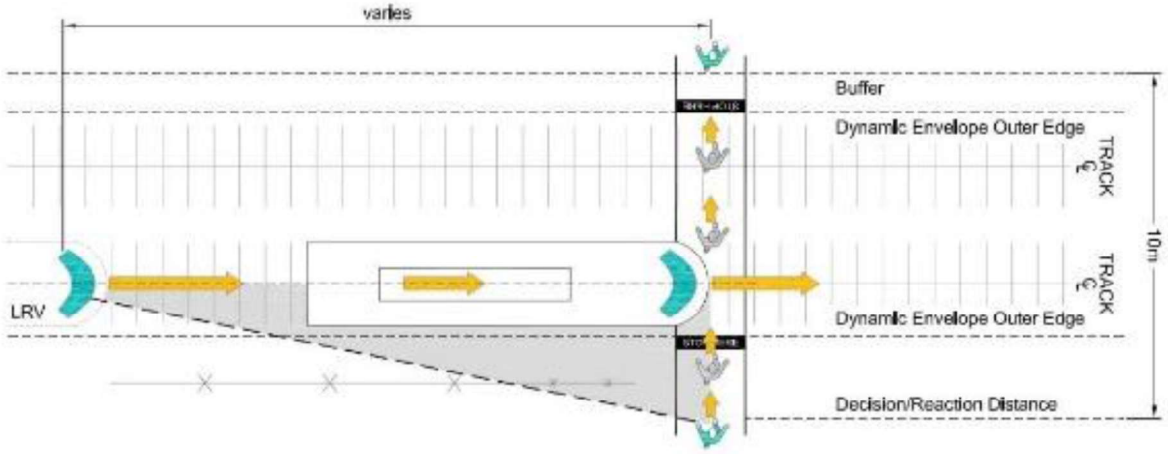

Figure 11-3 Minimum Pedestrian Sight Distance

TCRP Report 17 'Integration of Light Rail Transit into City Streets' recommends automatic gates for pedestrian crossings whenever LRV stopping sight distance is inadequate. As indicated by the Technical Memo 'Calgary LRT Green Line - Light Rail Vehicle (LRV) Service Braking Distances' and summarized in Table 11-2, the LRV stopping sight distance would be 307m for an initial speed of 80 km/h. Once again, the provision of flashing lights with gates is a suitable mitigation when it is not possible to provide the necessary LRT stopping sight distance.

At existing crossing locations, the installation of pedestrian automatic gates in place of bedstead barriers and swing gates has been done at some crossings, including Chinook. The primary challenge to installing pedestrian automatic gates at all crossings is the lack of sufficient pedestrian refuge area, especially in areas where the LRT has a center running alignment in a street median. The addition of pedestrian automatic gates further decreases what may already be an insufficient refuge area.

The provision of pedestrian automatic gates is a requirement for Stage 1 of the Green Line.

11.1.5 Do Not Stop on Track

To provide mitigation against motorists stopping on tracks, the "Keep Clear" zone should be indicated. Historically, this has been done in Calgary as shown in Figure 11-4. Do Not Stop on Tracks Signs (RB-59) should be installed in conjunction with the pavement markings.

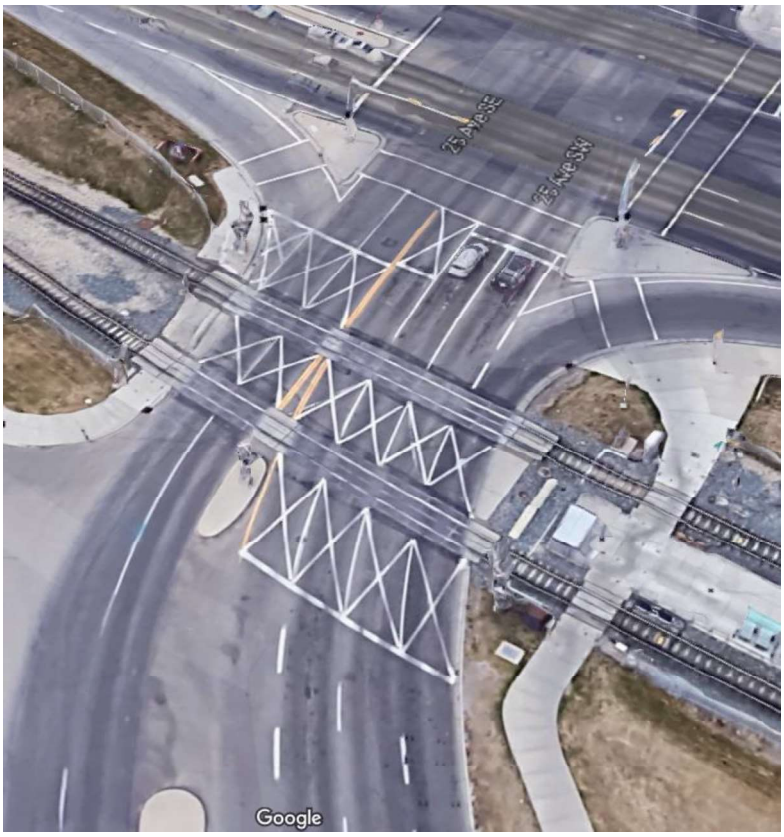

Figure 11-4 Keep Clear Zone Markings

To prevent motorists from driving around gates, medians or median barriers should be provided. These barriers should be appropriate to the Calgary climate and not impede snow clearing.

11.2 Calgary Transit Technical Specification T-SP-R-0069

There are a number of minor issues with the content of Calgary Transit Technical Specification T-SP-R-0069. These include:

- The document should be updated to include in-street operations, especially given the City's intent to develop an unban integrated low floor LRT system for the Green Line.
- References to RTD 10 should be eliminated as this was a draft document has been superseded by the Transport Canada Grade Crossings Standards (GCS) since 2014.
- 4.3.3.1 Flashing Lights. Starting flashing lights at-least 12 seconds prior to arrival of the train for pedestrian crossings does not conform with the Transport Canada GCS, AREMA C&S Manual or US MUTCD. A minimum of 20 seconds warning time should be provided for all crossings.

- 4.3.3.2 Automatic Gate Arms. The gate descent delay indicated does not conform with the Transport Canada GCS. Longer gate descent delays are sometimes necessary to permit a vehicle at the safe stopping distance when the warning devices activate to clear the gate arms. Upper limits for gate descent delays should be established.
- 4.4.5.4 Crossing Angle. The referenced content from RTD 10 was changed substantively in the Transport Canada Grade Crossings Standards (GCR) and Grade Crossings Standards (GCS). The crossing angles referenced should be maintained as a best practice, especially for pedestrian crossings, but they are no longer required by the GCS.
- Table 4.1 Examples of why design guidelines may not be met. The GCR and GCS do not prohibit the construction of an at-grade crossing within 30m of the near side of an adjacent intersection. The GCR and GCS do not prohibit the construction of a crossing with an angle of less that 45 or greater than 135 degrees. Cantilevered crossing warning signals can be provided using traffic signal structures.

It is also recommended that this document be revised to provide guidance concerning:

- Light unit alignment for flashing lights provided for roadway and pedestrian traffic;
- The usage of active second train warning signage; and
- Appropriate signage for non-exclusive alignments such as 7 Avenue.

11.3 Calgary Transit LRT Design Guidelines

There are a number of minor issues with the content of Calgary Transit LRT Design Guidelines. These include:

- References to Transport Canada General Order E-6 should be eliminated as this document has been superseded by the Transport Canada Grade Crossings Standards (GCS) since 2014.
- The design guidelines should be updated to include a minimum standard for pedestrian refuge areas. These areas should be provided before the LRT guideway in all instances.
- The DGM should be updated to include design requirements and operating circuits for second train warning and for interconnections with traffic signals.

11.4 Emergency Notification Signs

Transport Canada requires the installation of an emergency notification sign at all at-grade crossings. These signs provide information to roadway users so that they can notify Calgary Transit about emergencies and malfunctioning traffic control devices. Calls would be routed to the PS100 desk.

Emergency notification signs should conform to Figure 11-5.

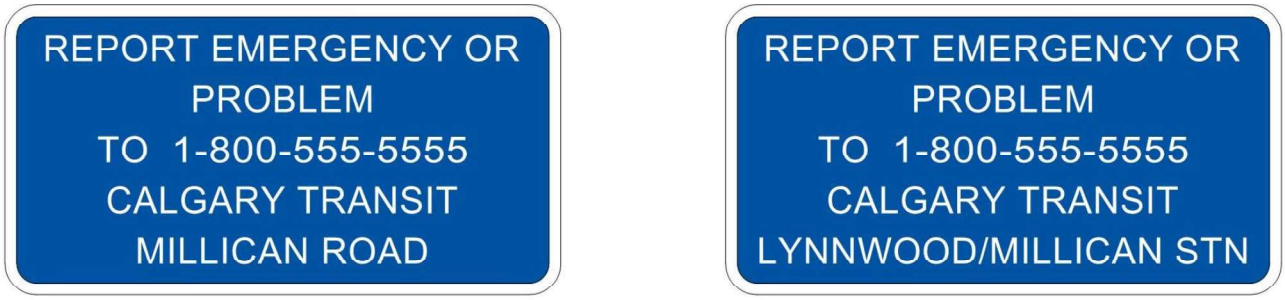

Figure 11-5 Emergency Notification Sign

It should be noted that CP and CN employ a different sign in Canada, pre-dating the US MUTCD recommended sign. These signs are typically placed on the back side of one of the standardized reflectorized crossing sign but can also be placed on the crossing most or the crossing house. All crossings that are shared with CP, such as those along the south end of the Red Line, have a CP emergency notification sign posted.

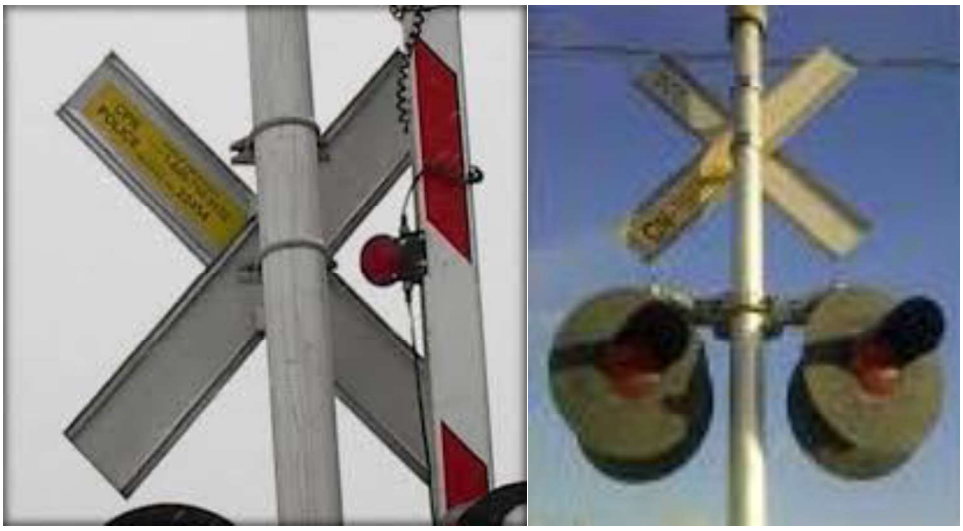

Figure 11-6 CP and CN Emergency Notification Signs (CP, CN)

Transport Canada and the Canadian MUTCD currently do not recommend a sign for this purpose.

The US MUTCD requires that emergency notification signs be positioned so that they do not obstruct any traffic control devices or limit the view of rail traffic approaching the grade crossing. Guidance is provided that signs should be oriented so as to face vehicles stopped at the grade crossing or on the traveled way near the crossing.

There is currently no indication that the lack of emergency notification signs is creating a hazard. This is, however, a low cost item (typically less than $200 per crossing) and

provides a means or reporting emergencies and problems that is consistent with other crossings in Calgary on CN and CP.

11.5 Desirable Data

Benchmarking should be done on the basis of:

- average collisions per crossing;
- average fatal injuries per crossing;
- average injuries per crossing;
- average number of near miss events per crossing;
- average collisions per million vehicle revenue miles;
- average injuries per million vehicle revenue miles; and
- average fatal injuries per million vehicle revenue miles.

This provides a means of benchmarking Calgary Transit's performance as the size of the system increases and against other agencies.

It is recommended that a means of reporting this data annually be established.

Appendix A: Crossing Assessments

Note that areas of concern are highlighted in red in the attached reports and are addressed in the report above.

12.

12.1 Lions Park West End Pedestrian Crossing

HATCH

Calgary Transit
, Calgary, Alberta

Crossing Safety Assessment

Issue and Revision Record					
Rev	**Date**	**Originator**	**Checker**	**Approver**	**Description**
0	2019-05-01	Jenny Xing	Andy Hamel	Dale Hein	Final

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The safety assessment of this grade crossing covers physical features which may affect road and rail user safety and it has sought to identify potential safety hazards. However, the auditors point out that no guarantee is made that every deficiency has been identified. Further, if all the recommendations in this assessment were addressed, this would not confirm that the crossing is 'safe'; rather, adoption of the recommendations should improve the level of safety of the facility.

HATCH

1. Summary

A safety assessment of the grade crossing located at in Calgary, Alberta (Red Line subdivision) was undertaken on May 2nd ,2019. Data on site was acquired by Jenny Xing and the assessment of the information provided was performed by Andy Hamel/Jenny Xing.

For the purposes of this report, crossing is described in a North/South orientation, while the rail line is described in an East/West orientation. The crossing is equipped with an active crossing warning system with flashing lights and bell(s).

2. Purpose

The Fundamental objectives of this assessment are:

1. Identify opportunities to reduce collision risk within the grade crossing environment.
2. Identify opportunities to minimize the frequency and severity of preventable crashes.
3. Consider the safety of all grade crossing users.
4. Verify compliance of the Grade Crossings Standards (GCS, dated July 2014) referred to in the most recent Grade Crossings Regulations (GCR, SOR 2014-275, November 28, 2014).
5. Ensure that all the crash mitigation measures/factors aimed to eliminate or reduce the identified safety problems are fully considered, evaluated and documented for review/action by the appropriate authorities.

3. Site Sketch

A site sketch is included to provide an aerial perspective of the layout for the crossing, which identifies the railway and roadway on appraoch to the grade crossing location. It identifies key components and considerations that impact the safety of the crossing which may include obstructions, signage, crossing infrastructure, and surrounding land use.

4. Assesment Data

The assessment data is provided in pages 4 to 11. Assessment questions are presented to reflect all requirements in the GCS for both passive and active warning systems. Assessment data not within compliance of the GCS is highlighted red for quick reference. Assessment data that is not applicable to the crossing is filled with N/A. Items not within compliance with the GCS are summarized following the assessment data along with suggested actions for remediation.

5. Recommendations

Following the report generated from site, items that do not comply with the Transport Canada's Grade Crossing Standards and Regulations are itemized in a summary table with suggested actions for remediation, if required. Responsibilities for remediation are identified in the adjacent column as per the GCR, where applicable.

6. Site Photos

In order to highlight conditions on site, photographs are included at the end of the report. The pictures are meant to highlight considerations of the report and may include items such as sightlines, signage, warning system equipment, road markings, road condition, rail condition, and site documentation.

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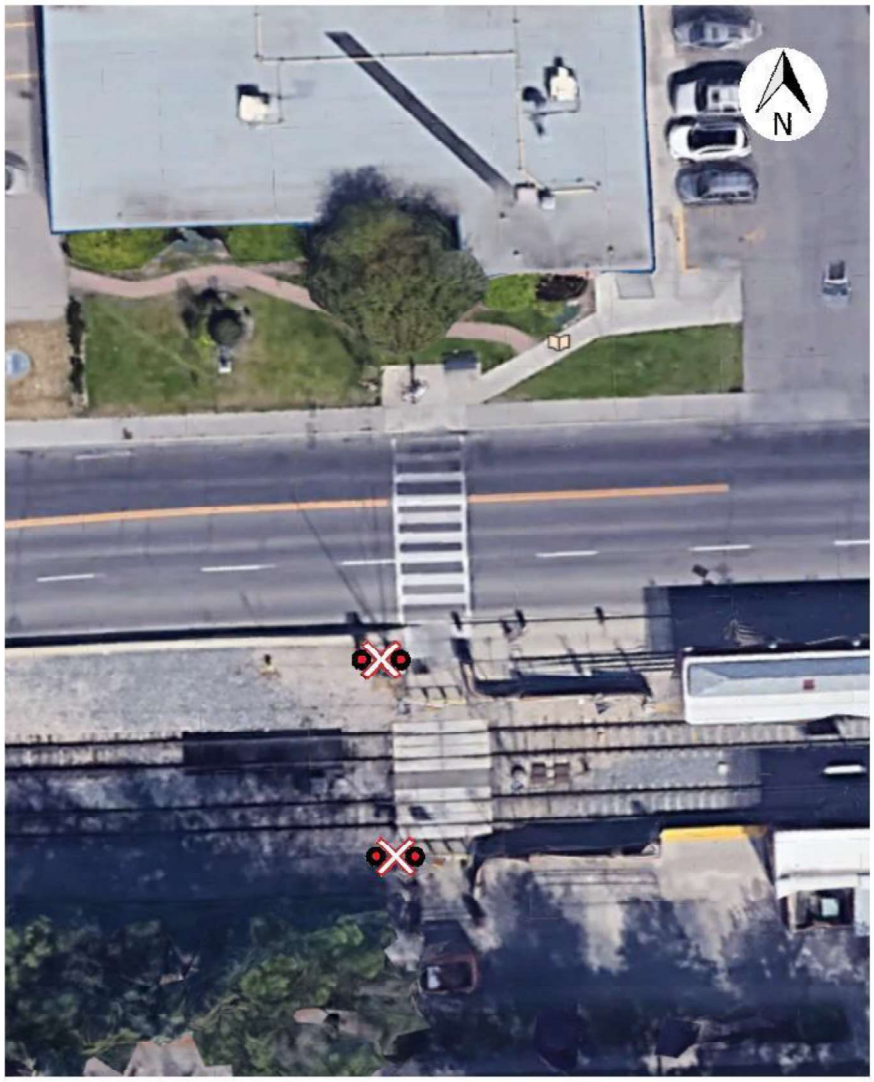
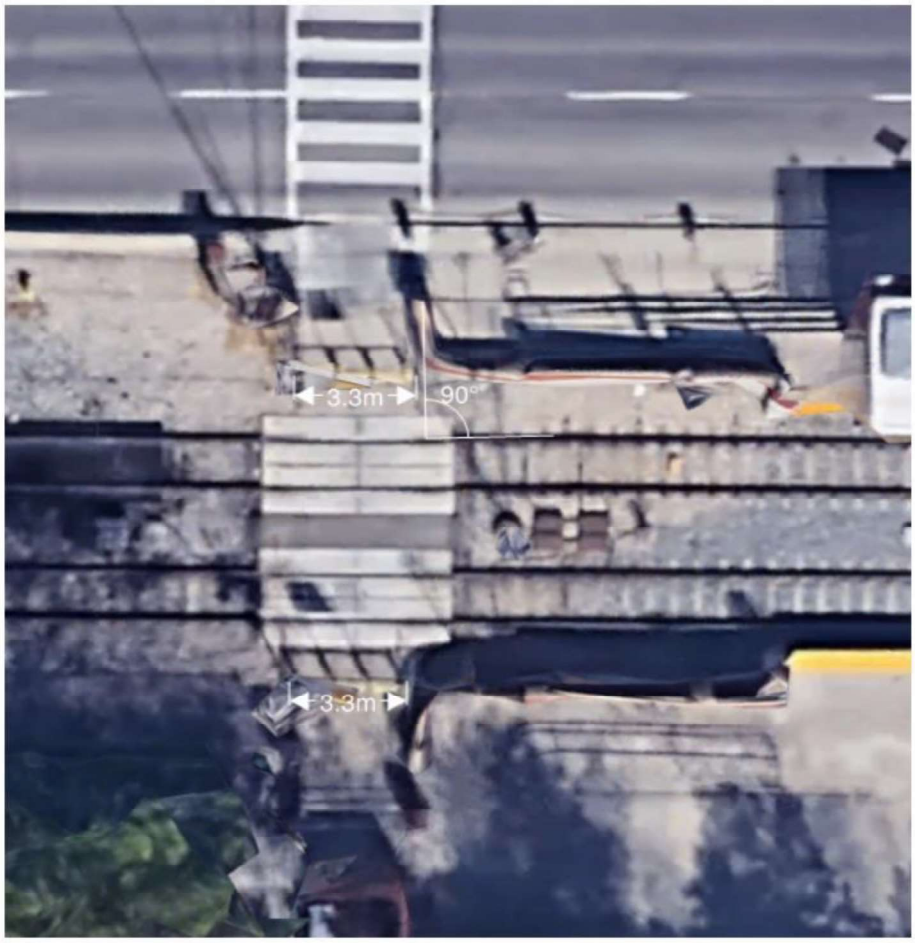
SITE SKETCH



Road Measurement Sketch



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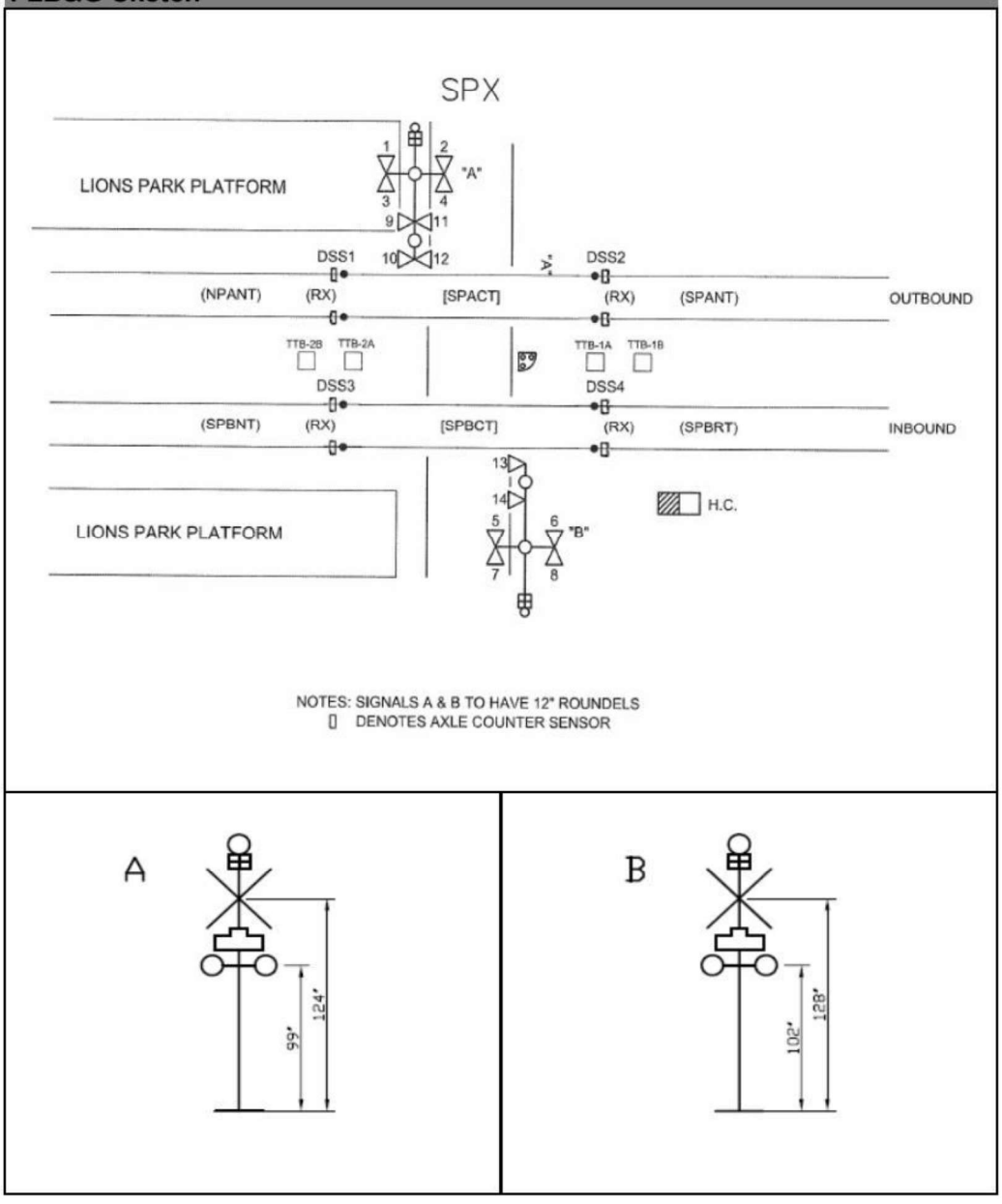
FLB&G Sketch



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ASSESSMENT DATA

Assessor Information	
Data acquisition by:	Jenny Xing
Crossing assessment by:	Andy Hamel/Jenny Xing
Date of site visit:	May 2nd ,2019
Comments:	
Railway Company Information	
Railway company:	Calgary Transit
Location Chainage:	
Subdivision:	Red Line
Rail orientation:	East/West
Number of tracks:	2
Can railway equipment pass each other at the crossing?	Yes
Average annual daily train traffic: (AADT)	200
Freight train design speed: (mph)	
Passenger train design speed: (mph)	
Type of crossing warning system:	Active: FLB
Is whistling used at crossing?	N/A
Class of track:	*CLASS 1*
Comments:	
Road Authority Information	
Road authority:	City of Calgary
Street name:	
Municipality:	Calgary
Province/Territory:	Alberta
Design vehicle:	
Design Vehicle Length: (m)	*6*
Average annual daily road traffic: (AADT)	
Public or private road?	
Urban or rural?	
Local, collector, arrterial, expressway, or freeway?	
Divided or undivided?	
Crossing cross angle: (degrees)	

Crossing Approaches	**North**	**South**
Road crossing design speed: (km/h)		
Number of traffic lanes:		
Traffic lane width: (m)		
Traffic lane width including shoulders: (m)		
Average grade of road approach:		
Stopping sight distance (SSD):		
Vehicle departure time: (calculated)		
Prepare to Stop required activation time:		
Interconnection delay timing:		

Sidewalk	**East**	**West**
Sidewalk present?		
Is sidewalk designated for persons using assistive devices?	Yes	Yes

Comments:

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HATCH

ASSESSMENT DATA

C NEW STANDARDS

5	Crossing Surface			East	West
	Road extensions off of the travelled way: (m)	min 0.5			
	East sidewalk extensions of the travelled way: (m)	min 0.5			
	West sidewalk extensions of the travelled way: (m)	min 0.5			
	Is crossing surface smooth and continuous?			Yes	
	Flangeway			**Min**	**Max**
	Flangeway width: (mm)	min 65	max 75		
	Flangeway depth: (mm)	min 50	max 75		
	Flangeway field side width: (mm)		max 0		
	Flangeway field side depth: (mm)		max 0		
	Top of rail to road crossing surface: (mm)	min -7	max 13		

Comments:

Flangeways and crossing surfaces are good.

6	Road Geometry			North	South
	East slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
	West slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
	Slope within 8m of the nearest rail: (%)		max 2%		
	Slope between 8m and 18m of the nearest rail: (%)	max_1 5%	max_2 10%		
	What is allowable percentage grade slope through crossing?				
	What is the grade slope through the crossing?				
	Is grade slope through crossing less than limit?				
	Are horizontal and vertical alignments smooth and continuous on approach?				
	Width of travelled way on each approach: (m)				
	Width of travelled way at crossing: (m)				
	Width through the crossing greater than approach?				
	Does the travelled way have curbs?				
	Grade crossing angle: (degrees)	min 0	max 180		

Comments:

Road geometry is good

7	Sightlines	North	South
	SSD calculated: (m)		
	SSD measured: (m)		
	D_{SSD} calculated: (m)		
	D_{SSD} driver's left measured: (m)		
	D_{SSD} driver's right measured: (m)		
	$D_{stopped}$ calculated: (m)		
	$D_{stopped}$ driver's left measured: (m)		
	$D_{stopped}$ driver's right measured: (m)		
	$D_{stopped}$ pedestrian's left measured: (m)		
	$D_{stopped}$ pedestrian's right measured: (m)		
	Are there any obstacles to driver's left that may affect visibility?		
	Are there any obstacles to driver's right that may affect visibility?		
	Is there any vegetation to driver's left that may affect visibility?		
	Is there any vegetation to driver's right that may affect visibility?		
	Is visibility along track impaired due to angle of crossing?		

