

INSURANCE CORPORATION OF BRITISH COLUMBIA



**INTERSECTION SAFETY MASTER PLAN:
INTEGRATED CORRIDOR PLAN -
TRANQUILLE/FORTUNE CORRIDOR**

KAMLOOPS, BRITISH COLUMBIA

**Engineering and
Planning Consultants**



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Quality Assured*

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1.0 INTRODUCTION

1.1 Background

The 2003 Safer Cities Program is an initiative of the Insurance Corporation of British Columbia (ICBC) to develop a holistic plan to proactively improve safety within communities by targeting various locations for 3E (engineering, education, and enforcement) solutions to road safety issues. The program includes an extensive process of consultation with stakeholders, such as municipalities, local police, and school districts and is under way at several locations throughout the province, including the City of Kamloops.

As part of the Integrated Corridor Plan, a section of the Safer Cities Program, in-service safety reviews were performed along the Tranquille/Fortune corridor within the City of Kamloops. The sites were selected by both City and Hamilton Associates staff. This report summarizes the findings of the in-service review on the Tranquille/Fortune Corridor.

1.2 Study Objectives

The overall objective of this study is to identify corridor-wide road safety issues at intersections. The results can also be used to identify typical community-wide safety issues. The stakeholders can then use the summary to identify locations where improvements can be immediately implemented or to identify issues that can be addressed on a corridor-wide basis.

Potential solutions were also identified for any noted issues at each of the study locations. However, it is important to note that these solutions are based on the site reviews only. More detailed reviews of the collision history and traffic operations may be required to confirm the required safety improvements.

1.3 Study Locations

The Tranquille/Fortune corridor study limits are between the Airport access and the Overlander Bridge, as shown in FIGURE 1.1. The study corridor length is approximately nine kilometres.

The study corridor is classified as an arterial roadway that connects the central business district and the North Shore area of Kamloops. The corridor between the Overlander Bridge and Southill Street generally has an urban four-lane cross-section, with left turn bays at some intersections. West of Southill Street, Tranquille Road is a two-lane roadway without sidewalks or curbs. Numerous driveways to residential and commercial properties are located along the corridor. The Tranquille/Fortune corridor is classified as a dangerous goods truck route. Tranquille Road west of 12th Street is part of the cycling network outlined in the City's Master Bicycle Plan.

According to information provided on the City of Kamloops web site, in 1999 traffic volumes along the corridor ranged from 32,000 vehicles per day on Fortune Drive between Larch Avenue and the Overlander Bridge, 21,000 vehicles per day between 7th and 8th Streets, to 18,000 vehicles per day on Tranquille Road between Singh Street and Holt Street. Peak hour volumes were 3,100 vehicles at 8th Street, 1,600 at Singh Street, and 1,100 at Southill Street. The peak hour occurred between 1615 and 1715 hours.

The corridor has 54 intersections along its length. Many of these are unsignalized T-intersections. Five intersections and one horizontal curve (near the airport) were reviewed in detail as part of this study. The annual collision frequency at major cross-streets along the study corridor is summarized in TABLE 1.1. Traffic control devices and the cross street classifications are shown in TABLE 1.2. The six study locations are highlighted.

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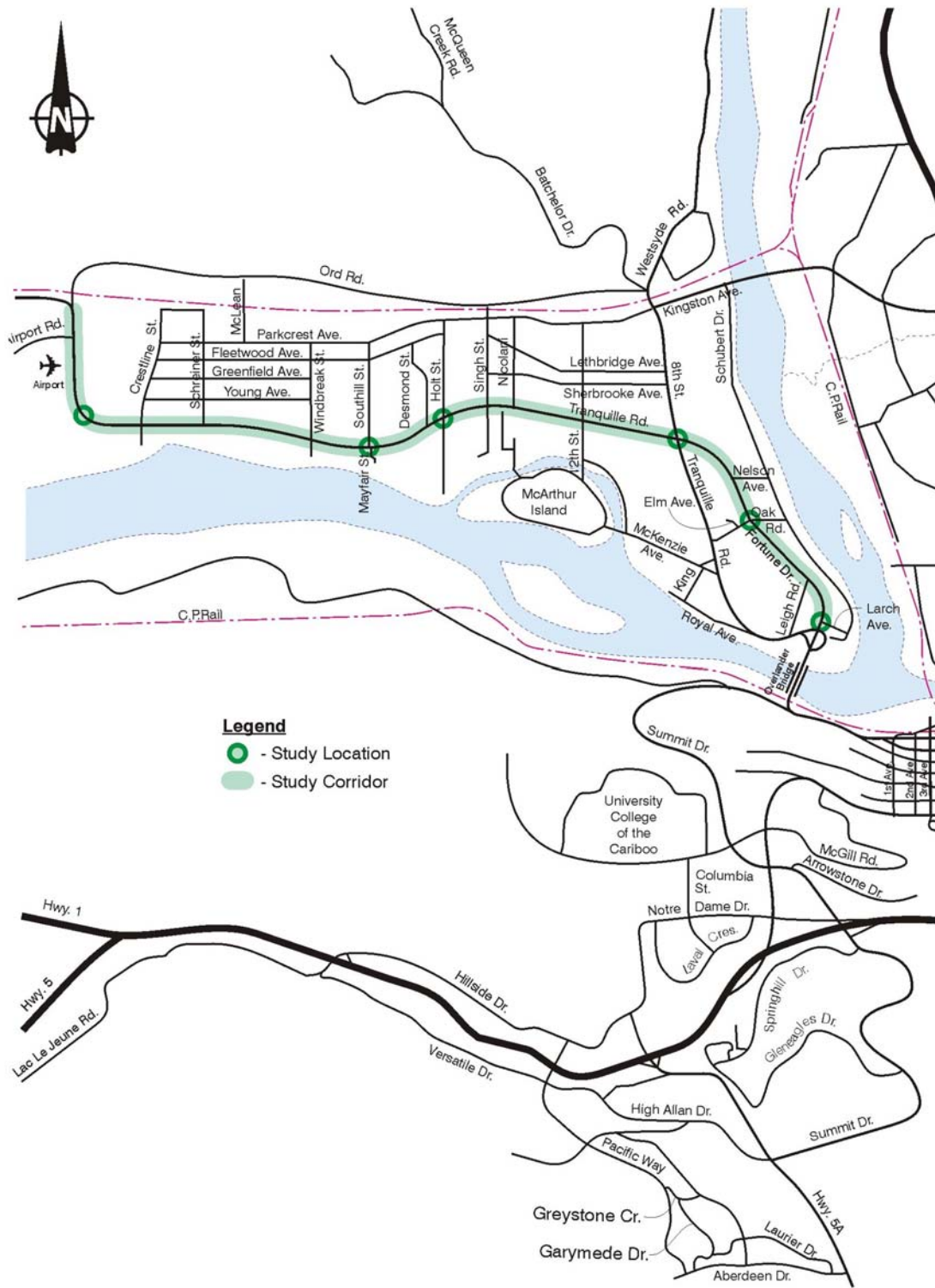


FIGURE 1.1 CORRIDOR STUDY LOCATION

TABLE 1.1 STUDY LOCATIONS AND COLLISION FREQUENCY

LOCATION	CRASHES 2000 – 2002		
	ALL SEVERITY	INJURY OR FATALITY	PERCENT INJURY OR FATALITY
Fortune/8th/Tranquille	150	52	35%
Fortune/7th/Sydney	38	19	50%
Tranquille/12th	35	19	54%
Fortune/Fort/Leigh	28	14	50%
Fortune/Nelson	25	14	56%
Tranquille/Desmond	23	5	22%
Fortune/Oak/Elm	19	10	53%
Tranquille/Singh	19	8	42%
Fortune/Baker/Larch	18	11	61%
Tranquille/Holt	18	10	56%
Tranquille/Windbreak	16	5	31%
Tranquille/Southill	13	7	54%
Tranquille/Popp	13	7	54%
Fortune/Vernon	11	3	27%

Blue shaded intersections were reviewed.

