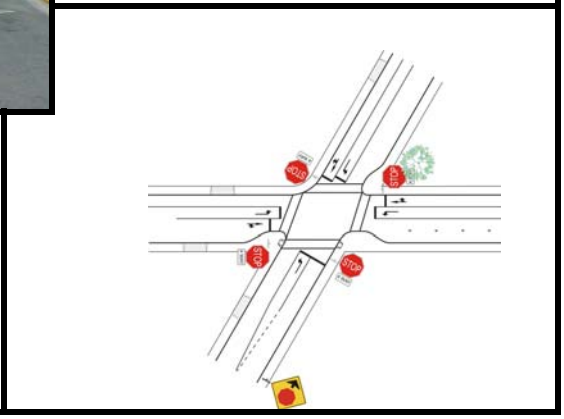
SAFER CITY INITIATIVE

INTERSECTION SAFETY MASTER PLAN

KAMLOOPS, BRITISH COLUMBIA



HAMILTON ASSOCIATES

INSURANCE CORPORATION OF BRITISH COLUMBIA

SAFER CITY

INTERSECTION SAFETY MASTER PLAN

DRAFT REPORT

ISO 9001 Registered
Quality Assured

KAMLOOPS, BRITISH COLUMBIA

Engineering and Planning Consultants

G.D. Hamilton Associates
Consulting Ltd.

9th Floor
1199 West Hastings
Vancouver
British Columbia
Canada V6E 3T5

Telephone: 604 / 684 4488
Facsimile: 604 / 684 5908
office@gdhamilton.com
www.gdhamilton.com

Prepared by:

Sarah Rocchi, P.Eng., PTOE
Project Manager

Sany Zein, M.Eng., P.Eng.
Vice President, Transportation

September 2003

7786

TABLE OF CONTENTS

THIS PAGE WAS INTENTIONALLY LEFT BLANK.

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 improve community traffic safety. The program includes an extensive program of consultation with stakeholders, such as municipalities and the police. Pilot programs are under way throughout the province, including the City of Kamloops.

The Kamloops Safer City Plan considers engineering, planning, enforcement, and community initiatives aimed at achieving safer drivers and roads. The engineering measures include addressing "black spot" (high-crash) locations and introducing proven road safety measures on an area-wide basis. Kamloops is also the pilot site for Safety Conscious Planning, a program developed by ICBC that includes processes and techniques for ensuring that safety is an explicit priority in land-use and transportation planning initiatives.

As the majority of collisions in an urban area tend to occur at intersections, ICBC requested that an Intersection Safety Master Plan be developed for Kamloops as part of the Safer City Plan.

1.2 Study Objectives

The objective of this plan is to develop and implement a program to improve intersection safety:

- Making road safety an explicit priority in intersection planning and operations;
- Equipping the City with the policies, procedures, skills and resources to enhance intersection safety;
- Undertaking initiatives in design, rehabilitation and operations to make intersections safer;
- Addressing the needs of cyclists and pedestrians at intersections and crossings; and,
- Improving the behaviour of road users at intersections.

1.3 Method

Key issues affecting intersection safety were developed based on a review of the following:

- Common issues at intersections studied under ICBC's Road Improvement Program;
- Issues identified as part of the community survey conducted for the Safer City project in December 2001;
- Recommended policies and guidelines for intersection operations and design, and reports dedicated to improving intersection safety.
- The City's existing policies and practices relating to intersection operations, maintenance and design;
- Common issues at five typical intersections in Kamloops, as summarized in the report, Strategy for Improving Intersection Safety: In-service Safety Reviews for Five Intersections, Kamloops, BC, (Hamilton Associates for ICBC, May, 2003);
- Recommended road classification and road form guidelines, being developed concurrently as part of the Safer City Plan;

Based on these issues, recommended procedures for intersection design, operations and maintenance were developed. Some of the procedures vary based on the types of roadways at the intersection, and so an intersection classification system was developed. Key design features to improve intersection safety were developed for each intersection class. Good practices for intersection traffic control were also developed. In addition, strategies for enforcement and education were also outlined.

2.0 BACKGROUND ANALYSIS

2.1 Preliminary Results of the Collision Analysis

A review of historical collision data was conducted by others to evaluate the characteristics of collisions in the City. The crash risk in Kamloops was analyzed using collision records from two databases:

- The police-reported Traffic Accident System (TAS) data; and,
- Insurance claims records.

The results of the analysis are summarized in a separate report. This information was also linked to the City's Planet GIS database. This will provide the City with an interactive tool to continually monitor intersection safety, and to incorporate collision history into the prioritization and implementation of intersection design projects.

The insurance claims data was reviewed to determine the locations in the City with the highest crash risk according to recorded frequency. These locations are summarized in TABLE 2.1 and in FIGURE 2.1. Except for the Overlander Bridge, all of the top 20 locations in Kamloops are at intersections. It is also noted that 5 of the top 6 locations are located in the Sahali Centre area, either along Columbia Street West, or along Summit Drive. The remaining locations are concentrated along the 8th Street/Tranquille Road corridors on the north shore, or in the downtown area, particularly along Lansdowne Street.

The collision type was identified based on the information provided in the collision type field of the TAS data for all collisions in Kamloops (both intersection and mid-block locations), and provides an indication of the relative configuration of the colliding vehicles at the time of impact. The collision type distribution is shown in FIGURE 2.2. Rear-ends (24 percent) were the most frequently occurring collision type, followed by off-road collisions (19 percent) and angle collisions (14 percent).