Comments:

HATCH

ASSESSMENT DATA
Sightlines are good.

HATCH

ASSESSMENT DATA

8 Signs & Pavement Markings

Crossing Sign(s)			North	South
Railway crossing sign present with reflective 50mm border?				
Number of tracks sign present and reflective?				
Height of cross buck from crown of road: (m)	min 1.5	max 2.5		
Is 100mm retroreflective strip on back of each blade?				
Distance of strip from crown of road: (mm)		max 300		
Distance of strip from top of cross buck: (mm)	min 70	max 70		
Crossing sign distance from shoulder: (m)	min 2	max 4.5		
Distance to nearest rail: (m)	min 3			
50mm strip on front post?				
Is sign post made of material such that if struck by a vehicle it will break?				
Condition of sign:				

Railway Crossing Ahead Sign and Advisory Speed Tab	North	South
Are vehicles required to slow prior to crossing due to shorter SSD?		
Is sign present upon approach?		
Is sign visible from SSD as defined by road speed?		
Is sign showing correct road orientation?		
Is Advisory Speed tab installed and correct?		
Advisory Speed: (km/h)		
Adjusted SSD: (m)		
Condition of sign:		

Stop Sign Ahead Sign	North	South
Stop sign ahead sign required?		
Stop sign ahead sign installed?		
Stop Sign visible from SSD at design road speed?		
Condition of sign:		

Stop Sign			North	South
Is D_{SSD} insufficient to warrant a stop sign?				
Is stop sign installed?				
Size of stop sign?				
Distance from crown of road to bottom of sign: (m)	min 1.8			
Distance from top of sign to centre of crossing sign: (m)	min 0.5	max 0.5		
Condition of sign:				

Emergency Notification Sign	
Is Emergency Notification Sign Present?	
Does Emergency Notification Sign contain all information?	
Can Emergency Notification Sign(s) be seen from both approach?	
Condition of sign:	

Stop Bars		North	South
Are stop bars able to be painted on approach?			
Are stop bars present?			
Distance from nearest rail (m):	min 5.0		
Distance from nearest signal (m):	min 2.0		
Condition of markings:			

'X' Markings	North	South
Is 'X' marking able to be painted on approach?		
Is X marking present?		
Condition of markings:		

Comments:

Railway crossing X-buck for northward direction is present but extremely faded. See photos.

HATCH

ASSESSMENT DATA

9 Warning Systems Specification			
Traffic volume cross product:			
Railway speed: (mph)			
Is there a sidewalk present?			
Number of tracks:			
Is there an intersection within a distance 'D" from the crossing?			
Flashing Lights and Bells			
Additional condition requires warning system?			
Lights and bells required?			
Are flashing lights and bells present?			
Gates			
Additional condition requires gates?			
Gates required?			
Are gates present?			
Sidewalk Flashing Lights		**North**	**South**
Is sidewalk outside island circuit?			
Additional lights required for sidewalk?			
Are flashing lights for the sidewalk present?			
Sidewalk Gates		**North**	**South**
Are gates required for sidewalk?			
Are gates for the sidewalk present?			
Comments:			

D DESIGN CALCULATIONS

10 Design Calculations		**North**	**South**
Vehicle clearance Distance (Cd) measured: (m)			
Pedestrian clearance Distance (Cd) measured: (m)			
Vehicle travel distance (S) calculated: (m)			
Departure Time (T_D) calculated: (s)			
Maximum approach grade within "S": (%)			
Grade adjustment factor "G":			
Design vehicle departure time "s" calculated: (s)			
Pedestrian Departure Time (T_P) calculated: (s)			
Departure Time measured: (s)			
Gate arm clearance time calculated: (s)			
Gate arm clearance time measured: (s)			
11 Location of Grade Crossings		**North**	**South**
Are there any intersections along approach to crossing?			
Queuing		**North**	**South**
Distance "D" from stop sign: (m)	min 30		
Distance "D" from traffic signal: (m)	min 60		
Is 'D' insufficient such that road vehicles might queue onto the tracks?			
Can traffic queue from adjacent intersection to within 2.4m of nearest track?			
Can traffic queue from crossing into adjacent intersections?			
Are there any queuing issues that would require traffic preemption?			
Comments:			

HATCH

ASSESSMENT DATA

E WARNING SYSTEM DESIGN

12 Warning System Operation - General

Flashing Lights			North	South
Cross buck present with reflective 50mm border?				
Number of tracks sign present and reflective?				
Distance from shoulder to outside of outer signal: (m)	min 1.88			
Distance to nearest rail: (m)	min 3			
Exposed signal foundation from crown of road: (mm)		max 100		
Bottom of lowest signal from crown of road: (m)	min 2.3	max 2.9		
Number of track sign to bottom of lowest signal: (mm)	min 125	max 175		
Cross bucks to top of highest signal: (mm)	min 125	max 175		
Radius of signal backgrounds: (mm)	min 305	max 305		
Distance from centre of signal to centre of mast: (mm)	min 380	max 380		
Condition of signals:				

Gates			North	South
Gate mechanism protrusion: (mm)		max 650		
Gate up protrusion height at edge of signal: (m)	min 5.2			
Gate down height from crown of road: (m)	min 1.1	max 1.4		
Gate tip to centre of mast: (m)		max 11.6		
Gate tip to edge of travelled lane: (m)	min -1	max 1		
Gate tip to tip of other gate: (m)	min 0	max 1		
First signal solid and other signals alternating?				
Gate tip to first gate signal: (mm)	min 355	max 915		
First gate signal to last gate signal: (m)	min 2.74			
Are gate signals equally spaced?				
Gate arm stripe width: (mm)	min 406	max 406		
Gate arm stripes vertical?				
Condition of gates:				

Sidewalk Gates			East	West
Sidewalk width: (m)				
Gate mechanism protrusion: (mm)		max 650		
Gate up protrusion height at edge of signal: (m)	min 5.2			
Gate down height from crown of road: (m)	min 1.1	max 1.4		
Gate tip to centre of mast: (m)		max 11.6		
Number of lights required:				
Does gate extend full width of sidewalk?				
Are gate signals equally spaced?				
Are gate signals alternating correctly?				
Gate arm stripe width: (mm)	min 406	max 406		
Gate arm stripes vertical?				
Condition of gates:				

Cantilevers			North	South
Height of cantilever from crown of road: (m)	min 5.2	max 6		
Radius of signal backgrounds: (mm)	min 305	max 305		
Condition of mast:				
Condition of signals:				

Crossing Case	
Distance of crossing case to edge of rail (m):	
Distance of crossing case to edge of road (m):	

Comments:

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ASSESSMENT DATA

Equipment

Is data recorder capable of retaining information up to 30 days?	
Is design failsafe?	
Is power out indicator installed and visible from the road?	
Do fouling circuits have at least two discrete conductors?	
Does track circuit detect a 0.06ohm resistance?	
Are non insulated joints properly bonded?	
Do insulated joints provide proper insulation?	
Does battery back-up give 8 hours continuous or 24 hours normal operation?	

Comments:

13 **Number and Location of Light Units**	**North**	**South**
Can front lights be seen from SSD?		
Can front lights be seen along entire approach?		
Can front lights be seen from intersections entering approach?		
Can back lights be seen by all vehicles stopped at crossing?		
Are additional lights required?		
Are additional lights installed?		

Cantilevers		**North**	**South**
Distance from centre of signal to edge of travelled lane: (m)	max 7.7		
Distance from second signal to edge of travelled lane: (m)	max 7.8		
Can front light be seen by all vehicles on approach?			
Is roadway classified as an expressway?			
Is a cantilever required?			
Is a cantilever installed?			

Sidewalk		**East**	**West**
Centre of warning system to centre of sidewalk: (m)	max 3.6		
Can at least one set of lights be seen by sidewalk from both sides of rail?			
Is sidewalk outside island circuit?			
Additional signal required?			
Are flashing lights for the sidewalk present?			

Comments:

14 **Light Units - Alignment**		**North**	**South**
Are signal alignment requirements available on site?			
Are all units 200mm or 300mm LEDs?		200mm inc	200mn inc
Light flash rate: (flashes per minute)	min 45 max 65		
Are all lights flashing alternatively and uniformly?			
Are front lights aligned to 1.6m above road at SSD (or when first visible)?			
Are back lights aligned to 1.6m above road at 15m from front lights?			
Are additional lights required for approaches?			
Are additional lights installed and aligned for 1.6m above road surface?			

Sidewalk		**East**	**West**
Are all light units 200mm or 300mm LEDs?			
Light flash rate: (flashes per minute)	min 45 max 65		
Are all lights flashing alternatively and uniformly?			
Are front lights aligned to 1.6m above road at 30m (or when first visible)?			

Comments:

200 mm incandescent lights at this crossing.

HATCH

ASSESSMENT DATA

15 Bells and Gates

Bells			North	South
Is bell installed on mast?			Yes	Yes
Is bell on side with sidewalk?				
Distance from sidewalk to bell mast: (m)		max 30		
Bell gong rate: (rings per minute)	min 100	max 325		
Does bell ring for as long as warning system is active?				

Gates			North	South
Is gate arm perpendicular to road approach?				
Gate descent delay measured: (s)				
Does gate arm stop if obstructed?				
Gate arm descent time: (s)	min 10	max 15		
Time to train arrival: (s)	min 0			
Gate ascent time: (s)	min 6	max 12		
Does gate arm descend smoothly and without rebound?				
Does gate arm return to proper position after clearance of obstruction?				

Comments:

16 Circuitry

Required warning time: (s)	
Measured or recorded warning time: (s)	
Are crossing warning times consistent?	
Are warning times less than 13s more than required?	
Are cut-out circuits installed, if required?	
Type of crossing equipment:	
Are directional stick circuits installed?	
Does stick have release timer or restrict train speeds through signaling?	
Are all wires properly tagged and clear?	

Comments:

17 Inspection and Testing - Warning Systems

Are plans available at location and up to date?	
Is there proof of testing at periods defined in GCS?	

Comments:

F INTERCONNECTED DEVICES

18 Prepare to Stop at Railway Crossing Sign	North	South
Is SSD restricted such that a prepared to stop at railway sign is required?	N/A	N/A
Is prepare to stop sign installed?		
Can the prepare to stop sign be seen from SSD?		
Do prepare to stop flashers activate with enough preemption?		
Does battery back-up allow Prepare to Stop sign to operate for up to 4 hours?		

19 Interconnection of Traffic Signals	North	South
Is intersection within 30m of crossing?		
Are there any queuing issues that would require traffic preemption?	N/A	N/A
Is interconnection installed?		
Does interconnection allow vehicles to clear the grade crossing?		
Does interconnection prevent vehicles from entering crossing?		
Does battery back-up allow traffic signals to operate for up to 4 hours?		

HATCH

ASSESSMENT DATA

20 Interconnected Devices - Inspection and Testing

Is there proof of testing of interconnected devices as defined in GCS?

Comments:

APPENDIX D - WHISTLE CESSATION

	North	South
Is SSD adequate?		
Are sightlines along track greater than 400m in both directions?		
Type of crossing warning system:	*Active: FLB*	
Number of tracks:	*2*	
Railway speed: (mph)		
Is crossing warning system adequate for whistle cessation?		
Is whistling required at crossing?		
Is whistling used at crossing?		

Comments:

ADDITIONAL COMMENTS

Comments:

Location equipped with pull gates.

The top hinge on the center pull gate on North (East) side is broken. Gate still somewhat operable but does get stuck.

Consider installing gates at this location or gate style lights mounted on top of posts between the pull gates to put flashing lights in peripheral vision of pedestrians distracted by phone/tablets.

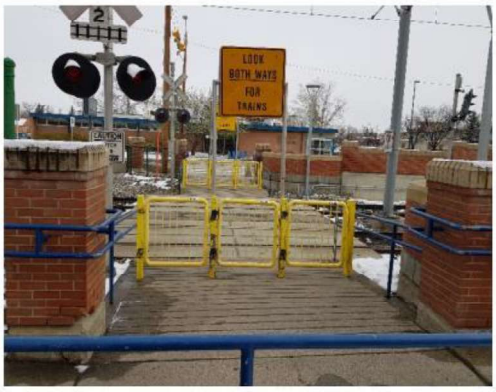
Replace the NB X-bucks as the existing sign is extremely faded.

HATCH

SITE PHOTOS

Lion's Park Looking North - 1

Lion's Park Looking North - 2



Lion's Park Looking North - 3

Lion's Park Looking NE

Lion's Park Looking NW

Lion's Park Looking South - 1

HATCH

SITE PHOTOS

Lion's Park Looking South - 2

12.2 Saddletowne Station South Pedestrian Crossing

HATCH

Calgary Transit
Saddletowne South PED-X, Calgary, Alberta

Crossing Safety Assessment

Issue and Revision Record					
Rev	**Date**	**Originator**	**Checker**	**Approver**	**Description**
0	2019-04-10	Jenny Xing	Andy Hamel	Dale Hein	Final

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To the extent that this report is based on information supplied by other parties, Hatch accepts no liability for any loss or damage suffered by the client, whether through contract or tort, stemming from any conclusions based on data supplied by parties other than Hatch and used by Hatch in preparing this report.

The safety assessment of this grade crossing covers physical features which may affect road and rail user safety and it has sought to identify potential safety hazards. However, the auditors point out that no guarantee is made that every deficiency has been identified. Further, if all the recommendations in this assessment were addressed, this would not confirm that the crossing is 'safe'; rather, adoption of the recommendations should improve the level of safety of the facility.

HATCH

1. Summary

A safety assessment of the grade crossing located at Saddletowne South PED-X in Calgary, Alberta (Blue Line subdivision) was undertaken on Apr 11, 2019. Data on site was acquired by Jenny Xing and the assessment of the information provided was performed by Andy Hamel/Jenny Xing.

For the purposes of this report, Saddletowne South PED-X crossing is described in an East/West orientation, while the rail line is described in a North/South orientation. The crossing is equipped with an active crossing warning system with flashing lights and bell(s).

2. Purpose

The Fundamental objectives of this assessment are:

1. Identify opportunities to reduce collision risk within the grade crossing environment.
2. Identify opportunities to minimize the frequency and severity of preventable crashes.
3. Consider the safety of all grade crossing users.
4. Verify compliance of the Grade Crossings Standards (GCS, dated July 2014) referred to in the most recent Grade Crossings Regulations (GCR, SOR 2014-275, November 28, 2014).
5. Ensure that all the crash mitigation measures/factors aimed to eliminate or reduce the identified safety problems are fully considered, evaluated and documented for review/action by the appropriate authorities.

3. Site Sketch

A site sketch is included to provide an aerial perspective of the layout for the crossing, which identifies the railway and roadway on appraoch to the grade crossing location. It identifies key components and considerations that impact the safety of the crossing which may include obstructions, signage, crossing infrastructure, and surrounding land use.

4. Assesment Data

The assessment data is provided in pages 4 to 11. Assessment questions are presented to reflect all requirements in the GCS for both passive and active warning systems. Assessment data not within compliance of the GCS is highlighted red for quick reference. Assessment data that is not applicable to the crossing is filled with N/A. Items not within compliance with the GCS are summarized following the assessment data along with suggested actions for remediation.

5. Recommendations

Following the report generated from site, items that do not comply with the Transport Canada's Grade Crossing Standards and Regulations are itemized in a summary table with suggested actions for remediation, if required. Responsibilities for remediation are identified in the adjacent column as per the GCR, where applicable.

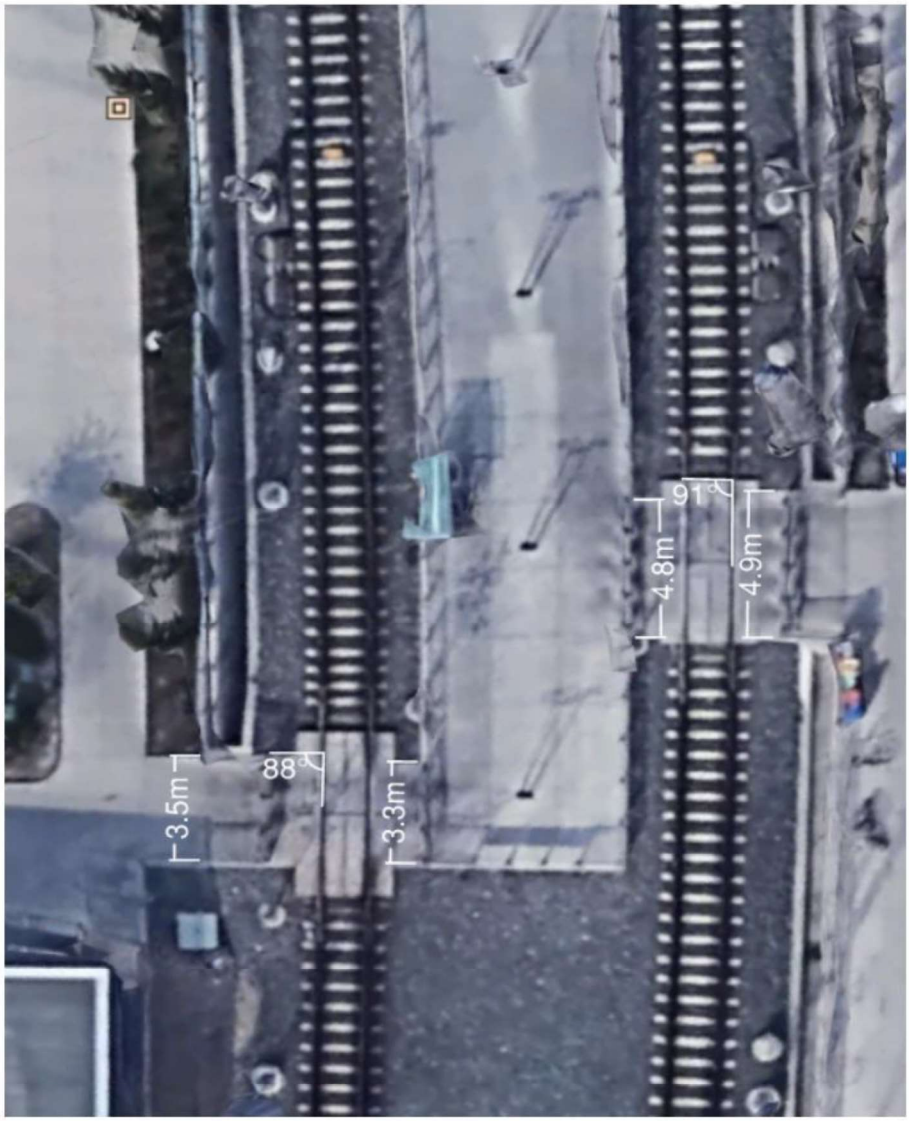
6. Site Photos

In order to highlight conditions on site, photographs are included at the end of the report. The pictures are meant to highlight considerations of the report and may include items such as sightlines, signage, warning system equipment, road markings, road condition, rail condition, and site documentation.

HATCH

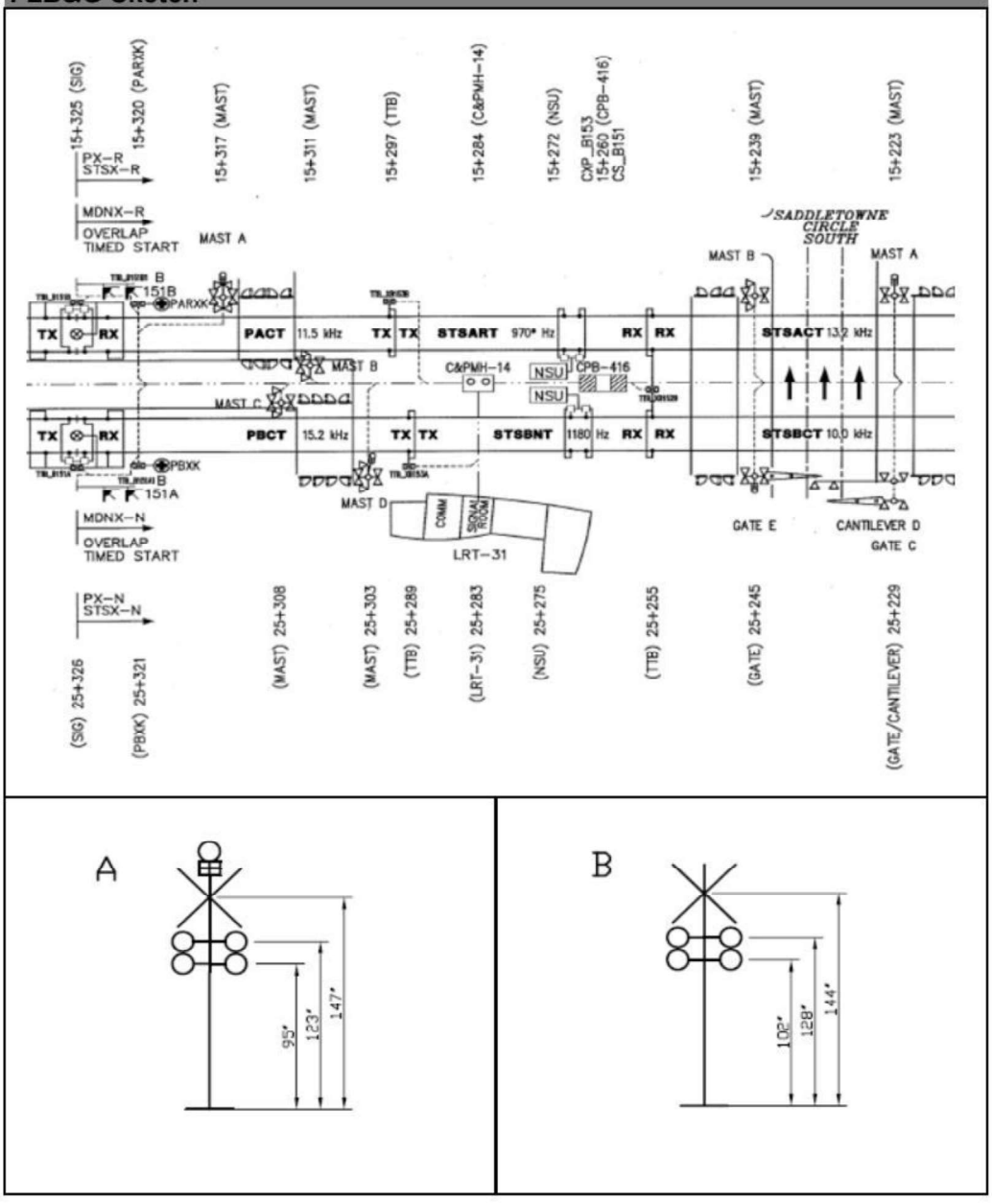
SITE SKETCH

SITE SKETCH



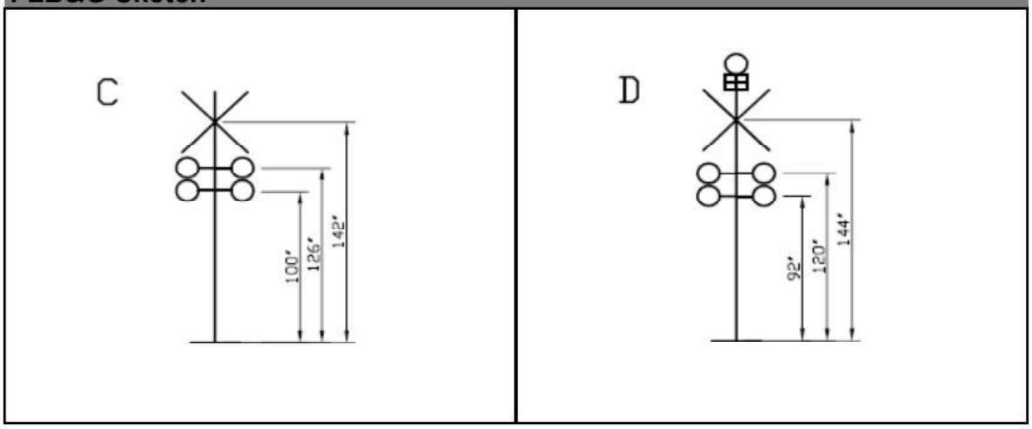
HATCH

FLB&G Sketch



HATCH

FLB&G Sketch



HATCH

ASSESSMENT DATA

Assessor Information

Data acquisition by:	Jenny Xing
Crossing assessment by:	Andy Hamel/Jenny Xing
Date of site visit:	2019-04-11

Comments:

Ped XING

Railway Company Information

Railway company:	Calgary Transit
Location Chainage:	
Subdivision:	Blue Line
Rail orientation:	North/South
Number of tracks:	2
Can railway equipment pass each other at the crossing?	Yes
Average annual daily train traffic: (AADT)	200
Freight train design speed: (mph)	
Passenger train design speed: (mph)	
Type of crossing warning system:	Active: FLB
Is whistling used at crossing?	N/A
Class of track:	*CLASS 1*

Comments:

Road Authority Information

Road authority:	City of Calgary
Street name:	Saddletowne South PED-X
Municipality:	Calgary
Province/Territory:	Alberta
Design vehicle:	N/A
Design Vehicle Length: (m)	*N/A*
Average annual daily road traffic: (AADT)	N/A
Public or private road?	
Urban or rural?	
Local, collector, arterial, expressway, or freeway?	
Divided or undivided?	
Crossing cross angle: (degrees)	

Crossing Approaches	**East**	**West**
Road crossing design speed: (km/h)		
Number of traffic lanes:		
Traffic lane width: (m)		
Traffic lane width including shoulders: (m)		
Average grade of road approach:		
Stopping sight distance (SSD):		
Vehicle departure time: (calculated)		
Prepare to Stop required activation time:		
Interconnection delay timing:		

Sidewalk	**North**	**South**
Sidewalk present?	Yes	Yes
Is sidewalk designated for persons using assistive devices?	Yes	Yes

Comments:

HATCH

ASSESSMENT DATA

C NEW STANDARDS

5 Crossing Surface			North	South
Road extensions off of the travelled way: (m)	min 0.5			
North sidewalk extensions of the travelled way: (m)	min 0.5			
South sidewalk extensions of the travelled way: (m)	min 0.5			
Is crossing surface smooth and continuous?				
Flangeway			**Min**	**Max**
Flangeway width: (mm)	min 65	max 75		
Flangeway depth: (mm)	min 50	max 75		
Flangeway field side width: (mm)		max 0		
Flangeway field side depth: (mm)		max 0		
Top of rail to road crossing surface: (mm)	min -7	max 13		
Comments:				

6 Road Geometry			East	West
North slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
South slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
Slope within 8m of the nearest rail: (%)		max 2%		
Slope between 8m and 18m of the nearest rail: (%)	max_1 5%	max_2 10%		
What is allowable percentage grade slope through crossing?			0.0%	
What is the grade slope through the crossing?				
Is grade slope through crossing less than limit?				
Are horizontal and vertical alignments smooth and continuous on approach?				
Width of travelled way on each approach: (m)				
Width of travelled way at crossing: (m)				
Width through the crossing greater than approach?				
Does the travelled way have curbs?				
Grade crossing angle: (degrees)	min 0	max 180	0	
Comments:				

7 Sightlines	East	West
SSD calculated: (m)		
SSD measured: (m)		
D_{SSD} calculated: (m)	0	0
D_{SSD} driver's left measured: (m)		
D_{SSD} driver's right measured: (m)		
$D_{stopped}$ calculated: (m)		
$D_{stopped}$ driver's left measured: (m)		
$D_{stopped}$ driver's right measured: (m)		
$D_{stopped}$ pedestrian's left measured: (m)		
$D_{stopped}$ pedestrian's right measured: (m)		
Are there any obstacles to driver's left that may affect visibility?		
Are there any obstacles to driver's right that may affect visibility?		
Is there any vegetation to driver's left that may affect visibility?		
Is there any vegetation to driver's right that may affect visibility?		
Is visibility along track impaired due to angle of crossing?		
Comments:		

HATCH

ASSESSMENT DATA

8 Signs & Pavement Markings

			East	West
Crossing Sign(s)				
Railway crossing sign present with reflective 50mm border?				
Number of tracks sign present and reflective?			N/A	N/A
Height of cross buck from crown of road: (m)	min 1.5	max 2.5		
Is 100mm retroreflective strip on back of each blade?				
Distance of strip from crown of road: (mm)		max 300		
Distance of strip from top of cross buck: (mm)	min 70	max 70		
Crossing sign distance from shoulder: (m)	min 2	max 4.5		
Distance to nearest rail: (m)	min 3			
50mm strip on front post?				
Is sign post made of material such that if struck by a vehicle it will break?				
Condition of sign:				
Railway Crossing Ahead Sign and Advisory Speed Tab			East	West
Are vehicles required to slow prior to crossing due to shorter SSD?				
Is sign present upon approach?				
Is sign visible from SSD as defined by road speed?				
Is sign showing correct road orientation?				
Is Advisory Speed tab installed and correct?				
Advisory Speed: (km/h)				
Adjusted SSD: (m)				
Condition of sign:				
Stop Sign Ahead Sign			East	West
Stop sign ahead sign required?				
Stop sign ahead sign installed?				
Stop Sign visible from SSD at design road speed?				
Condition of sign:				
Stop Sign			East	West
Is D_{SSD} insufficient to warrant a stop sign?				
Is stop sign installed?				
Size of stop sign?				
Distance from crown of road to bottom of sign: (m)	min 1.8			
Distance from top of sign to centre of crossing sign: (m)	min 0.5	max 0.5		
Condition of sign:				
Emergency Notification Sign				
Is Emergency Notification Sign Present?			No	
Does Emergency Notification Sign contain all information?				
Can Emergency Notification Sign(s) be seen from both approach?				
Condition of sign:				
Stop Bars			East	West
Are stop bars able to be painted on approach?				
Are stop bars present?				
Distance from nearest rail (m):	min 5.0			
Distance from nearest signal (m):	min 2.0			
Condition of markings:				
'X' Markings			East	West
Is 'X' marking able to be painted on approach?				
Is X marking present?				
Condition of markings:				
Comments:				

Page 9 of 16

HATCH

ASSESSMENT DATA

9 Warning Systems Specification

Traffic volume cross product:		
Railway speed: (mph)		
Is there a sidewalk present?	Yes	
Number of tracks:	2	
Is there an intersection within a distance 'D" from the crossing?		
Flashing Lights and Bells		
Additional condition requires warning system?		
Lights and bells required?	Yes	
Are flashing lights and bells present?		
Gates		
Additional condition requires gates?		
Gates required?		
Are gates present?		
Sidewalk Flashing Lights	**East**	**West**
Is sidewalk outside island circuit?		
Additional lights required for sidewalk?		
Are flashing lights for the sidewalk present?		
Sidewalk Gates	**East**	**West**
Are gates required for sidewalk?		
Are gates for the sidewalk present?		