TABLE 1.2 TRAFFIC CONTROL AND CLASSIFICATION OF MAJOR INTERSECTIONS IN THE STUDY CORRIDOR

MAJOR ST.	CROSS-STREET	CROSS-STREET CLASS	TRAFFIC CONTROL
Tranquille Rd.	Schreiner St.	Collector/Local	Actuated Signal
Tranquille Rd.	Windbreak	Collector	STOP
Tranquille Rd.	Southill St.	Collector	STOP (Overhead pedestrian signs)
Tranquille Rd.	Desmond St.	Local	Actuated Signal
Tranquille Rd.	Holt St.	Local	Actuated Signal
Tranquille Rd.	Singh St.	Arterial/local	Actuated Signal
Tranquille Rd.	Popp St.	Local	Pedestrian Signal
Tranquille Rd.	12th Street	Collector	Actuated Signal
Tranquille Rd.	8th St./Fortune	Arterial	Actuated Signal
Fortune Dr.	7th St./ Sydney Ave.	Collector	Actuated Signal
Fortune Dr.	Nelson Ave	Collector	Pedestrian Signal
Fortune Dr.	Elm Ave./Oak Rd.	Local	Pedestrian Signal
Fortune Dr.	Birch Ave.	Collector	STOP
Fortune Dr.	Wood St.	Collector	Pedestrian Signal
Fortune Dr.	Leigh Rd./Fort Ave.	Collector	Actuated Signal
Fortune Dr.	Baker St./Larch Ave.	Collector	STOP
Fortune Dr.	Tranquille/Overlander	Arterial	Interchange

Blue shaded intersections were reviewed.

Collision frequency is based on insurance claims data received from ICBC for the period from 2000 through 2002. Details on collision frequency at key locations along the corridor are provided in APPENDIX A. Some locations on this corridor have been studied previously as part of the Safer City Program. See Section 1.5 for a summary of other studies.

1.4 Method

The intersection reviews followed a systematic method of evaluating the physical, traffic, and human factor characteristics at each location. Site visits, drive-throughs, and walkabouts were conducted at the five study locations on Monday, April 5, 2004, to determine these characteristics. Two traffic safety specialists drove through the corridor several times to obtain impressions of corridor-wide characteristics such as laning, traffic flow, travel speed, pedestrian activity and any issues common to more than one intersection.

A comprehensive checklist was used to review and identify geometric and operational issues. Physical characteristics reviewed included laning, traffic control, sight distances, land use, horizontal and vertical grades, pedestrian facilities, road surface conditions, roadside furniture, and lighting. Traffic characteristics reviewed included qualitative vehicle volume observations, queuing, delays, vehicle speeds, and on-street parking. As well, road user behaviour was observed to identify human factor characteristics that may be contributing to the collision risk. ICBC insurance claims data, provided by ICBC Safer Cities Staff, was also reviewed.

1.5 Other Studies

The following recent Safer City Studies were referred to in the review of the Tranquille/Fortune corridor:

Blackspot Study for the Overlander Bridge, Kamloops, (September 11, 2002, Earth Tech Canada Ltd.) The study showed that there were 6 left turn crashes in 2.25 years at Fortune Drive and Larch Avenue. It was recommended that left turns from Larch onto Fortune be prohibited. Speed was identified as an issue on Fortune Drive and an ITS sign was recommended for the north end of the Overlander Bridge. The sign would provide the message “*Slow Down – High Crash Location*” when triggered by speeding northbound motorists.

Safer City, Intersection Safety Master Plan, (September, 2003, Hamilton Associates). The report outlined a plan to develop and implement a program to improve intersection safety. The methodology reviewed the 20 top collision intersections in Kamloops. The intersection of Tranquille/Fortune/8th had the second highest frequency of collision claims in the City, with an annual average of 34 claims. The report discusses the issues of geometric design, traffic control, traffic speeds, limited resources and documentation of existing policies.

Three Benefit/Cost Studies, Kamloops, (May 9, 2003, Earth Tech Canada Ltd.) The Fortune Drive and 8th Street intersection was selected as a candidate for a B/C analysis for the application of an anti-skid driving surface. The signals on Fortune Drive at 8th, 7th and Nelson were also studied and synchronization was recommended.

Pedestrian Zone, Tranquille Corridor. (January, 2004, CH2M Hill). Drawing illustrating a proposed Pedestrian Zone on Tranquille Road, between 9th and 12th Street. The plan shows a Special Crosswalk at 11th Street, a Pedestrian Signal at 10th Street and pedestrian fencing between the two intersections. An overhead sign reading “*High Pedestrian Zone, 50 km/hr*” identifies the corridor for eastbound traffic. A pedestrian sign “*You Stop – Until They Stop*” was recommended.

A street lighting study for the study corridor is currently underway.

2.0 FINDINGS

2.1 Collision Trends

An average of 183 collisions occurred along the corridor on an annual basis according to ICBC claims data. Summaries of both ICBC claims data and police-reported collisions provided by ICBC Safer City staff were reviewed for temporal, collision type and environmental trends, and are provided in APPENDIX A. Highlights are summarized in TABLES 2.1 and 2.2.

TABLE 2.1 COLLISION TRENDS ALONG THE TRANQUILLE/FORTUNE CORRIDOR

CATEGORY	FIELD	DATA SOURCE	PERCENT OF COLLISIONS	COMMENTS
Month	January	ICBC	11%	May be related to weather and road conditions
Day	Wednesday (highest)	ICBC	18%	Likely related to traffic volumes
	Sunday (lowest)	ICBC	9%	
Hour	1401 to 1500 h	ICBC	10%	Likely related to traffic volume
	1701 to 1800 h	ICBC	10%	
Severity	Injury	ICBC	34%	Average, comparable with other corridors in Kamloops
		Police	57%	Police are more likely to attend high severity collisions
Collision Type	Rear end collisions (highest)	Police	49%	Relatively high portion of rear end collisions
	Angle Collisions (2 nd highest)	Police	17%	Lower compared to other corridor studies
Contributing Cause	Driving without due care	Police	27%	Consistent with the high number of rear end collisions
	Following too closely	Police	21%	
	Failing to yield Right of way	Police	13%	Lower than other corridors

TABLE 2.2 CRASHES WITH VULNERABLE ROAD USERS

TYPE OF CRASH	NUMBER OF CRASHES
Pedestrian	26
Cyclists	17
Motorcycles	3
TOTAL	46

The proportion of rear end collisions is relatively high and may be related to speed differentials, frequent driveways, frequent pedestrian crossings, signal visibility and/or the absence of dedicated left turn lanes at many intersections. “Driving without due care” is a contributing factor to a vehicle collision that generally reflects on driver actions.

The incidence of 26 pedestrian and 17 cyclist collisions is relatively high. While it is indicative of school, playground or commercial activities that generate pedestrian traffic along a highly traveled corridor, it is nonetheless of particular concern to the adjacent community and the City of Kamloops. The recent fatal collision at a signalized intersection (Popp St) in this corridor, resulting in the death of two school age children, has heightened the awareness of pedestrian safety issues in the community. Additionally, pedestrian patterns in the area have recently changed, as several schools along the corridor have closed, and the catchment areas have been expanded for others.

TABLE 1.3 summarizes the variety of special pedestrian controls that are installed or proposed to increase the safety of pedestrians crossing the study corridor.

2.2 Corridor Speed

The posted speed limit along the corridor is generally 60 kilometres per hour, and is summarized in TABLE 2.3. The speed limit from 8th Street to just east of Singh Street was recently reduced to 50 kilometres per hour in response to the pedestrian fatality at Popp Street. City Council has received a request from the George Hilliard Elementary School Parent Advisory Council to consider the extension of the 50 kilometre per hour posted speed limit to Holt and Singh Streets, replacing the current 60 kilometre per hour posted speed limit.

Speed observations or data were available from two sources, a drive through conducted on April 5, 2004, and from surveys conducted and summarized by students in 2001. The 85th percentile information from the student surveys was obtained from the City's Planet GIS software. The results are summarized in TABLES 2.3 and 2.4 respectively. The drive through was conducted at the pace of traffic in the mid-afternoon period when traffic was relatively free-flow. The data collected by students was conducted in the mid-morning of a summer weekday, when free-flow conditions are likely to prevail.

TABLE 2.3 SPEED OBSERVATIONS (APRIL 2004)

SECTION	APPROXIMATE OBSERVED SPEED WESTBOUND	SPEED LIMIT
Fortune Drive (Leigh to 8 th St.)	58 km/h	60 km/h
Tranquille Road (8 th to Singh)	55 to 65 km/h	50 km/h
Tranquille Road (Singh to Schreiner)	65 to 70 km/h	60 km/h

TABLE 2.4 SPEED DATA (SUMMER 2001)

LOCATION	85 TH PERCENTILE SPEED		POSTED SPEED LIMIT
	Westbound	Eastbound	
Tranquille Road west of Desmond	54 km/h	56 km/h	60 km/h
Fortune Drive south of Spruce	55 km/h	58 km/h	60 km/h

Typically, for arterial roads studied under the ICBC Road Improvement Program, 85th percentile speeds up to 10 kilometres per hour are common. On the Tranquille/Fortune Corridor, according to the 85th percentile speeds sampled in 2001 were actually below the posted speed limit of 60 kilometres per hour. According to the drive through data in TABLE 2.3, prevailing speeds were generally within 10 kilometres per hour of the speed limit, except for the section from 8th Street to Singh Street, where the speed limit is lower.