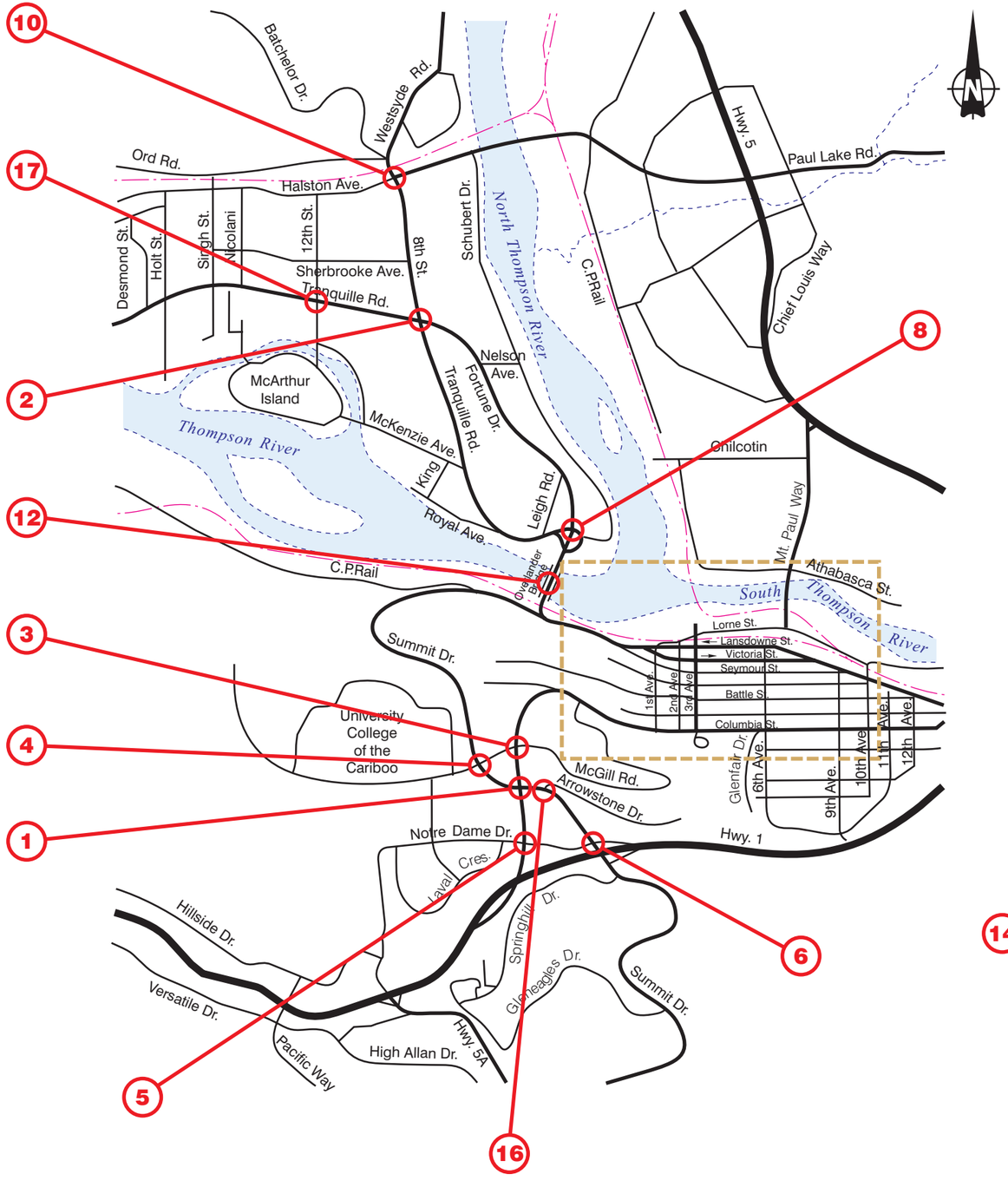
TABLE 2.1 SUMMARY OF TOP 20 COLLISIONS RANKED BY AVERAGE ANNUAL CLAIMS

RANK BY FREQUENCY	LOCATION	3-YEAR COLLISION TOTAL	ANNUAL AVERAGE
1	W Columbia St/Summit Dr	146	49
2	8th / Fortune / Tranquille	103	34
3	W Columbia St/Mcgill Rd	99	33
4	Mcgill Rd/Summit Dr	89	30
5	W Columbia St/Notre Dame Dr	77	26
6	Notre Dame Dr/Summit Dr	76	25
7	Columbia St/3rd Ave	72	24
8	Tranquille Rd/Fortune Dr	57	19
9	3rd Ave/Seymour St	49	16
10	8th St/Halston Ave	47	16
11	4th Ave/Lansdowne St	44	15
12	Overlander Bridge	43	14
13	3rd Ave/Lansdowne St	42	14
14	3rd Ave/Victoria St	40	13
15	6th Ave/Seymour St	37	12
16	Summit Dr/Arrowstone Dr	36	12
17	12th St/Tranquille Rd	36	12
18	2nd Ave/Lansdowne St	35	12
19	Seymour St/Victoria St	35	12
20	4th Ave/Columbia St	33	11

Rear-end and angle collisions are typical at urban intersections. Off-road collisions generally occur at high vehicle speed and curved road segments outside of intersections. Other types that most likely occurred at intersections include left-turn opposing and right-turn collisions. Further analysis is required to confirm these trends for intersections.

Additionally, collision causes reported by the police were reviewed and are summarized in FIGURE 2.3. While police-reported causes are subjective and generally relate primarily to driver behaviour, it can be seen that several of the behaviour-related causes are likely occurring at intersections, including failure to yield the right of way (16 percent), following too closely (14 percent), turning improperly (6 percent), and ignoring the traffic control devices (5 percent).

RANK BY FREQUENCY	LOCATION	ANNUAL AVERAGE
1	W Columbia Street & Summit Drive	49
2	8th Street & Fortune Drive/Tranquille Road	34
3	W Columbia Street & McGill Road	33
4	McGill Road & Summit Drive	30
5	W Columbia Street & 3rd Avenue	26
6	Notre Dame Drive & Summit Drive	25
7	Columbia Street & 3rd Avenue	24
8	Tranquille Road & Fortune Drive	19
9	3rd Avenue & Seymour Street	16
10	8th Street & Halston Ave	16
11	4th Avenue & Lansdowne Street	15
12	Overlander Bridge	14
13	3rd Avenue & Lansdowne Street	14
14	3rd Avenue & Victoria Street	13
15	6th Avenue & Seymour Street	12
16	Summit Drive & Arrowstone Drive	12
17	12th Street & Tranquille Road	12
18	2nd Avenue & Lansdowne Street	12
19	Seymour Street & Victoria Street	12
20	4th Avenue & Columbia Street	11



