

A TECHNICAL REVIEW OF PEDESTRIAN SIGNALS IN CANADA

A CITE Informational Report

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Transportation Association of Canada

May 2006

A Technical Review of Pedestrian Signals in Canada

Prepared by:

CANADIAN INSTITUTE OF TRANSPORTATION ENGINEERS



In Association with:

INSURANCE CORPORATION OF BRITISH COLUMBIA



ITE GREATER VANCOUVER SECTION



TRANSPORTATION ASSOCIATION OF CANADA



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PREFACE

The Canadian Institute of Transportation Engineers (CITE) is composed of more than 1,300 transportation engineers, planners, technologists and students across Canada. CITE is an integral part of the Institute of Transportation Engineers (ITE) which consists of more than 16,000 transportation professionals in more than 90 countries. These transportation professionals are responsible for the safe and efficient movement of people and goods on streets, highways and transit systems. Since 1930, ITE has been providing transportation professionals with programs and resources to help them meet those responsibilities. ITE and CITE programs and resources include professional development seminars, technical reports, a monthly journal, local, regional and international meetings and other forums for the exchange of opinion, ideas, techniques and research.

This report is an Informational Report of CITE in partnership with the Insurance Corporation of British Columbia (ICBC), the ITE Greater Vancouver Section and Transportation Association of Canada (TAC) and prepared by the Pedestrian Signal Technical Review Committee (PSTRC). The information in this report has been obtained from transportation engineering professionals and research. CITE Informational Reports are prepared for informational purposes only and do not include CITE recommendations on the best course of action or the preferred application of data.

The objective of the PSTRC was to conduct a national review of pedestrian (or half) signals in order to determine the state of practice for the traffic control device and to identify if the current design and application guidelines are still considered appropriate for Canada. The PSTRC members were:

- | | |
|--|--|
| • Jan O. Voss, Creative Transportation Solutions Ltd. | Chairperson and CITE Representative |
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EXECUTIVE SUMMARY

Pedestrian traffic signals at intersections feature signal control for vehicles on the major street and pedestrians crossing the major street, and stop sign control for motorists approaching on the minor street. This device has been in use in Canada since the mid-1960's, primarily in large metropolitan areas. They are not used by all Canadian jurisdictions, but are relatively common in parts of British Columbia, Alberta and Ontario. Where they are used, pedestrian signals are part of the hierarchy of traffic control devices commonly used by transportation professionals to enhance pedestrian safety.

In British Columbia, concerns have been raised that intersection pedestrian signals may not command the same respect from the motoring public that full traffic signals do. Of particular concern is the observation that minor street motorists often fail to come to a full stop on the stop-controlled approaches during the pedestrian phase which may put pedestrians crossing on a valid WALK display at risk. In addition, some transportation professionals are concerned that the different signal displays in different Canadian jurisdictions, the combination of stop sign control and signal control at a single intersection, and some innovative deployments of pedestrian signals, prevent the pedestrian signal from conveying a clear and simple meaning to all users.

The primary objectives of the technical review of pedestrian signals in Canada were:

- To conduct a national survey of public agencies to determine the extent of the use of intersection pedestrian signals as a traffic control device and to seek any input on any existing operational and/or safety concerns;
- To conduct a more detailed review of pedestrian signals including additional data collection and accident records;
- To conduct a telephone survey of randomly selected British Columbia motorists in order to determine their understanding of pedestrian signals and the intent of the flashing green ball display for main street traffic;
- To identify gaps or inconsistencies in existing guidelines for pedestrian signals; and
- To prepare an informational report to assist practitioners in the design and operation of pedestrian signals.

The Transportation Association of Canada's (TAC's) *Pedestrian Crossing Control Manual* and the *Pedestrian Crossing Control Manual for British Columbia* published by the Ministry of Transportation are the two main documents in Canada that currently provide design and application information for practitioners. Both documents were referenced extensively in this review.

Thirty road authorities across Canada, including 16 in British Columbia, responded to a national survey regarding their practices for pedestrian crossing control. Of those surveyed, 86% use pedestrian signals as a traffic control device. Survey responses reported a total inventory of 8,266 traffic signals of which 7,386 were full signals (89%) and 880 were pedestrian signals (11%). Of note, 86% of the surveyed pedestrian signal inventory was in Alberta (28%) and British Columbia (58%). Therefore, this traffic control device is predominantly used in Western Canada based on the survey responses. As well, of all reported pedestrian signals in Canada, 55% are installed at four-legged intersections, 31% at T-intersections, and 14% at mid-block locations. However, installation of

pedestrian signals at intersections is more popular in Western Canada than in Eastern Canada where the mid-block location is preferred.

The survey found that the *TAC Pedestrian Crossing Control Manual* and the *Pedestrian Crossing Control Manual for British Columbia* were the most common sources for warrant calculations for pedestrian signals, although some locally developed warrant systems were noted. A significant operating difference for pedestrian signals in British Columbia compared to other Canadian Provinces is the use of a flashing green display to differentiate pedestrian signals from other traffic signals; outside of British Columbia a solid green is used at pedestrian signals. In one other province, Ontario, a fast flashing green display is currently used to indicate a priority phase for one direction, however it is expected that this practice will be discontinued in the future.

Pedestrian signals are in use in the United States as well. However, they are not as prevalent as in Canada and the majority of them are located at mid block locations in large urban metropolitan areas. The *U.S. Manual on Uniform of Traffic Control Devices* prohibits the use of stop signs at signalized intersections for side streets or driveways unless the volumes are so low that an extremely low potential for conflict exists. As well, the flashing green ball display is not recognized as a valid signal display in the United States.

Field measurements of motorist compliance with traffic regulations at pedestrian signals were conducted to determine the extent of observed compliance problems in both Alberta and British Columbia. Failure to stop at the minor street stop signs during the pedestrian crossing display was of particular concern due to the risk exposure for pedestrians crossing the minor and/or major street crosswalks. A number of survey locations did have high non-compliance rates and further analysis was done to determine if this related to the satisfaction of pedestrian and full signal warrants for the intersection. As expected, it was found that locations warranting a full signal, but with a pedestrian signal in operation, tended to have the highest stop sign violation rates. However it should be noted that a comparison of the surveyed stop sign violation rates with those from a typical 2-way or 4-way stop controlled intersection could not be done within the scope of this project. Further study of stop sign non-compliance rates at intersections that do not have pedestrian signals is recommended for comparison purposes.

The Insurance Corporation of British Columbia (ICBC) is a Crown Corporation that provides automobile insurance to all British Columbia residents, as well as publishing the *Driver Training Guide* for new drivers. ICBC conducted a telephone survey of 604 randomly selected motorists to determine their understanding of pedestrian signal operation. The survey respondents were classified as long term residents as they had lived in British Columbia for an average of 32.6 years. When asked the meaning of a flashing green signal display, 38% of respondents understood that the display meant "proceed with caution" and 33% understood that they were approaching a pedestrian controlled intersection. However, 16% of the survey respondents answered that they did not know the meaning of the flashing green ball display and another 4% stated that they did not know or refused to answer. Seventy-four percent of respondents indicated that they had not experienced any confusion when approaching a four way intersection controlled by a pedestrian signal as a driver and 76% indicated no confusion as a pedestrian. Therefore, British Columbia residents are familiar with pedestrian signals and their operation, however up to 20% of long term residents are unsure what the flashing green ball display actually means. A determination of motorist comprehension of other traffic control devices in British Columbia would be beneficial to provide perspective on the significance of these findings.

The history of motor vehicle crashes involving pedestrians in the Greater Vancouver area of British Columbia was reviewed to determine whether an inordinate number of such collisions occurred at pedestrian signals. In particular, 14 Greater Vancouver pedestrian signal locations where driver compliance had been measured were reviewed over a recent 3 year period, however no significant trend of pedestrian related crashes was found. It was therefore concluded that although the lack of driver compliance with side street stop signs does increase pedestrians' exposure to risk, it has not resulted in reported pedestrian related crashes at these locations.

A review of available reports and studies on the relationship between pedestrian signals and collision statistics involving pedestrians elsewhere in Canada identified relevant research in both Edmonton, Alberta and Hamilton, Ontario. The City of Edmonton regularly reviews pedestrian collision activity trends since installation of these devices began. The most recent safety review by the City of Edmonton identified that the rate of pedestrian-motor vehicle collisions declined 40% between 1989 and 2000. A safety review of collision data for 25 pedestrian signals in Hamilton, Ontario also determined that the average collision rates decreased after installation of the pedestrian signals. While vehicle collision rates increased at some locations and decreased at other locations in Hamilton, the average vehicle collision rate over all of the locations studied was lower after the pedestrian signals were installed.