These findings appear to be inconsistent with those of the 2002 *Blackspot Study for the Overlander Bridge*, which identified speed as an issue on Fortune Drive. The City may wish to update the available speed data, as the current data is three years old.

2.3 Pedestrian Facilities

The locations of pedestrian crossing facilities along the corridor are summarized in TABLE 2.5. Pedestrian crossings are concentrated on the Tranquille Road (east-west) portion of the study corridor, with eight crossings provided in a 4.3 kilometre section, in addition to the six signals provided in this section. Additionally, diverse types of pedestrian control are provided. While marked and signed crosswalks are provided on the two-lane portion of Tranquille Road, on the four-lane section overhead pedestrian signs, pedestrian signals, marked crosswalks and special crosswalks are in place or have been proposed

The Pedestrian Crossing Control Manual (Transportation Association of Canada, 1998) indicates that “on roadways with high speeds, or high volumes..., this application (side-mounted signs) should only be used where the roadway is one through lane in each direction”. Based on these criteria, the crosswalk at Valhalla should be considered for an upgrade to overhead signs.

**TABLE 2.5 PEDESTRIAN CONTROL AT INTERSECTIONS IN THE STUDY
CORRIDOR**

MAJOR ST.	MAJOR ST. CROSS-SECTION	CROSS-STREET	CROSS-STREET CLASS	SPECIAL PEDESTRIAN CONTROL
Tranquille Rd.	two lane	Crestline St	Local	Crosswalk with side-mounted signs
Tranquille Rd.	two lane	Schreiner St.	Collector /Local	Crosswalk with side-mounted signs
Tranquille Rd.	two lane	Windbreak St.	Collector	Crosswalk with side-mounted signs
Tranquille Rd.	four-lane	Southill St.	Collector	Overhead Pedestrian Signs
Tranquille Rd.	four-lane	Popp St.	Local	Pedestrian Signal
Tranquille Rd.	four-lane	Valhalla Dr.	Local	Crosswalk with side-mounted signs
Tranquille Rd.	four-lane	11 th Street	Local	*Proposed Special Crosswalk
Tranquille Rd.	four-lane	10 th Street	Local	*Proposed median closing and pedestrian fencing
Tranquille Rd.	four-lane	10 th Street	Local	*Proposed Pedestrian Signal
Fortune Dr.	four-lane	Nelson Ave	Collector	Pedestrian Signal
Fortune Dr.	five-lane	Elm Ave./ Oak Rd.	Local	Pedestrian Signal
Fortune Dr.	four-lane	Wood St.	Collector	Pedestrian Signal

Blue shaded intersections were reviewed.

*Proposed by CH2M Hill, January, 2004, as part of a recommended Pedestrian Zone

2.3 Corridor Wide Issues

Based on the drive-throughs and the preliminary collision analysis, eight general types of safety issues were identified. The issues and suggested countermeasures are described in more detail in APPENDIX B, and are summarized in TABLE 2.6.

2.4 Action Plan

For each intersection, immediate, short-term and long-term engineering countermeasures were identified. The results are summarized for each study location in FIGURE 2.1, and a priority is also assigned to each of the short-term and long-term countermeasures in FIGURE 2.1.

TABLE 2.6 IDENTIFIED SAFETY ISSUES

SAFETY ISSUE		SUGGESTIONS
1	Conflicts between slow or stopped left turn vehicles and faster moving through vehicles	<ul style="list-style-type: none"> -Provide protected left turn phasing. -Provide left-turn bays through widening (long term). -Left turn management strategy (restrict at some locations, facilitate at others.) -Enforcement of speed and aggressive driving.
2	Visibility of traffic control devices	<ul style="list-style-type: none"> -Provide 300mm LED heads for primary signals. -Provide backboards, with retro-reflective tape, on secondary signal heads at some locations -Provide High Intensity or Diamond Grade reflective sheeting on warning and regulatory signs. -Repaint pavement markings more frequently with emphasis on pedestrian markings, or use more durable markings for crosswalks -Provide near-side signal heads on curved approaches
3	Access Management / Side Streets Close to Major Intersections	<ul style="list-style-type: none"> -Restrict left turn movements at driveways and minor side streets. -Review parking on the side streets approaching the through street. -Consolidate/relocate driveways as opportunities arise with redevelopment. -Redesign complex intersections so that side street access is further from the main street. -Delineation of roadway limits at side streets close to Tranquille/Fortune corridor, particularly at access to Elm Road from Oak Road.
4	Channelized Right Turns	<ul style="list-style-type: none"> -Realign channelized right-turn lanes (long term) -Provide enhanced additional signage and pavement markings.
5	Pedestrian issues	<ul style="list-style-type: none"> -Provide larger push-buttons -Re-align channelized right-turn lanes (long term) -See Section 2.6 for corridor-wide suggestions on “Safe Routes to School”, education, enforcement, and reviewing the location and variety of pedestrian controls. -Remove redundant right-turn lane, provide curb extension at 8th Street.
6	Human Factors Issues	<ul style="list-style-type: none"> -Review bus stop locations. -Provide advance intersection name signing or near side signal head at Oak Rd. -Bus stop pavement markings or curb extensions on east-west exit legs at Southill Street.
7	Sight Lines at Intersections	<ul style="list-style-type: none"> -Review sight lines at side streets and major driveways. -Remove vegetation or trim landscape plantings. -Install “hidden intersection” signs or advance street name signs. -Remove or relocate street furniture that interferes with the visibility of pedestrians, vehicles or cyclists. -Provide signals if warranted. -Restrict movements if reasonable alternatives exist.
8	Other issues*	See APPENDIX B.

NOTE: The above issues are not listed in any priority.

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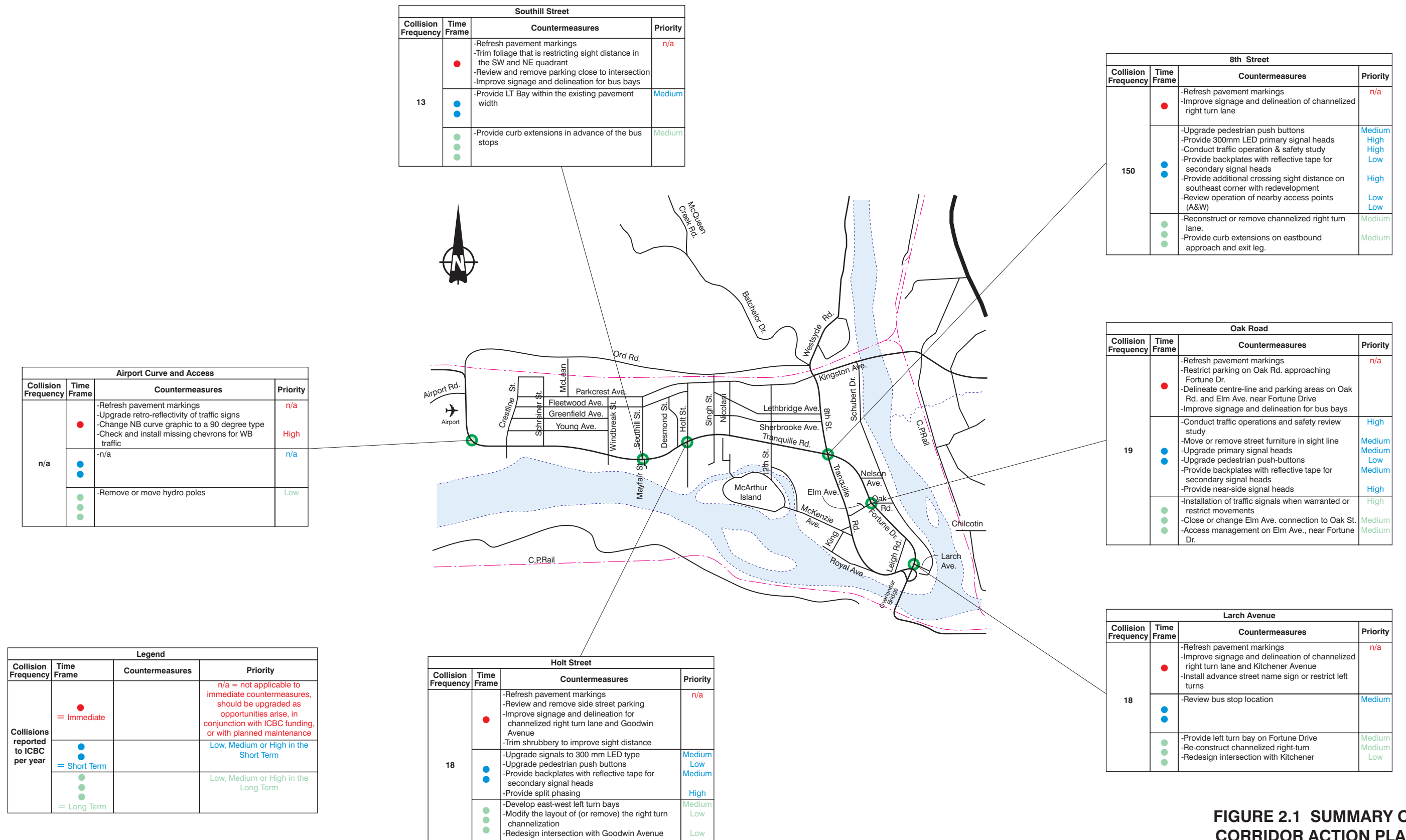