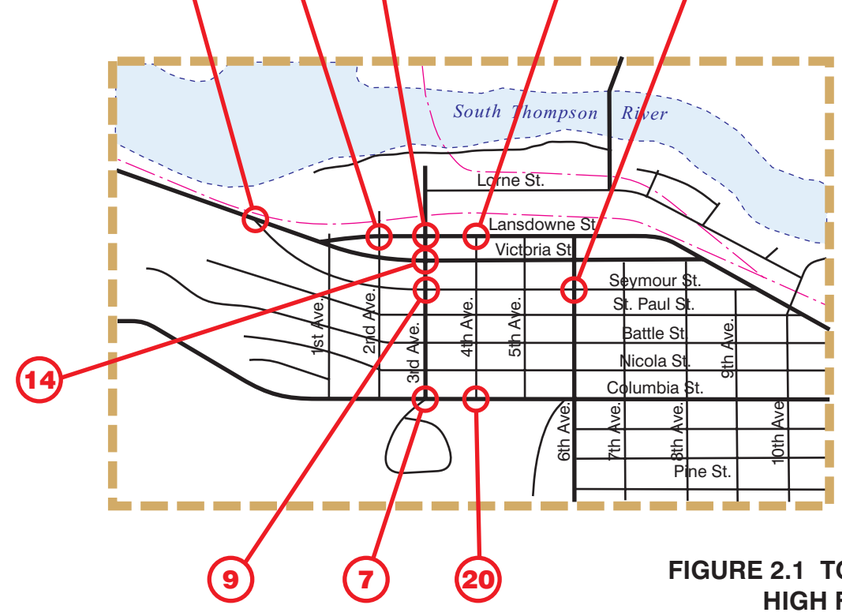


FIGURE 2.1 TOP 20 BLACKSPOTS HIGH FREQUENCY COLLISION LOCATIONS

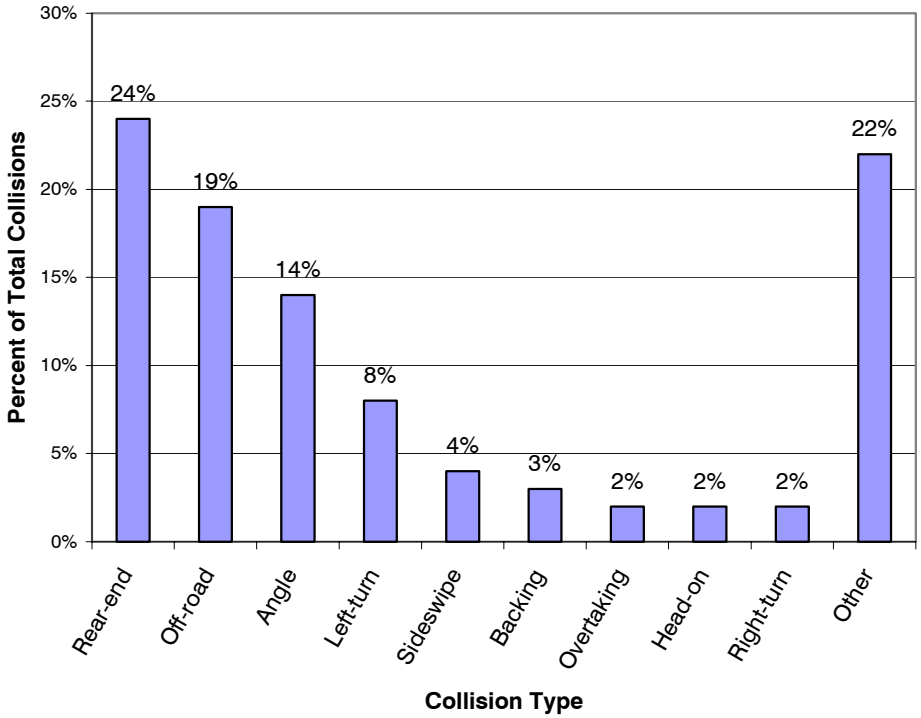


FIGURE 2.2 DISTRIBUTION OF COLLISIONS BY TYPE

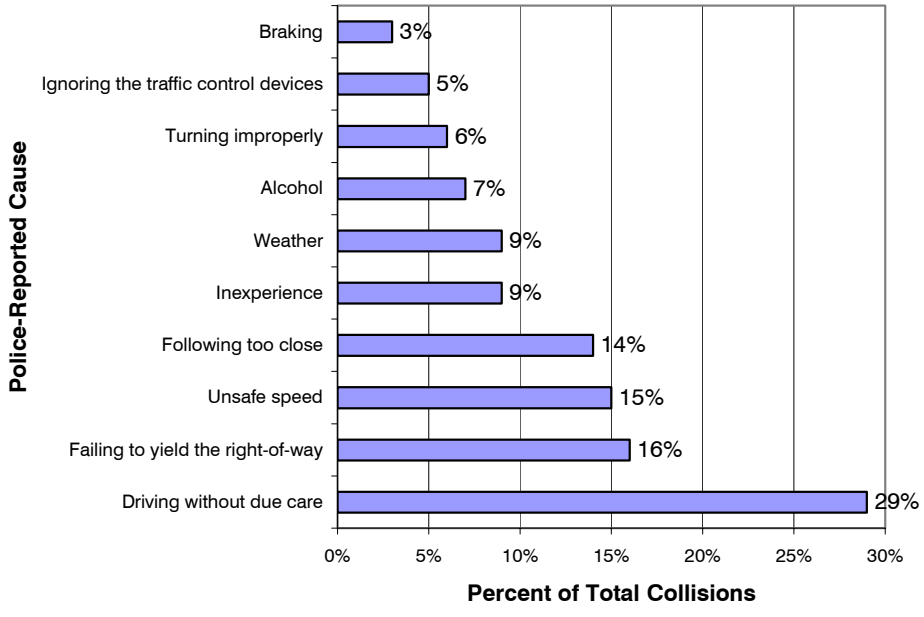


FIGURE 2.3 COLLISION CAUSES REPORTED BY THE POLICE

2.2 Community Survey Results

In December 2001, Safer City distributed over 20,000 questionnaires to the citizens of Kamloops. The goal was to collect as many road safety related concerns as possible from the community as a whole that may otherwise go un-noticed. Safer City received well over 3,500 issues of concern in response.

The issues identified in this survey are shown in FIGURE 2.4. Speeding was the most frequently cited concern at 26 percent. While many of the remaining issues can contribute to intersection collisions, the second-most frequently cited issue, red-light running (24 percent) can only apply to intersections.

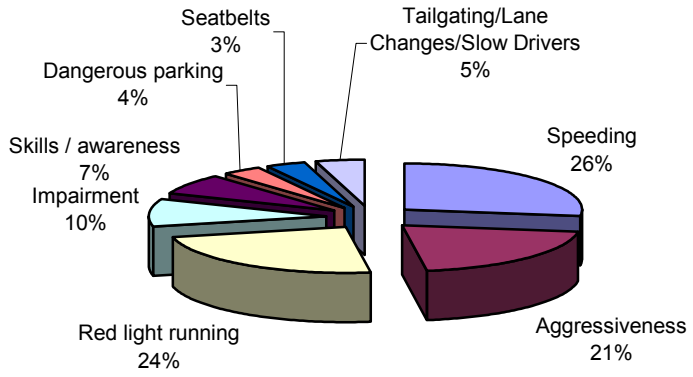


FIGURE 2.4 ROAD SAFETY ISSUES IDENTIFIED IN THE COMMUNITY SURVEY

3.0 ISSUES AFFECTING INTERSECTION SAFETY

Based on the results of the site reviews, the preliminary collision analysis, consultation with staff, police interview, review of the community survey, and the review of existing policies, the following five major issues were identified that affect intersection safety in Kamloops.

- Geometric design issues;
- Traffic control issues, especially visibility of traffic control;
- Traffic speeds on intersection approaches;
- Limited resources for proactive approach to operations and safety; and,
- Documentation of existing policies.

These issues were taken into consideration when developing the Intersection Safety Master Plan.

3.1 Geometric Design Issues

The results of the service reviews identified three issues relating to geometric design, namely wide approach lanes, downtown intersections and natural features. These issues are described in greater detail below.

Wide approach lanes, and the presence of parked vehicles may make some STOP signs less conspicuous. Drivers may notice the STOP sign late, or not at all, possibly contributing to angle and rear-end collisions. Wide lanes can also lead to lane use confusion and sideswipe collisions.

Wide cross-section could result in STOP signs outside of the driver's primary cone of vision

Because of the topography of the Kamloops area, numerous intersections had vertical curves and horizontal curves on the intersection approaches. Such features can reduce the visibility of the intersection ahead, reduce crossing sight distance, or make traffic control devices less conspicuous. At other locations, roadside vegetation further reduced stopping or crossing sight distance. Drivers may not anticipate the need to stop, or may stop late, contributing to rear-end and angle collisions.

Curved approach and retaining wall reduces driver's view of the intersection, and of cross-street traffic.

Typical downtown intersection with visual clutter, reduced crossing sight distance, as well as pedestrian and parking activity

Several issues were identified in the downtown area, some of which related to their geometric layout, including sidewalks that are too narrow for the demand; building setbacks causing a reduction in sight distance and pedestrian visibility; visual clutter reducing signal visibility; and parking close to the intersection.