The technical review identified some opportunities to improve the existing pedestrian crossing control manuals, primarily with the addition of figures illustrating additional scenarios. The review also noted discrepancies between jurisdictions in the design and deployment of pedestrian signals. In particular, the use of a flashing green ball display at pedestrian signals in British Columbia, versus the use of solid green elsewhere in Canada, was noted.

Overall, the study findings indicate that pedestrian signals are an appropriate traffic control device for specified traffic conditions. Traffic volumes and collision experience should be monitored following the installation of a pedestrian signal to ensure that the device remains the most suitable traffic control for the intersection.

1.0 INTRODUCTION

1.1 Background

Traffic engineering practitioners in Canada have a range of traffic control devices that can be considered for pedestrian crossings. In addition to traditional devices such as signed and marked crosswalks and traffic signals, innovative solutions such as in-pavement warning lights continue to be developed. There are some variations in devices and application practices across the country. However in general, pedestrian crossing protection fits into a hierarchy from the least to most protective devices as summarized below:

- Unmarked crosswalk;
- Marked crosswalk;
- Signed and marked crosswalk with side mounted signs;
- Signed and marked crosswalk with overhead mounted signs, internally illuminated or with down lighting;
- Signed and marked crosswalk with pedestrian actuated flashing beacons;
- Pedestrian (or half) traffic signals, at intersections or mid-block locations;
- Full traffic signals with pedestrian signal heads; and
- Grade separation.

Pedestrian signals have been in use in Canada since the mid-1960's, primarily in large metropolitan areas. Pedestrian traffic signals at intersections feature signal control for vehicles on the major street and pedestrians crossing the major street, and stop sign control for motorists approaching on the minor street. They are not used by all Canadian jurisdictions, but are relatively common in parts of British Columbia, Alberta and Ontario.

Design and application guidelines for pedestrian signals are provided in the *Pedestrian Crossing Control Manual* published by the Transportation Association of Canada (TAC, 1998) and in the *Pedestrian Crossing Control Manual for British Columbia*, first published by the British Columbia Ministry of Transportation (MoT) in 1994. The two documents are nearly identical in content, except for the references to the signal displays for vehicles. The TAC manual specifies the use of a solid green ball display while the British Columbia MoT document specifies the use of a flashing green ball during the "rest state" of the controller.

The fundamental requirements for traffic control devices, based upon the *Traffic Engineering Handbook* published by the Institute of Transportation Engineers, are to:

1. meet a need;
2. command attention;

3. convey a clear and simple meaning;
4. command respect of the road users; and
5. give adequate time for proper response.

In British Columbia, the following concerns were recently raised by both the media and practitioners regarding the misuse and/or misunderstanding by the motoring public of some aspects of the pedestrian signal traffic control device when located at intersections:

- Minor street motorists regularly fail to come to a full stop on the stop-controlled approaches during the pedestrian phase;
- The flashing green ball display in British Columbia may not convey a clear and simple meaning to motorists (especially tourists) as a flashing green ball display, albeit with a different flash rate, has historically indicated a protected left turn phase elsewhere in Canada; and
- Minor street motorists, while waiting for a gap in major street traffic, are observed getting out of their vehicles and pushing the pedestrian button to bring up the red for the major street in order to create a gap in the traffic flow.

These concerns indicate that pedestrian signals may not command the same respect that full traffic signals have from the motoring public. In addition, some transportation professionals are concerned that the different signal displays in different Canadian jurisdictions, the combination of stop sign control and signal control at a single intersection, and different deployments of “add-on” hardware could prevent the pedestrian signal from conveying a clear and simple meaning to all users.

These concerns prompted transportation professionals at Creative Transportation Solutions Ltd. (CTS), and LCP Signal Management Inc. (LCP) to initiate and fund a study of these issues in 2000. The primary objective of the study was to quantify the above noted concerns and determine if there was warrant for further study to review in more detail the current design and operation of pedestrian signals in B.C. The study included detailed surveys at 12 pedestrian signals in the Greater Vancouver area. Their key conclusions from a literature search, field observations, data collection and analysis were as follows:

1. British Columbia’s pedestrian signal operation is unique to North America.
2. Conflicting vehicle and pedestrian control on each leg is confusing to both road users and pedestrians.
3. The flashing green ball display for pedestrian signals is not included in the *Canadian Manual on Uniform Traffic Control Devices*;
4. The flashing green ball display is not recognized as a valid signal display in the United States;

5. The U.S. Manual on Uniform of Traffic Control Devices does not support the use of stop signs at signalized intersections for side streets or driveways unless the volumes are so low that an extremely low potential for conflict exists.
6. The observed stop sign violation rates at 10 of the 12 surveyed pedestrian signals exhibit unacceptable motorist behaviour which can be dangerous to all users of the intersection.
7. Non-compliance of stop sign by side street motorists during the pedestrian phase was found to increase as main street volumes increased.

The key recommendation from CTS and LCP was that a further technical review of these issues be conducted and this review should include, but not be limited to, examining design, operational and safety issues.

This initial study and the concern that motorists were not correctly interpreting the meaning of the flashing green ball display in British Columbia, were brought to the attention of various transportation and public agencies. In 2002, the Canadian Institute of Transportation Engineers (CITE), the Insurance Corporation of British Columbia (ICBC), the Greater Vancouver Section of the Institute of Transportation Engineers (GVITE) and the Transportation Association of Canada (TAC) agreed to jointly conduct a technical review of pedestrian signals in Canada. This document summarizes the findings of that technical review.

1.2 Technical Review Objectives

The primary objectives of the technical review of pedestrian signals in Canada were:

- To conduct a national survey of public agencies to determine the extent of the use of pedestrian signals as a traffic control device and to seek any input on any existing operational and/or safety concerns;
- To conduct a more detailed review of pedestrian signals including additional data collection and accident records;
- To conduct a telephone survey of randomly selected British Columbia motorists in order to determine their understanding of pedestrian signals and the intent of the flashing green ball display for main street traffic;
- To identify gaps or inconsistencies in existing guidelines for pedestrian signals; and
- To prepare an informational report to assist practitioners in the design and operation of pedestrian signals.