FIGURE 2.1 SUMMARY OF CORRIDOR ACTION PLAN

Immediate term improvements, which are summarized in TABLE 2.7, were identified as mitigating measures that could be immediately implemented at relatively low cost, and with minimal equipment mobilization. Opportunities may exist to incorporate some of the immediate mitigating measures as part of planned roadworks or regularly scheduled maintenance. Therefore, no particular priority was assigned to any of the immediate countermeasures in FIGURE 2.1. A priority is assigned to short and long term countermeasures however.

Short-term countermeasures tend to require some capital or special project funding, and are summarized in TABLE 2.8. To support such funding requests, some additional analysis or justification may be required. Potential areas of study to support funding are also indicated under the heading “Items to Consider to Support Measure” in TABLES 2.7 and 2.8. Longer-term projects require significant capital expenses, such as property acquisition or significant construction costs, and are summarized in TABLE 2.9.

TABLE 2.7 SUMMARY OF IMMEDIATE COUNTERMEASURES

IMMEDIATE COUNTERMEASURES	LOCATION					
	LARCH	OAK	EIGHTH	HOLT	SOUTHILL	AIRPORT CURVE
Left turn restrictions or advance street name signing	✓					
Refresh pavement markings or use more durable pavement markings	✓	✓	✓	✓	✓	
Improve signage and delineation for channelized right turns	✓		✓	✓		
Modify signs and upgrade sheeting						✓
Improve signage and delineation for roads close to the intersection	✓	✓		✓		
Improve signage and delineation for bus bays					✓	
Trim foliage				✓	✓	
Review side street parking and extend restrictions if necessary		✓		✓	✓	

TABLE 2.8 SUMMARY OF SHORT-TERM COUNTERMEASURES

SHORT-TERM COUNTERMEASURES	LOCATION						ITEMS TO CONSIDER TO SUPPORT MEASURE
	LARCH	OAK	EIGHTH	HOLT	SOUTHILL	AIRPORT CURVE	
Review and relocate bus stop locations	✓	✓			✓		Rear-end collisions and sideswipes
Upgrade primary signal heads		✓	✓	✓			Rear-end collisions
Upgrade pedestrian push buttons		✓	✓	✓			Pedestrian demand
Provide backplates with reflective tape for secondary signal heads		✓	✓	✓			Left-turn opposing collisions or signal head obscured by dark background
Provide left turn bays within existing pavement width					✓		Left-turn and rear-end collisions
Improve sight distance		✓	✓	✓			Angle or pedestrian collisions.
Provide near side signal heads		✓					Rear-end or angle collisions
Provide split phasing				✓			Left-turn and rear-end collisions

2.5 Follow-up Items

Besides the issues identified in the on-site reviews, the collision analysis to date highlighted additional issues:

Eighth Street/ Fortune Drive / Tranquille Road Intersection

The major intersection of Eighth/Fortune/Tranquille experiences 35 percent of the collisions that occur in the corridor and is one of the highest collision intersections in the City of Kamloops. This may reflect the high vehicle volumes using the intersection. The high collision frequency at Eighth Street may warrant an in-service operational and safety review to determine appropriate and cost-effective measures that can be undertaken to reduce the number and severity of collisions.

TABLE 2.9 SUMMARY OF LONG-TERM COUNTERMEASURES

LONG TERM COUNTERMEASURES	LOCATION						ITEMS TO CONSIDER TO SUPPORT MEASURE
	LARCH	OAK	EIGHTH	HOLT	SOUTHILL	AIRPORT CURVE	
Provide left turn bay(s) through widening	✓			✓			Left-turn opposing and sideswipe collisions
Remove or relocate more hazardous power-pole installations						✓	Pedestrian or fixed-object collisions
Reduce the angle of the channelized right-turns	✓		✓	✓			Right-turn rear-end collisions, pedestrian collisions
Signal installation or restriction of movements		✓					Angle collisions and pedestrian collisions, signal warrants
Review driveway operations and relocate/restrict movements where possible		✓	✓	✓			Sideswipe and angle collisions
Relocate or redesign intersecting roads close to the intersection.	✓	✓		✓			Angle collisions on side street
Provide curb extensions			✓		✓		Compatibility with long term plans, sideswipe and pedestrian collisions

Fortune Drive/Oak Road/Elm Avenue Intersection

The intersection of Fortune/Oak/Elm had 19 collisions in the 2000-2002 period. The pedestrian signal at the intersection facilitates the movement of pedestrians across the busy arterial street, but does little to assist side street traffic that has difficulty to enter or cross Fortune Drive. Finding a gap is made more difficult by the presence of sight obstructions and horizontal and vertical curves. The City plans to implement a full traffic signal at this location. Other safety issues identified at this location were the proximity of the Elm Drive intersection, lack of access management, street furniture blocking sight lines, and horizontal and vertical curves on the approaches. Given the geometric challenges at this location, an in-service operational and safety review is recommended prior to implementing signals.

Review of Pedestrian and Cyclist Collisions

The frequency of pedestrian collisions was relatively high. The City should review the location of and types of pedestrian collisions, in both the ICBC claims data and in the data provided by the police to identify any trends. Such an analysis would be useful input to the corridor-wide pedestrian strategy, and the education and enforcement campaigns, discussed in Sections 2.6 and 2.7 respectively.

2.6 Corridor-wide Countermeasures

Based on a review of the countermeasures frequently proposed in Section 2.4 the City may consider implementing the following countermeasures corridor-wide:

- provide 300 mm LED displays for all signal heads;
- provide backplates with reflective tape on primary and secondary signal heads; and,
- upgrade delineation of crosswalks and channelized right turns.

Additionally, given the high proportion of rear-end collisions, the frequency of pedestrian controls along the corridor, and the issues related to the lack of left-turn lanes, the City may also wish to consider the following three issues on a corridor wide basis:

- speed management;
- optimizing of pedestrian facilities; and
- left-turn management.

Review of Vehicle Speeds

The City has identified vehicle speed as an issue. However, available speed data indicates that drivers are generally travelling within 10 kilometres of the posted speed limit, except possibly in the section from 8th Street to Singh Street, where the speed limit is lower.

It may be that the current 60 km/hour limit is no longer appropriate. While the lane widths and access control along much of the corridor appears to be adequate for an arterial, many of the following characteristics suggest that a review of the current speed limit would be appropriate.

- frequent intersections,
- lack of sight distance at intersections,
- frequent pedestrian crossings,
- lack of left-turn bays, and
- adjacent residential land uses.

Many of these features were identified as safety issues in TABLE 2.6 above. If the City is able to address some of these issues, the 60 kilometre per hour speed limit may be appropriate in the long term. Alternatively, the City may wish to revise the speed limit and implement appropriate measures to reinforce that limit.

The City may wish to update the available speed data for the Tranquille/Fortune corridor to confirm that these findings are still current, as the most recent data is 3 years old. Data to establish speed profiles for the corridor is an important element to evaluate whether the posted speed limits are reasonable and whether compliance is an issue. The controlling factor in driver compliance with speed limits is the perception by the driving public that the posted limits are reasonable. This perception is based on the driver's intuitive estimation of the maximum speed at which they may proceed safely along a portion of roadway.

Once current, accurate data is available, the City may wish to undertake a review of the speed limits using an expert-system program such as USLIMITS (available at www.uslimits.com). Current 85th percentile speed data is a required input to such programs.

Once an appropriate speed limit has been determined, and/or measures to address speed-related concerns have been implemented, progression could be considered as a measure to manage speeds.