In addition, during the staff interviews for the policy review, staff indicated that sometimes additional guidance beyond published guidelines would be useful in the design of intersections, particularly with respect to pedestrian and downtown type areas.

3.2 Traffic Control Issues

During the site visits, some issues were noted with respect to traffic control. As discussed in Section 3.1, STOP sign visibility was occasionally reduced because of site features. At numerous intersections with signals, the visibility of the signals could be improved. However, during the policy review, staff noted that they had an ongoing program to update signal head visibility. City of Kamloops staff generally uses industry acceptable standards to review and improve intersection operations. However, their practices are not always formally documented. While a number of intersections are reviewed pro-actively every year, staff resources are inadequate to review the operation of all intersections on a regular basis. These issues will be discussed in greater detail in sections 3.4 and 3.5.

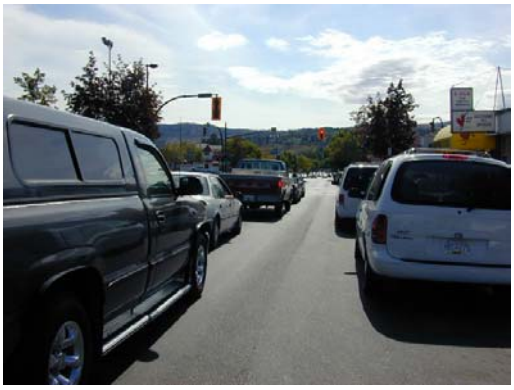
3.3 Traffic Speeds and Red Light Running

As discussed in Section 2.2, speeding was the most frequently cited concern in the community survey. The second-most frequently cited issue, red-light running (24 percent) is intersection specific.

Police also identified high travel speeds as a safety issue in the City of Kamloops, in interviews, and in the review of collisions, discussed in Section 2.1. High speeds related to long distances between intersections were also noted during the in-service safety reviews.

Intersection spacing may contribute to high vehicle speeds.

3.4 Limited Resources for Proactive Approach to Operations and Safety



Congested Conditions can contribute to collisions.

The efficiency of intersection operations has a major impact on the safety of intersections. Intersections that operate with congestion, long delays, and queues lead to driver impatience and frustration, resulting in driver risk-taking and aggressive driving behaviour. Perceived in-efficiencies such as long red phases that are accompanied by very low conflicting traffic volumes might be ignored. These situations would ultimately result in a higher intersection collision risk.

Currently, the traffic operational efficiency at major intersections is usually monitored as needed, or on request. Signalized intersections are typically reviewed as part of the overall surrounding network and corridor requirements. 24-hour counts are collected on a regular basis, and turning movement counts are conducted as needed to support operational analysis. Intersections are scheduled for review as part of pavement rehabilitation programs.

The City is currently using well-accepted practices to review signal operations reactively. However, signal operations should be reviewed proactively, and on a regular basis, to avoid congestion-related safety issues. In order to review operations proactively, intersection turning movement counts should be conducted on a regular basis. A proactive approach can allow operational improvements to be considered in conjunction with regular maintenance or other upgrades, such as pavement marking maintenance or redevelopment applications.

City staff indicated that they would prefer to undertake counts and operational reviews regularly, but that the largest challenge is finding adequate staff resources to undertake these tasks.

Additionally, in spite of pro-active policies relating to operations and design, safety issues may occur at an intersection because of site-specific features. Unless the safety performance is monitored on a regular basis, it is not possible to address such issues as they become apparent. It is recommended that the City maintain a database of the collision history at intersections and monitor it on a regular annual basis. The integration of the collision history at intersections into the Planet GIS database will facilitate this task.

3.5 Documentation of Existing Policies, Practices and Procedures

During the in-service reviews, it was noted that at several locations, the signal visibility was of a high level, and exceeded what was recommended in the documented procedures. While the City has a program in place to upgrade signal visibility, the rationale behind the upgrades, and the standards to which signals were being upgraded were not well documented.

Example of an intersection with (good) signal visibility that exceeds the current policy

Similarly, during the review of policies, the City often noted that safety-related operational and design decisions were based on standard practises, but that the practises were only informally documented.

Documentation of existing practices will ensure that operational improvements are implemented uniformly, in a rationale manner, resulting improved consistency for drivers.

Other possible operations-related policies that could be considered for adoption could include a minimum level of service that is acceptable for signalized intersections or the definition of criteria when protected left-turn phase is recommended (high approach speeds, multiple approach lanes, collision history, etc.)

4.0 ENGINEERING MASTER PLAN STRATEGY

Intersection safety requires a multi-disciplinary approach incorporating engineering, education and enforcement. A comprehensive approach to intersection safety should consider all phases of the infrastructure life cycle: design, operations and maintenance. Within the design and operational phases, both short-term (reactive) and long-term (proactive) approaches need to be pursued. Engineering approaches are discussed in Section 4, and education and enforcement approaches are discussed in Section 5.

4.1 Intersection Classification System

4.1.1 Background

The intersection classification system is used to identify improvements that are typically appropriate to enhance safety at a particular intersection. Roads are typically grouped into systems according to the type of service they provide to the public. A hierarchy of roads defines the gradation in function from access to mobility, and associated design features. As part of the Safer City initiative for Kamloops, a new system for classifying roads in the network is being developed, as well as new road form guidelines for each class. Depending on the road classifications of the two intersecting streets, certain design elements may be more of a priority. For example, a city is more likely to prioritize pedestrian movements and provide facilities like curb extensions in their downtown and residential neighbourhoods. In order to assist the City of Kamloops in some of the issues relating to intersection design, an intersection classification system was developed.

4.1.2 Description of the Intersection Classification System

The intersection classification system was developed to be consistent with the network classification program. FIGURE 4.1 shows the 36 possible combinations of intersections within the eight categories of the network classification system.

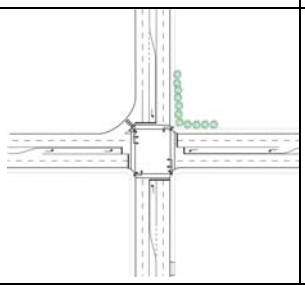
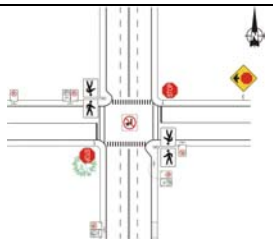
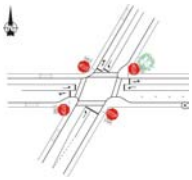
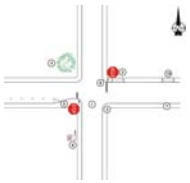
These intersection types were then grouped into six classifications of intersections with similar characteristics, as indicated by colour in FIGURE 4.1. Intersections were grouped based on traffic mix, traffic control type, number of approach lanes, and the classification of intersecting streets. A brief description of each of the types is provided in TABLE 4.1.