Comments:

Pull open (swing) gates are installed. On date of inspection, one of the swing gates remained open. It did not return to closed position on its own.

D DESIGN CALCULATIONS

10 Design Calculations

	East	West
Vehicle clearance Distance (Cd) measured: (m)		
Pedestrian clearance Distance (Cd) measured: (m)		
Vehicle travel distance (S) calculated: (m)		
Departure Time (T_D) calculated: (s)		
Maximum approach grade within "S": (%)		
Grade adjustment factor "G":		
Design vehicle departure time "s" calculated: (s)		
Pedestrian Departure Time (T_P) calculated: (s)		
Departure Time measured: (s)		
Gate arm clearance time calculated: (s)		
Gate arm clearance time measured: (s)		

11 Location of Grade Crossings

		East	West
Are there any intersections along approach to crossing?			
Queuing		**East**	**West**
Distance "D" from stop sign: (m)	min 30		
Distance "D" from traffic signal: (m)	min 60		
Is 'D' insufficient such that road vehicles might queue onto the tracks?			
Can traffic queue from adjacent intersection to within 2.4m of nearest track?			
Can traffic queue from crossing into adjacent intersections?			
Are there any queuing issues that would require traffic preemption?			

Comments:

HATCH

ASSESSMENT DATA

E WARNING SYSTEM DESIGN

12 Warning System Operation - General

			East	West
Flashing Lights				
Cross buck present with reflective 50mm border?				
Number of tracks sign present and reflective?			N/A	N/A
Distance from shoulder to outside of outer signal: (m)	min 1.88			
Distance to nearest rail: (m)	min 3			
Exposed signal foundation from crown of road: (mm)		max 100		
Bottom of lowest signal from crown of road: (m)	min 2.3	max 2.9		
Number of track sign to bottom of lowest signal: (mm)	min 125	max 175		
Cross bucks to top of highest signal: (mm)	min 125	max 175		
Radius of signal backgrounds: (mm)	min 305	max 305		
Distance from centre of signal to centre of mast: (mm)	min 380	max 380		
Condition of signals:				
Gates			**East**	**West**
Gate mechanism protrusion: (mm)		max 650		
Gate up protrusion height at edge of signal: (m)	min 5.2			
Gate down height from crown of road: (m)	min 1.1	max 1.4		
Gate tip to centre of mast: (m)		max 11.6		
Gate tip to edge of travelled lane: (m)	min -1	max 1		
Gate tip to tip of other gate: (m)	min 0	max 1		
First signal solid and other signals alternating?				
Gate tip to first gate signal: (mm)	min 355	max 915		
First gate signal to last gate signal: (m)	min 2.74			
Are gate signals equally spaced?				
Gate arm stripe width: (mm)	min 406	max 406		
Gate arm stripes vertical?				
Condition of gates:				
Sidewalk Gates			**North**	**South**
Sidewalk width: (m)				
Gate mechanism protrusion: (mm)		max 650		
Gate up protrusion height at edge of signal: (m)	min 5.2			
Gate down height from crown of road: (m)	min 1.1	max 1.4		
Gate tip to centre of mast: (m)		max 11.6		
Number of lights required:				
Does gate extend full width of sidewalk?				
Are gate signals equally spaced?				
Are gate signals alternating correctly?				
Gate arm stripe width: (mm)	min 406	max 406		
Gate arm stripes vertical?				
Condition of gates:				
Cantilevers			**East**	**West**
Height of cantilever from crown of road: (m)	min 5.2	max 6		
Radius of signal backgrounds: (mm)	min 305	max 305		
Condition of mast:				
Condition of signals:				
Crossing Case				
Distance of crossing case to edge of rail (m):				
Distance of crossing case to edge of road (m):				
Comments:				

Page 11 of 16

HATCH

ASSESSMENT DATA

Equipment

Is data recorder capable of retaining information up to 30 days?	
Is design failsafe?	
Is power out indicator installed and visible from the road?	
Do fouling circuits have at least two discrete conductors?	
Does track circuit detect a 0.06ohm resistance?	
Are non insulated joints properly bonded?	
Do insulated joints provide proper insulation?	
Does battery back-up give 8 hours continuous or 24 hours normal operation?	

Comments:

13 Number and Location of Light Units	**East**	**West**
Can front lights be seen from SSD?		
Can front lights be seen along entire approach?		
Can front lights be seen from intersections entering approach?		
Can back lights be seen by all vehicles stopped at crossing?		
Are additional lights required?		
Are additional lights installed?		

Cantilevers		**East**	**West**
Distance from centre of signal to edge of travelled lane: (m)	max 7.7		
Distance from second signal to edge of travelled lane: (m)	max 7.8		
Can front light be seen by all vehicles on approach?			
Is roadway classified as an expressway?			
Is a cantilever required?			
Is a cantilever installed?			

Sidewalk		**North**	**South**
Centre of warning system to centre of sidewalk: (m)	max 3.6		
Can at least one set of lights be seen by sidewalk from both sides of rail?			
Is sidewalk outside island circuit?			
Additional signal required?			
Are flashing lights for the sidewalk present?			

Comments:

14 Light Units - Alignment			**East**	**West**
Are signal alignment requirements available on site?				
Are all units 200mm or 300mm LEDs?			200	200
Light flash rate: (flashes per minute)	min 45	max 65		
Are all lights flashing alternatively and uniformly?				
Are front lights aligned to 1.6m above road at SSD (or when first visible)?				
Are back lights aligned to 1.6m above road at 15m from front lights?				
Are additional lights required for approaches?				
Are additional lights installed and aligned for 1.6m above road surface?				

Sidewalk			**North**	**South**
Are all light units 200mm or 300mm LEDs?				
Light flash rate: (flashes per minute)	min 45	max 65		
Are all lights flashing alternatively and uniformly?				
Are front lights aligned to 1.6m above road at 30m (or when first visible)?				

Comments:

HATCH

ASSESSMENT DATA

15 Bells and Gates

Bells			East	West
Is bell installed on mast?				
Is bell on side with sidewalk?				
Distance from sidewalk to bell mast: (m)		max 30		
Bell gong rate: (rings per minute)	min 100	max 325		
Does bell ring for as long as warning system is active?				

Gates			East	West
Is gate arm perpendicular to road approach?				
Gate descent delay measured: (s)				
Does gate arm stop if obstructed?				
Gate arm descent time: (s)	min 10	max 15		
Time to train arrival: (s)	min 0			
Gate ascent time: (s)	min 6	max 12		
Does gate arm descend smoothly and without rebound?				
Does gate arm return to proper position after clearance of obstruction?				

Comments:

16 Circuitry

Required warning time: (s)	
Measured or recorded warning time: (s)	25
Are crossing warning times consistent?	
Are warning times less than 13s more than required?	
Are cut-out circuits installed, if required?	
Type of crossing equipment:	
Are directional stick circuits installed?	
Does stick have release timer or restrict train speeds through signaling?	
Are all wires properly tagged and clear?	

Comments:

17 Inspection and Testing - Warning Systems

Are plans available at location and up to date?	
Is there proof of testing at periods defined in GCS?	

Comments:

F INTERCONNECTED DEVICES

18 Prepare to Stop at Railway Crossing Sign	East	West
Is SSD restricted such that a prepared to stop at railway sign is required?		
Is prepare to stop sign installed?		
Can the prepare to stop sign be seen from SSD?		
Do prepare to stop flashers activate with enough preemption?		
Does battery back-up allow Prepare to Stop sign to operate for up to 4 hours?		

19 Interconnection of Traffic Signals	East	West
Is intersection within 30m of crossing?		
Are there any queuing issues that would require traffic preemption?		
Is interconnection installed?		
Does interconnection allow vehicles to clear the grade crossing?		
Does interconnection prevent vehicles from entering crossing?		
Does battery back-up allow traffic signals to operate for up to 4 hours?		

HATCH

ASSESSMENT DATA

20 Interconnected Devices - Inspection and Testing

Is there proof of testing of interconnected devices as defined in GCS?

Comments:

APPENDIX D - WHISTLE CESSATION

	East	West
Is SSD adequate?		
Are sightlines along track greater than 400m in both directions?		
Type of crossing warning system:	*Active: FLB*	
Number of tracks:	*2*	
Railway speed: (mph)	*0*	
Is crossing warning system adequate for whistle cessation?		
Is whistling required at crossing?		
Is whistling used at crossing?		

Comments:

ADDITIONAL COMMENTS

Comments:

Consider installing powered (standard) Xing gates in place of swing gates.

Consider installing crossing-gate-styled LED light on top of posts of swing gates. Heights at this position would be in peripheral vision of someone distracted by phone or tablet.

HATCH

SITE PHOTOS

Saddletown Looking East - 1

Saddletown Looking East - 2

Saddletown Looking South

Saddletown Looking Southeast

Saddletown Looking Southwest

Saddletown Looking West - 1

HATCH

SITE PHOTOS

Saddletown Looking West - 2	Road Xing South of Saddletown Station, Looking West
	

12.3 Whitehorn Drive Mixed Crossing

HATCH

Calgary Transit
Whitehorn Drive, Calgary, Alberta

Crossing Safety Assessment

Issue and Revision Record					
Rev	**Date**	**Originator**	**Checker**	**Approver**	**Description**
0	2019-04-10	Jenny Xing	Andy Hamel	Dale Hein	Final

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The safety assessment of this grade crossing covers physical features which may affect road and rail user safety and it has sought to identify potential safety hazards. However, the auditors point out that no guarantee is made that every deficiency has been identified. Further, if all the recommendations in this assessment were addressed, this would not confirm that the crossing is 'safe'; rather, adoption of the recommendations should improve the level of safety of the facility.

HATCH

1. Summary

A safety assessment of the grade crossing located at Whitehorn Drive in Calgary, Alberta (Blue Line subdivision) was undertaken on Apr 11, 2019. Data on site was acquired by Jenny Xing and the assessment of the information provided was performed by Andy Hamel/Jenny Xing.

For the purposes of this report, Whitehorn Drive crossing is described in an East/West orientation, while the rail line is described in a North/South orientation. The crossing is equipped with an active crossing warning system with flashing lights, bell(s) and gates.

2. Purpose

The Fundamental objectives of this assessment are:

1. Identify opportunities to reduce collision risk within the grade crossing environment.
2. Identify opportunities to minimize the frequency and severity of preventable crashes.
3. Consider the safety of all grade crossing users.
4. Verify compliance of the Grade Crossings Standards (GCS, dated July 2014) referred to in the most recent Grade Crossings Regulations (GCR, SOR 2014-275, November 28, 2014).
5. Ensure that all the crash mitigation measures/factors aimed to eliminate or reduce the identified safety problems are fully considered, evaluated and documented for review/action by the appropriate authorities.

3. Site Sketch

A site sketch is included to provide an aerial perspective of the layout for the crossing, which identifies the railway and roadway on appraoch to the grade crossing location. It identifies key components and considerations that impact the safety of the crossing which may include obstructions, signage, crossing infrastructure, and surrounding land use.

4. Assesment Data

The assessment data is provided in pages 4 to 11. Assessment questions are presented to reflect all requirements in the GCS for both passive and active warning systems. Assessment data not within compliance of the GCS is highlighted red for quick reference. Assessment data that is not applicable to the crossing is filled with N/A. Items not within compliance with the GCS are summarized following the assessment data along with suggested actions for remediation.

5. Recommendations

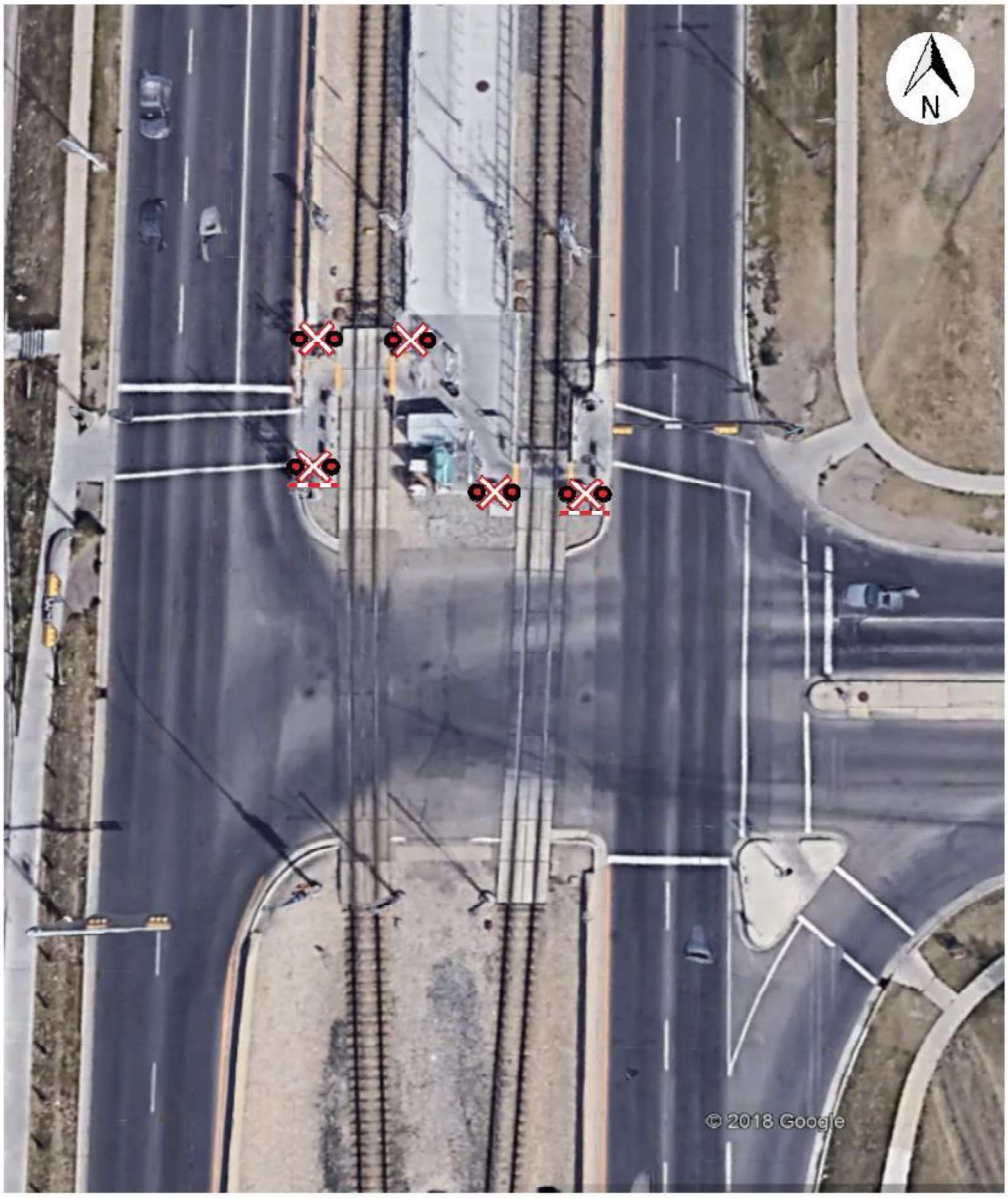
Following the report generated from site, items that do not comply with the Transport Canada's Grade Crossing Standards and Regulations are itemized in a summary table with suggested actions for remediation, if required. Responsibilities for remediation are identified in the adjacent column as per the GCR, where applicable.

6. Site Photos

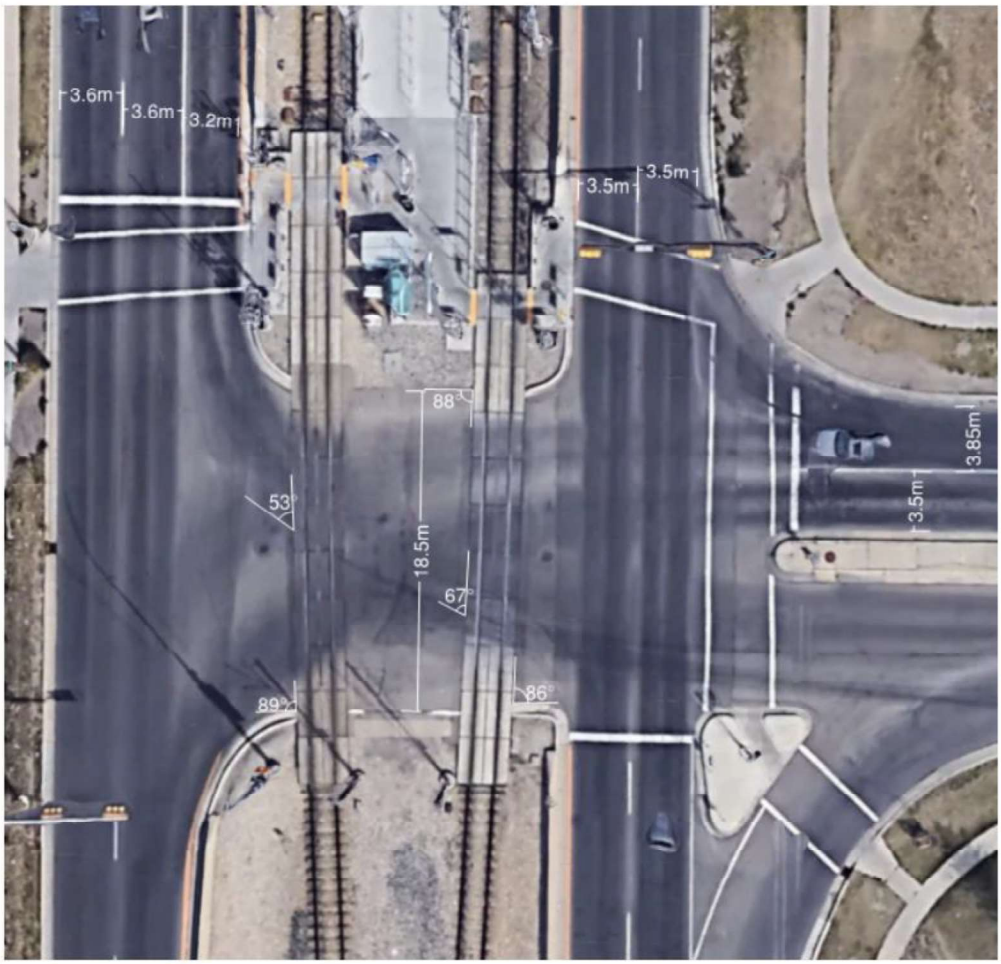
In order to highlight conditions on site, photographs are included at the end of the report. The pictures are meant to highlight considerations of the report and may include items such as sightlines, signage, warning system equipment, road markings, road condition, rail condition, and site documentation.

HATCH

SITE SKETCH

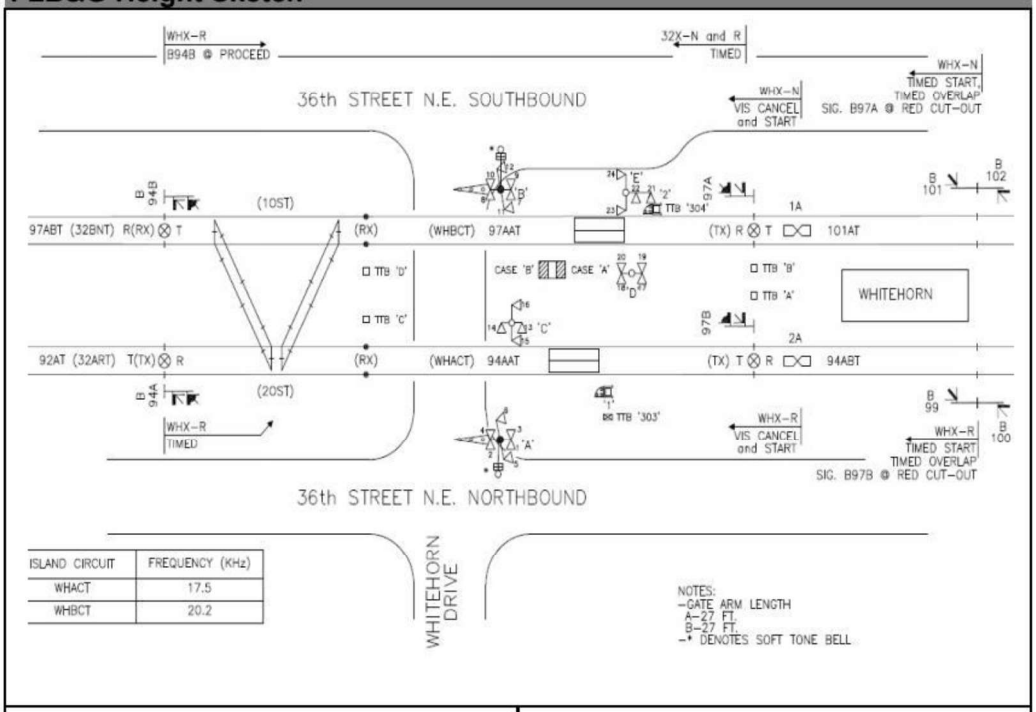


Road Measurement Sketch



HATCH

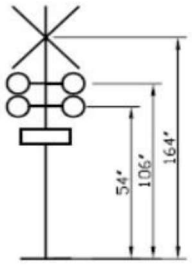
FLB&G Height Sketch



HATCH

FLB&G Height Sketch

C



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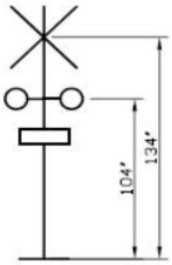

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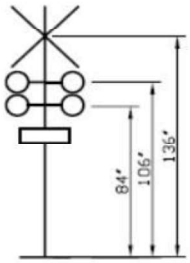

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HATCH

ASSESSMENT DATA

Assessor Information

Data acquisition by:	Jenny Xing
Crossing assessment by:	Andy Hamel/Jenny Xing
Date of site visit:	2019-04-11
Comments:	

Railway Company Information

Railway company:	Calgary Transit
Location Chainage:	
Subdivision:	Blue Line
Rail orientation:	North/South
Number of tracks:	2
Can railway equipment pass each other at the crossing?	Yes
Average annual daily train traffic: (AADT)	200
Freight train design speed: (mph)	
Passenger train design speed: (mph)	
Type of crossing warning system:	Active: FLB & G
Is whistling used at crossing?	N/A
Class of track:	*CLASS 1*
Comments:	

Road Authority Information

Road authority:	City of Calgary
Street name:	Whitehorn Drive
Municipality:	Calgary
Province/Territory:	Alberta
Design vehicle:	
Design Vehicle Length: (m)	*6*
Average annual daily road traffic: (AADT)	
Public or private road?	Public
Urban or rural?	Urban
Local, collector, arterial, expressway, or freeway?	Arterial
Divided or undivided?	Divided
Crossing cross angle: (degrees)	

Crossing Approaches	**East**	**West**
Road crossing design speed: (km/h)	50	50
Number of traffic lanes:		
Traffic lane width: (m)		
Traffic lane width including shoulders: (m)		
Average grade of road approach:		
Stopping sight distance (SSD):	*65*	*65*
Vehicle departure time: (calculated)	*6.39*	*6.39*
Prepare to Stop required activation time:		
Interconnection delay timing:		

Sidewalk	**North**	**South**
Sidewalk present?	No	No
Is sidewalk designated for persons using assistive devices?		

Comments:

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HATCH

ASSESSMENT DATA

C NEW STANDARDS

5 Crossing Surface			North	South
Road extensions off of the travelled way: (m)	min 0.5			
North sidewalk extensions of the travelled way: (m)	min 0.5			
South sidewalk extensions of the travelled way: (m)	min 0.5			
Is crossing surface smooth and continuous?			Yes	
Flangeway			**Min**	**Max**
Flangeway width: (mm)	min 65	max 120		
Flangeway depth: (mm)	min 50	max		
Flangeway field side width: (mm)		max 0		
Flangeway field side depth: (mm)		max 0		
Top of rail to road crossing surface: (mm)	min -25	max 25		

Comments:

Minimum flangeway width & depth. Crossing surface in very good condition.