In the interim, the City should seriously consider extending and enforcing the reduced speed limit to Southill Street. There are very few differences in the corridor characteristics (as listed above) between Southill and Singh Streets, and between Singh and 8th Streets that would justify the current variation in speed limits.

The City Police (RCMP) were interviewed. They have increased speed enforcement and police visibility in the Tranquille/Fortune corridor; however they are not able to sustain the effort due to staff limitations. The police find that generally speeds decrease during periods of enforcement but return to higher levels after a short period of time. Most of the apprehended speeders are residents of the North Shore area.

The police indicated that effective enforcement is hampered due to very limited locations to set up their radar speed equipment and safely stop and ticket offenders. However, because of the built-up nature of the corridor, few opportunities exist to provide police pull-outs for enforcement. Some opportunities may exist to provide pull-outs in the long-term in the section west of Southill.

Pedestrian Crossing a Major Arterial Roadway

There are a number of pedestrian generators on both sides of the Tranquille/Fortune corridor. Twenty-six pedestrian collisions during the 2000-2002 period is considered to be a safety issue. The number and variety of pedestrian controls (see TABLE 2.5) are indicative of the pedestrian safety concern and the measures taken to improve pedestrian crossing safety. However, the frequency of controls may mean that drivers are less likely to notice them. Additionally, the variety of controls may confound driver expectations. Westbound drivers who have yielded appropriately at several overhead controls in a row may not notice the post-mounted signs at the marked crosswalks.

Improving pedestrian safety requires a comprehensive program of engineering, education and enforcement. Consideration should be given to a pedestrian safety review. Engineering solutions could involve standardization of controls, upgrading controls and or consolidating crosswalks. Such a review should include information such as pedestrian demand, pedestrian desire lines and availability of gaps, and could be incorporated into a “Safe Routes to Schools” program.

Left Turn Management

Closely spaced intersections may account for the incidence of rear-end collisions (49%) and angle collisions (17%). Many intersections, especially in the Fortune Drive section, do not have left turn bays or turning restrictions. The City may wish to review the feasibility of a left turn management plan for The Tranquille/Fortune corridor. In a left-turn management plan, left-turn access would be improved at some locations through the provision of left-turn phases, or even maybe even left-turn bays in the long term. At other, lower volume locations, left-turns would be restricted. This is expected to reduce last-minute weaving manoeuvres and associated collisions.

Such a plan may have some impact on the traffic volumes on local cross streets, so evaluating the impact through the use of a micro-simulation model, and consultation with affected residents and businesses would be an important part of such a plan.

2.7 Education and Enforcement Initiatives

As discussed previously, insufficient data was available to confirm that high vehicle speeds are an issue on this corridor. Once current speed data is available, and an appropriate corridor speed limit has been set, this may assist the police in targeting their enforcement program.

In addition to speed enforcement, consideration could be given to enforcing aggressive driving (especially last minute lane changes to avoid being delayed by left-turning drivers) and crosswalk compliance (targeting drivers who do not yield to pedestrians in crosswalk). Crosswalk “sting” operations have been successful in garnering earned media that can be useful in educating drivers and pedestrians about the importance of crosswalk compliance. In a “crosswalk sting” operation, a police officer waits at a crosswalk, indicating that he would like to cross. A second officer waits downstream to issue violations to those drivers who do not yield to the officer waiting to cross.

This may be an opportunity to implement relevant education programs for pedestrians and motorists. A “*safe routes to school*” program requires the review of traffic engineering components, such as crosswalk consolidation and improvements. The program also has a significant education component. Pedestrians can also be educated regarding their duties at a crosswalk. If the majority of pedestrians are school-aged, school visits by City staff and enforcement personnel may be effective.

APPENDIX A COLLISION ANALYSIS

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INTERSECTION SAFETY MASTER PLAN: INTEGRATED CORRIDOR PLAN -
TRANQUILLE/FORTUNE CORRIDOR, KAMLOOPS, BRITISH COLUMBIA

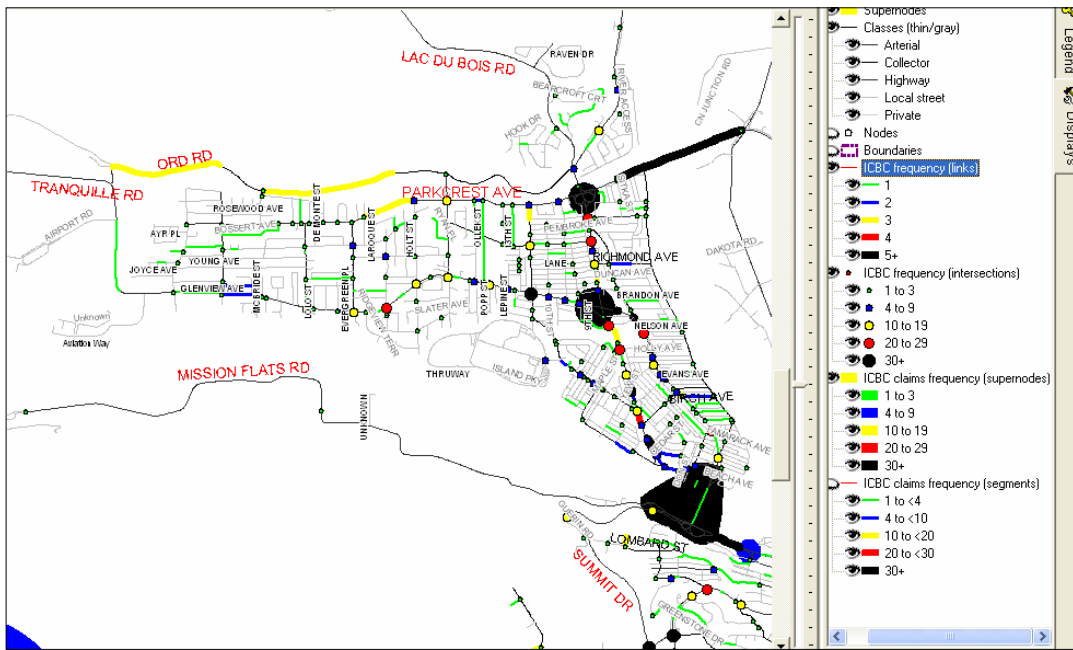


FIGURE A.1 COLLISIONS BY LOCATION

Source: ICBC Claims data

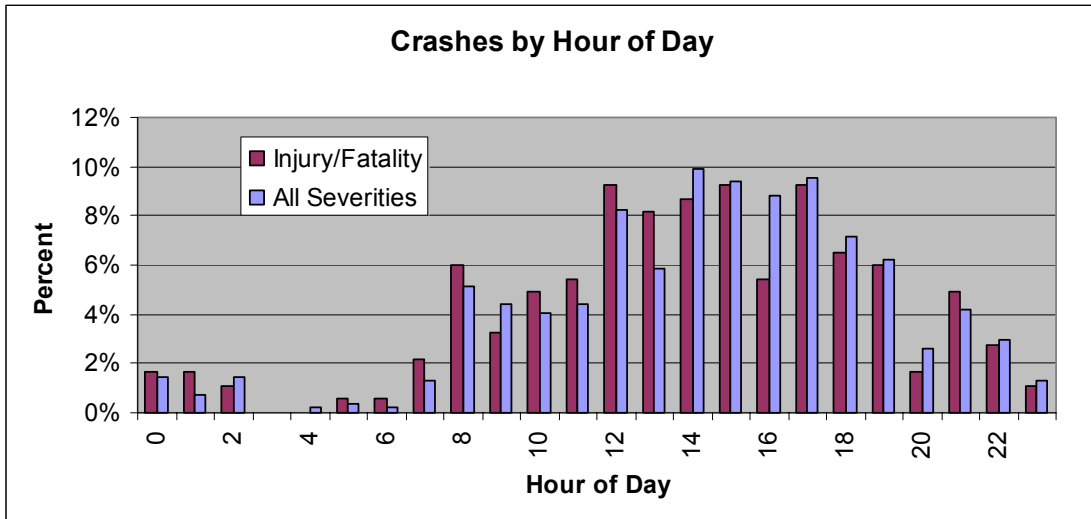


FIGURE A.2 COLLISIONS BY TIME OF DAY (2000-2002)