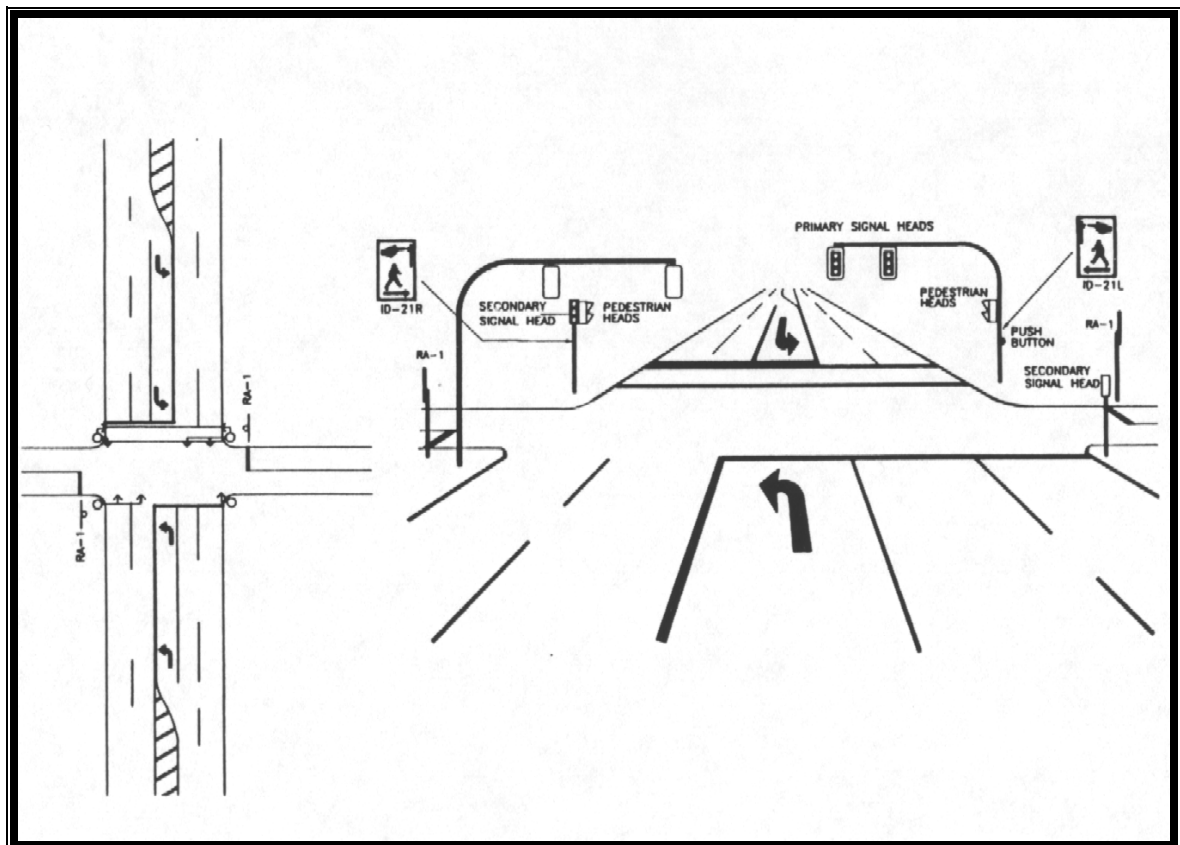
2.0 CURRENT GUIDELINES

2.1 TAC Pedestrian Crossing Control Manual

In March 1998, TAC published the national *Pedestrian Crossing Control Manual* using the April 1994 British Columbia manual as a template. This document was intended to augment the *Manual of Uniform Traffic Control Devices (MUTCD)* published by TAC. The significant difference between the TAC and British Columbia pedestrian signal manuals is that the British Columbia manual specifies the use of a flashing green ball display for the “rest” state of the controller for main street operation while the TAC manual specifies the use of a solid green ball display.

Both manuals specify the use of Stop Signs for side street control at a pedestrian signal that is located at an intersection. **FIGURE 2.1** illustrates a typical pedestrian signal layout at an intersection from this manual. This figure is included in both the TAC Pedestrian Crossing Control Manual and the British Columbia Pedestrian Crossing Control Manual.

FIGURE 2.1
TYPICAL LAYOUT OF A PEDESTRIAN SIGNAL



2.2 Pedestrian Crossing Control Manual for British Columbia

The *Pedestrian Crossing Control Manual for British Columbia* was first published by the British Columbia Ministry of Transportation & Highways in April 1994. It superseded the April 1992 *Pedestrian Crossing Practice* guidelines. The primary purpose of this publication was to offer operational guidelines and warrants for the use of devices for the control of traffic and pedestrians. In addition, the manual provides information about various pedestrian crossing devices approved for use in British Columbia.

The primary reason for the use of the flashing green ball display in British Columbia is to inform oncoming motorists of the presence of a pedestrian controlled signal and that all movements on the main street are permissive, including left turns from the main street. As well, the motorists may encounter vehicles accessing the main street from the side street during the green signal display.

2.3 Discussion of the TAC and British Columbia Pedestrian Crossing Control Manuals

A critical review of the *TAC Pedestrian Crossing Control Manual* and the *Pedestrian Crossing Control Manual for British Columbia* was conducted by the steering committee. It was found that it would be beneficial to incorporate the following additional material into future revisions of these documents:

1. Guidance for installing pedestrian signals at midblock locations;
2. Layout illustrations for pedestrian signals at T-intersections and midblock locations; and
3. A layout illustration for a pedestrian signal at an intersection with two crossings of the major street, either in place of or in addition to the existing illustration with a single crossing.

2.4 Ontario Guidelines

In Ontario, the *Ontario Traffic Manual* series provides information and guidance to transportation practitioners to promote uniform traffic control devices and systems across the province. Prior to the development of these documents, the *Ontario Manual of Uniform Traffic Control Devices* was the primary source for traffic control guidance. The following books in the series deal with pedestrian crossing control:

- *Book 5 – Regulatory Signs*
- *Book 6 – Warning Signs*

- *Book 8 – Information Signs*
- *Book 11 – Pavement Markings*
- *Book 12 – Traffic Signals*

Development of a manual to bring together the application of signals, signs and pavement markings pertaining to pedestrian control and protection is planned. This document will be *Book 15 – Pedestrian Control and Protection*.

Until Book 15 is published, practitioners are also referred to the *Ontario Manual of Uniform Traffic Control Devices* for further details on pedestrian crossing installation and how the various components comprising a Pedestrian Crossover are combined.

The Pedestrian Crossover is a specific device defined in the *Ontario Highway Traffic Act* which is similar in function to the Special Crosswalk device in the *TAC Pedestrian Crossing Control Manual* and the *Pedestrian Crossing Control Manual for British Columbia* in that it incorporates pedestrian actuated flashing yellow beacons with an overhead sign. However, the appearance of the Ontario Pedestrian Crossover sign is different than the TAC Special Crosswalk sign.

Warrant criteria for Pedestrian Crossovers and Intersection Pedestrian Signals are provided in the *Ontario Traffic Manual Book 12*. The warrant method considers adjustment factors to account for vulnerable pedestrians including senior citizens, disabled pedestrians and children unaccompanied by an adult and unassisted by a crossing guard. Volumes of vehicles and pedestrians and pedestrian delay due to lack of gaps in traffic are the key considerations. Eight hours of data are required for the evaluation.

It is notable that in Ontario, a circular flashing advanced green display currently indicates priority for one direction over the opposing direction, typically to provide a protected-permissive left turn operation in one direction only, and is currently used in many jurisdictions. The flash rate for this function in Ontario is 150 to 180 flashes per minute, which is a higher frequency than the flashing circular green display used for pedestrian signals in British Columbia at 60 per minute. The *Ontario Highway Traffic Act* recognizes the flashing circular green for this purpose. A review of the *Ontario Traffic Manual Book 12* is currently underway, and it is anticipated that the use of the flashing circular green for traffic priority will be phased out in Ontario with the revised version of the manual.

2.5 United States Guidelines

The use of pedestrian signals in the United States is fairly limited and is primarily concentrated at mid-block locations in the downtown cores of a number of major metropolitan areas (e.g.

Seattle, Los Angeles). However, a number of jurisdictions have tested pedestrian signals located at intersections (e.g. Issaquah, Washington which is a suburb of Seattle). A number of pedestrian signals located at intersections in other U.S. jurisdictions have been converted to full signal operation after encountering operational difficulties such as motorist confusion with the traffic control device.

Pedestrian signals in the United States use the solid green ball display for the “rest state” of the controller for main street operation because the flashing solid green ball display is not recognized as a valid signal display by the *Manual on Uniform Traffic Control Devices 2003 Edition* published by the U.S. Department of Transportation and the Federal Highway Administration. As well, in Section 4D.01 of the U.S. *MUTCD 2003 Edition*, the manual states that stop signs shall not be used in conjunction with a traffic control signal operation except:

- If the display is flashing red (i.e. to reinforce a stop sign);
- Or if the minor street or driveway is located within or adjacent to an area controlled by the signal and the volumes are so low that an extremely low potential for conflict exists.

This document also states as a standard that:

Midblock crosswalks shall not be signalized if they are located within 90 metres (300 ft) from the nearest traffic control signal, unless the proposed traffic control signal will not restrict the progressive movement of traffic.

In addition, it provides guidance that:

Midblock crosswalks should not be signalized if they are located within 30 metres (100 ft) from side streets or driveways that are controlled by STOP signs or YIELD signs.

Following this guidance would reduce problems related to motorists turning onto the major street conflicting with pedestrians crossing the street.

3.0 CURRENT CANADIAN PRACTICES

All public agency members of TAC were surveyed in order to quantify the use of pedestrian signals across Canada. The key objectives of this were:

- To determine the extent of the use of pedestrian signals as a traffic control device;
- To seek input on any existing operational and/or safety concerns;
- To determine if actual pedestrian signal policies vary significantly from provincial and national manuals; and
- To gather information on the different warrant systems in use for determining when a pedestrian signal is warranted or not.

A total of thirty road authorities in Canada responded to the national survey including sixteen from British Columbia. The data collected was overrepresented from British Columbia and conversely underrepresented in provinces such as Ontario and Quebec as a number of major cities (e.g. Ottawa, Montreal, etc.) did not participate in the survey. The results of the national survey should be used with caution as the results are not considered to be an accurate national representation.