6 Road Geometry			East	West
North slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
South slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
Slope within 8m of the nearest rail: (%)		max 2%		
Slope between 8m and 18m of the nearest rail: (%)	max_1 5%	max_2 10%		
What is allowable percentage grade slope through crossing?				
What is the grade slope through the crossing?				
Is grade slope through crossing less than limit?				
Are horizontal and vertical alignments smooth and continuous on approach?				
Width of travelled way on each approach: (m)				
Width of travelled way at crossing: (m)				
Width through the crossing greater than approach?				
Does the travelled way have curbs?				
Grade crossing angle: (degrees)	min 0	max 180		

Comments:

7 Sightlines	East	West
SSD calculated: (m)		
SSD measured: (m)		
D_{SSD} calculated: (m)		
D_{SSD} driver's left measured: (m)		
D_{SSD} driver's right measured: (m)		
$D_{stopped}$ calculated: (m)		
$D_{stopped}$ driver's left measured: (m)		
$D_{stopped}$ driver's right measured: (m)		
$D_{stopped}$ pedestrian's left measured: (m)		
$D_{stopped}$ pedestrian's right measured: (m)		
Are there any obstacles to driver's left that may affect visibility?	No	
Are there any obstacles to driver's right that may affect visibility?	No	
Is there any vegetation to driver's left that may affect visibility?	No	
Is there any vegetation to driver's right that may affect visibility?	No	
Is visibility along track impaired due to angle of crossing?	No	

Comments:

HATCH

ASSESSMENT DATA

8 Signs & Pavement Markings

			East	West
Crossing Sign(s)				
Railway crossing sign present with reflective 50mm border?			Yes	Yes
Number of tracks sign present and reflective?			Yes	Yes
Height of cross buck from crown of road: (m)	min 1.5	max 2.5		
Is 100mm retroreflective strip on back of each blade?			N/A	
Distance of strip from crown of road: (mm)		max 300	N/A	
Distance of strip from top of cross buck: (mm)	min 70	max 70	N/A	
Crossing sign distance from shoulder: (m)	min 2	max 4.5		
Distance to nearest rail: (m)	min 3			
50mm strip on front post?			N/A	
Is sign post made of material such that if struck by a vehicle it will break?				
Condition of sign:				
Railway Crossing Ahead Sign and Advisory Speed Tab			East	West
Are vehicles required to slow prior to crossing due to shorter SSD?			No	No
Is sign present upon approach?				
Is sign visible from SSD as defined by road speed?				
Is sign showing correct road orientation?				
Is Advisory Speed tab installed and correct?				
Advisory Speed: (km/h)				
Adjusted SSD: (m)				
Condition of sign:				
Stop Sign Ahead Sign			East	West
Stop sign ahead sign required?				
Stop sign ahead sign installed?			N/A	N/A
Stop Sign visible from SSD at design road speed?			N/A	N/A
Condition of sign:			N/A	N/A
Stop Sign			East	West
Is D_{SSD} insufficient to warrant a stop sign?				
Is stop sign installed?				
Size of stop sign?			N/A	N/A
Distance from crown of road to bottom of sign: (m)	min 1.8		N/A	N/A
Distance from top of sign to centre of crossing sign: (m)	min 0.5	max 0.5	N/A	N/A
Condition of sign:			N/A	N/A
Emergency Notification Sign				
Is Emergency Notification Sign Present?			No	
Does Emergency Notification Sign contain all information?				
Can Emergency Notification Sign(s) be seen from both approach?				
Condition of sign:				
Stop Bars			East	West
Are stop bars able to be painted on approach?			Yes	Yes
Are stop bars present?			Yes	Yes
Distance from nearest rail (m):	min 5.0			
Distance from nearest signal (m):	min 2.0			
Condition of markings:				
'X' Markings			East	West
Is 'X' marking able to be painted on approach?			No	No
Is X marking present?			No	No
Condition of markings:				

Comments:

Crossing protected by traffic lights intersection.

HATCH

ASSESSMENT DATA

9 Warning Systems Specification		
Traffic volume cross product:		
Railway speed: (mph)		
Is there a sidewalk present?	No	
Number of tracks:	2	
Is there an intersection within a distance 'D" from the crossing?		
Flashing Lights and Bells		
Additional condition requires warning system?		
Lights and bells required?		
Are flashing lights and bells present?	Yes	
Gates		
Additional condition requires gates?		
Gates required?		
Are gates present?	Yes	
Sidewalk Flashing Lights	**East**	**West**
Is sidewalk outside island circuit?		
Additional lights required for sidewalk?		
Are flashing lights for the sidewalk present?		
Sidewalk Gates	**East**	**West**
Are gates required for sidewalk?	No	No
Are gates for the sidewalk present?		

Comments:

Recommend splitting crossing control for each track for Ped Xing and adding gates to both tracks of Ped Xings. Separate Ped Xing is in inland circuit.

D DESIGN CALCULATIONS

10 Design Calculations	East	West
Vehicle clearance Distance (Cd) measured: (m)		
Pedestrian clearance Distance (Cd) measured: (m)		
Vehicle travel distance (S) calculated: (m)	6	6
Departure Time (T_D) calculated: (s)	4.4	4.4
Maximum approach grade within "S": (%)	0.0%	0.0%
Grade adjustment factor "G":	1	1
Design vehicle departure time "s" calculated: (s)	6.39	6.39
Pedestrian Departure Time (T_P) calculated: (s)	N/A	N/A
Departure Time measured: (s)		
Gate arm clearance time calculated: (s)	4.00	4.00
Gate arm clearance time measured: (s)		
11 Location of Grade Crossings	**East**	**West**
Are there any intersections along approach to crossing?	No	No
Queuing	**East**	**West**
Distance "D" from stop sign: (m) min 30		
Distance "D" from traffic signal: (m) min 60		
Is 'D' insufficient such that road vehicles might queue onto the tracks?		
Can traffic queue from adjacent intersection to within 2.4m of nearest track?		
Can traffic queue from crossing into adjacent intersections?		
Are there any queuing issues that would require traffic preemption?		

Comments:

There are intersections nearby, but not studied.

HATCH

ASSESSMENT DATA

E WARNING SYSTEM DESIGN

12 Warning System Operation - General

Flashing Lights			East	West
Cross buck present with reflective 50mm border?				
Number of tracks sign present and reflective?				
Distance from shoulder to outside of outer signal: (m)	min 1.88			
Distance to nearest rail: (m)	min 3			
Exposed signal foundation from crown of road: (mm)		max 100		
Bottom of lowest signal from crown of road: (m)	min 2.3	max 2.9		
Number of track sign to bottom of lowest signal: (mm)	min 125	max 175		
Cross bucks to top of highest signal: (mm)	min 125	max 175		
Radius of signal backgrounds: (mm)	min 305	max 305		
Distance from centre of signal to centre of mast: (mm)	min 380	max 380		
Condition of signals:			Good	Good

Gates			East	West
Gate mechanism protrusion: (mm)		max 650		
Gate up protrusion height at edge of signal: (m)	min 5.2			
Gate down height from crown of road: (m)	min 1.1	max 1.4		
Gate tip to centre of mast: (m)		max 11.6	*	
Gate tip to edge of travelled lane: (m)	min -1	max 1	N/A	N/A
Gate tip to tip of other gate: (m)	min 0	max 1		
First signal solid and other signals alternating?				
Gate tip to first gate signal: (mm)	min 355	max 915		
First gate signal to last gate signal: (m)	min 2.74			
Are gate signals equally spaced?				
Gate arm stripe width: (mm)	min 406	max 406		
Gate arm stripes vertical?				
Condition of gates:				

Sidewalk Gates			North	South
Sidewalk width: (m)			N/A	N/A
Gate mechanism protrusion: (mm)		max 650	N/A	N/A
Gate up protrusion height at edge of signal: (m)	min 5.2		N/A	N/A
Gate down height from crown of road: (m)	min 1.1	max 1.4	N/A	N/A
Gate tip to centre of mast: (m)		max 11.6	N/A	N/A
Number of lights required:			N/A	N/A
Does gate extend full width of sidewalk?			N/A	N/A
Are gate signals equally spaced?			N/A	N/A
Are gate signals alternating correctly?			N/A	N/A
Gate arm stripe width: (mm)	min 406	max 406	N/A	N/A
Gate arm stripes vertical?			N/A	N/A
Condition of gates:			N/A	N/A

Cantilevers			East	West
Height of cantilever from crown of road: (m)	min 5.2	max 6	N/A	N/A
Radius of signal backgrounds: (mm)	min 305	max 305	N/A	N/A
Condition of mast:			N/A	N/A
Condition of signals:			N/A	N/A

Crossing Case	
Distance of crossing case to edge of rail (m):	
Distance of crossing case to edge of road (m):	

Comments:

* Gate is parallel to track and does not substantially block lane.

HATCH

ASSESSMENT DATA

Equipment

Is data recorder capable of retaining information up to 30 days?	
Is design failsafe?	
Is power out indicator installed and visible from the road?	
Do fouling circuits have at least two discrete conductors?	
Does track circuit detect a 0.06ohm resistance?	
Are non insulated joints properly bonded?	
Do insulated joints provide proper insulation?	
Does battery back-up give 8 hours continuous or 24 hours normal operation?	

Comments:

13 Number and Location of Light Units			**East**	**West**
Can front lights be seen from SSD?				
Can front lights be seen along entire approach?				
Can front lights be seen from intersections entering approach?				
Can back lights be seen by all vehicles stopped at crossing?				
Are additional lights required?				
Are additional lights installed?				
Cantilevers			**East**	**West**
Distance from centre of signal to edge of travelled lane: (m)		max 7.7		
Distance from second signal to edge of travelled lane: (m)		max 7.8		
Can front light be seen by all vehicles on approach?				
Is roadway classified as an expressway?				
Is a cantilever required?				
Is a cantilever installed?				
Sidewalk			**North**	**South**
Centre of warning system to centre of sidewalk: (m)		max 3.6	N/A	N/A
Can at least one set of lights be seen by sidewalk from both sides of rail?			N/A	N/A
Is sidewalk outside island circuit?				
Additional signal required?				
Are flashing lights for the sidewalk present?				

Comments:

14 Light Units - Alignment			**East**	**West**
Are signal alignment requirements available on site?				
Are all units 200mm or 300mm LEDs?			300	300
Light flash rate: (flashes per minute)	min 45	max 65		
Are all lights flashing alternatively and uniformly?				
Are front lights aligned to 1.6m above road at SSD (or when first visible)?				
Are back lights aligned to 1.6m above road at 15m from front lights?				
Are additional lights required for approaches?				
Are additional lights installed and aligned for 1.6m above road surface?				
Ped Xing			**North**	**South**
Are all light units 200mm or 300mm LEDs?			200	200
Light flash rate: (flashes per minute)	min 45	max 65		
Are all lights flashing alternatively and uniformly?				
Are front lights aligned to 1.6m above road at 30m (or when first visible)?				

Comments:

HATCH

ASSESSMENT DATA

15 Bells and Gates

Bells			East	West
Is bell installed on mast?				
Is bell on side with sidewalk?				
Distance from sidewalk to bell mast: (m)		max 30		
Bell gong rate: (rings per minute)	min 100	max 325		
Does bell ring for as long as warning system is active?				

Gates			East	West
Is gate arm perpendicular to road approach?			No	Yes
Gate descent delay measured: (s)			*3*	*3*
Does gate arm stop if obstructed?				
Gate arm descent time: (s)	min 10	max 15		
Time to train arrival: (s)	min 0		25	25
Gate ascent time: (s)	min 6	max 12		
Does gate arm descend smoothly and without rebound?				
Does gate arm return to proper position after clearance of obstruction?				

Comments:

Gate for SB left turn to EB is parallel to track and is easily driven around.

16 Circuitry

Required warning time: (s)	*20.00*
Measured or recorded warning time: (s)	25-30
Are crossing warning times consistent?	Yes
Are warning times less than 13s more than required?	
Are cut-out circuits installed, if required?	
Type of crossing equipment:	
Are directional stick circuits installed?	
Does stick have release timer or restrict train speeds through signaling?	
Are all wires properly tagged and clear?	

Comments:

17 Inspection and Testing - Warning Systems

Are plans available at location and up to date?	
Is there proof of testing at periods defined in GCS?	

Comments:

F INTERCONNECTED DEVICES

18 Prepare to Stop at Railway Crossing Sign

	East	West
Is SSD restricted such that a prepared to stop at railway sign is required?		
Is prepare to stop sign installed?		
Can the prepare to stop sign be seen from SSD?		
Do prepare to stop flashers activate with enough preemption?		
Does battery back-up allow Prepare to Stop sign to operate for up to 4 hours?		

19 Interconnection of Traffic Signals

	East	West
Is intersection within 30m of crossing?		
Are there any queuing issues that would require traffic preemption?		
Is interconnection installed?		
Does interconnection allow vehicles to clear the grade crossing?		
Does interconnection prevent vehicles from entering crossing?		
Does battery back-up allow traffic signals to operate for up to 4 hours?		

HATCH

ASSESSMENT DATA

20 Interconnected Devices - Inspection and Testing

Is there proof of testing of interconnected devices as defined in GCS?

Comments:

APPENDIX D - WHISTLE CESSATION

	East	West
Is SSD adequate?		
Are sightlines along track greater than 400m in both directions?		
Type of crossing warning system:	*Active: FLB & G*	
Number of tracks:	*2*	
Railway speed: (mph)		
Is crossing warning system adequate for whistle cessation?		
Is whistling required at crossing?		
Is whistling used at crossing?		

Comments:

ADDITIONAL COMMENTS

Comments:

The control of PED warning devices for each track should be split. As is, there is nuisance ringing on the opposite track each time a train activates the crossing (unless there happens to be a train on both tracks at once). Pedestrians are accustomed to ignoring the warning devices due to nuisance ringing.

Refuge areas between the raod and track on each side are relatively small. Larger refuge areas recommended.

Recommend splitting control of ped warning devices, expand refuge areas and add gates to each ped crossing.

Interconnection with traffic signals not studied. No conflict between crossing warning system and traffic signals were observed while at the crossing.

HATCH

SITE PHOTOS

Whitehorn Looking East - 1

Whitehorn Looking East - 2

Whitehorn Looking East - 3

Whitehorn Looking East - 4

Whitehorn Looking Northeast From Refuge

Whitehorn Looking Northeast - 1

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SITE PHOTOS

Whitehorn Looking Northeast - 2

Whitehorn Looking Northwest

Whitehorn Looking South - 1

Whitehorn Looking South - 2

Whitehorn Looking Southwest - 1

Whitehorn Looking Southwest - 2

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SITE PHOTOS

Whitehorn Looking West - 1

Whitehorn Looking West - 2

Whitehorn Looking West - 3

Whitehorn Looking West - 4

Whitehorn Looking West - 5

Whitehorn Looking North

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12.4 162 Ave SW Mixed Crossing

HATCH

Calgary Transit
162 Ave S, Calgary, Alberta

Crossing Safety Assessment

Issue and Revision Record					
Rev	**Date**	**Originator**	**Checker**	**Approver**	**Description**
0	2019-05-02	Jenny Xing	Andy Hamel	Dale Hein	Final

The safety assessment of this grade crossing covers physical features which may affect road and rail user safety and it has sought to identify potential safety hazards. However, the auditors point out that no guarantee is made that every deficiency has been identified. Further, if all the recommendations in this assessment were addressed, this would not confirm that the crossing is 'safe'; rather, adoption of the recommendations should improve the level of safety of the facility.

HATCH

1. Summary

A safety assessment of the grade crossing located at 162 Ave S in Calgary, Alberta (Red Line subdivision) was undertaken on May 02, 2019. Data on site was acquired by Jenny Xing and the assessment of the information provided was performed by Andy Hamel.

For the purposes of this report, 162 Ave S crossing is described in an East/West orientation, while the rail line is described in a North/South orientation. The crossing is equipped with an active crossing warning system with flashing lights, bell(s) and gates.

2. Purpose

The Fundamental objectives of this assessment are:

1. Identify opportunities to reduce collision risk within the grade crossing environment.
2. Identify opportunities to minimize the frequency and severity of preventable crashes.
3. Consider the safety of all grade crossing users.
4. Verify compliance of the Grade Crossings Standards (GCS, dated July 2014) referred to in the most recent Grade Crossings Regulations (GCR, SOR 2014-275, November 28, 2014).
5. Ensure that all the crash mitigation measures/factors aimed to eliminate or reduce the identified safety problems are fully considered, evaluated and documented for review/action by the appropriate authorities.

3. Site Sketch

A site sketch is included to provide an aerial perspective of the layout for the crossing, which identifies the railway and roadway on appraoch to the grade crossing location. It identifies key components and considerations that impact the safety of the crossing which may include obstructions, signage, crossing infrastructure, and surrounding land use.

4. Assesment Data

The assessment data is provided in pages 4 to 11. Assessment questions are presented to reflect all requirements in the GCS for both passive and active warning systems. Assessment data not within compliance of the GCS is highlighted red for quick reference. Assessment data that is not applicable to the crossing is filled with N/A. Items not within compliance with the GCS are summarized following the assessment data along with suggested actions for remediation.

5. Recommendations

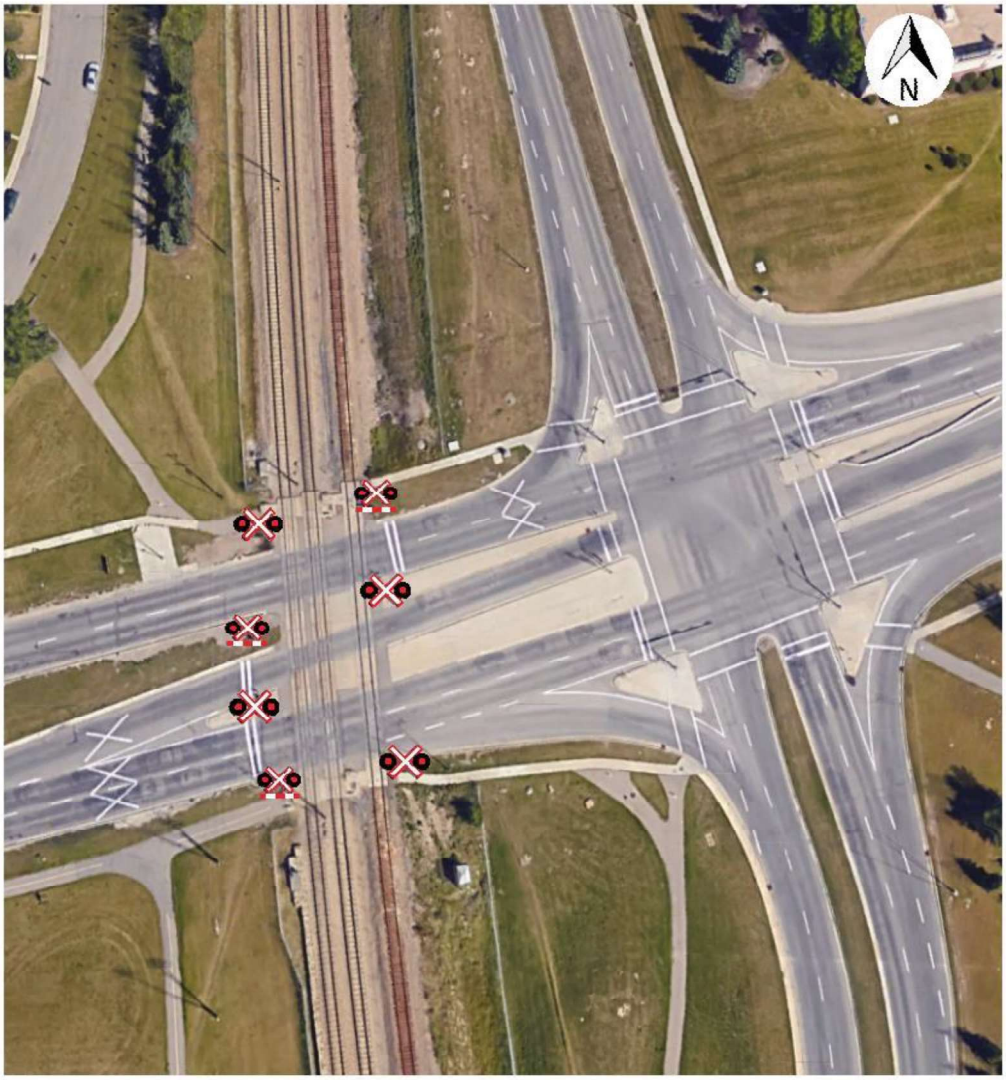
Following the report generated from site, items that do not comply with the Transport Canada's Grade Crossing Standards and Regulations are itemized in a summary table with suggested actions for remediation, if required. Responsibilities for remediation are identified in the adjacent column as per the GCR, where applicable.

6. Site Photos

In order to highlight conditions on site, photographs are included at the end of the report. The pictures are meant to highlight considerations of the report and may include items such as sightlines, signage, warning system equipment, road markings, road condition, rail condition, and site documentation.

HATCH

SITE SKETCH



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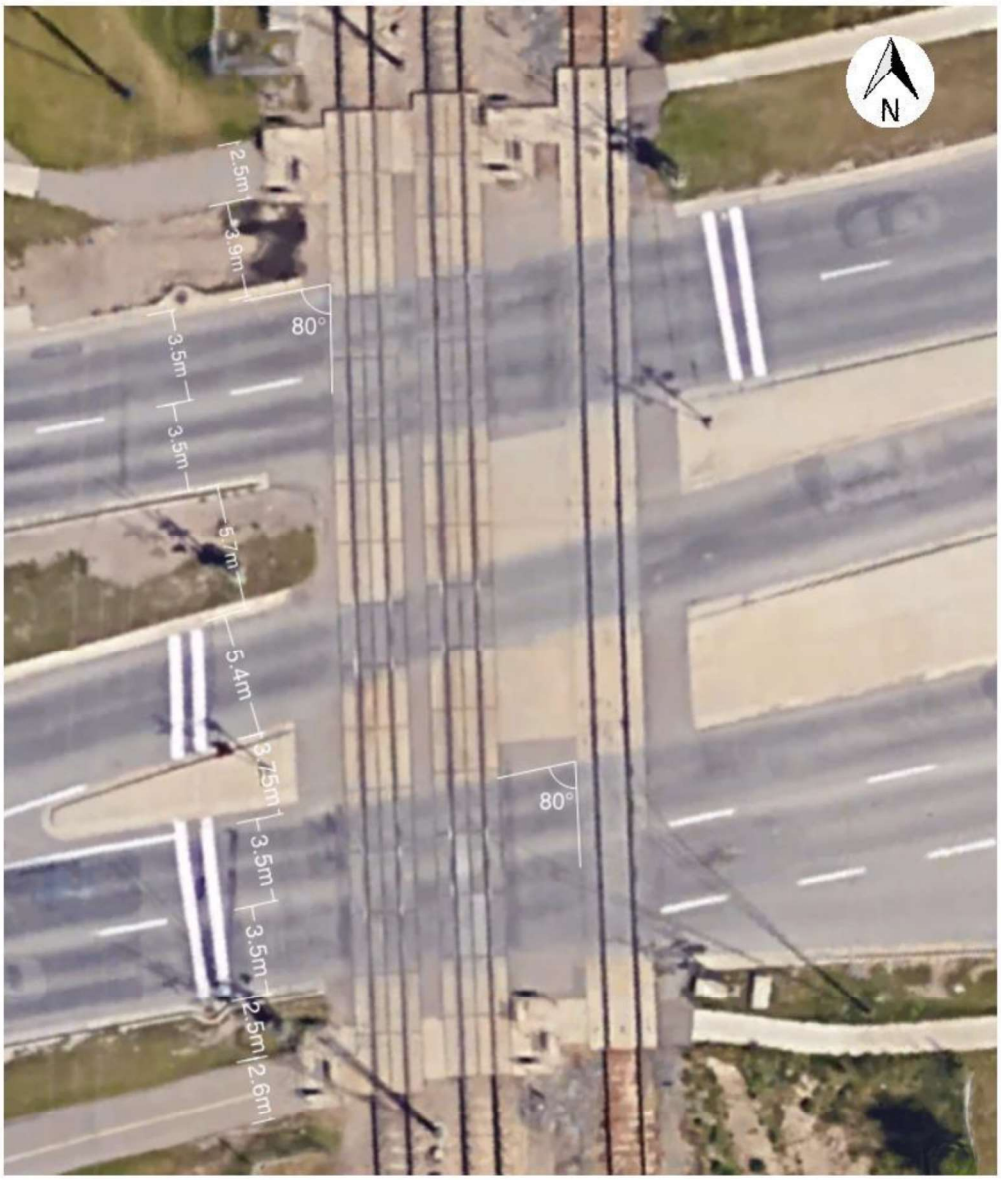
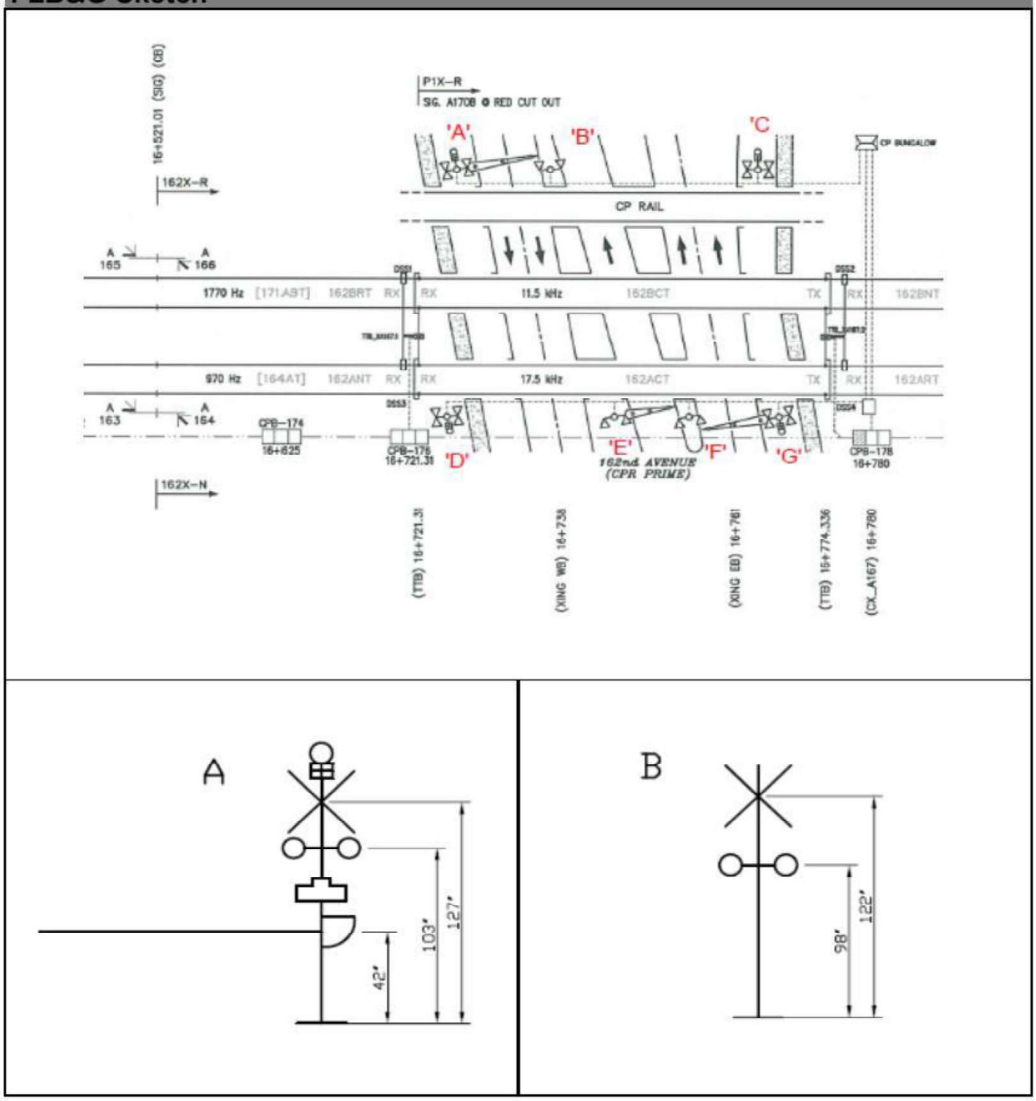
Road Measurement Sketch