Source: ICBC claims data graphed by ICBC Safer City staff

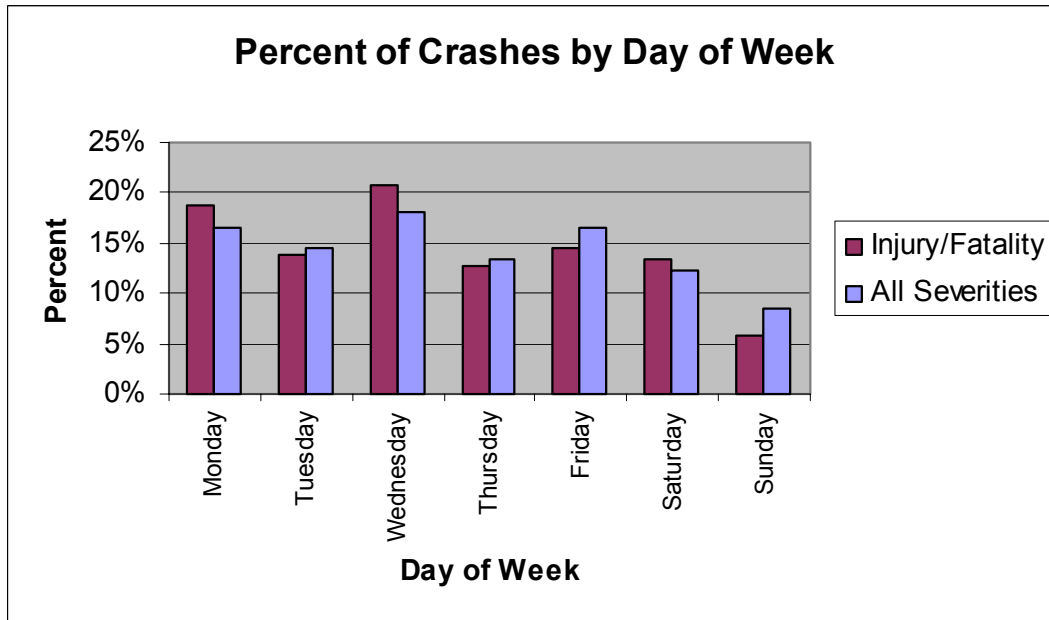


FIGURE A.3 COLLISIONS BY DAY OF WEEK (2000-2002)

Source: ICBC claims data graphed by ICBC Safer City staff

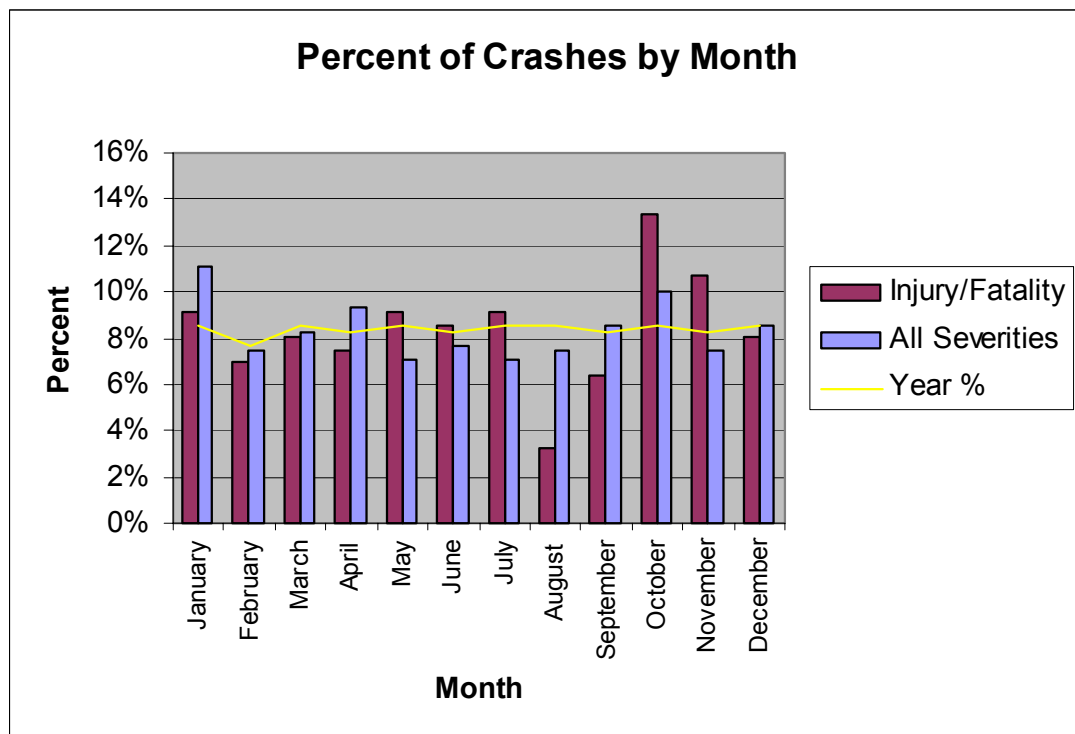


FIGURE A.4 COLLISIONS BY MONTH (2000-2002)

Source: ICBC claims data graphed by ICBC Safer City staff

**APPENDIX B TRANQUILLE/FORTUNE CORRIDOR –
DESCRIPTION OF ISSUES**

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Intersection Safety Strategy

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Issue 1

Safety Issue: Conflicts between slow or stopped left turn vehicles in the centre lane and faster moving through vehicles


Safety Issue Description: The heaviest traveled portion of the corridor is generally four lanes wide. A fifth left-turn bay is provided on Tranquille/Fortune at Oak Street, 7th Street, 8th Street, 9th Street, 10th Street, 12th Street, and Singh Street. Left turns are permitted at most locations

At intersections where left turn and through traffic must share the left lane, left-turning vehicles may delay following motorists, leading them to make last-minute lane changes to avoid being caught behind the left-turning vehicle. This may contribute to rear-end and side-swipe collisions. Additionally, where left turn bays are not provided, the presence of a vehicle waiting to turn in the opposing centre lane can block the view of opposing through traffic, contributing to left turn opposing collisions.

TABLE B.1 LACK OF LEFT TURN BAYS

LOCATION	DESCRIPTION	PHOTOGRAPH
Larch Avenue	The lack of a southbound left-turn bay means that motorists on Fortune Drive may get trapped behind left-turning vehicles, resulting in left-turn rear-end and sideswipe collisions. A slight horizontal curve can further limit the visibility afforded approaching southbound left-turn vehicles and can hide the layout of the intersection.	
Holt Street	The lack of westbound and eastbound left-turn bays means that drivers may get trapped behind left-turning vehicles, resulting in left-turn rear-end, left-turn opposing, and sideswipe collisions. Lane designation signing is provided to give advance warning about the dual use of the left lane.	

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Southill Street	<p>Since westbound left-turn volumes are relatively low, through drivers may not expect leading vehicles to turn left at this location, contributing to rear-end collisions. The eastbound approach is a single lane, with little room for through vehicles to pass by a stopped left turning vehicle and may result in a rear-end or sideswipe collision. Additionally, a through driver may attempt to bypass a left-turn vehicle by entering the right-turn-only lane, contributing to left-turn opposing collisions.</p>	
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Expected Crash Types: left turn opposing, sideswipe, rear-end

Expected Frequency: varies with respect to volume of left-turn and opposing traffic

Suggestions: The City may consider the following mitigation measures where they apply:

- Provide a protected left-turn phase (if significant volumes of left-turn opposing collisions);
- Provide left-turn lanes through widening or within the existing right-of-way (at Southill Street);
- Enforcement of speeding and aggressive driving, or,
- Restrict left turns at certain locations, facilitate at others (left-turn management strategy).

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Issue 2

Safety Issue: Visibility of Traffic Control Devices

Safety Issue Descriptions: Issues associated with the visibility of traffic control devices, along with possible measures to address them, are summarized below.

1. *Signal head visibility:* Many of the signal heads along the Tranquille/Fortune corridor have 200mm diameter displays. Secondary signals often have no backboards. Drivers may not notice the smaller 200 mm primary signal heads and run a red light, or brake late, contributing to angle and rear-end collisions. The study corridor is a truck route with a high collision record. The majority of collisions occur at signalized intersections, therefore signal visibility is important.

Possible solution: The City is planning to phase in 300 mm LED heads for all displays for both primary heads. The City could also consider backboards with reflective tape for primary and secondary signal heads. For secondary signal heads, this should be considered at locations with high volumes of left-turning traffic or high frequency of left-turn opposing collisions.

2. *Reflectivity of signs:* This sign, warning of the curve by the airport utilizes engineering grade retro-reflective sheeting. This type of sheeting has limited retro-reflective properties. As a result these devices may not be immediately noticeable to drivers at night, especially in adverse environmental conditions, in cluttered areas or along vertical or horizontal curves. This may contribute to last minute braking or other erratic maneuvers, increasing the potential for rear-end or angle collisions.