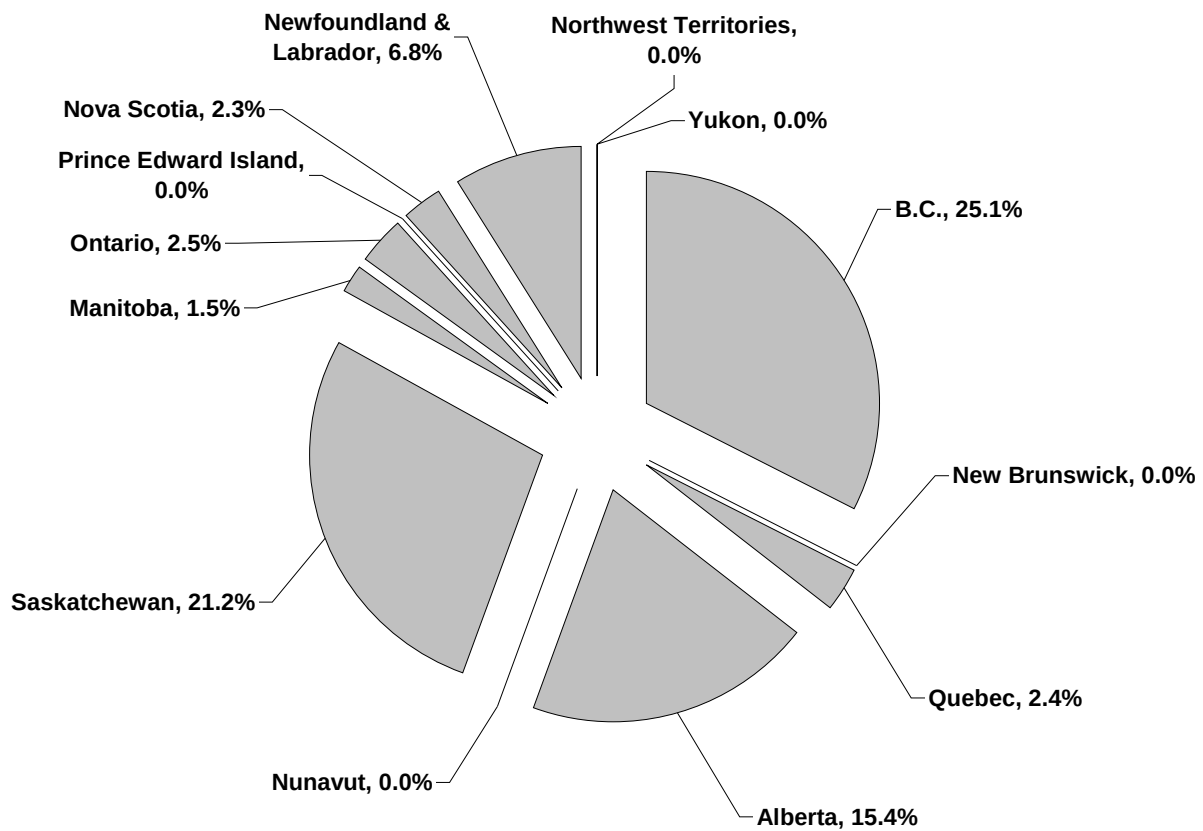
3.1 Traffic Signal Inventory

Survey responses reported a total inventory of 8,266 traffic signals of which 7,386 were full signals (89%) and 880 were pedestrian signals (11%). **TABLE 3.1** lists each survey respondent by province or territory and the number of full and pedestrians signals in their inventory. Of note, 86% of the surveyed pedestrian signal inventory is in Alberta (28%) and British Columbia (58%) as illustrated on **FIGURE 3.1**. Therefore, this traffic control device is predominantly used in Western Canada based on the survey responses. As well, it is interesting to note that the ratio of pedestrian signals to the total inventory is significantly higher in British Columbia (20%) than elsewhere in Canada.

TABLE 3.1
LIST OF RESPONDENTS TO TAC NATIONAL SURVEY

#	PROVINCE / TERRITORY	ROAD AUTHORITY	FULL SIGNALS	PED SIGNALS	TOTAL
1	Alberta	Government of Alberta	125	2 (1.6%)	127
2		Calgary	775	6 (0.8%)	781
3		Edmonton	600	223 (37.2%)	823
4		Red Deer	88	14 (15.9%)	102
		SUB TOTAL ALBERTA	1588	245 (15.4%)	1833
5	British Columbia	Ministry of Transportation	530	37 (7%)	567
6		Abbotsford	61	14 (23%)	75
7		Burnaby	194	44 (22.7%)	238
8		Chilliwack	34	3 (8.8%)	37
9		Delta	56	11 (19.6%)	67
10		Kamloops	58	12 (20.7%)	70
11		Kelowna	65	9 (13.8%)	74
12		Langley (Township)	50	8 (16%)	58
13		Mission	5	4 (80%)	9
14		North Vancouver (District)	43	7 (16.3%)	50
15		Port Moody	22	2 (9.1%)	24
16		Prince George	31	11 (35.5%)	42
17		Richmond	125	45 (36%)	170
18		Surrey	210	38 (18.1%)	248
19		Vancouver	433	257 (59.4%)	690
20	Victoria	115	9 (7.8%)	124	
	SUB TOTAL BRITISH COLUMBIA	2032	511 (25.1%)	2543	
21	Manitoba	Manitoba Transportation	130	2 (1.5%)	132
		SUB TOTAL MANITOBA	130	2 (1.5%)	132
22	Newfoundland & Labrador	St. Johns	88	6 (6.8%)	94
		SUB TOTAL NEWFOUNDLAND & LABRADOR	88	6 (6.8%)	94
23	Nova Scotia	Halifax	260	6 (2.3%)	266
		SUB TOTAL NOVA SCOTIA	260	6 (2.3%)	266
24	Ontario	Oakville	232	0 (0%)	232
25		Toronto	1925	54 (2.8%)	1979
		SUB TOTAL ONTARIO	2157	54 (2.5%)	2211
26	Quebec	Government of Quebec	800	10 (1.3%)	810
27		Gatineau	180	14 (7.8%)	194
		SUB TOTAL QUEBEC	980	24 (2.4%)	1004
28	Saskatchewan	Saskatchewan Highways & Transportation	n/a	n/a	0
29		Regina	151	32 (21.2%)	183
		SUB TOTAL SASKATCHEWAN	151	32 (21.2%)	183
30	Yukon	Government of Yukon	0	0 (0%)	0
		SUB TOTAL YUKON	0	0 (0%)	0
TOTAL BASED ON SURVEY RESPONDENTS			7386	880	8266
			89.4%	10.6%	100%

FIGURE 3.1
PERCENTAGE OF TOTAL SIGNAL INVENTORY
THAT ARE PEDESTRIAN SIGNALS*



* Note: Based on TAC survey respondents

3.2 Pedestrian Signals

The majority of the responding road authorities (86%) indicated that pedestrian signals are used in their jurisdictions. While the number of pedestrian signals installed vary by jurisdiction, as well as the warrants used for pedestrian signal installation and the proportion of pedestrian signals to other crossing facilities, most of the participating jurisdictions replied that they will continue to use pedestrian signals wherever warranted. As well, pedestrian signals may operate freely or in a coordinated manner. Within a coordinated system, the pedestrian signal typically uses either the coordination cycle time or half of the coordination cycle time (i.e., double cycled).

The national standard set out in the TAC *Pedestrian Crossing Control Manual* is adhered to by most jurisdictions outside of British Columbia. Within British Columbia, the majority of jurisdictions that responded indicated that they follow the guidelines in the British Columbia manual.

3.3 Location of Pedestrian Signals

Across Canada, the four-legged intersection is the most common location to install pedestrian signals. Of all reported pedestrian signals in Canada, 55% are installed at four-legged intersections, 31% at T-intersections, and 14% at mid-block locations as summarized in **TABLE 3.2**. However, installation of pedestrian signals at intersections is more popular in Western Canada than in Eastern Canada where the mid-block location is preferred. The one known exception to this in Western Canada is the City of Kelowna where their preference is to install the devices at mid-block locations.

3.4 Signal Conversion

The survey indicated that there have been a few cases of pedestrian signals being converted to full traffic signals. The 30 jurisdictions responding have on an average one signal conversion in their history, and never more than five for any jurisdiction. The most common reason provided for conversion was that the traffic volume at a pedestrian signal increased or was anticipated to increase to the level where the warrant for a full traffic signal would be met.

Of note, some jurisdictions have not converted pedestrian signals to full signals because of the potential adverse traffic impacts associated with the upgrade as side streets may see increased volumes, speeds and shortcutting through residential neighbourhoods.