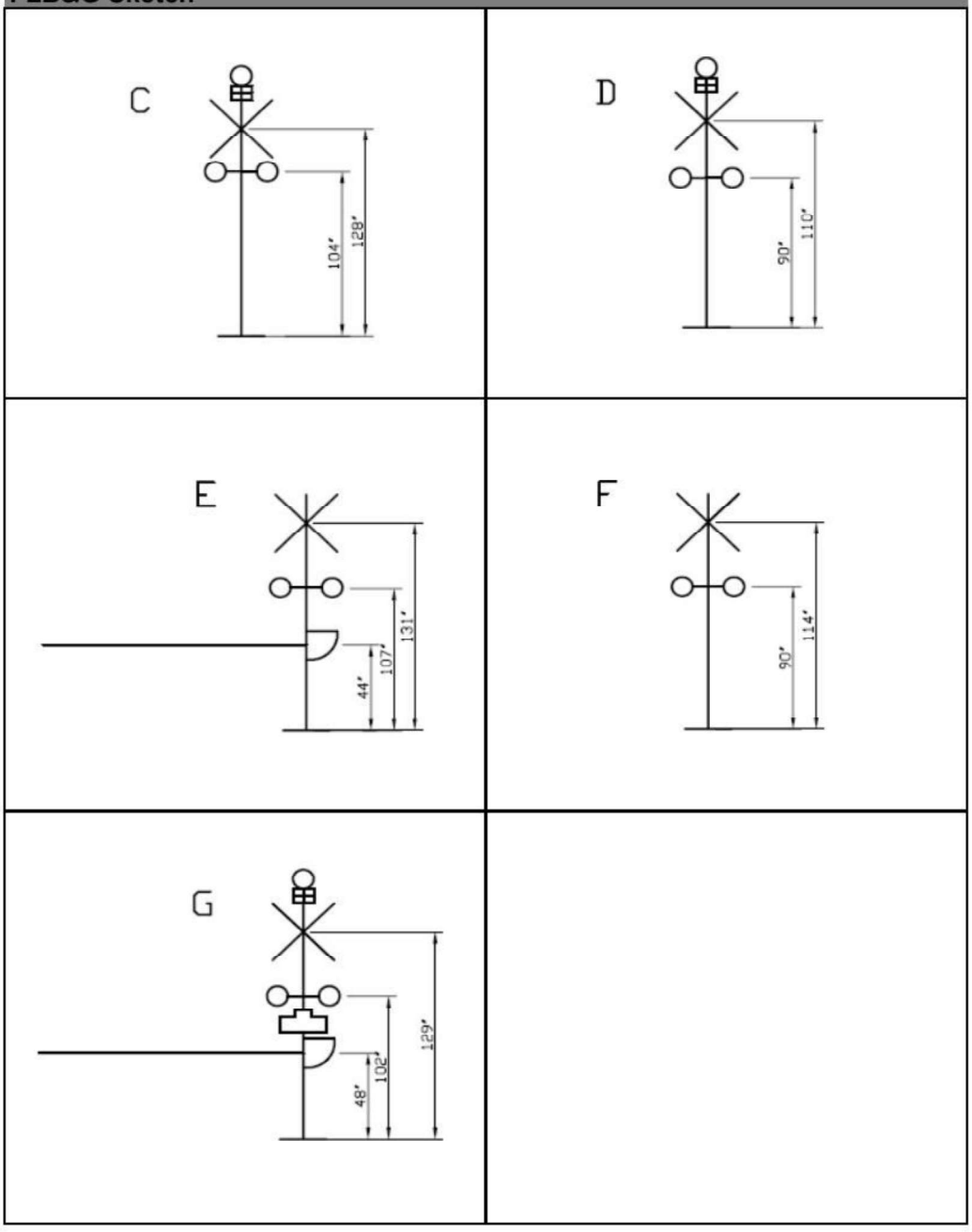
HATCH

FLB&G Sketch



HATCH

FLB&G Sketch



HATCH

ASSESSMENT DATA

Assessor Information

Data acquisition by:	Jenny Xing
Crossing assessment by:	Andy Hamel
Date of site visit:	2019-05-02
Comments:	

Railway Company Information

Railway company:	Calgary Transit
Location Chainage:	
Subdivision:	Red Line
Rail orientation:	North/South
Number of tracks:	2
Can railway equipment pass each other at the crossing?	Yes
Average annual daily train traffic: (AADT)	200
Freight train design speed: (mph)	
Passenger train design speed: (mph)	
Type of crossing warning system:	Active: FLB & G
Is whistling used at crossing?	Yes
Class of track:	*CLASS 1*
Comments:	

Railway Company Information

Railway company:	Canadian Pacific Railway
Location ID:	
Subdivision:	Aldersyde
Rail orientation:	North/South
Number of tracks:	1
Can railway equipment pass each other at the crossing?	N/A
Average annual daily train traffic: (AADT)	
Freight train design speed: (mph)	
Passenger train design speed: (mph)	
Type of crossing warning system:	Active: FLB & G
Is whistling used at crossing?	Yes
Class of track:	*CLASS 1*
Comments:	

Road Authority Information

Road authority:	City of Calgary
Street name:	162 Ave S
Municipality:	Calgary
Province/Territory:	Alberta
Design vehicle:	
Design Vehicle Length: (m)	*6*
Average annual daily road traffic: (AADT)	19000
Public or private road?	Public
Urban or rural?	Urban
Local, collector, arterial, expressway, or freeway?	Arterial
Divided or undivided?	Divided
Crossing cross angle: (degrees)	

HATCH

ASSESSMENT DATA

			East	West
	Crossing Approaches			
	Road crossing design speed: (km/h)		60	60
	Number of traffic lanes:		5	5
	Traffic lane width: (m)			
	Traffic lane width including shoulders: (m)			
	Average grade of road approach:			
	Stopping sight distance (SSD):			
	Vehicle departure time: (calculated)			
	Prepare to Stop required activation time:			
	Interconnection delay timing:			
	Sidewalk		**North**	**South**
	Sidewalk present?		Yes	Yes
	Is sidewalk designated for persons using assistive devices?		Yes	Yes
	Comments:			

C NEW STANDARDS

				North	South
5	**Crossing Surface**				
	Road extensions off of the travelled way: (m)	min 0.5			
	North sidewalk extensions of the travelled way: (m)	min 0.5			
	South sidewalk extensions of the travelled way: (m)	min 0.5			
	Is crossing surface smooth and continuous?				
	Flangeway			**Min**	**Max**
	Flangeway width: (mm)	min 65	max 75		
	Flangeway depth: (mm)	min 50	max 75		
	Flangeway field side width: (mm)		max 0		
	Flangeway field side depth: (mm)		max 0		
	Top of rail to road crossing surface: (mm)	min -7	max 13		
	Comments:				

				East	West
6	**Road Geometry**				
	North slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
	South slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
	Slope within 8m of the nearest rail: (%)		max 2%		
	Slope between 8m and 18m of the nearest rail: (%)	max_1 5%	max_2 10%		
	What is allowable percentage grade slope through crossing?				
	What is the grade slope through the crossing?				
	Is grade slope through crossing less than limit?				
	Are horizontal and vertical alignments smooth and continuous on approach?				
	Width of travelled way on each approach: (m)				
	Width of travelled way at crossing: (m)				
	Width through the crossing greater than approach?				
	Does the travelled way have curbs?				
	Grade crossing angle: (degrees)	min 0	max 180		
	Comments:				

		East	West
7	**Sightlines**		
	SSD calculated: (m)		
	SSD measured: (m)		

HATCH

ASSESSMENT DATA

D_{SSD} calculated: (m)				
D_{SSD} driver's left measured: (m)				
D_{SSD} driver's right measured: (m)				
$D_{stopped}$ calculated: (m)				
$D_{stopped}$ driver's left measured: (m)				
$D_{stopped}$ driver's right measured: (m)				
$D_{stopped}$ pedestrian's left measured: (m)				
$D_{stopped}$ pedestrian's right measured: (m)				
Are there any obstacles to driver's left that may affect visibility?				
Are there any obstacles to driver's right that may affect visibility?				
Is there any vegetation to driver's left that may affect visibility?				
Is there any vegetation to driver's right that may affect visibility?				
Is visibility along track impaired due to angle of crossing?				
Comments:				

8 **Signs & Pavement Markings**				
Crossing Sign(s)			**East**	**West**
Railway crossing sign present with reflective 50mm border?				
Number of tracks sign present and reflective?				
Height of cross buck from crown of road: (m)	min 1.5	max 2.5		
Is 100mm retroreflective strip on back of each blade?				
Distance of strip from crown of road: (mm)		max 300		
Distance of strip from top of cross buck: (mm)	min 70	max 70		
Crossing sign distance from shoulder: (m)	min 2	max 4.5		
Distance to nearest rail: (m)	min 3			
50mm strip on front post?				
Is sign post made of material such that if struck by a vehicle it will break?				
Condition of sign:				
Railway Crossing Ahead Sign and Advisory Speed Tab			**East**	**West**
Are vehicles required to slow prior to crossing due to shorter SSD?				
Is sign present upon approach?				
Is sign visible from SSD as defined by road speed?				
Is sign showing correct road orientation?				
Is Advisory Speed tab installed and correct?				
Advisory Speed: (km/h)				
Adjusted SSD: (m)				
Condition of sign:				
Stop Sign Ahead Sign			**East**	**West**
Stop sign ahead sign required?				
Stop sign ahead sign installed?				
Stop Sign visible from SSD at design road speed?				
Condition of sign:				
Stop Sign			**East**	**West**
Is D_{SSD} insufficient to warrant a stop sign?				
Is stop sign installed?				
Size of stop sign?				
Distance from crown of road to bottom of sign: (m)	min 1.8			
Distance from top of sign to centre of crossing sign: (m)	min 0.5	max 0.5		
Condition of sign:				
Emergency Notification Sign				

HATCH

ASSESSMENT DATA

Is Emergency Notification Sign Present?			
Does Emergency Notification Sign contain all information?			
Can Emergency Notification Sign(s) be seen from both approach?			
Condition of sign:			
Stop Bars		**East**	**West**
Are stop bars able to be painted on approach?			
Are stop bars present?			
Distance from nearest rail (m):	min 5.0		
Distance from nearest signal (m):	min 2.0		
Condition of markings:			
'X' Markings		**East**	**West**
Is 'X' marking able to be painted on approach?			
Is X marking present?			
Condition of markings:			

Comments:

9	**Warning Systems Specification**		
Traffic volume cross product:			
Railway speed: (mph)			
Is there a sidewalk present?			
Number of tracks:			
Is there an intersection within a distance 'D" from the crossing?			
Flashing Lights and Bells			
Additional condition requires warning system?			
Lights and bells required?			
Are flashing lights and bells present?			
Gates			
Additional condition requires gates?			
Gates required?			
Are gates present?			
Sidewalk Flashing Lights		**East**	**West**
Is sidewalk outside island circuit?			
Additional lights required for sidewalk?			
Are flashing lights for the sidewalk present?			
Sidewalk Gates		**East**	**West**
Are gates required for sidewalk?			
Are gates for the sidewalk present?			

Comments:

D DESIGN CALCULATIONS

10	**Design Calculations**	**East**	**West**
Vehicle clearance Distance (Cd) measured: (m)			
Pedestrian clearance Distance (Cd) measured: (m)			
Vehicle travel distance (S) calculated: (m)			
Departure Time (T_D) calculated: (s)			
Maximum approach grade within "S": (%)			
Grade adjustment factor "G":			
Design vehicle departure time "s" calculated: (s)			
Pedestrian Departure Time (T_P) calculated: (s)			
Departure Time measured: (s)			

HATCH

ASSESSMENT DATA

	Gate arm clearance time calculated: (s)				
	Gate arm clearance time measured: (s)				
11	**Location of Grade Crossings**			**East**	**West**
	Are there any intersections along approach to crossing?				
	Queuing			**East**	**West**
	Distance "D" from stop sign: (m)	min 30			
	Distance "D" from traffic signal: (m)	min 60			
	Is 'D' insufficient such that road vehicles might queue onto the tracks?				
	Can traffic queue from adjacent intersection to within 2.4m of nearest track?				
	Can traffic queue from crossing into adjacent intersections?				
	Are there any queuing issues that would require traffic preemption?				
	Comments:				

E WARNING SYSTEM DESIGN

12	**Warning System Operation - General**				
	Flashing Lights			**East**	**West**
	Cross buck present with reflective 50mm border?				
	Number of tracks sign present and reflective?				
	Distance from shoulder to outside of outer signal: (m)	min 1.88			
	Distance to nearest rail: (m)	min 3			
	Exposed signal foundation from crown of road: (mm)		max 100		
	Bottom of lowest signal from crown of road: (m)	min 2.3	max 2.9		
	Number of track sign to bottom of lowest signal: (mm)	min 125	max 175		
	Cross bucks to top of highest signal: (mm)	min 125	max 175		
	Radius of signal backgrounds: (mm)	min 305	max 305		
	Distance from centre of signal to centre of mast: (mm)	min 380	max 380		
	Condition of signals:				
	Gates			**East**	**West**
	Gate mechanism protrusion: (mm)		max 650		
	Gate up protrusion height at edge of signal: (m)	min 5.2			
	Gate down height from crown of road: (m)	min 1.1	max 1.4		
	Gate tip to centre of mast: (m)		max 11.6		
	Gate tip to edge of travelled lane: (m)	min -1	max 1		
	Gate tip to tip of other gate: (m)	min 0	max 1		
	First signal solid and other signals alternating?				
	Gate tip to first gate signal: (mm)	min 355	max 915		
	First gate signal to last gate signal: (m)	min 2.74			
	Are gate signals equally spaced?				
	Gate arm stripe width: (mm)	min 406	max 406		
	Gate arm stripes vertical?				
	Condition of gates:				
	Sidewalk Gates			**North**	**South**
	Sidewalk width: (m)				
	Gate mechanism protrusion: (mm)		max 650		
	Gate up protrusion height at edge of signal: (m)	min 5.2			
	Gate down height from crown of road: (m)	min 1.1	max 1.4		
	Gate tip to centre of mast: (m)		max 11.6		
	Number of lights required:				
	Does gate extend full width of sidewalk?				
	Are gate signals equally spaced?				
	Are gate signals alternating correctly?				
	Gate arm stripe width: (mm)	min 406	max 406		

HATCH

ASSESSMENT DATA

			East	West
Gate arm stripes vertical?				
Condition of gates:				
Cantilevers			**East**	**West**
Height of cantilever from crown of road: (m)	min 5.2	max 6		
Radius of signal backgrounds: (mm)	min 305	max 305		
Condition of mast:				
Condition of signals:				
Crossing Case				
Distance of crossing case to edge of rail (m):				
Distance of crossing case to edge of road (m):				
Comments:				
Equipment				
Is data recorder capable of retaining information up to 30 days?				
Is design failsafe?				
Is power out indicator installed and visible from the road?				
Do fouling circuits have at least two discrete conductors?				
Does track circuit detect a 0.06ohm resistance?				
Are non insulated joints properly bonded?				
Do insulated joints provide proper insulation?				
Does battery back-up give 8 hours continuous or 24 hours normal operation?				
Comments:				
13 Number and Location of Light Units			**East**	**West**
Can front lights be seen from SSD?				
Can front lights be seen along entire approach?				
Can front lights be seen from intersections entering approach?				
Can back lights be seen by all vehicles stopped at crossing?				
Are additional lights required?				
Are additional lights installed?				
Cantilevers			**East**	**West**
Distance from centre of signal to edge of travelled lane: (m)		max 7.7		
Distance from second signal to edge of travelled lane: (m)		max 7.8		
Can front light be seen by all vehicles on approach?				
Is roadway classified as an expressway?				
Is a cantilever required?				
Is a cantilever installed?				
Sidewalk			**North**	**South**
Centre of warning system to centre of sidewalk: (m)		max 3.6		
Can at least one set of lights be seen by sidewalk from both sides of rail?				
Is sidewalk outside island circuit?				
Additional signal required?				
Are flashing lights for the sidewalk present?				
Comments:				
14 Light Units - Alignment			**East**	**West**
Are signal alignment requirements available on site?				
Are all units 200mm or 300mm LEDs?			300mm	300mm
Light flash rate: (flashes per minute)	min 45	max 65		

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HATCH

ASSESSMENT DATA

			North	South
Are all lights flashing alternatively and uniformly?				
Are front lights aligned to 1.6m above road at SSD (or when first visible)?				
Are back lights aligned to 1.6m above road at 15m from front lights?				
Are additional lights required for approaches?				
Are additional lights installed and aligned for 1.6m above road surface?				
Sidewalk			**North**	**South**
Are all light units 200mm or 300mm LEDs?				
Light flash rate: (flashes per minute)	min 45	max 65		
Are all lights flashing alternatively and uniformly?				
Are front lights aligned to 1.6m above road at 30m (or when first visible)?				

Comments:

15 Bells and Gates

Bells			**East**	**West**
Is bell installed on mast?				
Is bell on side with sidewalk?				
Distance from sidewalk to bell mast: (m)		max 30		
Bell gong rate: (rings per minute)	min 100	max 325		
Does bell ring for as long as warning system is active?				
Gates			**East**	**West**
Is gate arm perpendicular to road approach?				
Gate descent delay measured: (s)				
Does gate arm stop if obstructed?				
Gate arm descent time: (s)	min 10	max 15		
Time to train arrival: (s)	min 0			
Gate ascent time: (s)	min 6	max 12		
Does gate arm descend smoothly and without rebound?				
Does gate arm return to proper position after clearance of obstruction?				

Comments:

16 Circuitry

Required warning time: (s)	
Measured or recorded warning time: (s)	
Are crossing warning times consistent?	
Are warning times less than 13s more than required?	
Are cut-out circuits installed, if required?	
Type of crossing equipment:	
Are directional stick circuits installed?	
Does stick have release timer or restrict train speeds through signaling?	
Are all wires properly tagged and clear?	

Comments:

17 Inspection and Testing - Warning Systems

Are plans available at location and up to date?	
Is there proof of testing at periods defined in GCS?	

Comments:

F INTERCONNECTED DEVICES

HATCH

ASSESSMENT DATA

18 Prepare to Stop at Railway Crossing Sign	East	West
Is SSD restricted such that a prepared to stop at railway sign is required?		
Is prepare to stop sign installed?		
Can the prepare to stop sign be seen from SSD?		
Do prepare to stop flashers activate with enough preemption?		
Does battery back-up allow Prepare to Stop sign to operate for up to 4 hours?		

19 Interconnection of Traffic Signals	East	West
Is intersection within 30m of crossing?		
Are there any queuing issues that would require traffic preemption?		
Is interconnection installed?		
Does interconnection allow vehicles to clear the grade crossing?		
Does interconnection prevent vehicles from entering crossing?		
Does battery back-up allow traffic signals to operate for up to 4 hours?		

20 Interconnected Devices - Inspection and Testing	
Is there proof of testing of interconnected devices as defined in GCS?	

Comments:

APPENDIX D - WHISTLE CESSATION

	East	West
Is SSD adequate?		
Are sightlines along track greater than 400m in both directions?		
Type of crossing warning system:	*Active: FLB & G*	
Number of tracks:	*3*	
Railway speed: (mph)		
Is crossing warning system adequate for whistle cessation?		
Is whistling required at crossing?		
Is whistling used at crossing?		

Comments:

ADDITIONAL COMMENTS

Comments:

In the NE quadrant, center of mast to center of sidewalk is 4.5 meters.

On North sidewalk, Z barriers are present but there is evidence that cyclist and pedestrians bypassing them. Recommend installing fence if not upgraded to FLB&G.

Consider installing FLB&G for sidewalks or alternatively installing gate style lights on top of short posts at z barrier to put lights in peripheral vision of pedestrians distracted by phone or tablet.

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ASSESSMENT DATA
Recorded outbound warning time is around 27 seconds. Gate horizontal time for East gate is 15 seconds and 17 seconds for West. Gate delay is 8 seconds. Recorded inbound warning time is 27 seconds for preferred and 32 seconds for unpreferred. Gate horizontal time is 17 seconds and gate delay is 8 seconds.

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SITE PHOTOS

162Ave Lookng E

162Ave Lookng E - 2

162Ave Lookng E - 3

162Ave Looking N

162Ave Looking N - 2

162Ave Looking S

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SITE PHOTOS

162Ave Looking W

162Ave Lookng W - 2

162Ave N sidewalk Lookng E

162Ave N sidewalk Lookng E - 2

162Ave N sidewalk Lookng E

162Ave S sidewalk Looking W

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SITE PHOTOS

162Ave S sidewalk Looking W - 2	162Ave S sidewalk Lookng E
	
162Ave, CP mileage	162Ave, Emergency contact sign
	

12.5 Ave SW (Chinook Station) Mixed Crossing

HATCH

Calgary Transit
61 Ave SW, Calgary, Alberta

Crossing Safety Assessment

Issue and Revision Record					
Rev	**Date**	**Originator**	**Checker**	**Approver**	**Description**
0	2019-05-02	Jenny Xing	Andy Hamel	Dale Hein	Final

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The safety assessment of this grade crossing covers physical features which may affect road and rail user safety and it has sought to identify potential safety hazards. However, the auditors point out that no guarantee is made that every deficiency has been identified. Further, if all the recommendations in this assessment were addressed, this would not confirm that the crossing is 'safe'; rather, adoption of the recommendations should improve the level of safety of the facility.

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1. Summary

A safety assessment of the grade crossing located at 61 Ave SW in Calgary, Alberta (Red Line subdivision) was undertaken on May 02, 2019. Data on site was acquired by Jenny Xing/Andy Hamel and the assessment of the information provided was performed by .

For the purposes of this report, 61 Ave SW crossing is described in an East/West orientation, while the rail line is described in a North/South orientation. The crossing is equipped with an active crossing warning system with flashing lights, bell(s) and gates.

2. Purpose

The Fundamental objectives of this assessment are:

1. Identify opportunities to reduce collision risk within the grade crossing environment.
2. Identify opportunities to minimize the frequency and severity of preventable crashes.
3. Consider the safety of all grade crossing users.
4. Verify compliance of the Grade Crossings Standards (GCS, dated July 2014) referred to in the most recent Grade Crossings Regulations (GCR, SOR 2014-275, November 28, 2014).
5. Ensure that all the crash mitigation measures/factors aimed to eliminate or reduce the identified safety problems are fully considered, evaluated and documented for review/action by the appropriate authorities.

3. Site Sketch

A site sketch is included to provide an aerial perspective of the layout for the crossing, which identifies the railway and roadway on appraoch to the grade crossing location. It identifies key components and considerations that impact the safety of the crossing which may include obstructions, signage, crossing infrastructure, and surrounding land use.

4. Assesment Data

The assessment data is provided in pages 4 to 11. Assessment questions are presented to reflect all requirements in the GCS for both passive and active warning systems. Assessment data not within compliance of the GCS is highlighted red for quick reference. Assessment data that is not applicable to the crossing is filled with N/A. Items not within compliance with the GCS are summarized following the assessment data along with suggested actions for remediation.

5. Recommendations

Following the report generated from site, items that do not comply with the Transport Canada's Grade Crossing Standards and Regulations are itemized in a summary table with suggested actions for remediation, if required. Responsibilities for remediation are identified in the adjacent column as per the GCR, where applicable.

6. Site Photos

In order to highlight conditions on site, photographs are included at the end of the report. The pictures are meant to highlight considerations of the report and may include items such as sightlines, signage, warning system equipment, road markings, road condition, rail condition, and site documentation.

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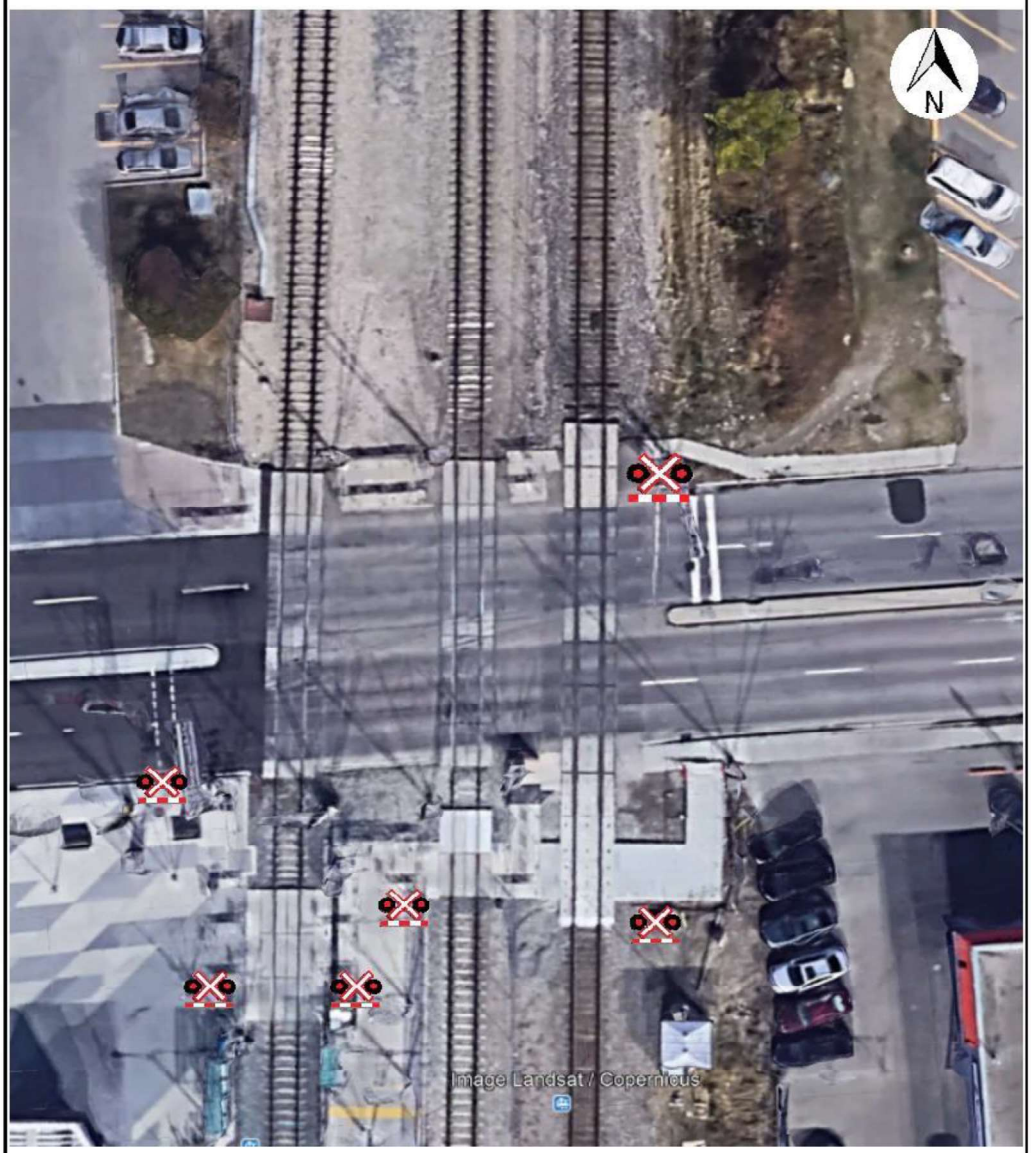
SITE SKETCH



Road Measurement Sketch

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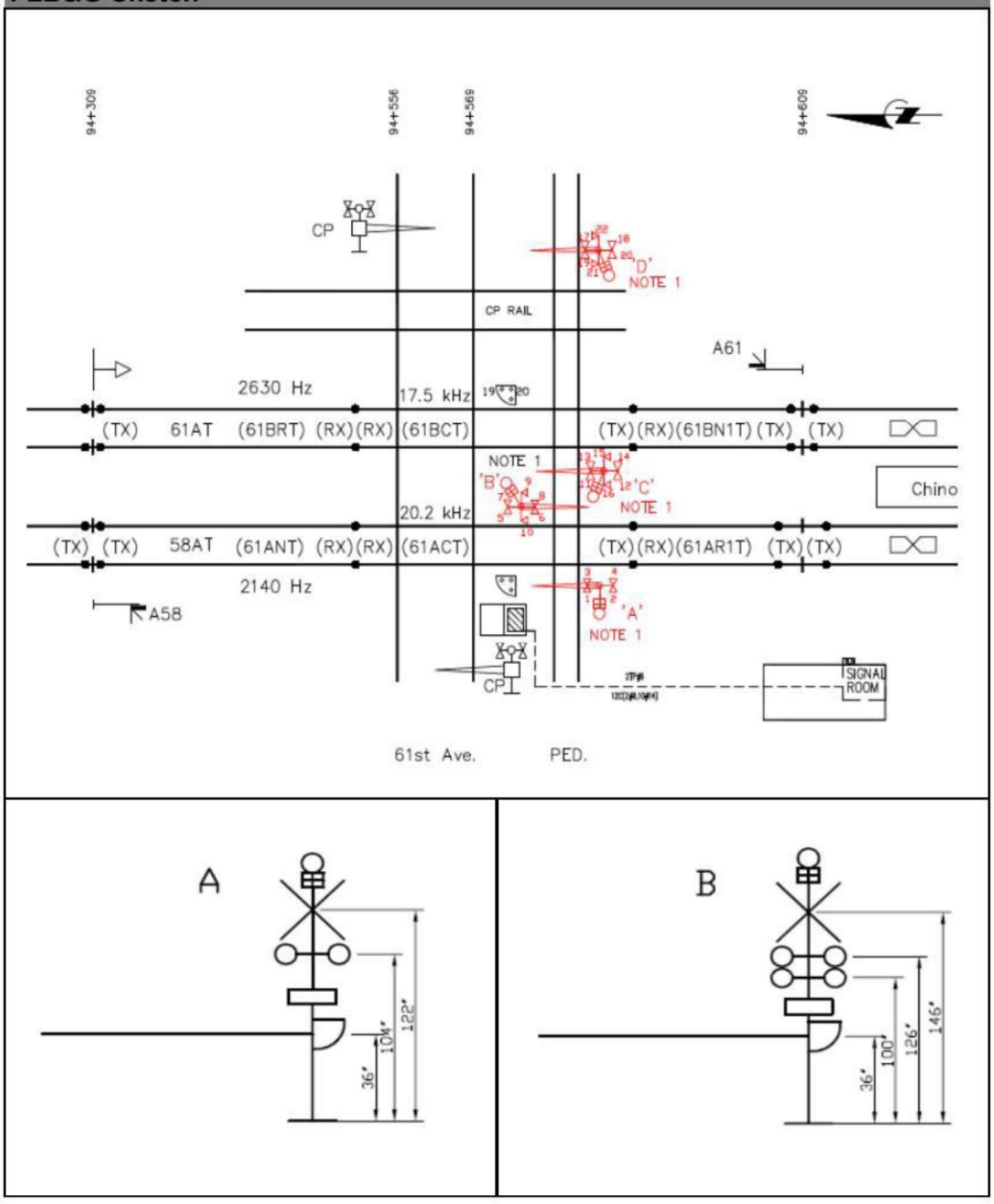
FLB&G Sketch