Engineering grade curve and speed tab signs

Possible solution: The City may consider providing Diamond Grade reflective sheeting on all warning and regulatory signs.

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3. *Additional traffic control issues* are identified in TABLE B.2

TABLE B.2 TRAFFIC CONTROL ISSUES

LOCATION	DESCRIPTION AND POSSIBLE COUNTERMEASURES	PHOTOGRAPH
Southill, Larch, Oak, Holt, 8th	<p>Pavement marking, such as pedestrian zebra crosswalks are in poor condition due to excessive wear during the winter months. This may reduce their effectiveness in alerting motorists and pedestrians to exercise caution.</p> <p>The City may wish to renew pavement markings as early as practical in the spring, or use durable pavement marking materials to reduce maintenance needs.</p>	 <p style="text-align: center;"><i>Pavement markings at Southill Street</i></p>

Expected Crash Types: rear-end, sideswipe, angle and pedestrian

Expected Frequency: infrequent

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Issue 3

Safety Issue: Access Management / Side Streets Too Close to Intersection

Safety Issue Description: The locations of many private accesses, particularly along side streets on the Tranquille/Fortune corridor are close to intersections. Such accesses may not be conspicuous to approaching drivers or may have limited visibility. Some drivers may fail to anticipate vehicles slowing to turn into the accesses, leading to sudden braking and possibly contributing to rear-end and angle type collisions.

TAC guidelines recommend that 55 metres be provided between a signal and a driveway on collector roads.

This issue was identified at the following locations:

- Oak Rd., westbound approach
- Oak Rd., eastbound approach
- Holt Drive, southbound and northbound approaches
- 8th street, north exit leg.



At the east leg at Oak Rd. and Fortune Dr. the driveways and parking are very close to the intersection.



Oak Road looking west



8th Street looking north to fast food entrance

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At other locations, access to a sidestreet is provided within 50 metres of the intersection. Where the distance between intersections is short, traffic waiting at a red signal or waiting to turn left at an intersection may queue back to the exit leg at the adjacent downstream intersection. Turning drivers may be surprised, contributing to rear-end collisions. Side street drivers may have difficulty in judging gaps, due to the possibility of turning vehicles from Tranquille Road/Fortune Drive. The risk is particularly high during peak periods, when higher volumes generate longer queues.

These locations are summarized below.

- Kitchener Crescent at Larch Avenue;
- Elm Ave. at Oak Road;
- Goodwin Place at Holt Street.




Larch Avenue, looking west past Kitchener Drive to Fortune Drive. The presence of a channelized right turn shortens the weaving distance.





From Oak Road intersection (west leg) looking North to Elm Road. The large area of unmarked pavement and uncontrolled access creates a very large conflict area close to Tranquille Road

TABLE B.3 ADDITIONAL ACCESS MANAGEMENT ISSUES

LOCATION	DESCRIPTION OF ISSUE	PHOTOGRAPH
Fortune Drive Larch Street To 7th Street	There are approximately 25 access points from streets and lanes onto Fortune Drive in this 1.5 kilometre section. In addition there are many driveways to access private property. Most accesses permits all movements, resulting in many potential vehicle conflicts and possible collisions.	

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Various locations	Parking on the side streets close to the intersection can reduce visibility of crossing pedestrians and stop signs, and interfere with vehicles turning from the Fortune/Tranquille Corridor. The City may consider reviewing parking on all side street approaches to the Tranquille/Fortune corridor.	 <p><i>Eastbound view of Oak St approaching Fortune Drive.</i></p>  <p><i>Southbound on Southhill. Parked vehicles could obscure the stop sign</i></p>
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Expected Crash Types: angle and rear-end

Expected Frequency: infrequent

Suggestions:

- Restrict left turn movements into or out of major private driveways, especially those close to intersections, possibly with a median;
- Close, consolidate or relocate driveways, lane and street intersections, possibly long-term with redevelopment;
- Review all streets that intersect the Tranquille/Fortune corridor and restrict parking close to the intersection that may restrict the view of traffic control devices or pedestrians.
- Restrict movements from side streets too close to major intersections.
- Re-design to relocate side street so that it is further from the main intersection(long term).

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Issue 4

Safety Issue: Channelized Right Turn Lanes

Safety Issue Descriptions:

Delineation and Layout of Channelized Right Turn Lanes:

The shallow angle of the right-turn lane means that drivers must crane their necks to look for gaps. This is a difficult manoeuvre, particularly for older drivers, which increases the difficulty for the right-turn drivers to judge available gaps and can reduce the right turn capacity.



Lack of delineation on channelized right-turn lane, combined with a driveway on the exit leg may lead to conflicts

The limited delineation at the exits of the channelized right-turn lanes may cause drivers to incorrectly assume that an acceleration lane is provided, resulting in sudden braking and possibly contributing to rear-end type collisions. Channelized right turns can also contribute to access-related issues, as discussed in Issue 3, and to conflicts with pedestrians, as discussed in Issue 5. Channelized right turns are present at the following locations:

- Northbound approach to Larch Avenue
- Westbound, southbound and eastbound approaches to 8th Street
- Eastbound and westbound approaches to Holt Street.

Suggestions: Clearly mark and sign the yield point with dashed lane continuity lines, oversize and additional (left-hand side) yield signs. Clearly mark and sign the pedestrian crossing area.

In the long term, the City may wish to redesign the channelized right turn, to optimize the motorists' view of pedestrians and vehicles to their left. The pedestrian crossing should be situated where it is most visible to approaching motorists, typically midway along the curve. A diagrammatic layout of the common design and also the recommended design are shown in FIGURE B.1.

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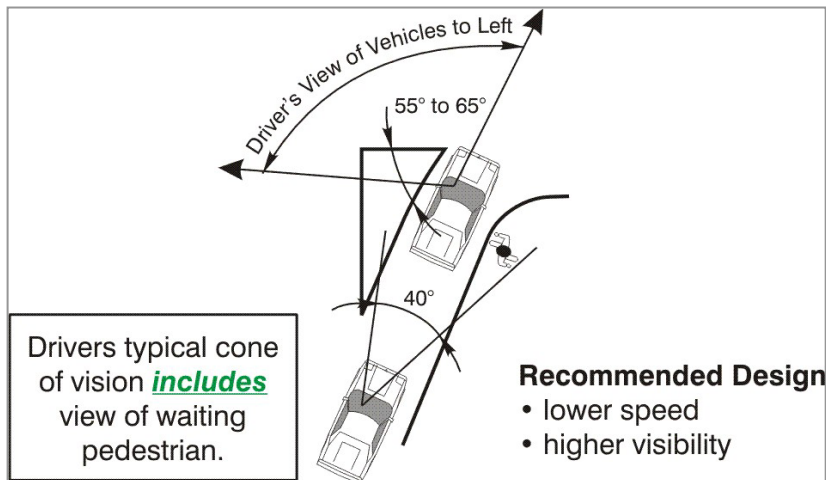
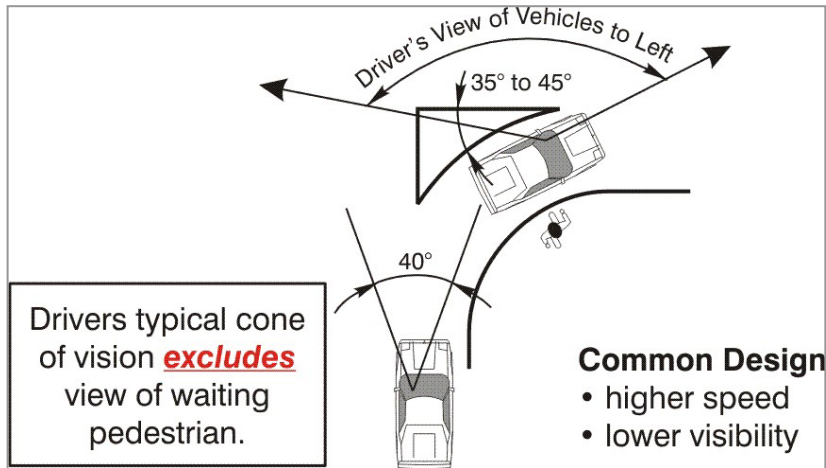


FIGURE B.1 MODIFIED RIGHT-TURN LANE

(Source: FHWA website, Reference 16)

Expected Crash Types: angle and rear-end

Expected Frequency: infrequent

Intersection Safety Strategy




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Issue 5

Safety Issue: Pedestrian Issues

Safety Issue Description: Issues that were noted relating to pedestrian safety are summarized in TABLE B.4.