	Express-way	Major Arterial	Minor Arterial/ Hillside	Downtown/ Commercial Arterial	Primary Collector	Neighbour-hood Collector	Local	Industrial
Express-way						X	X	X
Major Arterial							X	
Minor Arterial/ Hillside					STOP 4-WAY	STOP	STOP	STOP
Downtown/ Commercial Arterial				STOP 4-WAY	STOP 4-WAY	STOP	STOP	STOP
Primary Collector					STOP 4-WAY	STOP	STOP	STOP
Neighbour-hood Collector						STOP	STOP	X
Local							STOP	X
Industrial								STOP

INTERSECTION CLASS	TYPICAL CONTROL
Major (M)	**Signal**
Primarily Major (PM)	**Signal**
Mixed	**2-way STOP/Pedestrian Signal/Semi-Actuated Signal**
Primarily Local (PL)	**4-way STOP/Possible signal**
Local (A)	**2-way STOP/YIELD**
Incompatible Road Functions	**Varies**

FIGURE 4.1 INTERSECTION CLASSIFICATION SYSTEM

TABLE 4.1 INTERSECTION CLASSES

CLASS	DESCRIPTION	TYPICAL LAYOUT	EXAMPLE
MAJOR	An intersection between two major arterials and/or expressways. Movement of through traffic is most important. Access to adjacent properties and movement of pedestrians is a lower priority. Generally controlled by a multi-phase traffic signal.		
PRIMARILY MAJOR	An intersection between two roadways that have a strong proportion of through traffic, but which also allow some access to adjacent streets. Pedestrian volumes could be high. Fairly typical in downtown areas. Generally controlled by a traffic signal.		
MIXED	Occur where a local road crosses roadway of a much higher classification. Such intersections are common in traditional grid-style road networks. They usually have pedestrian or semi-actuated signals, or two-way STOP control.		
PRIMARILY LOCAL	At this intersection, traffic volumes are relatively balanced. Pedestrian volumes are likely high, and providing access to the adjoining properties is a priority. Such intersections usually have 4-way STOP control, or roundabouts, but a signal may be considered under certain situations.		
LOCAL	At this intersection, traffic volumes are relatively low. Access to adjacent properties and movement of bicycles and pedestrians is the priority. Generally has two-way STOP control		
Incompat-ible Functions	In a typical road hierarchy, intersections between expressways and local streets are not recommended. When they occur, they are frequently candidates for closure, turn restrictions or re-classification of one of the intersecting streets.	No diagram provided	No photo provided

Recommended safety features were developed for each intersection class, to contribute toward the overall safety of the intersection. The guidelines can be grouped in the following categories:

- Laning,
- Traffic Operations
- Traffic Control Display,
- Pedestrian Facilities,
- Bicycle Facilities,
- Access Management, and,
- Sight Distance at Intersections.

These safety features are summarized in APPENDIX A of this report. As recommended safety features were developed for each class, certain items were considered to be desirable, no matter what the intersection class, including sidewalks, sidewalk letdowns, providing adequate sight distance, and ensuring good visibility of the traffic control. For convenience, these good practices are grouped by the type of traffic control as general guidelines in APPENDIX B.

Nevertheless, some key issues are more important for certain classes. For example, providing left turn bays is a priority at major intersections, but is generally not required, or even recommended for intersections with local streets. Therefore, the specific safety design features were outlined for each intersection class. More description of the classes and their specific features are provided in a separate report titled Model Guidelines for Intersection Design and Operations.

Some of these features were considered to be governing factors. That is, any difference between the specified feature and observed conditions may affect either the given classification or require supportive treatments to address potential safety issues.

For example, for major intersections, left-turn vehicles should be provided with a dedicated left turn lane, properly aligned with the opposing left-turn lane. If a dedicated left turn lane is not provided, the City may wish to consider left-turn restrictions or a left-turn phase. Alternatively, it may be that one of the intersecting streets is designated as a major arterial, but is really functioning as more of a collector, and should be considered for re-classification.

For new intersections, it is recommended that the intersections be designed to the guidelines of the appropriate classification. For existing intersections, if intersections do not meet the classification guidelines, and if operational or safety issues have been identified, the City may wish to upgrade to the proposed guidelines. This approach will be discussed in greater detail in section 4.4.

Some intersections were classified as “Incompatible Road Functions.” It is desirable to minimize the interconnection of lanes with arterials and of collectors with expressway. Such intersections should not be permitted in new construction of roadways, and where such intersections exist in the current network, mitigation measures should be considered if safety issues exist. If safety issues do not exist, the design standards for a “Mixed” intersection generally apply.

4.2 Pro-Active Strategies – Proposed Modifications to Existing Policies, Practices and Procedures

As noted in Section 3.5, in some cases, good safety-related practises were not well documented, particularly as they related to intersection control. In conjunction with the development of the intersection classification system, general guidelines were identified for signalized intersections, roundabouts and intersections with STOP signs, summarized in APPENDIX B. It is recommended that the City incorporate these good practices into their Traffic Advisory Manual and/or the Kamloops Design Manual.

Other procedures that should be adopted and documented are summarized below:

- The traffic operational efficiency at major intersections should be monitored on a regular basis, as operational efficiency can have a direct bearing on the collision risk. This information is also useful for pro-active prioritization of projects.

- In order to conduct operational reviews on a pro-active basis, the City should conduct an annual traffic count program, consisting of both 24-hour short counts and manual intersection counts. Ideally, a location should be counted at least once very two to three years to account for any growth and variations in the network. In order to minimize the staff resources required, the City may wish to consider monitoring the data from count-capable vehicle detectors, or including any counts conducted as part of a traffic impact study in the summary of the annual count program. Counts should be conducted in accordance with published traffic survey procedures.

- The City should formally document its standard practices relating to the timing of clearance intervals at signalized intersections.

- Road safety audits should be conducted for new and retrofit projects.

One of the largest challenges in achieving this goal will be to allocate adequate staff resources to the pro-active review of safety and operations.

4.3 Reactive Strategies – Black Spot Improvements & System-wide Improvements

The City should conduct a reactive program on a rolling yearly basis, or every second year as a minimum. Collision data should be analyzed annually to identify high crash locations and over-represented collision types. Blackspot studies can then be implemented every year, in partnership with ICBC's Road Improvement Program where possible.

The studies will identify collision causes and potential countermeasures, which are implemented as and when funding becomes available. The City should identify cost-sharing opportunities for this funding where possible. The information on high crash locations can also be used as input to education and enforcement campaigns, which will be discussed in Section 5.

4.4 Implementation of the Modified Guidelines

Currently many intersections exist in Kamloops which do not meet the model guidelines. It is not feasible or even necessary to review and upgrade all of these intersections at once. It is proposed that intersections be compared with the general design guidelines and safety features as part of regularly occurring activities of the planning and operations department of the City of Kamloops. Opportunities for possible upgrades to intersections should be considered whenever the following events occur.

- Regular review of collision history of intersections recommended in Section 4.2;
- Regular and budgeted maintenance work;
- Planned major rehabilitation and or reconstruction
- As part of the blackspot program, and/or
- In conjunction with the proposed redevelopment of adjacent properties.

Of course, Kamloops may consider it a priority to retrofit certain items, but this would require an allocation from the capital works plan.