3.5 Technical Warrants

The national survey also included questions about warrant criteria used to justify pedestrian signal installations. Many municipalities use the warrants in either the TAC *Pedestrian Crossing Control Manual* or the *Pedestrian Crossing Control Manual for British Columbia*. Each manual provides an evaluation system in which a calculation is made based on the site conditions of the road under consideration, the pedestrian volume at the location, and crossing opportunities, then adjusted for community size, pedestrian ability, and collision history. Each manual also calls for committees to be set up to facilitate community involvement and to monitor and review existing and planned pedestrian corridors.

Some jurisdictions have locally developed warrant systems. These local warrants typically use similar parameters as the manuals (i.e. traffic volume, pedestrian volume, road geometry, etc.). For example, the City of Vancouver has a special system that determines real-time gaps in traffic, pedestrian volume, and delay. The process is similar to the manuals but Vancouver conducts more precise calculations instead of using charts. Vancouver then uses that information to augment the warrant system of the B.C. manual.

3.6 Non-Technical Considerations

A number of public agencies stated in their survey responses that some of the pedestrian signals have been installed as a result of public demand and/or decision maker influence with no technical justification.

3.7 Future of Pedestrian Signals

The majority of public agencies that responded to the TAC survey stated that they will continue to use pedestrian signals.

TABLE 3.2
LOCATION OF PEDESTRIAN SIGNAL INSTALLATIONS*

#	PROVINCE / TERRITORY	ROAD AUTHORITY	LOCATION OF PEDESTRIAN SIGNAL			
			4-Leg Intersection	T-Intersection	Mid Block	TOTAL
1	Alberta	Government of Alberta	2	0	0	2
2		Calgary	4	2	0	6
3		Edmonton	125	72	26	223
4		Red Deer	7	7	0	14
		SUB TOTAL ALBERTA	138	81	26	245
5	British Columbia	Ministry of Transportation	29	6	2	37
6		Abbotsford	3	10	1	14
7		Burnaby	23	18	3	44
8		Chilliwack	2	1	0	3
9		Delta	4	6	1	11
10		Kamloops	2	9	1	12
11		Kelowna	4	5	0	9
12		Langley (Township)	4	2	2	8
13		Mission	1	3	0	4
14		North Vancouver (District)	1	5	1	7
15		Port Moody	0	2	0	2
16		Prince George	8	2	1	11
17		Richmond	10	30	5	45
18		Surrey	13	17	8	38
19		Vancouver	198	52	7	257
20	Victoria	0	8	1	9	
	SUB TOTAL BRITISH COLUMBIA	302	176	33	511	
21	Manitoba	Manitoba Transportation	1	1	0	2
		SUB TOTAL MANITOBA	1	1	0	2
22	Newfoundland & Labrador	St. Johns	0	1	5	6
		SUB TOTAL NEWFOUNDLAND & LABRADOR	0	1	5	6
23	Nova Scotia	Halifax	3	1	2	6
		SUB TOTAL NOVA SCOTIA	3	1	2	6
24	Ontario	Oakville	0	0	0	0
25		Toronto	0	0	54	54
		SUB TOTAL ONTARIO	0	0	54	54
26	Quebec	Government of Quebec	8	2	0	10
27		Gatineau	7	4	3	14
		SUB TOTAL QUEBEC	15	6	3	24
28	Saskatchewan	Saskatchewan Highways & Transportation	n/a	n/a	n/a	n/a
29		Regina	29	3	0	32
		SUB TOTAL SASKATCHEWAN	29	3	0	32
30	Yukon	Governnment of Yukon	0	0	0	0
		SUB TOTAL YUKON	0	0	0	0
TOTAL BASED ON SURVEY RESPONDENTS			488	269	123	880
			55%	31%	14%	100%

* Note: Based on TAC survey respondents

4.0 PROVINCIAL GOVERNMENT LEGISLATION

British Columbia, Quebec, and the Yukon Territories have provincial regulations for pedestrian crossing facilities. Other provinces, including Ontario, Alberta, and Saskatchewan follow the relevant Highway Traffic Act for that province.

Manitoba considers pedestrian signals to be in the same category as full traffic signals. Thus, no special legislation was created for pedestrian-only signals. Nova Scotia and Newfoundland do not currently have provincial legislation with regards to pedestrian crossing facilities. Of note, each of these provinces had only six reported pedestrian signals in the national survey.

Regarding the flashing green ball display currently in use in British Columbia for pedestrian signals, the *British Columbia Motor Vehicle Act* specifies the following in Section 131:

- (5) *When rapid intermittent flashes of green light are exhibited at an intersection or at a place other than an intersection by a traffic control signal,*
 - (a) *the driver of a vehicle approaching the intersection or signal and facing the signal must cause it to approach the intersection or signal in such a manner that he or she is able to cause the vehicle to stop before reaching the signal or any crosswalk in the vicinity of the signal if a stop should become necessary, and must yield the right of way to pedestrians lawfully in a crosswalk in the vicinity of the signal or in the intersection, and*
 - (b) *a pedestrian may proceed across the roadway with caution and at an intersection only in a marked or unmarked crosswalk.*

Conversely in Ontario, where the flashing green ball display indicates a protected left turn phase, the *Ontario Highway Traffic Act* states in Section 144 the following with respect to the actions a motorist may take when faced with such a signal display:

Flashing green

(13) *A driver approaching a traffic control signal showing a circular flashing green indication or a solid or flashing left turn green arrow indication in conjunction with a circular green indication and facing the indication may, despite subsection 141 (5), proceed forward or turn left or right unless otherwise directed. R.S.O. 1990, c. H.8, s. 144 (13).*

Therefore, the legal definition for flashing green ball displays in British Columbia and Ontario are not similar and thus may significantly contribute to the confusion of motorists when visiting the other province for the first time.

5.0 STAKEHOLDER INPUT

5.1 British Columbia Driver Comprehension of Pedestrian Signals

ICBC conducted a provincial telephone survey of 604 randomly selected British Columbia motorists in December 2002 in order to determine their understanding of pedestrian signal operations. For a typical motorist telephone survey, ICBC targets achieving a minimum sample size of 400 in order for the results to have a 5% margin of error at the 95% level of confidence. The sample size of 604 reduced the margin of error to 4% at the same level of confidence.

The following four (4) questions, which were developed by ICBC in consultation with the Pedestrian Signal Technical Review Committee, were asked of participants:

1. *Do you know the meaning of the 'flashing green' signal that is located at some intersections?*
2. *As a motorist, have you experienced any confusion when you have approached a four way intersection controlled by one of these pedestrian signals?*
3. *As a pedestrian, have you experienced any confusion when attempting to cross a four way intersection controlled by one of these signals?*
4. *How long have you lived in British Columbia?*

Question 4 was asked primarily due to concerns about the understanding of the flashing green ball display by residents who have only recently moved to British Columbia. The results of the telephone survey are presented in **FIGURE 5.1**, **FIGURE 5.2**, **FIGURE 5.3** and **FIGURE 5.4** for questions 1, 2, 3 and 4 respectively.

The key findings of the telephone survey can be summarized as follows:

- From Question 1 regarding the meaning of the flashing green ball indication, it is noted that 71% of the survey respondents either answered correctly (33% said Pedestrian controlled intersection) or answered with the Driver Training Guide's information (38% said proceed with caution). However, 16% of the survey respondents answered that they did not know the meaning of the flashing green ball display and another 4% stated that they did not know or refused to answer (n=604).
- From Question 2 regarding whether as a motorist user they experienced any confusion when approaching a British Columbia pedestrian signal, 74% stated no. The result correlated well with the first question's results (n=604).