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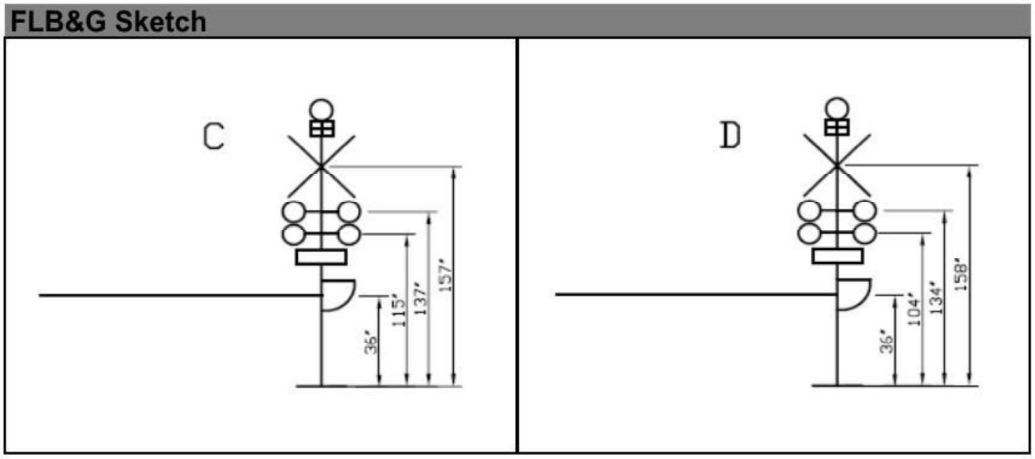
FLB&G Sketch



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ASSESSMENT DATA

Assessor Information	
Data acquisition by:	Jenny Xing/Andy Hamel
Crossing assessment by:	
Date of site visit:	2019-05-02
Comments:	
Railway Company Information	
Railway company:	Calgary Transit
Location Chainage:	
Subdivision:	Red Line
Rail orientation:	North/South
Number of tracks:	2
Can railway equipment pass each other at the crossing?	Yes
Average annual daily train traffic: (AADT)	200
Freight train design speed: (mph)	
Passenger train design speed: (mph)	
Type of crossing warning system:	Active: FLB & G
Is whistling used at crossing?	Yes
Class of track:	*CLASS 1*
Comments:	
Railway Company Information	
Railway company:	Canadian Pacific Railway
Location mileage:	
Subdivision:	Aldersyde
Rail orientation:	North/South
Number of tracks:	1
Can railway equipment pass each other at the crossing?	N/A
Average annual daily train traffic: (AADT)	
Freight train design speed: (mph)	
Passenger train design speed: (mph)	
Type of crossing warning system:	Active: FLB & G
Is whistling used at crossing?	Yes
Class of track:	*CLASS 1*
Comments:	
Road Authority Information	
Road authority:	City of Calgary
Street name:	61 Ave SW
Municipality:	Calgary
Province/Territory:	Alberta
Design vehicle:	
Design Vehicle Length: (m)	*6*
Average annual daily road traffic: (AADT)	13000
Public or private road?	Public
Urban or rural?	Urban
Local, collector, arterial, expressway, or freeway?	Arterial
Divided or undivided?	Undivided
Crossing cross angle: (degrees)	
Crossing Approaches	**East** **West**

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ASSESSMENT DATA		
Road crossing design speed: (km/h)	50	50
Number of traffic lanes:	4	4
Traffic lane width: (m)		
Traffic lane width including shoulders: (m)		
Average grade of road approach:		
Stopping sight distance (SSD):	*65*	*65*
Vehicle departure time: (calculated)	*0.00*	*0.00*
Prepare to Stop required activation time:		
Interconnection delay timing:		
Sidewalk	**North**	**South**
Sidewalk present?	Yes	Yes
Is sidewalk designated for persons using assistive devices?	Yes	Yes
Comments:		

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ASSESSMENT DATA

C NEW STANDARDS

5 Crossing Surface			North	South
Road extensions off of the travelled way: (m)	min 0.5			
North sidewalk extensions of the travelled way: (m)	min 0.5			
South sidewalk extensions of the travelled way: (m)	min 0.5			
Is crossing surface smooth and continuous?				
Flangeway			**Min**	**Max**
Flangeway width: (mm)	min 65	max 75		
Flangeway depth: (mm)	min 50	max 75		
Flangeway field side width: (mm)		max 0		
Flangeway field side depth: (mm)		max 0		
Top of rail to road crossing surface: (mm)	min -7	max 13		
Comments:				

6 Road Geometry			East	West
North slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
South slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
Slope within 8m of the nearest rail: (%)		max 2%		
Slope between 8m and 18m of the nearest rail: (%)	max_1 5%	max_2 10%		
What is allowable percentage grade slope through crossing?				
What is the grade slope through the crossing?				
Is grade slope through crossing less than limit?				
Are horizontal and vertical alignments smooth and continuous on approach?				
Width of travelled way on each approach: (m)				
Width of travelled way at crossing: (m)				
Width through the crossing greater than approach?				
Does the travelled way have curbs?				
Grade crossing angle: (degrees)	min 0	max 180		
Comments:				

7 Sightlines	East	West
SSD calculated: (m)		
SSD measured: (m)		
D_{SSD} calculated: (m)		
D_{SSD} driver's left measured: (m)		
D_{SSD} driver's right measured: (m)		
$D_{stopped}$ calculated: (m)		
$D_{stopped}$ driver's left measured: (m)		
$D_{stopped}$ driver's right measured: (m)		
$D_{stopped}$ pedestrian's left measured: (m)		
$D_{stopped}$ pedestrian's right measured: (m)		
Are there any obstacles to driver's left that may affect visibility?		
Are there any obstacles to driver's right that may affect visibility?		
Is there any vegetation to driver's left that may affect visibility?		
Is there any vegetation to driver's right that may affect visibility?		
Is visibility along track impaired due to angle of crossing?		
Comments:		

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ASSESSMENT DATA

8 Signs & Pavement Markings

			East	West
Crossing Sign(s)				
Railway crossing sign present with reflective 50mm border?				
Number of tracks sign present and reflective?				
Height of cross buck from crown of road: (m)	min 1.5	max 2.5		
Is 100mm retroreflective strip on back of each blade?				
Distance of strip from crown of road: (mm)		max 300		
Distance of strip from top of cross buck: (mm)	min 70	max 70		
Crossing sign distance from shoulder: (m)	min 2	max 4.5		
Distance to nearest rail: (m)	min 3			
50mm strip on front post?				
Is sign post made of material such that if struck by a vehicle it will break?				
Condition of sign:				
Railway Crossing Ahead Sign and Advisory Speed Tab			East	West
Are vehicles required to slow prior to crossing due to shorter SSD?				
Is sign present upon approach?				
Is sign visible from SSD as defined by road speed?				
Is sign showing correct road orientation?				
Is Advisory Speed tab installed and correct?				
Advisory Speed: (km/h)				
Adjusted SSD: (m)				
Condition of sign:				
Stop Sign Ahead Sign			East	West
Stop sign ahead sign required?				
Stop sign ahead sign installed?				
Stop Sign visible from SSD at design road speed?				
Condition of sign:				
Stop Sign			East	West
Is D_{SSD} insufficient to warrant a stop sign?				
Is stop sign installed?				
Size of stop sign?				
Distance from crown of road to bottom of sign: (m)	min 1.8			
Distance from top of sign to centre of crossing sign: (m)	min 0.5	max 0.5		
Condition of sign:				
Emergency Notification Sign				
Is Emergency Notification Sign Present?				
Does Emergency Notification Sign contain all information?				
Can Emergency Notification Sign(s) be seen from both approach?				
Condition of sign:				
Stop Bars			East	West
Are stop bars able to be painted on approach?				
Are stop bars present?				
Distance from nearest rail (m):	min 5.0			
Distance from nearest signal (m):	min 2.0			
Condition of markings:				
'X' Markings			East	West
Is 'X' marking able to be painted on approach?			Yes	Yes
Is X marking present?			No	No
Condition of markings:				
Comments:				

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ASSESSMENT DATA

9 Warning Systems Specification

Traffic volume cross product:
Railway speed: (mph)
Is there a sidewalk present?
Number of tracks:
Is there an intersection within a distance 'D" from the crossing?

Flashing Lights and Bells

Additional condition requires warning system?
Lights and bells required?
Are flashing lights and bells present?

Gates

Additional condition requires gates?
Gates required?
Are gates present?

Sidewalk Flashing Lights	East	West
Is sidewalk outside island circuit?		
Additional lights required for sidewalk?		
Are flashing lights for the sidewalk present?		

Sidewalk Gates	East	West
Are gates required for sidewalk?		
Are gates for the sidewalk present?		

Comments:

D DESIGN CALCULATIONS

10 Design Calculations	East	West
Vehicle clearance Distance (Cd) measured: (m)		
Pedestrian clearance Distance (Cd) measured: (m)		
Vehicle travel distance (S) calculated: (m)		
Departure Time (T_D) calculated: (s)		
Maximum approach grade within "S": (%)		
Grade adjustment factor "G":		
Design vehicle departure time "s" calculated: (s)		
Pedestrian Departure Time (T_P) calculated: (s)		
Departure Time measured: (s)		
Gate arm clearance time calculated: (s)		
Gate arm clearance time measured: (s)		

11 Location of Grade Crossings	East	West
Are there any intersections along approach to crossing?		

Queuing		East	West
Distance "D" from stop sign: (m)	min 30		
Distance "D" from traffic signal: (m)	min 60		
Is 'D' insufficient such that road vehicles might queue onto the tracks?			
Can traffic queue from adjacent intersection to within 2.4m of nearest track?			
Can traffic queue from crossing into adjacent intersections?			
Are there any queuing issues that would require traffic preemption?			

Comments:

HATCH

ASSESSMENT DATA

E WARNING SYSTEM DESIGN

12 Warning System Operation - General

Flashing Lights			East	West
Cross buck present with reflective 50mm border?				
Number of tracks sign present and reflective?				
Distance from shoulder to outside of outer signal: (m)	min 1.88			
Distance to nearest rail: (m)	min 3			
Exposed signal foundation from crown of road: (mm)		max 100		
Bottom of lowest signal from crown of road: (m)	min 2.3	max 2.9		
Number of track sign to bottom of lowest signal: (mm)	min 125	max 175		
Cross bucks to top of highest signal: (mm)	min 125	max 175		
Radius of signal backgrounds: (mm)	min 305	max 305		
Distance from centre of signal to centre of mast: (mm)	min 380	max 380		
Condition of signals:				

Gates			East	West
Gate mechanism protrusion: (mm)		max 650		
Gate up protrusion height at edge of signal: (m)	min 5.2			
Gate down height from crown of road: (m)	min 1.1	max 1.4		
Gate tip to centre of mast: (m)		max 11.6		
Gate tip to edge of travelled lane: (m)	min -1	max 1		
Gate tip to tip of other gate: (m)	min 0	max 1		
First signal solid and other signals alternating?				
Gate tip to first gate signal: (mm)	min 355	max 915		
First gate signal to last gate signal: (m)	min 2.74			
Are gate signals equally spaced?				
Gate arm stripe width: (mm)	min 406	max 406		
Gate arm stripes vertical?				
Condition of gates:				

Sidewalk Gates			North	South
Sidewalk width: (m)				
Gate mechanism protrusion: (mm)		max 650		
Gate up protrusion height at edge of signal: (m)	min 5.2			
Gate down height from crown of road: (m)	min 1.1	max 1.4		
Gate tip to centre of mast: (m)		max 11.6		
Number of lights required:				
Does gate extend full width of sidewalk?				
Are gate signals equally spaced?				
Are gate signals alternating correctly?				
Gate arm stripe width: (mm)	min 406	max 406		
Gate arm stripes vertical?				
Condition of gates:				

Cantilevers			East	West
Height of cantilever from crown of road: (m)	min 5.2	max 6		
Radius of signal backgrounds: (mm)	min 305	max 305		
Condition of mast:				
Condition of signals:				

Crossing Case	
Distance of crossing case to edge of rail (m):	
Distance of crossing case to edge of road (m):	

Comments:

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ASSESSMENT DATA

Equipment

Is data recorder capable of retaining information up to 30 days?	
Is design failsafe?	
Is power out indicator installed and visible from the road?	
Do fouling circuits have at least two discrete conductors?	
Does track circuit detect a 0.06ohm resistance?	
Are non insulated joints properly bonded?	
Do insulated joints provide proper insulation?	
Does battery back-up give 8 hours continuous or 24 hours normal operation?	

Comments:

13 Number and Location of Light Units	East	West
Can front lights be seen from SSD?		
Can front lights be seen along entire approach?		
Can front lights be seen from intersections entering approach?		
Can back lights be seen by all vehicles stopped at crossing?		
Are additional lights required?		
Are additional lights installed?		

Cantilevers		East	West
Distance from centre of signal to edge of travelled lane: (m)	max 7.7		
Distance from second signal to edge of travelled lane: (m)	max 7.8		
Can front light be seen by all vehicles on approach?			
Is roadway classified as an expressway?			
Is a cantilever required?			
Is a cantilever installed?			

Sidewalk		North	South
Centre of warning system to centre of sidewalk: (m)	max 3.6		
Can at least one set of lights be seen by sidewalk from both sides of rail?			
Is sidewalk outside island circuit?			
Additional signal required?			
Are flashing lights for the sidewalk present?			

Comments:

14 Light Units - Alignment			East	West
Are signal alignment requirements available on site?				
Are all units 200mm or 300mm LEDs?				
Light flash rate: (flashes per minute)	min 45	max 65		
Are all lights flashing alternatively and uniformly?				
Are front lights aligned to 1.6m above road at SSD (or when first visible)?				
Are back lights aligned to 1.6m above road at 15m from front lights?				
Are additional lights required for approaches?				
Are additional lights installed and aligned for 1.6m above road surface?				

Sidewalk			North	South
Are all light units 200mm or 300mm LEDs?				
Light flash rate: (flashes per minute)	min 45	max 65		
Are all lights flashing alternatively and uniformly?				
Are front lights aligned to 1.6m above road at 30m (or when first visible)?				

Comments:

HATCH

ASSESSMENT DATA

15 Bells and Gates

Bells			East	West
Is bell installed on mast?				
Is bell on side with sidewalk?				
Distance from sidewalk to bell mast: (m)		max 30		
Bell gong rate: (rings per minute)	min 100	max 325		
Does bell ring for as long as warning system is active?				

Gates			East	West
Is gate arm perpendicular to road approach?				
Gate descent delay measured: (s)				
Does gate arm stop if obstructed?				
Gate arm descent time: (s)	min 10	max 15		
Time to train arrival: (s)	min 0			
Gate ascent time: (s)	min 6	max 12		
Does gate arm descend smoothly and without rebound?				
Does gate arm return to proper position after clearance of obstruction?				

Comments:

16 Circuitry

Required warning time: (s)	
Measured or recorded warning time: (s)	
Are crossing warning times consistent?	
Are warning times less than 13s more than required?	
Are cut-out circuits installed, if required?	
Type of crossing equipment:	
Are directional stick circuits installed?	
Does stick have release timer or restrict train speeds through signaling?	
Are all wires properly tagged and clear?	

Comments:

17 Inspection and Testing - Warning Systems

Are plans available at location and up to date?	
Is there proof of testing at periods defined in GCS?	

Comments:

F INTERCONNECTED DEVICES

18 Prepare to Stop at Railway Crossing Sign	East	West
Is SSD restricted such that a prepared to stop at railway sign is required?		
Is prepare to stop sign installed?		
Can the prepare to stop sign be seen from SSD?		
Do prepare to stop flashers activate with enough preemption?		
Does battery back-up allow Prepare to Stop sign to operate for up to 4 hours?		

19 Interconnection of Traffic Signals	East	West
Is intersection within 30m of crossing?		
Are there any queuing issues that would require traffic preemption?		
Is interconnection installed?		
Does interconnection allow vehicles to clear the grade crossing?		
Does interconnection prevent vehicles from entering crossing?		
Does battery back-up allow traffic signals to operate for up to 4 hours?		

HATCH

ASSESSMENT DATA

20 Interconnected Devices - Inspection and Testing

Is there proof of testing of interconnected devices as defined in GCS?

Comments:

APPENDIX D - WHISTLE CESSATION

	East	West
Is SSD adequate?		
Are sightlines along track greater than 400m in both directions?		
Type of crossing warning system:	*Active: FLB & G*	
Number of tracks:	*3*	
Railway speed: (mph)		
Is crossing warning system adequate for whistle cessation?		
Is whistling required at crossing?		
Is whistling used at crossing?		

Comments:

ADDITIONAL COMMENTS

Comments:

Signal Masts C&D on the NB PedX are missing the "2" tracks signs.

"B" mast shown in wrong location on track layout drawings. (It is on south side of PedX)

200mm LEDs on masts A & C.
300mm LEDs on masts B & D.
300mm LEDs on CP masts.

On sidewalk on North side of Avenue, no railway X-Buck visible from sidewalk when EB.Z barriers are present. Consider adding FLB&G on sidewalk for pedestrians or adding crossing gate style lights on short posts to put flashing lights in peripheral vision for pedestrians distracted by phone or tablet.

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SITE PHOTOS

61st Ave Looking E

61st Ave Looking E - 2

61st Ave Looking NE

61st Ave Looking W

61st Ave Looking W - 2

61st Ave, N sidewalk Looking E

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SITE PHOTOS

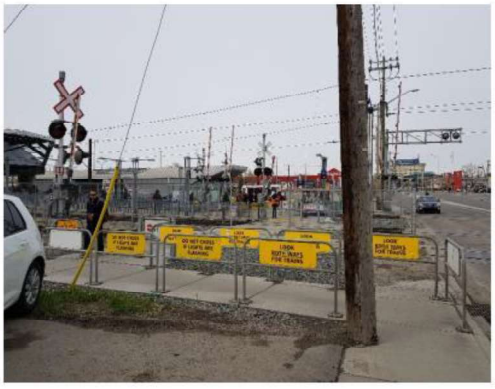
61st Ave, N sidewalk Looking E - 2

61st Ave, N sidewalk Looking W

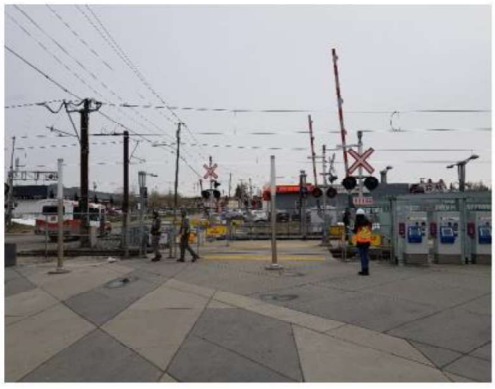
NB Ped Looking E

NB Ped Looking SW

NB Ped Lookng W



SB Ped Lookng E



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SITE PHOTOS

SB Ped Looking E2

SB Ped Looking E3

SB Ped Looking SW

East Gate

West Gate

12.6 12 Ave NE at 36 St NE Mixed Crossing

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Calgary Transit
12 Ave NE, Calgary, Alberta

Crossing Safety Assessment

Issue and Revision Record					
Rev	**Date**	**Originator**	**Checker**	**Approver**	**Description**
0	2019-04-10	Jenny Xing	Andy Hamel	Dale Hein	Final

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The safety assessment of this grade crossing covers physical features which may affect road and rail user safety and it has sought to identify potential safety hazards. However, the auditors point out that no guarantee is made that every deficiency has been identified. Further, if all the recommendations in this assessment were addressed, this would not confirm that the crossing is 'safe'; rather, adoption of the recommendations should improve the level of safety of the facility.

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1. Summary

A safety assessment of the grade crossing located at 12 Ave NE in Calgary, Alberta (Blue Line subdivision) was undertaken on Apr 11, 2019. Data on site was acquired by Jenny Xing and the assessment of the information provided was performed by Andy Hamel/Jenny Xing.

For the purposes of this report, 12 Ave NE crossing is described in an East/West orientation, while the rail line is described in a North/South orientation. The crossing is equipped with an active crossing warning system with flashing lights, bell(s) and gates.

2. Purpose

The Fundamental objectives of this assessment are:

1. Identify opportunities to reduce collision risk within the grade crossing environment.
2. Identify opportunities to minimize the frequency and severity of preventable crashes.
3. Consider the safety of all grade crossing users.
4. Verify compliance of the Grade Crossings Standards (GCS, dated July 2014) referred to in the most recent Grade Crossings Regulations (GCR, SOR 2014-275, November 28, 2014).
5. Ensure that all the crash mitigation measures/factors aimed to eliminate or reduce the identified safety problems are fully considered, evaluated and documented for review/action by the appropriate authorities.

3. Site Sketch

A site sketch is included to provide an aerial perspective of the layout for the crossing, which identifies the railway and roadway on appraoch to the grade crossing location. It identifies key components and considerations that impact the safety of the crossing which may include obstructions, signage, crossing infrastructure, and surrounding land use.

4. Assesment Data

The assessment data is provided in pages 4 to 11. Assessment questions are presented to reflect all requirements in the GCS for both passive and active warning systems. Assessment data not within compliance of the GCS is highlighted red for quick reference. Assessment data that is not applicable to the crossing is filled with N/A. Items not within compliance with the GCS are summarized following the assessment data along with suggested actions for remediation.

5. Recommendations

Following the report generated from site, items that do not comply with the Transport Canada's Grade Crossing Standards and Regulations are itemized in a summary table with suggested actions for remediation, if required. Responsibilities for remediation are identified in the adjacent column as per the GCR, where applicable.

6. Site Photos

In order to highlight conditions on site, photographs are included at the end of the report. The pictures are meant to highlight considerations of the report and may include items such as sightlines, signage, warning system equipment, road markings, road condition, rail condition, and site documentation.

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SITE SKETCH

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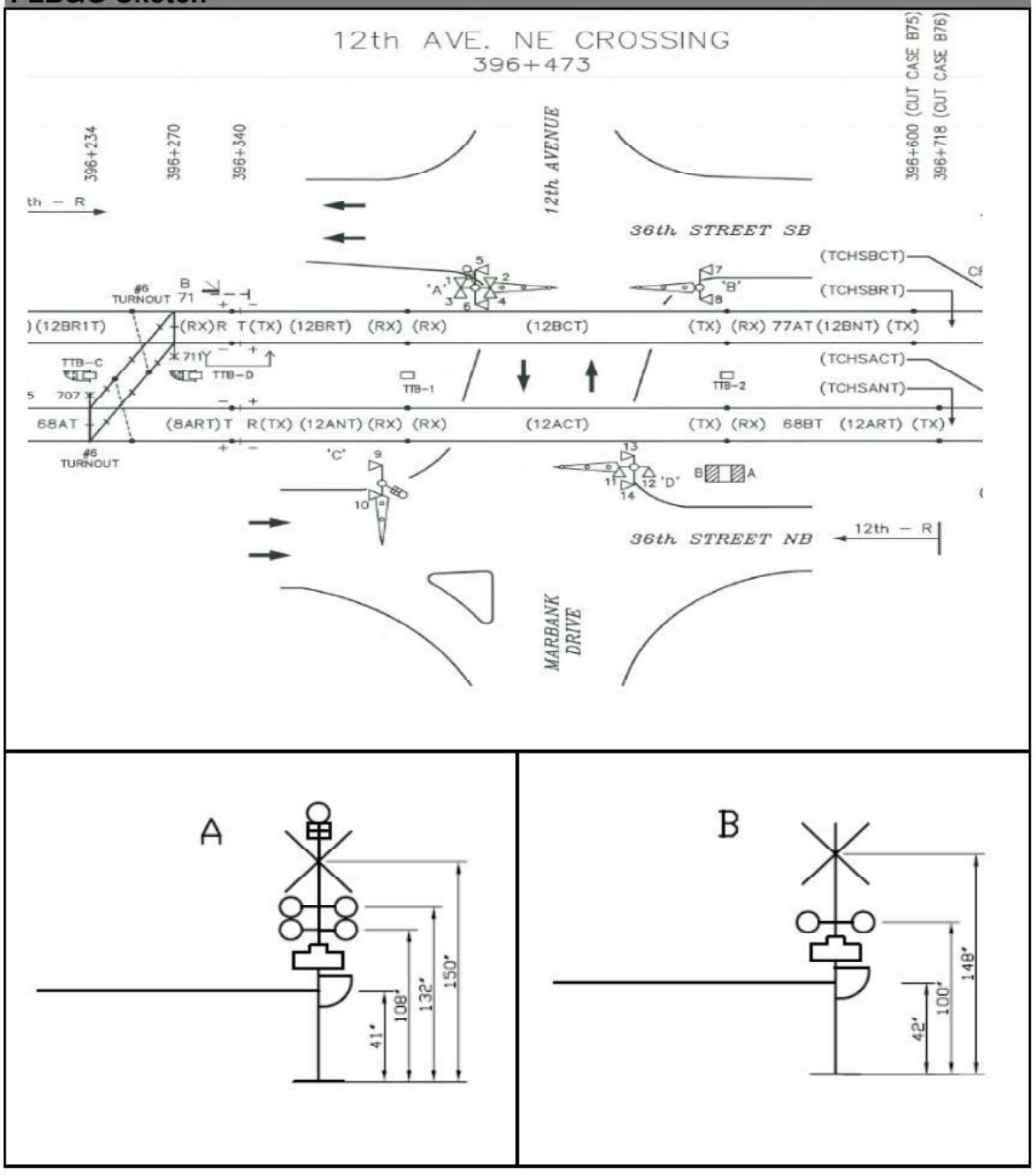
Road Measurement Sketch

HATCH

FLB&G Sketch



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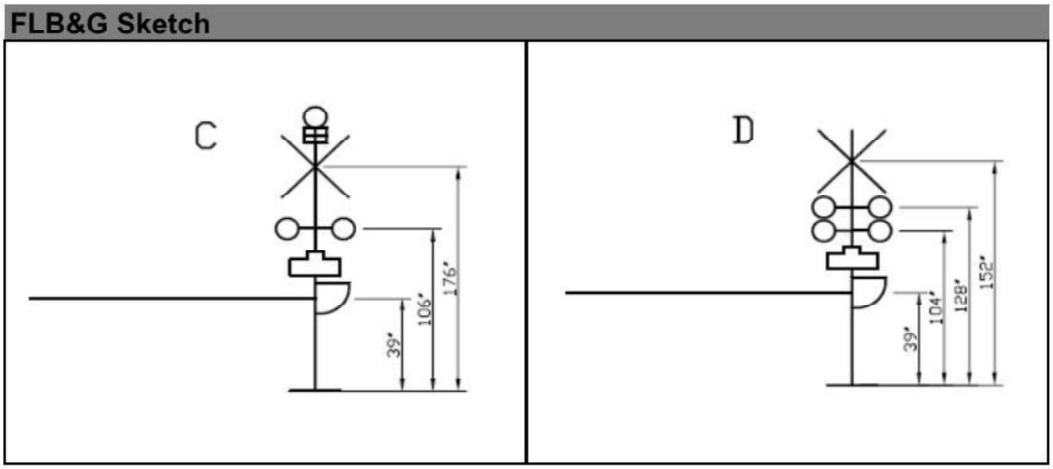
FLB&G Sketch