When the intersection collision history is reviewed, for the top 20 intersections, the City should compare the existing layout with the recommended safety features for that class and the general design guidelines for that control type. This should be a relatively straightforward exercise, as most of the intersection data is contained in the Planet GIS software.

If the intersection meets the safety features and design guidelines for that class, and safety issues are still occurring, that intersection should be referred to the blackspot program. Also, if significant variations from the guidelines are noted, the intersection could also be referred to the blackspot program.
Options to mitigate identified deficiencies include:

- Long-term mitigation measures;
- Short-term low-cost mitigation measures;
- Upgrading or reclassification;
- Traffic calming where appropriate;

If the variations are less serious, the City should review if the deficiency relates to any identified collision patterns, operational issues or documented concerns at that intersection. In the report Model Guidelines for Intersection Design and Operations, information is provided on specific conditions that might "trigger" the need for an update to the recommended safety feature. For example, the guidelines recommend one signal head per approach lane. The additional cost of a longer mast arm may deter staff from making this improvement at all intersections. It should nevertheless be considered at any intersection with a history of over-represented rear-end collisions, or angle collisions. If an additional signal head on the mast arm cannot be funded, the City may wish to consider providing an additional post-mounted signal head at a much lower cost.

Besides through the annual review of collision history, any intersections affected by a planned major rehabilitation or reconstruction or redevelopment of adjacent properties, should be reviewed to confirm if opportunities exist to upgrade to the recommended guidelines.

If the collision history is not noteworthy, the City may also decide to "live" with a certain variation from the safety features – the variation may be not too serious, or not feasible to change. Where the condition is infeasible to change, low cost mitigating measures such as signage and delineation should be considered.

A demonstration project to compare 20 existing intersections with the intersection classification system has recently been conducted, and will be documented in a separate document.

5.0 EDUCATION AND ENFORCEMENT MASTER PLAN STRATEGY

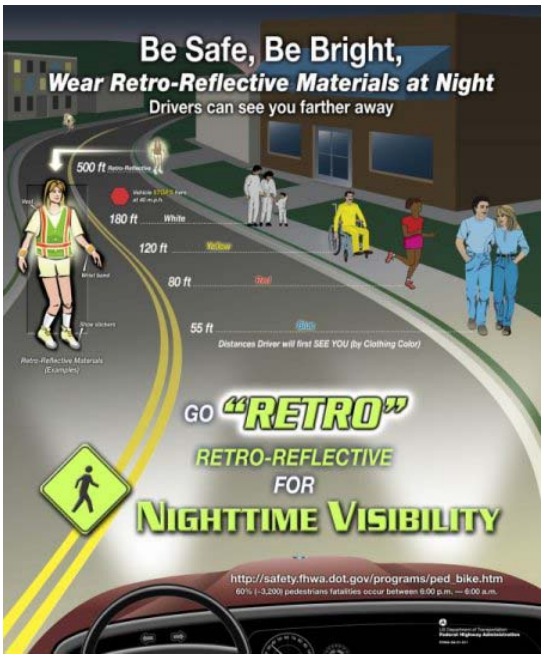
5.1 Background

General

As discussed in Section 2.2, community surveys and interviews with Kamloops police noted driver, pedestrian and cyclist behaviour as some of the factors that are contributing to safety issues at intersections. The majority of education and enforcement programs across North America are focused on the drunk driving, young drivers, seat belt usage, speeding and red-light-running. While all of these behaviours can contribute to collisions at intersections, only one of them, red-light running, is intersection-specific.

Education

The loss prevention calendar is a co-ordinated schedule of enforcement and education initiatives to occur on certain weeks during the year, throughout the province of British Columbia. The strength of the message is increased by using both enforcement and education, and because it occurs throughout the entire province. For example, typically the calendar focuses on pedestrian safety in September as children return to school. A related enforcement campaign could include additional enforcement at crosswalks. Education campaigns might remind drivers to "Slow down – the kids are back in school!"



Example of an education campaign used as part of the Loss Prevention Calendar

ICBC staff also attempt to attract media interest ("earned media") to these campaigns, in order to further distribute the message. Loss prevention campaign themes typically focus on the same five behavioural issues discussed above, as well as auto crime and pedestrian safety. Initiatives that might be most applicable to intersection safety include speed and aggressive driving.

Enforcement

Enforcement initiatives are generally co-ordinated with the loss prevention calendar, although individual detachments may select different priorities at their discretion. Recognizing the challenges that Canada's road safety community faces, Transport Canada has developed Road Safety Vision 2010 which incorporates the goal and strategies of a previous plan with a national target and several sub-targets. The efforts of Canada's road safety community to develop and implement effective strategies are intended to achieve this same level of success. The RCMP have adopted the Road Safety Vision 2010.

The national target calls for decreases of 30 percent in the average numbers of road users killed or seriously injured during the 2008-2010 period (compared to 1996-2001). In addition to the overall national target, Road Safety Vision 2010 contains a number of sub-targets reflecting Canada's major road safety problem areas. One of these targets is speed and intersection-related crashes.

5.2 Targeted Violations

Previous research has indicated that in order for an education campaign to be effective, it is important to focus on one or two important issues at a time. As discussed in Section 2.1, the most common collision types at intersections are rear-end, angle collisions and left-turn opposing collisions. At signalized intersections, angle collisions are generally the result of one driver running the red light. Reasons for red-light running could be aggressive driving, or inattentiveness. Similarly, rear-end collisions can be the result of driver distraction and following too closely. Driver behaviours contributing to left-turn opposing collisions include running the amber, and accepting inappropriate gaps. All of these behaviours are exacerbated by speeding. Drivers need more reaction time to brake when they are traveling at higher speeds, making it more likely that they will run the amber.

Based on this preliminary review of collision trends, and in consultation with ICBC, and RCMP staff, the following messages were proposed as the focus of any intersection-specific education/ enforcement campaign for Safer Cities:

- An intersection is a risky place;
- Don't run red lights; and,
- Slow down on the approaches to an intersection.

Collision data for Kamloops should be reviewed every two years to identify intersection-related collision trends. Based on this review, the messages described above could be re-assessed, and tailored to the current needs of the community of Kamloops.

ICBC may wish to research any state-of the art knowledge concerning education and enforcement of the focus issues described above.

5.3 Target Audience/Time of Day

The target audience should be those drivers who are primarily involved in intersection collisions. This could be determined from a review of the TAS data.

Similarly, upon review of the collision data, the time of day when most intersection collisions occur could be identified (likely the afternoon rush hour), and enforcement should be focussed on these time periods.

5.4 Recommended Education and Enforcement Methods

Education

Where enforcement programs have been deployed with the greatest success and highest levels of community support, they have been implemented as one element of an overall traffic safety management program.

A well-designed public information and education campaign will assist motorists and the general public to understand the safety issues inherent to red light running and speeding on intersection approaches, providing information and data that explains these issues, why they are dangerous, and what actions are currently being undertaken to reduce the incidence of these violations. One of the key messages of an education campaign can be the economic and emotional toll of red light running. The emotional toll of related collisions to the victims and their families is quite obvious but indirect economic costs of red light running related crashes in terms of lost productivity, higher insurance premiums, and medical cost can be significant as well.