FIGURE 5.1
ICBC MOTORIST SURVEY - QUESTION #1

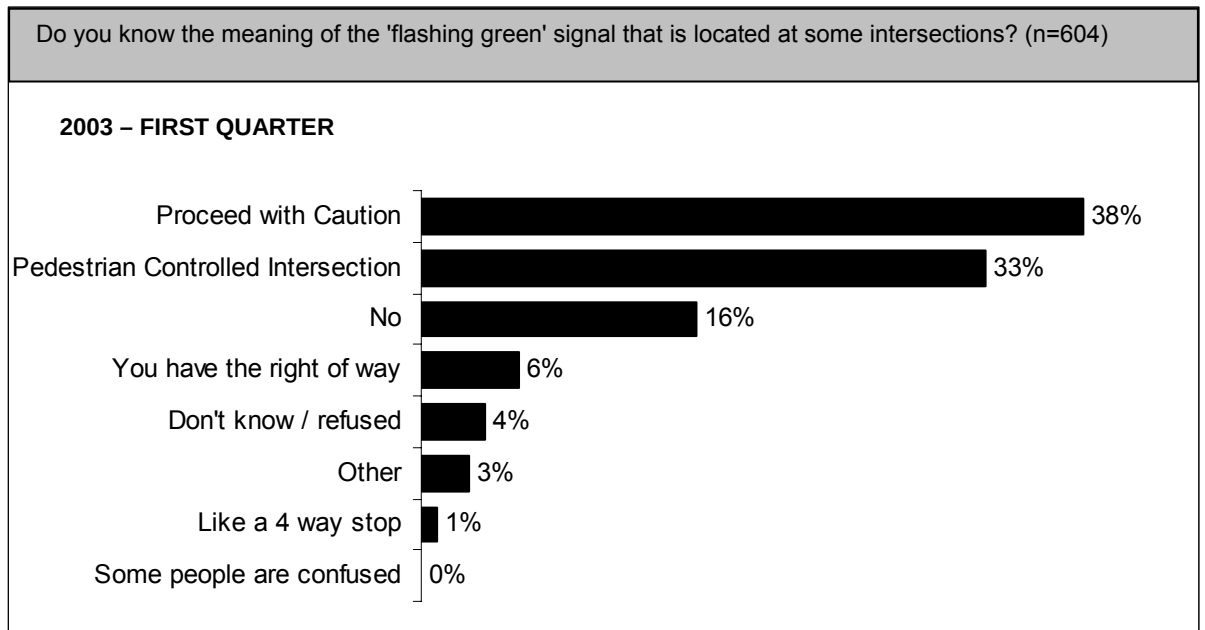


FIGURE 5.2
ICBC MOTORIST SURVEY - QUESTION #2

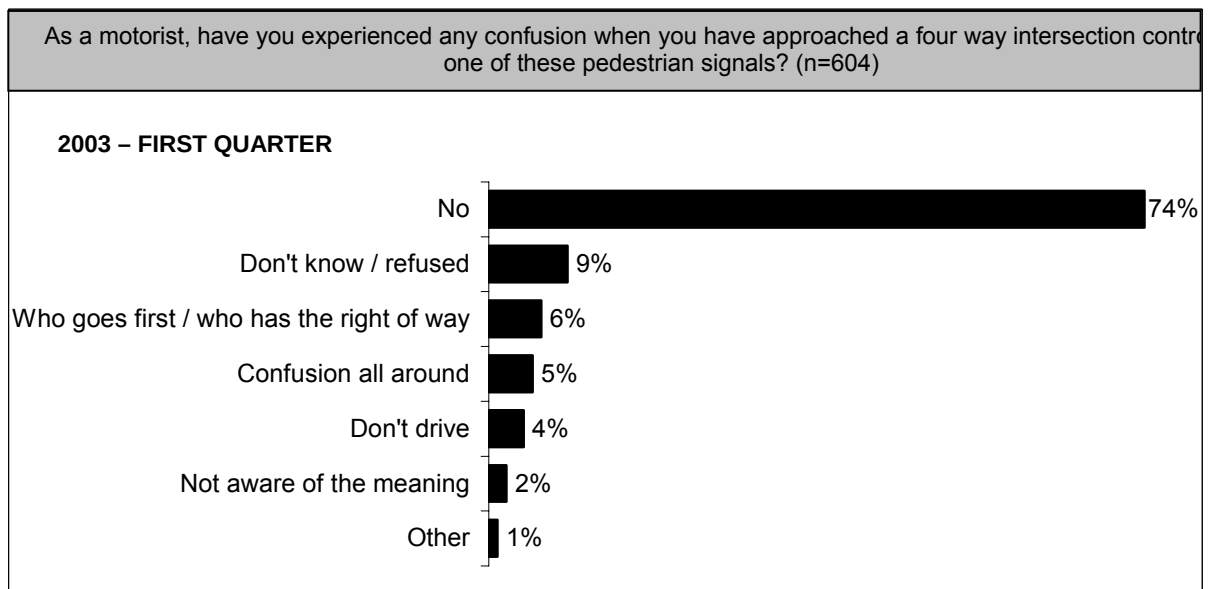


FIGURE 5.1
ICBC MOTORIST SURVEY - QUESTION #3

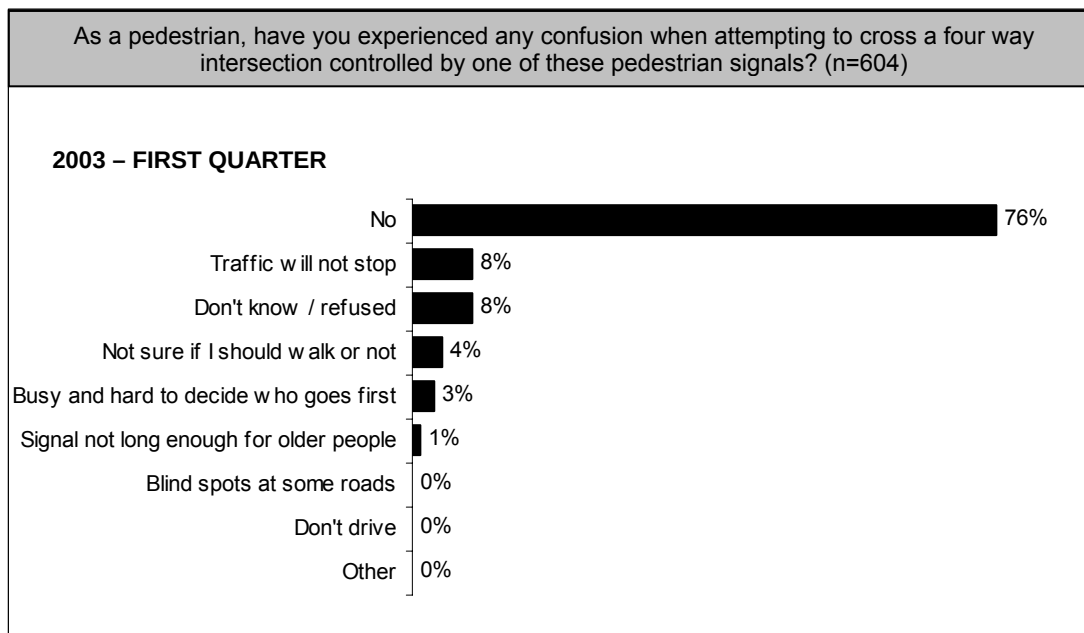
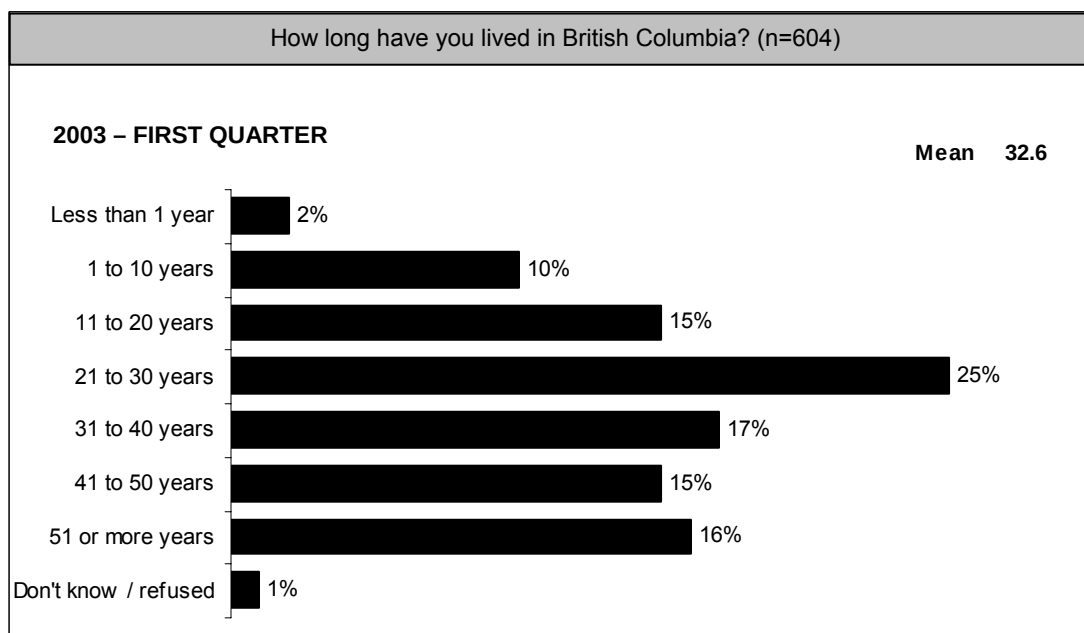


FIGURE 5.1
ICBC MOTORIST SURVEY - QUESTION #4



- From Question 3 regarding whether as a pedestrian user they experienced any confusion when using a British Columbia pedestrian signal, 78% stated no. Again this result correlated well with the answers to the first question (n=604).
- From Question 4 regarding how long the survey respondents have lived in British Columbia, the mean was 32.6 years. The result of this question is interesting because the first pedestrian signal was installed in the City of Vancouver in 1967 and therefore the motoring public should be familiar with pedestrian signals and their operation in British Columbia. The results of Question 2 and 3 correlate well with the results of Question 4 (n=604).