TABLE B.4 PEDESTRIAN ISSUES

LOCATION	ISSUE	PHOTO
Eighth Street	Some crosswalks at the intersection have older, smaller push buttons. The elderly may find it difficult to activate the small push buttons on the activated crosswalks and so may cross without pressing them. The City may wish to consider providing larger, more accessible push-buttons and new signs.	
Oak Road	The northwest corner of the Oak Road intersection has planters, street furniture and utility poles that may obscure the pedestrians' view of oncoming vehicles and motorists' view of pedestrians. The City may want to consider the removal or relocation of the street furniture.	No picture available.
8 th /Tranquille/ Fortune	Building reduces sight distance to pedestrians. Drivers may not anticipate the appearance of crossing pedestrians, contributing to pedestrian conflicts and secondary rear-end or sideswipe collisions.	
8 th /Tranquille/ Fortune	A dedicated right-turn lane is provided on the eastbound approach to 8 th Street. However, traffic volumes are minimal, due to the presence of a connector road that provides the same function. This underutilized lane unnecessarily lengthens the crossing distance for pedestrians, reducing their exposure to conflicts.	

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Expected Crash Types: Pedestrian, rear-end, angle, sideswipe

Expected Frequency: Infrequent

Suggestions:

- Provide larger pedestrian push buttons.
- Remove or relocate street furniture that may reduce visibility of pedestrians.
- If compatible with development proposed for the southwest corner of 8th Street intersection, remove the existing right-turn lane on the eastbound approach and provide a curb extension on the eastbound exit leg.
- Implement safe routes to school, education and enforcement programs
- Review the location, variety and frequency of pedestrian crossing treatments to achieve consistency and meet driver expectations.

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Issue 6

Safety Issue: Human Factors

Safety Issue Description: Even though the driving task may be complex, there should not be any unexpected situations that may surprise or overwhelm the driver. Surprised drivers may take evasive manoeuvres, such as lane changing or severe braking.

TABLE B.5 HUMAN FACTORS ISSUES

LOCATION	DESCRIPTION OF ISSUE/COUNTERMEASURE	PHOTOGRAPH
Oak Road	<p>The retaining wall restricts the visibility of the upcoming intersection.</p> <p>Provision of advance intersection signing and near-side signal heads may improve visibility of the intersection and signals.</p>	
Southill Street	<p>Tranquille Road widens from 1 to 2 lanes east of Southill. The transition (taper) takes place through the far side bus stop. When a bus is loading or unloading it will block the transition area. This may cause eastbound vehicles in the curb lane to suddenly swerve or stop, which may result in a side-swipe or rear-end collision. Consideration can be given for the transition to take place beyond the bus stop. This could be reinforced through additional pavement markings or the construction of a curb extension.</p>	
Southill Street	<p>A bus stop is provided in the westbound exit leg, with minimal delineation. In spite of the</p>	

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	<p>overhead lane designation signs, some drivers may assume that the curb lane continues, and get “trapped” in the bus stop area, possibly contributing to sideswipe collisions. Additional pavement markings on the exit leg, a more conspicuous bus stop sign, or a curb extension would provide additional positive guidance regarding the location of the Bus stop.</p>	
Oak/Elm Street	<p>Elm Street connects onto Oak Street close to the intersection of Oak Street with Fortune Drive. It is difficult to differentiate the public portion of Elm Street from the private parking areas. The City may want to close the Elm St. connection to Oak St. particularly when the installation of a full traffic signal occurs. In the short term, additional delineation should be provided.</p>	

Expected Crash Types: Pedestrian, angle, side swipe and rear end

Expected Frequency: infrequent

Suggestions: (see table above)





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Issue 7

Safety Issue: Sight lines at intersections

Safety Issue Description: A driver entering an arterial roadway should be able to see oncoming vehicles or pedestrians in order to enter the through roadway safely. Restricted sight lines may be a contributing factor to collisions.

LOCATION	DESCRIPTION OF ISSUE	PHOTOGRAPH
Oak Road	Traffic entering Fortune Road from the east leg of Oak Street has restricted sight distance to the south due to the curve in the roadway. Similarly traffic entering from the west leg has sight restrictions to the north. This issue will be remedied by the installation of a full traffic signal.	 <p style="text-align: center;">Looking south from the east leg of Oak St.</p>
Southill Street	<p>Northbound sight distance to the west is restricted by vegetation. Trimming or removal of the vegetation will improve the sight line.</p> <p>Southbound traffic has sight distance restrictions to the east that may be improved by the trimming of some landscape plantings.</p>	 <p style="text-align: center;">Looking west from the south leg</p>  <p style="text-align: center;">Looking east from the north leg</p>
Larch Avenue	Eastbound left turn traffic at Larch has sightlines reduced to the north by the curve. Sight lines to the south may be adequate but driver judgement may be complicated by the speed of oncoming vehicles, curve and the bridge abutments.	 <p style="text-align: center;">Curve to the north of Larch St.</p>

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Expected Crash Types: Pedestrian, angle, rear end

Expected Frequency: Infrequent

Suggestions:

- Review the sight lines at all side streets along the corridor and take appropriate measures to improve the sight distances such as removing obstacles and vegetation;
- The installation of traffic signals, if warranted may address some of these issues;
- If it is not practical to improve the sight lines due to geometric features such as horizontal curves, the installation of “hidden intersection” or advance street name signs on the through street may warn the through traffic to be more vigilant of entering traffic. The City may wish to restrict certain movements if adequate sight distance cannot be provided at an unsignalized intersection and reasonable alternatives exist for diverted traffic.

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Issue 8

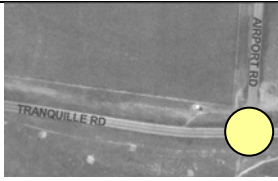


Safety Issue: Other issues

Safety Issue Description: Issues that did not fall into any of the six previous categories are summarized in TABLE B.6.

TABLE B.6 OTHER ISSUES

LOCATION	ISSUE	PHOTO
Curve between Aviation Way and Airport Road	Motorists approaching the 90 degree curve are warned in advance of the upcoming curve and advised to reduce their speed to 50 kilometres per hour in order to safely and comfortably negotiate the curve. The southbound warning sign graphic suggests a 45 degree change of direction and does not prepare drivers for the much sharper reduced speed curve and can result in a run off the road collision. A 90-degree curve sign is used on the other approach (next photo down), so there is inconsistency in the signing between the two approaches to the same curve.	
Curve between Aviation Way and Airport Road	The curve signs and advisory speed tabs appear to be aging and may have reduced nighttime retro-reflectivity properties. The sign aging is especially evident on the curve speed advisory tab for westbound traffic.	
Curve between Aviation Way and Airport Road	Wooden utility poles adjacent the curve may be struck by vehicles that leave the roadway. Narrow gravel shoulders may not allow drivers to recover vehicle control if they leave the traveling lanes.	
Curve between Aviation Way and Airport Road	The curve is delineated by chevrons installed by the City in November, 2000. It appears that the chevron that should directly face westbound traffic is missing..	

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<p>Airport Road</p>	<p>The small advance directional signing for the airport on the approach to Airport Road may not be seen by northbound drivers causing a driver to make sudden unsafe manoeuvres. There are single lane approaches to the intersection and through traffic may conflict with turning vehicles. A northbound auxiliary bypass lane may be considered.</p>	
<p>Oak Street</p>	<p>There is a southbound bus bay constructed south of the Oak Street intersection, however the active bus stop is located north of the intersection. When a bus is loading or discharging passengers it blocks the right southbound traffic lane, possibly contributing to rear-end collisions.</p>	
<p>Larch Street</p>	<p>A bus stop is located on the west side the tee intersection. When a bus occupies the bus stop, southbound traffic behind it is blocked. If at the same time a southbound vehicle is stopped in the left lane waiting to make a left turn into Larch Street, all southbound traffic on Fortune is blocked.</p>	

Expected Crash Types: On the curve: Loss of control, rollover, striking fixed objects, sideswipe and head on. At the intersection: tail end, sideswipe

Expected Frequency: Infrequent

Suggestions:

- Replace curve and advisory speed signs with high intensity or diamond grade retro-reflective sheeting;
- Raised pavement markers may be used to delineate curves
- Remove or set back utility poles;
- Change curve sign to approximate the severity of the curve and to be consistent with signing on the opposite approach);
- Review chevron signs and move or install as required to provide positive guidance for approaching motorists;
- Install larger and more conspicuous airport directional signs;

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- Construct a bypass lane for northbound traffic at the airport access,
- Review the feasibility to relocate bus stops to improve safety and traffic flow.

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