An on-going educational program should be designed to combat red light running, in general, and be delivered in a way so as to reflect the interests, concerns, and needs of various audiences to which they are addressed. Red light running education campaigns are most likely to change behaviour of licensed drivers who are either not aware of the danger associated with running red lights or assign them as a very low risk. Background material on education campaigns that have been effective in improving road safety is found in APPENDIX C.

Many agencies have initiated campaigns to reduce red light running in conjunction with programs to introduce red light cameras. Links to the websites with examples of these campaigns are also provided in APPENDIX C.

Example of an anti-red-light running campaign used in Ontario

The on-going public information and education program should use various media. The City should monitor the effectiveness of the educational program and modify it in order to achieve maximum effectiveness.

Enforcement

Although intersection safety cameras are deployed at several intersections in Kamlloops, police officers will always have an important role to play in enforcing both red light violations and the many other forms of traffic violations at intersections as part of an overall traffic safety management program. Police officers can be effectively used for both random and targeted enforcement.

Random enforcement refers to the random selection of the locations to be enforced and this may be performed by either single or multiple officers. Random enforcement makes police presence visible and reminds drivers that enforcement is taking place.

Targeted Enforcement is when problem locations are identified and officer staff resources are committed to enforcement for a particular period. Such stepped up enforcement can again work as a visible reminder to motorists that the traffic laws should not be violated.

Other strategies to consider are summarized below:

- Police can be more effective in enforcing at intersections with a little guidance. One of the techniques used is to set targets, monitor, and increase enforcement. For example, some municipalities have set targets of observing 100 percent compliance with a certain safety-related ordinance and requesting that police monitor that target. If the target is not, the police are requested to ensure that a minimum number of violation notices relating to that infraction.
- Another approach to provide more guidance is the "Adopt an Intersection Program" – each patrol unit could be assigned a black spot. When the unit was not busy, they are requested to sit at their assigned intersections and enforce violations. This can raise police visibility at certain locations.
- Intersections are one of the targets of the RCMP's Road Safety Vision, 2010, that has been accepted in BC. This information can be leveraged to focus more enforcement at intersections.

Integrated Approach

The main focus of the intersection-related education and enforcement strategy should be to support the existing loss prevention calendar, especially those initiatives targeted at intersections, such as speeding and aggressive driving.

Where possible, the campaign should be co-ordinated with other agencies – this could include insurance brokers, the Attorney General's office (responsible for red light cameras) schools, and/or businesses.

5.5 Evaluation

Any education or enforcement programs should be evaluated to determine their effectiveness. Some of the methods that can be used to evaluate the proposed programs are summarized in TABLE 5.2.

TABLE 5.2 POSSIBLE EVALUATION CRITERIA FOR EDUCATION AND ENFORCEMENT INITIATIVES

VIOLATION TYPE	EVALUATION CRITERIA	METHODS
Speed	Speeding Violations	Officer citations Manual surveys
	85th percentile speed on key intersection approaches corridors	Tube counters Intersection Safety camera Autoscope data
	Collisions	TAS, TZMIT,Claims data
	Public Opinion/Awareness	Surveys, opinion polls, focus groups,
Red Light Running	Red Light Violations	Officer citations Intersection Safety camera Autoscope data Manual surveys
	Total Collisions	TAS, TZMIT, claims data
	Public Opinion/Awareness	Opinion polls, surveys, focus groups

THIS PAGE WAS INTENTIONALLY LEFT BLANK.

APPENDIX A
SUMMARY OF KEY FEATURES FOR INTERSECTIONS BY CLASS

THIS PAGE WAS INTENTIONALLY LEFT BLANK.

INTERSECTION CLASSIFICATION GUIDELINES

ELEMENT	Major	Primarily Major	Mixed	Primarily Local	Local/Industrial
Major Characteristics					
Intersecting Roadways	Expressway/Expressway Expressway/Major Arterial Expressway/Minor Arterial Major Arterial/ Major Arterial Major Arterial/Industrial	Expressway/DT Arterial Expressway/Prim Collector Major Arterial/Minor Arterial Major Arterial/DT Arterial Major Arterial/Prim. Collector Major Arterial/NH Collector Minor Arterial/Minor Arterial Minor Arterial/DT Arterial	Minor Arterial/NH Collector Minor Arterial /Local Minor Arterial/Industrial DT Arterial/NH Collector DT Arterial/Local DT Arterial/Industrial Prim. Collector/NH Collector Primary Collector/Local Primary Collector/Industrial	Minor Arterial/Prim. Collector DT Arterial/DT Arterial DT Arterial/Prim Collector Prim. Collector/Prim.Collector	NH Collector/NH Collector NH Collector/Local Local/Local Industrial/Industrial
Traffic Control	Signal	Signal or roundabout	Semi-actuated signal, ped signal, or two-way stop	Four-way STOP, possible signal, or roundabout	Two-way STOP, yield, or traffic circle
Through Approach Lanes (major/minor)	2+/2+	2+/(1-2)	2+/1	1-2/1-2	1/1
Traffic Mix	Through	Through/distribution	Through/local	Distribution/local	Local
Lanes					
Left-turn treatment	Lanes*/lanes*	Lanes*/(lanes*, restrictions, or shared)	(Lanes*, restrict, or shared)/(shared, or restricted)	Shared or lanes/shared or lanes	Shared/shared
Right-turn Treatment	Channelized per FHWA pedestrian guidelines** if required	Per FHWA pedestrian guidelines**if required	Shared	Non-channelized unless skewed	None
Parking Setback	Parking not supported	To provide turn lanes, curb extensions	To provide turn lanes, improve crosswalk visibility/6m	To provide turn lanes	6m
Traffic operations					
Traffic Counts	Every two years	Every two years	As required	As required	As required
Left-turn phase	Protected only	Protected-permitted, permitted, or restricted	Permitted or restricted	Permitted or protected-permitted	n/a
Traffic Control Display					
300/300/300 Primary Signal Heads with Backplates	One per approach lane	One per approach lane	One per approach lane	One per approach lane	n/a

See Notes on following page

INTERSECTION CLASSIFICATION GUIDELINES

ELEMENT	Major	Primarily Major	Mixed	Primarily Local	Local/Industrial
Tertiary (Auxiliary) Signal Heads	If approach lanes >3, curved, heavy truck volumes	If approach curved	If approach curved	If approach curved	n/a
STOP Signs	n/a	n/a	600 mm diamond grade oversize if rural	600 mm diamond grade oversize if rural	600 mm diamond grade oversize if rural
Pedestrian Facilities					
Sidewalks	Urban: sidewalks both sides Rural: shoulder both sides	Urban: sidewalks both sides Rural: shoulder both sides	Urban: sidewalks both sides Rural: shoulder both sides	Urban: sidewalks both sides Rural: shoulder both sides	Urban: sidewalk one side Rural/Ind.: shoulder both sides
Marked Crosswalks	Yes	Yes	Optional	Yes	Optional
Curb Extensions	None	Consider with pedestrian volumes and parking lanes	Consider with pedestrian volumes and parking lanes	Consider with pedestrian volumes and parking lanes	In conjunction with traffic calming, safe routes to school
Curb Radius	12 m	12 m	7.6 m	7.6 m	4.5m- urban, 15 m ind.
Bicycle Facilities					
Bicycle lanes	Shoulder, WCL, or marked lane	WCL or marked lane	WCL/shared	WCL	Shared
Bicycle Actuation	Maybe	No	Yes	No	n/a
Access Management					
Median	Raised	Raised, painted, or none	Raised, painted or none/none	As needed for peds, channelization	No
Driveway offset***	25 to 70 m	25 to 70 m	25 to 70m/15 m	20 to 55 m	15 m
Sight Distance at Intersections					
Required Sight Distance	Turning	Turning	Turning	Crossing	Crossing

Notes: n/a = not applicable; DT = Downtown; Prim = Primary;NH = Neighbourhood; WCL = Wide Curb Lane

*Any left turn lanes should be aligned with opposing left-turn lane

**Source: http://safety.fhwa.dot.gov/saferjourney/Library/countermeasures/15.htm

***Based on TAC Geometric Design Guide for Canadian Roads, Table 3.2.8.2

/ Separates the difference between standards for the major and the minor street in that intersection type.