Given that pedestrian signals in British Columbia have been in operation since 1967 and the average number of years that the ICBC motorist survey respondent lived in British Columbia was 32.6 years, it can be concluded that British Columbia residents are familiar with this traffic control device and their operation. However it is noted that up to 20% of long term residents are unsure what the flashing green ball display actually means. It is unknown though how this percentage compares to motorist comprehension of other traffic control devices in British Columbia and whether the 20% is significant or not.

5.2 Police Enforcement Agencies

The City of Vancouver Police Department, the City of Burnaby RCMP Detachment and the City of Surrey RCMP collectively oversee a population of over 1.2 million (or 57% of the population in Greater Vancouver). Each of these police enforcement agencies were contacted regarding their experience with pedestrian signals and motorists adherence to the *British Columbia Motor Vehicle Act* at these locations. Only one comment was received and that was from the Traffic Section of the Vancouver Police Department who advised that from a pedestrian safety point of view, the signal operation seems to work fine. However, when the pedestrian phase is active, many motorists on the side streets are observed by the Vancouver Police Department to simply drive past the stop signs without stopping, which can be a safety issue for pedestrians crossing the main street with the WALK signal.

6.0 EVALUATION OF EFFECTIVENESS AND SAFETY OF PEDESTRIAN SIGNALS

In order to evaluate the effectiveness and safety of intersection pedestrian signals, the British Columbia intersections analyzed in the summer of 2000 were resurveyed and claims data analysis undertaken to reevaluate the motorist stop sign violation rates on the minor street and to determine if there are any safety issues. As well, the type of traffic control that is warranted

at each intersection (i.e. a full signal, a pedestrian signal or stop sign control) was determined in order to ascertain the appropriateness of the existing traffic control device.

6.1 Stop Sign Compliance Surveys

In order to quantify the observed lack of stop sign compliance at British Columbia's intersection pedestrian signals, special surveys were commissioned at pedestrian signals located throughout Greater Vancouver in the summer of 2002 with additional follow-up surveys in the summer of 2003. As part of these surveys, standard vehicle and pedestrian intersection counts were also conducted in order to quantify the demand by location. Outside of British Columbia, the City of Edmonton conducted the same compliance surveys at two locations.

TABLE 6.1 and **TABLE 6.2** summarize the observed stop sign violation rates for the weekday midday and afternoon peak hours respectively. Data is presented for both summer 2000 and summer 2002 for comparison purposes.

TABLE 6.1
OBSERVED STOP SIGN VIOLATION RATES AT PEDESTRIAN SIGNALS
WEEKDAY MIDDAY PEAK HOUR

No.	Province	Date	Intersection	Municipality	Intersection Type	Stop Sign Violation Rate*	
						Year 2000	Year 2002
1	ALBERTA	Oct 7, 2002 (Mon)	109th St & 84th Avenue	Edmonton	4-leg		0%
2		Oct 7, 2002 (Mon)	65th/Fulton Rd & 106th Ave	Edmonton	4-leg with service roads		3%
3	BRITISH COLUMBIA	July 17, 2002 (Wed)	Vine St. @ 4th Ave.	Vancouver	4-leg	54%	59%
4		Aug 28, 2002 (Wed)	Yew St. @ 4th Ave.	Vancouver	4-leg	62%	50%
5		July 24, 2002 (Wed)	Carleton @ Hastings	Burnaby	4-leg	41%	31%
6		July 24, 2002 (Wed)	Madison @ Hastings	Burnaby	4-leg	2%	28%
7		July 24, 2002 (Wed)	Alpha @ Hastings	Burnaby	4-leg	18%	25%
8		July 31, 2002 (Wed)	Capilano @ Eldon	North Vancouver	4-leg	0%	9%
9		July 31, 2002 (Wed)	Cloverley @ Keith	North Vancouver	4-leg	4%	0%
10		July 31, 2002 (Wed)	Scott Rd @ 90th Ave.	Surrey	4-leg		0%
11		Aug 7, 2002 (Wed)	Westwood @ Guildford	Coquitlam	T-intersection	45%	6%
12		Aug 7, 2002 (Wed)	Scott Rd @ 93A Ave.	Surrey	4-leg	25%	10%
13		Aug 14, 2002 (Wed)	225th Ave @ Lougheed	Maple Ridge	4-leg	45%	6%
14		Aug 14, 2002 (Wed)	152nd St @ 98th Ave	Surrey	T-intersection		0%
15		Aug 14, 2002 (Wed)	136th St @ 16th Ave	Surrey	4-leg		0%
16		Aug 21, 2002 (Wed)	Eastwood & Guildford	Coquitlam	T-intersection		14%
17		Aug 21, 2002 (Wed)	Minoru @ Richmond Ctr	Richmond	T-intersection		30%
18		Aug 21, 2002 (Wed)	No. 2 Rd @ Garrison	Richmond	T-intersection		8%

* Stop sign violation rate is for left and through movements on the minor street only

From **TABLE 6.1** and **TABLE 6.2**, the following observations can be made:

- There is no consistent trend on the observed stop sign violation rates between the 2000 and 2002 surveys. Some locations were subject to increased rates while rates decreased at other locations.
- The observed stop sign violation rates at the two intersections in Edmonton are very low and thus do not indicate an operational problem at these locations
- Those locations with high main street volumes and high side street volumes (i.e. on 4th Street in Vancouver and Hastings Street in Burnaby) show high stop sign violation rates by minor street motorists for both the 2000 and 2002 surveys.