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ASSESSMENT DATA

Assessor Information

Data acquisition by:	Jenny Xing
Crossing assessment by:	Andy Hamel/Jenny Xing
Date of site visit:	2019-04-11
Comments:	

Railway Company Information

Railway company:	Calgary Transit
Location Chainage:	
Subdivision:	Blue Line
Rail orientation:	North/South
Number of tracks:	2
Can railway equipment pass each other at the crossing?	Yes
Average annual daily train traffic: (AADT)	200
Freight train design speed: (mph)	
Passenger train design speed: (mph)	
Type of crossing warning system:	Active: FLB & G
Is whistling used at crossing?	N/A
Class of track:	*CLASS 1*
Comments:	

Road Authority Information

Road authority:	City of Calgary
Street name:	12 Ave NE
Municipality:	Calgary
Province/Territory:	Alberta
Design vehicle:	
Design Vehicle Length: (m)	*6*
Average annual daily road traffic: (AADT)	11000
Public or private road?	Public
Urban or rural?	Urban
Local, collector, arterial, expressway, or freeway?	Arterial
Divided or undivided?	Undivided
Crossing cross angle: (degrees)	

Crossing Approaches	**East**	**West**
Road crossing design speed: (km/h)	50	50
Number of traffic lanes:		
Traffic lane width: (m)		
Traffic lane width including shoulders: (m)		
Average grade of road approach:		
Stopping sight distance (SSD):	*65*	*65*
Vehicle departure time: (calculated)	*0.00*	*0.00*
Prepare to Stop required activation time:		
Interconnection delay timing:		

Sidewalk	**North**	**South**
Sidewalk present?	Yes	Yes
Is sidewalk designated for persons using assistive devices?	Yes	Yes

Comments:

HATCH

ASSESSMENT DATA

C NEW STANDARDS

5 Crossing Surface			North	South
Road extensions off of the travelled way: (m)	min 0.5			
North sidewalk extensions of the travelled way: (m)	min 0.5			
South sidewalk extensions of the travelled way: (m)	min 0.5			
Is crossing surface smooth and continuous?				
Flangeway			**Min**	**Max**
Flangeway width: (mm)	min 65	max 75		
Flangeway depth: (mm)	min 50	max 75		
Flangeway field side width: (mm)		max 0		
Flangeway field side depth: (mm)		max 0		
Top of rail to road crossing surface: (mm)	min -7	max 13		
Comments:				

6 Road Geometry			East	West
North slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
South slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
Slope within 8m of the nearest rail: (%)		max 2%		
Slope between 8m and 18m of the nearest rail: (%)	max_1 5%	max_2 10%		
What is allowable percentage grade slope through crossing?				
What is the grade slope through the crossing?				
Is grade slope through crossing less than limit?				
Are horizontal and vertical alignments smooth and continuous on approach?				
Width of travelled way on each approach: (m)				
Width of travelled way at crossing: (m)				
Width through the crossing greater than approach?				
Does the travelled way have curbs?				
Grade crossing angle: (degrees)	min 0	max 180	*0*	
Comments:				

7 Sightlines	East	West
SSD calculated: (m)		
SSD measured: (m)		
D_{SSD} calculated: (m)		
D_{SSD} driver's left measured: (m)		
D_{SSD} driver's right measured: (m)		
$D_{stopped}$ calculated: (m)		
$D_{stopped}$ driver's left measured: (m)		
$D_{stopped}$ driver's right measured: (m)		
$D_{stopped}$ pedestrian's left measured: (m)		
$D_{stopped}$ pedestrian's right measured: (m)		
Are there any obstacles to driver's left that may affect visibility?		
Are there any obstacles to driver's right that may affect visibility?		
Is there any vegetation to driver's left that may affect visibility?		
Is there any vegetation to driver's right that may affect visibility?		
Is visibility along track impaired due to angle of crossing?		
Comments:		

HATCH

ASSESSMENT DATA

8 Signs & Pavement Markings

			East	West
Crossing Sign(s)				
Railway crossing sign present with reflective 50mm border?				
Number of tracks sign present and reflective?				
Height of cross buck from crown of road: (m)	min 1.5	max 2.5		
Is 100mm retroreflective strip on back of each blade?				
Distance of strip from crown of road: (mm)		max 300		
Distance of strip from top of cross buck: (mm)	min 70	max 70		
Crossing sign distance from shoulder: (m)	min 2	max 4.5		
Distance to nearest rail: (m)	min 3			
50mm strip on front post?				
Is sign post made of material such that if struck by a vehicle it will break?				
Condition of sign:				
Railway Crossing Ahead Sign and Advisory Speed Tab			East	West
Are vehicles required to slow prior to crossing due to shorter SSD?			No	No
Is sign present upon approach?				
Is sign visible from SSD as defined by road speed?				
Is sign showing correct road orientation?				
Is Advisory Speed tab installed and correct?				
Advisory Speed: (km/h)				
Adjusted SSD: (m)			*N/A*	*N/A*
Condition of sign:				
Stop Sign Ahead Sign			East	West
Stop sign ahead sign required?				
Stop sign ahead sign installed?				
Stop Sign visible from SSD at design road speed?				
Condition of sign:				
Stop Sign			East	West
Is D_{SSD} insufficient to warrant a stop sign?				
Is stop sign installed?				
Size of stop sign?				
Distance from crown of road to bottom of sign: (m)	min 1.8			
Distance from top of sign to centre of crossing sign: (m)	min 0.5	max 0.5		
Condition of sign:				
Emergency Notification Sign				
Is Emergency Notification Sign Present?			No	
Does Emergency Notification Sign contain all information?				
Can Emergency Notification Sign(s) be seen from both approach?				
Condition of sign:				
Stop Bars			East	West
Are stop bars able to be painted on approach?				
Are stop bars present?				
Distance from nearest rail (m):	min 5.0			
Distance from nearest signal (m):	min 2.0			
Condition of markings:				
'X' Markings			East	West
Is 'X' marking able to be painted on approach?			Yes	Yes
Is X marking present?			No	No
Condition of markings:				
Comments:				

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HATCH

ASSESSMENT DATA

9 Warning Systems Specification			
Traffic volume cross product:			
Railway speed: (mph)			
Is there a sidewalk present?		Yes	
Number of tracks:		2	
Is there an intersection within a distance 'D" from the crossing?		No	
Flashing Lights and Bells			
Additional condition requires warning system?			
Lights and bells required?			
Are flashing lights and bells present?		Yes	
Gates			
Additional condition requires gates?			
Gates required?			
Are gates present?		Yes	
Sidewalk Flashing Lights		**East**	**West**
Is sidewalk outside island circuit?		No	No
Additional lights required for sidewalk?		No	No
Are flashing lights for the sidewalk present?			
Sidewalk Gates		**East**	**West**
Are gates required for sidewalk?		No	No
Are gates for the sidewalk present?		No	No
Comments:			

D DESIGN CALCULATIONS

10 Design Calculations		East	West
Vehicle clearance Distance (Cd) measured: (m)			
Pedestrian clearance Distance (Cd) measured: (m)			
Vehicle travel distance (S) calculated: (m)			
Departure Time (T_D) calculated: (s)			
Maximum approach grade within "S": (%)			
Grade adjustment factor "G":			
Design vehicle departure time "s" calculated: (s)			
Pedestrian Departure Time (T_P) calculated: (s)			
Departure Time measured: (s)			
Gate arm clearance time calculated: (s)			
Gate arm clearance time measured: (s)			
11 Location of Grade Crossings		**East**	**West**
Are there any intersections along approach to crossing?			
Queuing		**East**	**West**
Distance "D" from stop sign: (m)	min 30		
Distance "D" from traffic signal: (m)	min 60		
Is 'D' insufficient such that road vehicles might queue onto the tracks?			
Can traffic queue from adjacent intersection to within 2.4m of nearest track?			
Can traffic queue from crossing into adjacent intersections?			
Are there any queuing issues that would require traffic preemption?			
Comments:			

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ASSESSMENT DATA

E WARNING SYSTEM DESIGN

12 Warning System Operation - General

Flashing Lights			East	West
Cross buck present with reflective 50mm border?				
Number of tracks sign present and reflective?				
Distance from shoulder to outside of outer signal: (m)	min 1.88			
Distance to nearest rail: (m)	min 3			
Exposed signal foundation from crown of road: (mm)		max 100		
Bottom of lowest signal from crown of road: (m)	min 2.3	max 2.9		
Number of track sign to bottom of lowest signal: (mm)	min 125	max 175		
Cross bucks to top of highest signal: (mm)	min 125	max 175		
Radius of signal backgrounds: (mm)	min 305	max 305		
Distance from centre of signal to centre of mast: (mm)	min 380	max 380		
Condition of signals:				

Gates			East	West
Gate mechanism protrusion: (mm)		max 650		
Gate up protrusion height at edge of signal: (m)	min 5.2			
Gate down height from crown of road: (m)	min 1.1	max 1.4		
Gate tip to centre of mast: (m)		max 11.6		
Gate tip to edge of travelled lane: (m)	min -1	max 1		
Gate tip to tip of other gate: (m)	min 0	max 1		
First signal solid and other signals alternating?				
Gate tip to first gate signal: (mm)	min 355	max 915		
First gate signal to last gate signal: (m)	min 2.74			
Are gate signals equally spaced?				
Gate arm stripe width: (mm)	min 406	max 406		
Gate arm stripes vertical?				
Condition of gates:				

Sidewalk Gates			North	South
Sidewalk width: (m)			N/A	N/A
Gate mechanism protrusion: (mm)		max 650		
Gate up protrusion height at edge of signal: (m)	min 5.2			
Gate down height from crown of road: (m)	min 1.1	max 1.4		
Gate tip to centre of mast: (m)		max 11.6		
Number of lights required:				
Does gate extend full width of sidewalk?				
Are gate signals equally spaced?				
Are gate signals alternating correctly?				
Gate arm stripe width: (mm)	min 406	max 406		
Gate arm stripes vertical?				
Condition of gates:				

Cantilevers			East	West
Height of cantilever from crown of road: (m)	min 5.2	max 6		
Radius of signal backgrounds: (mm)	min 305	max 305		
Condition of mast:				
Condition of signals:				

Crossing Case	
Distance of crossing case to edge of rail (m):	
Distance of crossing case to edge of road (m):	

Comments:

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ASSESSMENT DATA

Equipment

Is data recorder capable of retaining information up to 30 days?	
Is design failsafe?	
Is power out indicator installed and visible from the road?	
Do fouling circuits have at least two discrete conductors?	
Does track circuit detect a 0.06ohm resistance?	
Are non insulated joints properly bonded?	
Do insulated joints provide proper insulation?	
Does battery back-up give 8 hours continuous or 24 hours normal operation?	

Comments:

13 Number and Location of Light Units	East	West
Can front lights be seen from SSD?		
Can front lights be seen along entire approach?		
Can front lights be seen from intersections entering approach?		
Can back lights be seen by all vehicles stopped at crossing?		
Are additional lights required?		
Are additional lights installed?		

Cantilevers		East	West
Distance from centre of signal to edge of travelled lane: (m)	max 7.7		
Distance from second signal to edge of travelled lane: (m)	max 7.8		
Can front light be seen by all vehicles on approach?			
Is roadway classified as an expressway?			
Is a cantilever required?			
Is a cantilever installed?			

Sidewalk		North	South
Centre of warning system to centre of sidewalk: (m)	max 3.6	N/A	
Can at least one set of lights be seen by sidewalk from both sides of rail?		N/A	
Is sidewalk outside island circuit?		*No*	
Additional signal required?			
Are flashing lights for the sidewalk present?			

Comments:

14 Light Units - Alignment			East	West
Are signal alignment requirements available on site?				
Are all units 200mm or 300mm LEDs?			300	300
Light flash rate: (flashes per minute)	min 45	max 65		
Are all lights flashing alternatively and uniformly?				
Are front lights aligned to 1.6m above road at SSD (or when first visible)?				
Are back lights aligned to 1.6m above road at 15m from front lights?				
Are additional lights required for approaches?				
Are additional lights installed and aligned for 1.6m above road surface?				

Sidewalk			North	South
Are all light units 200mm or 300mm LEDs?				200
Light flash rate: (flashes per minute)	min 45	max 65		
Are all lights flashing alternatively and uniformly?				
Are front lights aligned to 1.6m above road at 30m (or when first visible)?				

Comments:

HATCH

ASSESSMENT DATA

15 Bells and Gates

Bells			East	West
Is bell installed on mast?				
Is bell on side with sidewalk?				Yes
Distance from sidewalk to bell mast: (m)		max 30		1
Bell gong rate: (rings per minute)	min 100	max 325		
Does bell ring for as long as warning system is active?				

Gates			East	West
Is gate arm perpendicular to road approach?			*	*
Gate descent delay measured: (s)			*3*	*3*
Does gate arm stop if obstructed?				
Gate arm descent time: (s)	min 10	max 15		
Time to train arrival: (s)	min 0			
Gate ascent time: (s)	min 6	max 12		
Does gate arm descend smoothly and without rebound?				
Does gate arm return to proper position after clearance of obstruction?				

Comments:

*Gate for southbound left turn lane to Eastbound across track is parallel with track and does not substantially block the lane. (Not perpendicular to road).

16 Circuitry

Required warning time: (s)	*20.00*
Measured or recorded warning time: (s)	25 - 30
Are crossing warning times consistent?	Yes
Are warning times less than 13s more than required?	
Are cut-out circuits installed, if required?	
Type of crossing equipment:	
Are directional stick circuits installed?	
Does stick have release timer or restrict train speeds through signaling?	
Are all wires properly tagged and clear?	

Comments:

17 Inspection and Testing - Warning Systems

Are plans available at location and up to date?	
Is there proof of testing at periods defined in GCS?	

Comments:

F INTERCONNECTED DEVICES

18 Prepare to Stop at Railway Crossing Sign

	East	West
Is SSD restricted such that a prepared to stop at railway sign is required?		
Is prepare to stop sign installed?		
Can the prepare to stop sign be seen from SSD?		
Do prepare to stop flashers activate with enough preemption?		
Does battery back-up allow Prepare to Stop sign to operate for up to 4 hours?		

19 Interconnection of Traffic Signals

	East	West
Is intersection within 30m of crossing?		
Are there any queuing issues that would require traffic preemption?		
Is interconnection installed?		
Does interconnection allow vehicles to clear the grade crossing?		
Does interconnection prevent vehicles from entering crossing?		
Does battery back-up allow traffic signals to operate for up to 4 hours?		

HATCH

ASSESSMENT DATA

20 Interconnected Devices - Inspection and Testing

Is there proof of testing of interconnected devices as defined in GCS?

Comments:

APPENDIX D - WHISTLE CESSATION

	East	West
Is SSD adequate?		
Are sightlines along track greater than 400m in both directions?		
Type of crossing warning system:	*Active: FLB & G*	
Number of tracks:	*2*	
Railway speed: (mph)		
Is crossing warning system adequate for whistle cessation?		
Is whistling required at crossing?		
Is whistling used at crossing?		

Comments:

ADDITIONAL COMMENTS

Comments:

No crossbuck or 2 tracks sign visible for westbound pedestrians while in crosswalk.

Westward pedestrians must cross four lanes before getting to track and there is no refuge point until after crossing both tracks. Could be issue for small children and people with disabilities.

Interconnection with traffic signals not studied. No conflict between crossing warning system and traffic signals were observed while at the crossing.

HATCH

SITE PHOTOS

12th Ave Looking East - 1

12th Ave Looking East - 2

12th Ave Looking East - 3

12th Ave Looking East - 4

12th Ave Looking NE in Refuge

12th Ave Looking North - 1

HATCH

SITE PHOTOS

12th Ave Looking North - 2

12th Ave Looking North - 3

12th Ave Looking Northeast

12th Ave Looking Northwest

12th Ave Looking South - 1

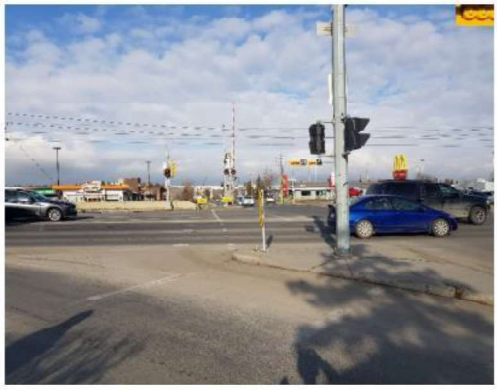
12th Ave Looking South - 2

HATCH

SITE PHOTOS

12th Ave Looking South - 3

12th Ave Looking West - 1



12th Ave Looking West - 2

12th Ave Refuge PBs

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12.7 7 Ave S at 3 St SE Mixed Crossing

HATCH

Calgary Transit
7Ave 3rd Street SE, Calgary, Alberta

Crossing Safety Assessment

Issue and Revision Record					
Rev	**Date**	**Originator**	**Checker**	**Approver**	**Description**
0	2019-05-02	Jenny Xing	Andy Hamel	Dale Hein	Final

The safety assessment of this grade crossing covers physical features which may affect road and rail user safety and it has sought to identify potential safety hazards. However, the auditors point out that no guarantee is made that every deficiency has been identified. Further, if all the recommendations in this assessment were addressed, this would not confirm that the crossing is 'safe'; rather, adoption of the recommendations should improve the level of safety of the facility.

HATCH

1. Summary

A safety assessment of the grade crossing located at 7Ave 3rd Street SE in Calgary, Alberta (Red and Blue Line subdivision) was undertaken on May 02, 2019. Data on site was acquired by Jenny Xing and the assessment of the information provided was performed by Andy Hamel.

For the purposes of this report, 7Ave 3rd Street SE crossing is described in a North/South orientation, while the rail line is described in an East/West orientation. The crossing is equipped with a passive crossing equipped with stop signs.

2. Purpose

The Fundamental objectives of this assessment are:

1. Identify opportunities to reduce collision risk within the grade crossing environment.
2. Identify opportunities to minimize the frequency and severity of preventable crashes.
3. Consider the safety of all grade crossing users.
4. Verify compliance of the Grade Crossings Standards (GCS, dated July 2014) referred to in the most recent Grade Crossings Regulations (GCR, SOR 2014-275, November 28, 2014).
5. Ensure that all the crash mitigation measures/factors aimed to eliminate or reduce the identified safety problems are fully considered, evaluated and documented for review/action by the appropriate authorities.

3. Site Sketch

A site sketch is included to provide an aerial perspective of the layout for the crossing, which identifies the railway and roadway on appraoch to the grade crossing location. It identifies key components and considerations that impact the safety of the crossing which may include obstructions, signage, crossing infrastructure, and surrounding land use.

4. Assesment Data

The assessment data is provided in pages 4 to 11. Assessment questions are presented to reflect all requirements in the GCS for both passive and active warning systems. Assessment data not within compliance of the GCS is highlighted red for quick reference. Assessment data that is not applicable to the crossing is filled with N/A. Items not within compliance with the GCS are summarized following the assessment data along with suggested actions for remediation.

5. Recommendations

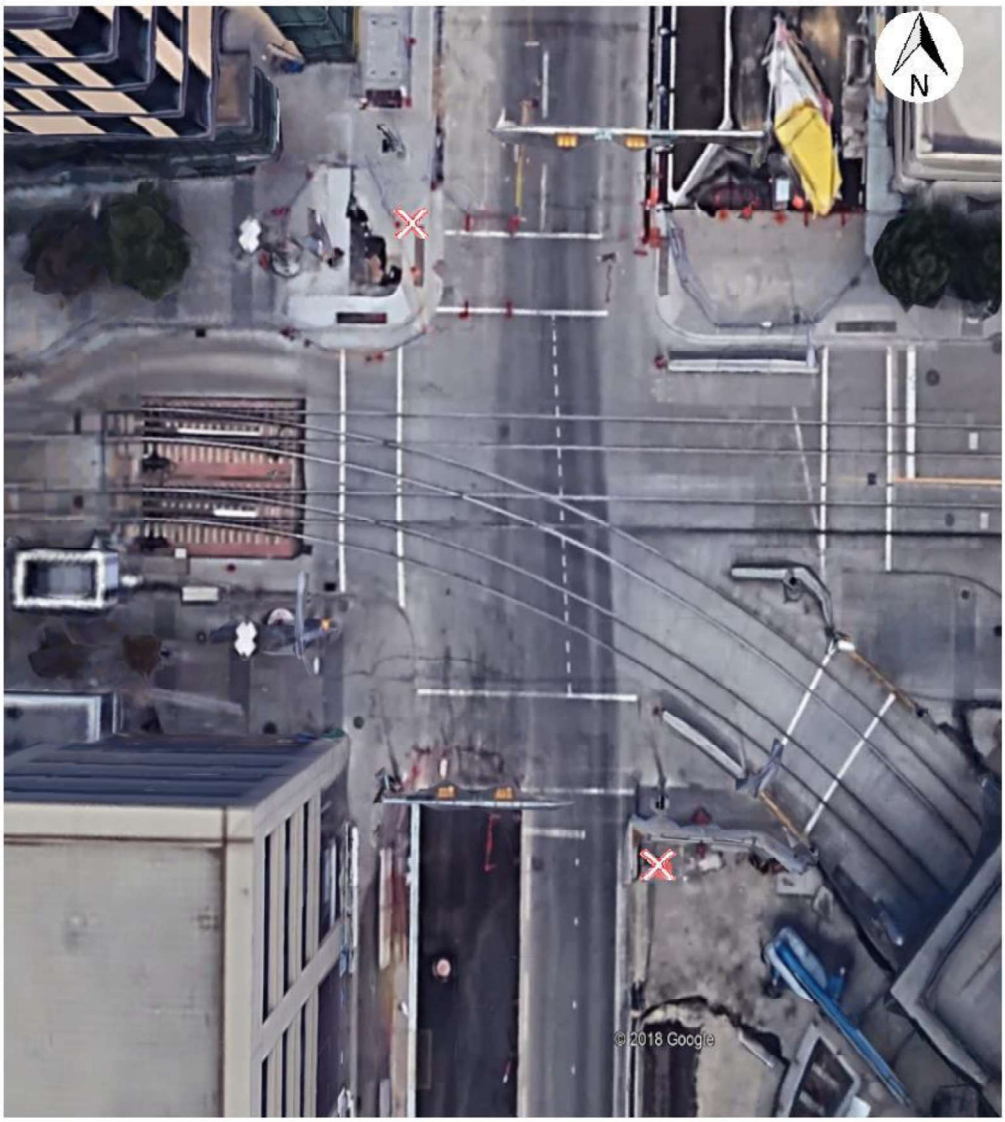
Following the report generated from site, items that do not comply with the Transport Canada's Grade Crossing Standards and Regulations are itemized in a summary table with suggested actions for remediation, if required. Responsibilities for remediation are identified in the adjacent column as per the GCR, where applicable.

6. Site Photos

In order to highlight conditions on site, photographs are included at the end of the report. The pictures are meant to highlight considerations of the report and may include items such as sightlines, signage, warning system equipment, road markings, road condition, rail condition, and site documentation.

HATCH

SITE SKETCH



Road Measurement Sketch

HATCH

ASSESSMENT DATA

Assessor Information

Data acquisition by:	Jenny Xing
Crossing assessment by:	Andy Hamel
Date of site visit:	2019-05-02
Comments:	

Railway Company Information

Railway company:	Calgary Transit
Location Chainage:	
Subdivision:	Red and Blue Line
Rail orientation:	East/West
Number of tracks:	2
Can railway equipment pass each other at the crossing?	Yes
Average annual daily train traffic: (AADT)	400
Freight train design speed: (mph)	
Passenger train design speed: (mph)	
Type of crossing warning system:	X Sign & Traffic Signals
Is whistling used at crossing?	N/A
Class of track:	*CLASS 1*
Comments:	

Road Authority Information

Road authority:	City of Calgary
Street name:	7Ave 3rd Street SE
Municipality:	Calgary
Province/Territory:	Alberta
Design vehicle:	
Design Vehicle Length: (m)	*6*
Average annual daily road traffic: (AADT)	NA
Public or private road?	Public
Urban or rural?	Urban
Local, collector, arterial, expressway, or freeway?	Arterial
Divided or undivided?	Undivided
Crossing cross angle: (degrees)	

Crossing Approaches	**North**	**South**
Road crossing design speed: (km/h)	50	50
Number of traffic lanes:	2	2
Traffic lane width: (m)		
Traffic lane width including shoulders: (m)		
Average grade of road approach:		
Stopping sight distance (SSD):	*65*	*65*
Vehicle departure time: (calculated)	*0.00*	*0.00*
Prepare to Stop required activation time:		
Interconnection delay timing:		

Sidewalk	**East**	**West**
Sidewalk present?	Yes	Yes
Is sidewalk designated for persons using assistive devices?	Yes	Yes

Comments:

West lane under construction

HATCH

ASSESSMENT DATA

C NEW STANDARDS

5 Crossing Surface			East	West
Road extensions off of the travelled way: (m)	min 0.5			
East sidewalk extensions of the travelled way: (m)	min 0.5			
West sidewalk extensions of the travelled way: (m)	min 0.5			
Is crossing surface smooth and continuous?				
Flangeway			**Min**	**Max**
Flangeway width: (mm)	min 65	max 75		
Flangeway depth: (mm)	min 50	max 75		
Flangeway field side width: (mm)		max 0		
Flangeway field side depth: (mm)		max 0		
Top of rail to road crossing surface: (mm)	min -7	max 13		
Comments:				

6 Road Geometry			North	South
East slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
West slope within 5m of the nearest rail at a sidewalk or path: (%)		max 2%		
Slope within 8m of the nearest rail: (%)		max 2%		
Slope between 8m and 18m of the nearest rail: (%)	max_1 5%	max_2 10%		
What is allowable percentage grade slope through crossing?				
What is the grade slope through the crossing?				
Is grade slope through crossing less than limit?				
Are horizontal and vertical alignments smooth and continuous on approach?				
Width of travelled way on each approach: (m)				
Width of travelled way at crossing: (m)				
Width through the crossing greater than approach?				
Does the travelled way have curbs?				
Grade crossing angle: (degrees)	min 0	max 180		
Comments:				

7 Sightlines	North	South
SSD calculated: (m)		
SSD measured: (m)		
D_{SSD} calculated: (m)	*0*	*0*
D_{SSD} driver's left measured: (m)		
D_{SSD} driver's right measured: (m)		
$D_{stopped}$ calculated: (m)		
$D_{stopped}$ driver's left measured: (m)		
$D_{stopped}$ driver's right measured: (m)		
$D_{stopped}$ pedestrian's left measured: (m)		
$D_{stopped}$ pedestrian's right measured: (m)		
Are there any obstacles to driver's left that may affect visibility?		
Are there any obstacles to driver's right that may affect visibility?		
Is there any vegetation to driver's left that may affect visibility?		
Is there any vegetation to driver's right that may affect visibility?		
Is visibility along track impaired due to angle of crossing?		
Comments:		