Blue – Recognized as a governing factor to influence safety of the intersection classification and any differences between the specified guideline and observed conditions may affect either the given classification or require supportive treatments to address potential safety issues.

Black – Recognized as a guideline for different classes of intersections that will contribute toward overall safety of the roadway network

.

APPENDIX B
GENERAL GUIDELINES FOR INTERSECTIONS BY TYPE OF CONTROL

THIS PAGE WAS INTENTIONALLY LEFT BLANK.

TABLE B-1 GENERAL GUIDELINES FOR A SIGNALIZED INTERSECTION

#	DESIGN FEATURE	RATIONALE
1	One signal head per approach lane, all lenses 300 mm LED, backplates with reflective tape.	Improve signal visibility
	Tertiary signal head on cross-sections more than 5 lanes wide	
2	Secondary signal head - all lenses 300 mm LED. Backplates with reflective tape preferred.	Improve signal visibility, esp. for left turn vehicles
3	Remove sight distance obstacle such as buildings* or bushes.	Improve intersection sight distance
4	Provide bike lane or wide curb lane – between 4.3 and 4.5 m	Accommodates bicycles.
5	Sidewalks	Accommodates pedestrians
6	Provide pedestrian let-downs, parallel to crosswalks	Accommodates pedestrians
	Remove brush/shrubbery/street furniture near crosswalks	Improves visibility of pedestrians to driver
7	Set high volume driveways at least 25 metres back from the intersection**	Driveway movements do not interfere with intersection operations.
8	Provide adequate storage length for left turn bays	Queues should not extend into through lane.
9	Overhead street name signs	Improves intersection visibility, reduces last minute lane changes
10	Clearance intervals should be based on City-wide policy. If angle collisions prevail, consider increasing all-red phase	Allows vehicles time to clear intersection.
11	Advance warning flashers or near side signal heads	When a horizontal curve obstructs sight distance.

*Likely long term or with redevelopment.

** See TAC Guidelines (Reference 13)

TABLE B-2 GENERAL GUIDELINES FOR A ROUNDABOUT*

FEATURE	RATIONALE
Truck apron	Slower speeds
Single lane, simple	Better for bikes, slower speeds
Well-defined crossings	Better visibility of pedestrians
Splitter islands	-Facilitate the perception of the intersection on the approach; -Provide pedestrian refuge, allowing a two stage crossing; -Separate the exit and entry flows thus avoiding head on collisions; -Improve capacity by allowing entering drivers to differentiate between exiting and -circulating vehicles; -Constrained entry slows drivers, better visibility of pedestrians
Lots of deflection	Slower speeds
Yield at entry	Allows for flow in the roundabout
Unconstrained visibility to the left	To allow safe entry

* Adapted from the British Columbia Community Traffic Manual

TABLE B-3 GENERAL GUIDELINES FOR INTERSECTIONS WITH STOP SIGNS

#	DESIGN FEATURE	RATIONALE
1	Conspicuous STOP or YIELD signs – possibly use oversize	Improve visibility and compliance with traffic control
	Ensure STOP/YIELD signs visible and highly reflective through maintenance, tree trimming, inventory and upgrade programs	
2	Provide STOP Bar	Improve visibility and compliance with traffic control
3	Remove sight distance obstacle such as buildings, berms or bushes	Improve intersection sight distance
4	Right-turn radius should be the minimum possible for the vehicle mix	Reduces turning speed, lane use confusion
5	Provide crosswalks where demand exists	Accommodates pedestrians
	Remove brush/shrubbery near crosswalks	Improves visibility of pedestrians to driver
6	Provide crosswalk letdowns	Accommodates pedestrians
7	Restrict parking within 6 metres of the intersection	Improve visibility of STOP sign
8	Use Intersection Ahead or STOP ahead signs as necessary	to increase conspicuousness of the intersection

APPENDIX C
RESOURCES FOR EDUCATION AND ENFORCEMENT CAMPAIGNS

THIS PAGE WAS INTENTIONALLY LEFT BLANK.

TABLE C-1 WEBSITES RELATING TO ENFORCEMENT AND EDUCATION INITIATIVES FOR INTERSECTION SAFETY

RESOURCE TOPIC	WEBSITE SPONSOR	WEB ADDRESS
Road Safety Vision 2010.	Transport Canada	http://www.tc.gc.ca/roadsafety/vision/2001/targets.htm#management
Education and Enforcement Strategies	FHWA	http://safety.fhwa.dot.gov/rlcguide/ch4.htm#42
Intersection Safety Enforcement	FHWA	http://safety.fhwa.dot.gov/fourthlevel/interbriefing/05enforcemnt.htm
Intersection Safety Tips For Drivers	ICBC	www.icbc.com/Road_Safety/roadsafety_tips_daily_inter.html
	State Farm	www.statefarm.com/di/safedriv.htm
Red Light Cameras	FHWA	http://safety.fhwa.dot.gov/rlcguide/index.htm
Anti-red-light Running Advocacy groups	Stop Red Light Running- FHWA site	http://www.fhwa.dot.gov/safety/programs/srlr.htm
	American Trauma Society's Commitment to STOP RED LIGHT RUNNING	http://208.58.30.127/RLR/
	The Red means STOP coalition	http://www.orgsites.com/az/rms/index.html
	The Light is Red for a Reason:So Stop	http://www.nhtsa.dot.gov/people/outreach/safesobr/12qp/redlight.html
	Highway Technet Featured Projects:	http://www.library.unt.edu/gpo/OTA/featproj/fp_dp112.html

TABLE C-2 ANTI-RED-LIGHT RUNNING CAMPAIGNS IN CONJUNCTION WITH RED LIGHT CAMERA PROGRAMS

JURISDICTION	RED LIGHT CAMERA WEB SITE
Toronto	http://www.city.toronto.on.ca/transportation/redlightcams.htm
Alberta	https://www.ama.ab.ca/mission_possible/newsletters/2001q3/p08.html
Region of Peel	http://www.region.peel.on.ca/news/2001/september/010924a.htm
City of St. Albert	http://www.city.st-albert.ab.ca/Admin/documents/PostedData/Red_Light_Poster.pdf