HATCH

ASSESSMENT DATA

8 Signs & Pavement Markings

			North	South
Crossing Sign(s)				
Railway crossing sign present with reflective 50mm border?				
Number of tracks sign present and reflective?				
Height of cross buck from crown of road: (m)	min 1.5	max 2.5		
Is 100mm retroreflective strip on back of each blade?				
Distance of strip from crown of road: (mm)		max 300		
Distance of strip from top of cross buck: (mm)	min 70	max 70		
Crossing sign distance from shoulder: (m)	min 2	max 4.5		
Distance to nearest rail: (m)	min 3			
50mm strip on front post?				
Is sign post made of material such that if struck by a vehicle it will break?				
Condition of sign:				
Railway Crossing Ahead Sign and Advisory Speed Tab			North	South
Are vehicles required to slow prior to crossing due to shorter SSD?				
Is sign present upon approach?				
Is sign visible from SSD as defined by road speed?				
Is sign showing correct road orientation?				
Is Advisory Speed tab installed and correct?				
Advisory Speed: (km/h)				
Adjusted SSD: (m)				
Condition of sign:				
Stop Sign Ahead Sign			North	South
Stop sign ahead sign required?				
Stop sign ahead sign installed?				
Stop Sign visible from SSD at design road speed?				
Condition of sign:				
Stop Sign			North	South
Is D_{SSD} insufficient to warrant a stop sign?				
Is stop sign installed?				
Size of stop sign?				
Distance from crown of road to bottom of sign: (m)	min 1.8			
Distance from top of sign to centre of crossing sign: (m)	min 0.5	max 0.5		
Condition of sign:				
Emergency Notification Sign				
Is Emergency Notification Sign Present?				
Does Emergency Notification Sign contain all information?				
Can Emergency Notification Sign(s) be seen from both approach?				
Condition of sign:				
Stop Bars			North	South
Are stop bars able to be painted on approach?				
Are stop bars present?				
Distance from nearest rail (m):	min 5.0			
Distance from nearest signal (m):	min 2.0			
Condition of markings:				
'X' Markings			North	South
Is 'X' marking able to be painted on approach?				
Is X marking present?				
Condition of markings:				
Comments:				

Page 7 of 16

HATCH

ASSESSMENT DATA

9 Warning Systems Specification

Traffic volume cross product:		
Railway speed: (mph)		
Is there a sidewalk present?		
Number of tracks:		
Is there an intersection within a distance 'D" from the crossing?		
Flashing Lights and Bells		
Additional condition requires warning system?		
Lights and bells required?		
Are flashing lights and bells present?		
Gates		
Additional condition requires gates?		
Gates required?		
Are gates present?		
Sidewalk Flashing Lights	**North**	**South**
Is sidewalk outside island circuit?		
Additional lights required for sidewalk?		
Are flashing lights for the sidewalk present?		
Sidewalk Gates	**North**	**South**
Are gates required for sidewalk?		
Are gates for the sidewalk present?		
Comments:		

D DESIGN CALCULATIONS

10 Design Calculations	**North**	**South**
Vehicle clearance Distance (Cd) measured: (m)		
Pedestrian clearance Distance (Cd) measured: (m)		
Vehicle travel distance (S) calculated: (m)		
Departure Time (T_D) calculated: (s)		
Maximum approach grade within "S": (%)		
Grade adjustment factor "G":		
Design vehicle departure time "s" calculated: (s)		
Pedestrian Departure Time (T_P) calculated: (s)		
Departure Time measured: (s)		
Gate arm clearance time calculated: (s)		
Gate arm clearance time measured: (s)		
11 Location of Grade Crossings	**North**	**South**
Are there any intersections along approach to crossing?		
Queuing	**North**	**South**
Distance "D" from stop sign: (m) min 30		
Distance "D" from traffic signal: (m) min 60		
Is 'D' insufficient such that road vehicles might queue onto the tracks?		
Can traffic queue from adjacent intersection to within 2.4m of nearest track?		
Can traffic queue from crossing into adjacent intersections?		
Are there any queuing issues that would require traffic preemption?		
Comments:		

HATCH

ASSESSMENT DATA

E WARNING SYSTEM DESIGN

12 Warning System Operation - General

Flashing Lights			North	South
Cross buck present with reflective 50mm border?				
Number of tracks sign present and reflective?				
Distance from shoulder to outside of outer signal: (m)	min 1.88			
Distance to nearest rail: (m)	min 3			
Exposed signal foundation from crown of road: (mm)		max 100		
Bottom of lowest signal from crown of road: (m)	min 2.3	max 2.9		
Number of track sign to bottom of lowest signal: (mm)	min 125	max 175		
Cross bucks to top of highest signal: (mm)	min 125	max 175		
Radius of signal backgrounds: (mm)	min 305	max 305		
Distance from centre of signal to centre of mast: (mm)	min 380	max 380		
Condition of signals:				

Gates			North	South
Gate mechanism protrusion: (mm)		max 650		
Gate up protrusion height at edge of signal: (m)	min 5.2			
Gate down height from crown of road: (m)	min 1.1	max 1.4		
Gate tip to centre of mast: (m)		max 11.6		
Gate tip to edge of travelled lane: (m)	min -1	max 1		
Gate tip to tip of other gate: (m)	min 0	max 1		
First signal solid and other signals alternating?				
Gate tip to first gate signal: (mm)	min 355	max 915		
First gate signal to last gate signal: (m)	min 2.74			
Are gate signals equally spaced?				
Gate arm stripe width: (mm)	min 406	max 406		
Gate arm stripes vertical?				
Condition of gates:				

Sidewalk Gates			East	West
Sidewalk width: (m)				
Gate mechanism protrusion: (mm)		max 650		
Gate up protrusion height at edge of signal: (m)	min 5.2			
Gate down height from crown of road: (m)	min 1.1	max 1.4		
Gate tip to centre of mast: (m)		max 11.6		
Number of lights required:				
Does gate extend full width of sidewalk?				
Are gate signals equally spaced?				
Are gate signals alternating correctly?				
Gate arm stripe width: (mm)	min 406	max 406		
Gate arm stripes vertical?				
Condition of gates:				

Cantilevers			North	South
Height of cantilever from crown of road: (m)	min 5.2	max 6		
Radius of signal backgrounds: (mm)	min 305	max 305		
Condition of mast:				
Condition of signals:				

Crossing Case	
Distance of crossing case to edge of rail (m):	
Distance of crossing case to edge of road (m):	

Comments:

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HATCH

ASSESSMENT DATA

Equipment

Is data recorder capable of retaining information up to 30 days?	
Is design failsafe?	
Is power out indicator installed and visible from the road?	
Do fouling circuits have at least two discrete conductors?	
Does track circuit detect a 0.06ohm resistance?	
Are non insulated joints properly bonded?	
Do insulated joints provide proper insulation?	
Does battery back-up give 8 hours continuous or 24 hours normal operation?	

Comments:

13 Number and Location of Light Units	North	South
Can front lights be seen from SSD?		
Can front lights be seen along entire approach?		
Can front lights be seen from intersections entering approach?		
Can back lights be seen by all vehicles stopped at crossing?		
Are additional lights required?		
Are additional lights installed?		

Cantilevers		North	South
Distance from centre of signal to edge of travelled lane: (m)	max 7.7		
Distance from second signal to edge of travelled lane: (m)	max 7.8		
Can front light be seen by all vehicles on approach?			
Is roadway classified as an expressway?			
Is a cantilever required?			
Is a cantilever installed?			

Sidewalk		East	West
Centre of warning system to centre of sidewalk: (m)	max 3.6		
Can at least one set of lights be seen by sidewalk from both sides of rail?			
Is sidewalk outside island circuit?			
Additional signal required?			
Are flashing lights for the sidewalk present?			

Comments:

14 Light Units - Alignment			North	South
Are signal alignment requirements available on site?				
Are all units 200mm or 300mm LEDs?				
Light flash rate: (flashes per minute)	min 45	max 65		
Are all lights flashing alternatively and uniformly?				
Are front lights aligned to 1.6m above road at SSD (or when first visible)?				
Are back lights aligned to 1.6m above road at 15m from front lights?				
Are additional lights required for approaches?				
Are additional lights installed and aligned for 1.6m above road surface?				

Sidewalk			East	West
Are all light units 200mm or 300mm LEDs?				
Light flash rate: (flashes per minute)	min 45	max 65		
Are all lights flashing alternatively and uniformly?				
Are front lights aligned to 1.6m above road at 30m (or when first visible)?				

Comments:

HATCH

ASSESSMENT DATA

15 Bells and Gates

Bells			North	South
Is bell installed on mast?				
Is bell on side with sidewalk?				
Distance from sidewalk to bell mast: (m)		max 30		
Bell gong rate: (rings per minute)	min 100	max 325		
Does bell ring for as long as warning system is active?				

Gates			North	South
Is gate arm perpendicular to road approach?				
Gate descent delay measured: (s)				
Does gate arm stop if obstructed?				
Gate arm descent time: (s)	min 10	max 15		
Time to train arrival: (s)	min 0			
Gate ascent time: (s)	min 6	max 12		
Does gate arm descend smoothly and without rebound?				
Does gate arm return to proper position after clearance of obstruction?				

Comments:

16 Circuitry

Required warning time: (s)	
Measured or recorded warning time: (s)	
Are crossing warning times consistent?	
Are warning times less than 13s more than required?	
Are cut-out circuits installed, if required?	
Type of crossing equipment:	
Are directional stick circuits installed?	
Does stick have release timer or restrict train speeds through signaling?	
Are all wires properly tagged and clear?	

Comments:

17 Inspection and Testing - Warning Systems

Are plans available at location and up to date?	
Is there proof of testing at periods defined in GCS?	

Comments:

F INTERCONNECTED DEVICES

18 Prepare to Stop at Railway Crossing Sign	North	South
Is SSD restricted such that a prepared to stop at railway sign is required?		
Is prepare to stop sign installed?		
Can the prepare to stop sign be seen from SSD?		
Do prepare to stop flashers activate with enough preemption?		
Does battery back-up allow Prepare to Stop sign to operate for up to 4 hours?		

19 Interconnection of Traffic Signals	North	South
Is intersection within 30m of crossing?		
Are there any queuing issues that would require traffic preemption?		
Is interconnection installed?		
Does interconnection allow vehicles to clear the grade crossing?		
Does interconnection prevent vehicles from entering crossing?		
Does battery back-up allow traffic signals to operate for up to 4 hours?		

HATCH

ASSESSMENT DATA

20 Interconnected Devices - Inspection and Testing

Is there proof of testing of interconnected devices as defined in GCS?

Comments:

APPENDIX D - WHISTLE CESSATION

	North	South
Is SSD adequate?		
Are sightlines along track greater than 400m in both directions?		
Type of crossing warning system:	*X Sign & Traffic Signals*	
Number of tracks:	*2*	
Railway speed: (mph)		
Is crossing warning system adequate for whistle cessation?		
Is whistling required at crossing?		
Is whistling used at crossing?		

Comments:

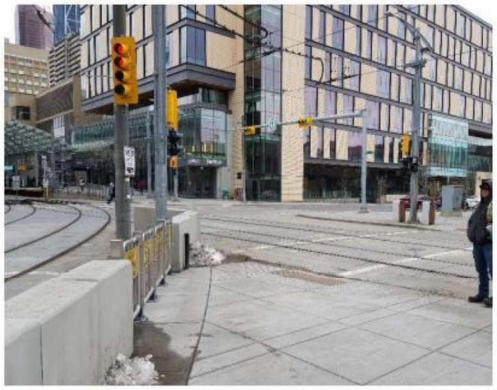
ADDITIONAL COMMENTS

Comments:

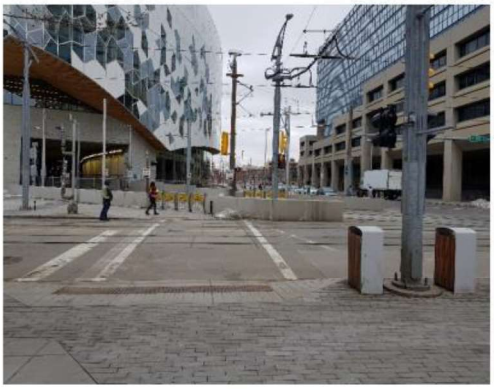
HATCH

SITE PHOTOS

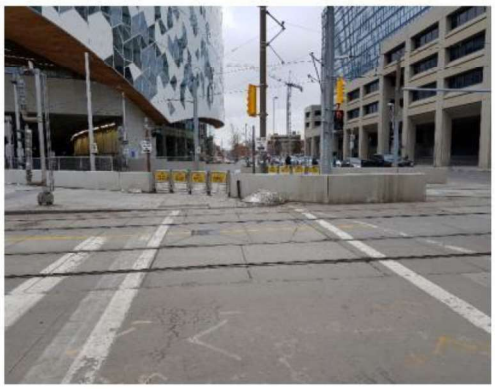
3rd St E Ped xing looking NW



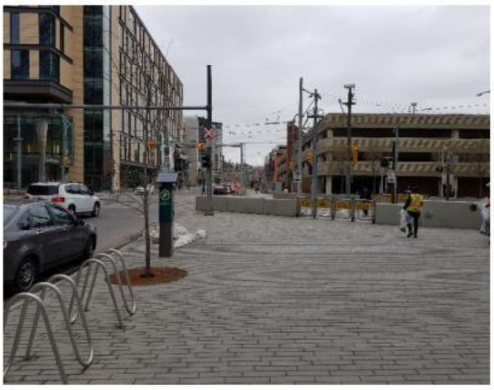
3rd St E Ped xing looking S



3rd St E Ped xing looking S - 2



3rd St E(E) looking N



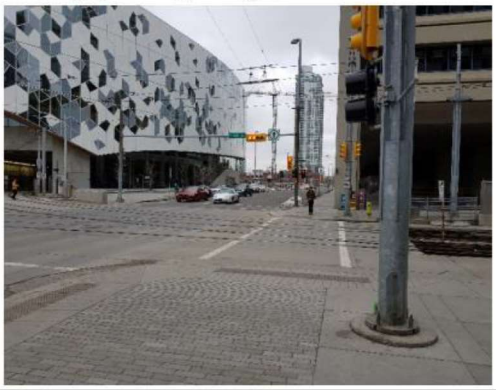
3rd St E(W) Ped xing looking N

3rd St E(W) Ped xing looking S

HATCH

SITE PHOTOS

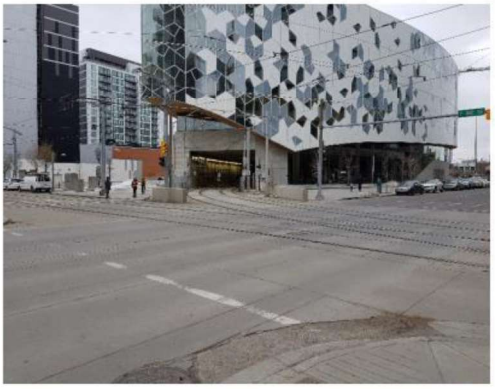
3rd St E(W) Ped xing looking S - 2



3rd St intersection looking NE

3rd St intersection looking NW

3rd St intersection looking SE



3rd St looking N

3rd St looking N - 2

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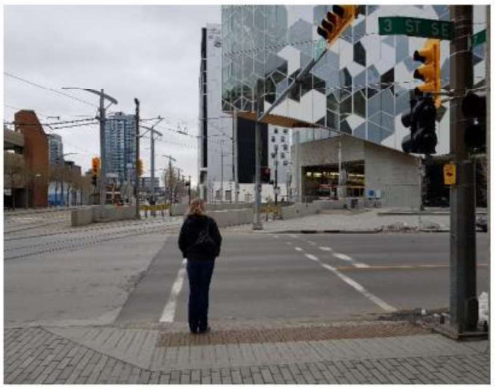
HATCH

SITE PHOTOS

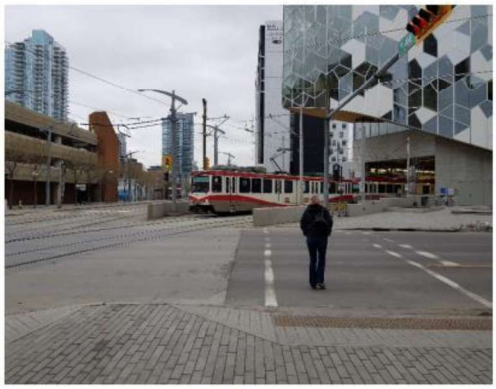
3rd St looking NE

3rd St Xwalk(N) looking W

3rd St Xwalk(S) looking E

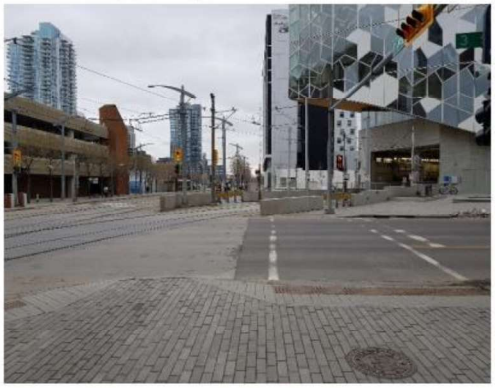


3rd St Xwalk(S) looking E - 2



3rd St Xwalk(S) looking E - 3

3rd St Xwalk(S) looking E - 4



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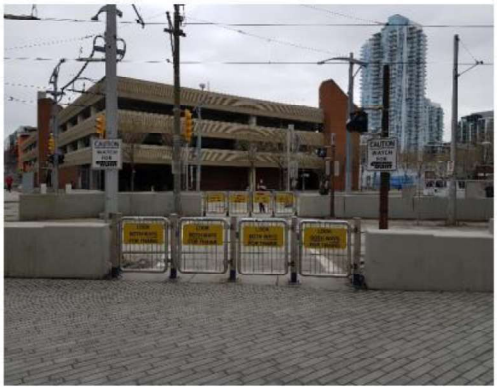
HATCH

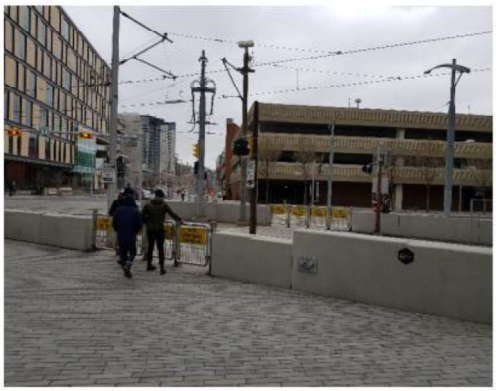
SITE PHOTOS

Library Ped xing looking W

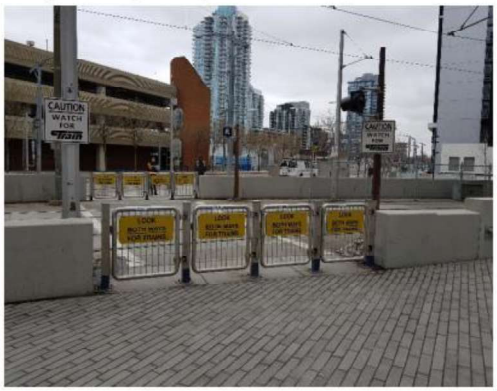
Library Ped xing looking N



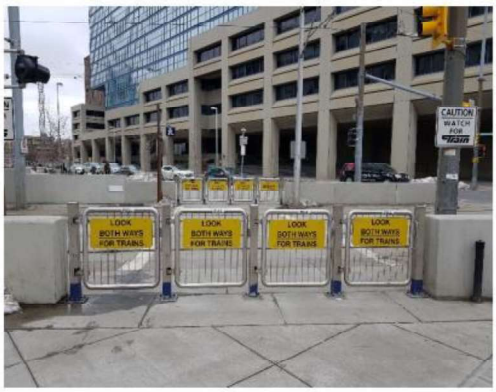
Library Ped xing looking N - 2



Library Ped xing looking NE



Library Ped xing looking SW



West side of 4th St looking N

Appendix B: Calgary Transit Crossing Inventory

13.

Line	Location	Crossing Type	Territory	Flashing Lights	Bells	Ped-X			Road Automatic Gate Arms	2nd Train Light and Associated Signage
						Bedsteads	Swing Gates	Automatic Gate Arms (incl. Emergency Swing Gate)		
Red Line S	3 St SE	PED-X	LRT ROW	Yes	Yes		Yes			
Red Line S	Erlton Stampede Station	PED-X	LRT ROW	Yes	Yes	Yes				
Red Line S	25 Av SE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Red Line S	36 Av SE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Red Line S	39 Av SE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Red Line S	50 Av SE	MIXED	CP ROW	Yes	Yes	Yes			Yes	
Red Line S	58 Av SE	MIXED	CP ROW	Yes	Yes	Yes			Yes	
Red Line S	61 Av SE	MIXED	CP ROW	Yes	Yes	Yes			Yes	
Red Line S	Chinook Station	PED-X	LRT ROW	Yes	Yes			Yes		
Red Line S	Heritage Dr SE	MIXED	CP ROW	Yes	Yes	Yes			Yes	
Red Line S	Heritage Station	PED-X	LRT ROW	Yes	Yes	Yes				
Red Line S	Southland Station	PED-X	LRT ROW	Yes	Yes	Yes				
Red Line S	Anderson Station	PED-X	CP ROW	Yes	Yes			Yes		
Red Line S	Anderson Station Wy SE	ROAD	CP ROW	Yes	Yes				Yes	
Red Line S	Fish Creek Lacombe Station	PED-X	LRT ROW	Yes	Yes	Yes				
Red Line S	James McKevitt Rd SW	ROAD	CP ROW	Yes	Yes				Yes	
Red Line S	Shawnessy Station	PED-X	LRT ROW	Yes	Yes		Yes	Yes		
Red Line S	162 Av SW	MIXED	CP ROW	Yes	Yes	Yes			Yes	
Red Line S	Somerset Station North	PED-X	CP ROW	Yes	Yes			Yes		
Red Line S	Somerset Station South - East	PED-X	CP ROW	Yes	Yes			Yes		
Red Line S	Somerset Station South - West	PED-X	LRT ROW	Yes	Yes			Yes		

Line	Location	Crossing Type	Territory	Flashing Lights	Bells	Ped-X			Road Automatic Gate Arms	2nd Train Light and Associated Signage
						Bedsteads	Swing Gates	Automatic Gate Arms (incl. Emergency Swing Gate)		
Red Line S	Shawville Gate	MIXED	CP ROW	Yes	Yes	Yes			Yes	
Blue Line NE	7 Av/4 St SE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Blue Line NE	6 Av SE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Blue Line NE	Deerfoot Tr SE	ROAD	LRT ROW	Yes	Yes				Yes	
Blue Line NE	28 St. SE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Blue Line NE	4 Av NE	ROAD	LRT ROW	Yes	Yes				Yes	
Blue Line NE	5 Av NE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Blue Line NE	8 Av NE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Blue Line NE	12 Av NE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Blue Line NE	16 Av NE	ROAD	LRT ROW	Yes	Yes				Yes	
Blue Line NE	16 Av NE	ROAD	LRT ROW	Yes	Yes				Yes	
Blue Line NE	20 Av NE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Blue Line NE	26 Av NE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Blue Line NE	32 Av NE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Blue Line NE	Whitehorn Station	PED-X	LRT ROW	Yes	Yes	Yes				
Blue Line NE	Whitehorn Drive	ROAD	LRT ROW	Yes	Yes				Yes	
Blue Line NE	39 Av NE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Blue Line NE	44 Av NE	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Blue Line NE	McKnight Westwind Station	PED-X	LRT ROW	Yes	Yes		Yes			
Blue Line NE	Martindale Bv NE (south leg)	MIXED	LRT ROW	Yes	Yes		Yes		Yes	
Blue Line NE	Martindale Bv NE (north leg)	MIXED	LRT ROW	Yes	Yes			Yes	Yes	
Blue Line NE	Saddletowne Circle NE (south leg)	MIXED	LRT ROW	Yes	Yes		Yes		Yes	
Blue Line NE	Saddletowne Station South	PED-X	LRT ROW	Yes	Yes		Yes			

Line	Location	Crossing Type	Territory	Flashing Lights	Bells	Ped-X			Road Automatic Gate Arms	2nd Train Light and Associated Signage
						Bedsteads	Swing Gates	Automatic Gate Arms (incl. Emergency Swing Gate)		
Blue Line NE	Saddletowne Station North	PED-X	LRT ROW	Yes	Yes		Yes			
Blue Line NE	Saddletowne Circle NE (north leg)	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Red Line NW	7 Av SW	PED-X	In-Street Operations	Yes	Yes	Yes				
Red Line NW	6 Av SW	MIXED	In-Street Operations	Yes	No	Yes				
Red Line NW	5 Av SW	MIXED	In-Street Operations	Yes	Yes	Yes			Yes	
Red Line NW	4 Av SW	MIXED	In-Street Operations	Yes	Yes	Yes				
Red Line NW	2 Av NW	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Red Line NW	Sunnyside Station South	PED-X	LRT ROW	Yes	Yes		Yes			Yes
Red Line NW	Sunnyside Station North	PED-X	LRT ROW	Yes	Yes		Yes			Yes
Red Line NW	4 Av NW	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Red Line NW	SAIT Campus	PED-X	LRT ROW	Yes	Yes	Yes				Yes
Red Line NW	SAIT/ACA/Jubilee Station	PED-X	LRT ROW	Yes	Yes		Yes			
Red Line NW	Jubilee Cr NW	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Red Line NW	14 St NW (east leg)	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Red Line NW	14 St NW (west leg)	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Red Line NW	Lions Park Station East	PED-X	LRT ROW	Yes	Yes	Yes				

Line	Location	Crossing Type	Territory	Flashing Lights	Bells	Ped-X			Road Automatic Gate Arms	2nd Train Light and Associated Signage
						Bedsteads	Swing Gates	Automatic Gate Arms (incl. Emergency Swing Gate)		
Red Line NW	Lions Park Station West	PED-X	LRT ROW	Yes	Yes		Yes			
Red Line NW	14 Av NW	MIXED	LRT ROW	Yes	Yes	Yes			Yes	
Red Line NW	Banff Trail Station	PED-X	LRT ROW	Yes	Yes			Yes		
Blue Line W	11 St SW	MIXED	LRT ROW	Yes	Yes			Yes	Yes	
Blue Line W	26 St SW	ROAD	LRT ROW	Yes	No				Yes	
Blue Line W	Shagnappi Station	PED-X	LRT ROW	Yes	Yes			Yes		
Blue Line W	47 St SW	ROAD	LRT ROW	Yes	No				Yes	
Blue Line W	45 St SW Station (47 St SW east)	PED-X	LRT ROW	Yes	Yes			Yes		
Blue Line W	47 ST SW (west)	PED-X	LRT ROW	Yes	Yes			Yes		
Blue Line W	Sarcee Tr SW	ROAD	LRT ROW	Yes	No				Yes	
Blue Line W	Sarcee Tr Greenway (Pathway)	PED-X	LRT ROW	Yes	Yes			Yes		
Blue Line W	Sirocco Station (Costello Bv SW east)	PED-X	LRT ROW	Yes	Yes			Yes		
Blue Line W	Costello Bv SW	ROAD	LRT ROW	Yes	No				Yes	
Blue Line W	Costello Bv SW (west)	PED-X	LRT ROW	Yes	Yes			Yes		
Blue Line W	Christie Park Ga SW (east)	PED-X	LRT ROW	Yes	Yes			Yes		
Blue Line W	Christie Park Ga SW	ROAD	LRT ROW	Yes	No				Yes	
Blue Line W	Christie Park Ga SW (west)	PED-X	LRT ROW	Yes	Yes			Yes		
7 Avenue S	3 St SE	MIXED	In-Street Operations	Yes	Yes					
7 Avenue S	3 St SE	PED-X	In-Street Operations	Yes	Yes		Yes			
7 Avenue S	Macleod Tr SE	MIXED	In-Street Operations	No	No					

Line	Location	Crossing Type	Territory	Flashing Lights	Bells	Ped-X			Road Automatic Gate Arms	2nd Train Light and Associated Signage
						Bedsteads	Swing Gates	Automatic Gate Arms (incl. Emergency Swing Gate)		
7 Avenue S	1 St SE	MIXED	In-Street Operations	No	No					
7 Avenue S	Centre St S	MIXED	In-Street Operations	No	No					
7 Avenue S	1 St SW	MIXED	In-Street Operations	No	No					
7 Avenue S	2 St SW	MIXED	In-Street Operations	No	No					
7 Avenue S	3 St SW	MIXED	In-Street Operations	No	No					
7 Avenue S	4 St SW	MIXED	In-Street Operations	No	No					
7 Avenue S	5 St SW	MIXED	In-Street Operations	No	No					
7 Avenue S	6 St SW	MIXED	In-Street Operations	No	No					
7 Avenue S	7 St SW	MIXED	In-Street Operations	No	No					
7 Avenue S	8 St SW	MIXED	In-Street Operations	No	No					
7 Avenue S	9 St SW	MIXED	In-Street Operations	No	No					
7 Avenue S	10 St SW	MIXED	In-Street Operations	No	No					