TABLE 6.2
OBSERVED STOP SIGN VIOLATION RATES AT PEDESTRIAN SIGNALS
WEEKDAY AFTERNOON PEAK HOUR

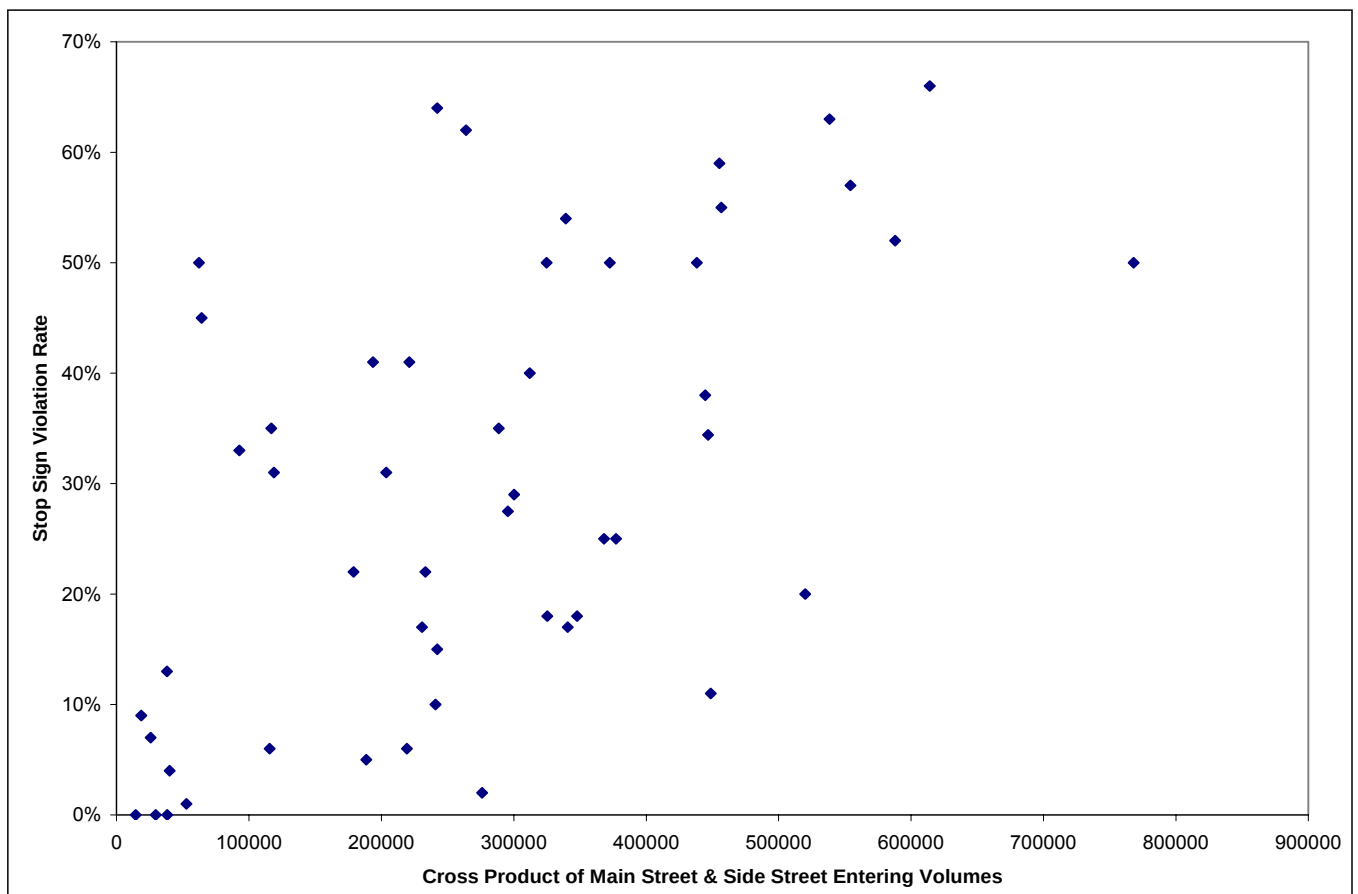
No.	Province	Date	Intersection	Municipality	Intersection Type	Stop Sign Violation Rate*	
						Year 2000	Year 2002
1	ALBERTA	Oct 7, 2002 (Mon)	109th St & 84th Avenue	Edmonton	4-leg		2%
2		Oct 7, 2002 (Mon)	65th/Fulton Rd & 106th Ave	Edmonton	4-leg with service roads		0%
3	BRITISH COLUMBIA	July 17, 2002 (Wed)	Vine St. @ 4th Ave.	Vancouver	4-leg	57%	66%
4		Aug 28, 2002 (Wed)	Yew St. @ 4th Ave.	Vancouver	4-leg	55%	50%
5		July 24, 2002 (Wed)	Carleton @ Hastings	Burnaby	4-leg	50%	29%
6		July 24, 2002 (Wed)	Madison @ Hastings	Burnaby	4-leg	20%	34%
7		July 24, 2002 (Wed)	Alpha @ Hastings	Burnaby	4-leg	52%	11%
8		July 31, 2002 (Wed)	Capilano @ Eldon	North Vancouver	4-leg	0%	7%
9		July 31, 2002 (Wed)	Cloverley @ Keith	North Vancouver	4-leg	0%	7%
10		July 31, 2002 (Wed)	Scott Rd @ 90th Ave.	Surrey	4-leg		5%
11		Aug 7, 2002 (Wed)	Westwood @ Guildford	Coquitlam	T-intersection	31%	6%
12		Aug 7, 2002 (Wed)	Scott Rd @ 93A Ave.	Surrey	4-leg		18%
13		Aug 14, 2002 (Wed)	225th Ave @ Lougheed	Maple Ridge	4-leg	64%	15%
14		Aug 14, 2002 (Wed)	152nd St @ 98th Ave	Surrey	T-intersection		0%
15		Aug 14, 2002 (Wed)	136th St @ 16th Ave	Surrey	4-leg		0%
16		Aug 21, 2002 (Wed)	Eastwood & Guildford	Coquitlam	T-intersection		0%
17		Aug 21, 2002 (Wed)	Minoru @ Richmond Ctr	Richmond	T-intersection		21%
18		Aug 21, 2002 (Wed)	No. 2 Rd @ Garrison	Richmond	T-intersection		15%

* Stop sign violation rate is for left and through movements on the minor street only

However, it should be noted that a comparison of the stop sign violation rates with those from a typical 2-way or 4-way stop controlled intersection could not be done within the scope of this project. Such a comparison could allow the determination of whether a pedestrians' exposure to risk increases, decreases or has no change at a pedestrian signal.

FIGURE 6.1 illustrate the relationship between the stop sign violation rate and the cross product of the main street and side street entering volumes (2-way) for the data from 2000, 2002 and 2003. Of note, the data collected for each year was done with the same methodology, same survey forms and in many cases, the same data collectors to ensure consistency in the field work. From **FIGURE 6.1**, there is no clear relationship between stop sign violation rates and the cross product of the main and side street traffic volumes. However, the plotted trend line does illustrate an increasing trend in stop sign violation rates when traffic volumes increase.

FIGURE 6.1
RELATIONSHIP BETWEEN STOP SIGN VIOLATION RATES
AND CROSS PRODUCT OF MAIN AND SIDE STREET ENTERING TRAFFIC VOLUMES*



* Data plotted is from 2000, 2002 and 2003 and includes both the weekday midday and afternoon peak hour.

6.2 Warrant Analysis

It is generally understood among traffic engineering professionals that traffic control device warrants are the key consideration when deciding what traffic control is appropriate for a particular site. However it is also recognized that there are cases where traffic control devices which do not, or no longer, meet technical warrant criteria, are in operation. As part of this project, the possibility that stop sign non-compliance at pedestrian signals results from the use of an inappropriate traffic control device was examined.

Nationally, TAC provides warrant procedures for full signals and pedestrian signals. For full signals, the method is described in *Canadian Traffic Signal Warrant Procedure*, published in February 2003. Pedestrian signal warrants are described in the *Pedestrian Crossing Control Manual* published in March 1998. In the province of British Columbia, full signal warrants are provided in the Ministry of Transportation *Electrical and Traffic Engineering Manual*; the numerical requirements for this method are identical to those published by ITE and the US Federal Highway Administration in the *Manual of Uniform Traffic Control Devices 2003 Edition*.

In addition, the *Pedestrian Crossing Control Manual for British Columbia* was the basis for the TAC pedestrian signal warrants, and therefore has the same requirements. Other provinces, and some jurisdictions within British Columbia, have unique methods for determining warrants. For example, the City of Vancouver uses a supplementary field measurement of gaps and delays for pedestrian crossings in addition to the Ministry of Transportation method.

There was discussion among project steering committee members regarding the appropriateness of these methods, and it was agreed that the results of these analyses generally concurred with engineering judgement and resulting in the selection of suitable traffic control devices.

For the 16 intersection pedestrian signal locations in British Columbia where stop sign non-compliance was measured in the field, available traffic count data was used to estimate whether full and pedestrian traffic signal warrants are currently met. As well, a number of locations were recounted in 2003 to confirm the 2002 data and initial warrant assessments. The result of this analysis is summarized in **TABLE 6.3** and the key findings are noted below:

- Locations where full signals are warranted have high non-compliance with side street stop signs;
- Two of the three locations where full signals are nearly warranted and pedestrian signals are likely not warranted have high non-compliance rates; the third has low non-compliance;

TABLE 6.3 – ANALYSIS OF TRAFFIC CONTROL DEVICE WARRANTS & STOP SIGN NON-COMPLIANCE

Location No.	Intersection	Countdown Timers	Municipality	Survey No. (if multiple surveys)	Data Reviewed ^{1, 2, 3}	Preliminary Analysis		Stop Sign Non-Compliance ⁷	Comments
						Ped Signal Warrant ⁵ Likely Met?	Ped Signal Warrant ⁵ Likely Met?		
1	Vine St @ 4th Ave	None	Vancouver	1	Vehicle & Ped TMC, 2002	Yes	Yes	224 (65%)	
				2	Vehicle & Ped TMC, 2003	Yes ⁴	Yes ⁴	226 (50%)	
2	Yew St @ 4th Ave	None	Vancouver	1	Vehicle & Ped TMC, 2002	Yes	Yes	86 (38%)	
				2	Vehicle & Ped TMC, 2003	Yes ⁴	Yes	242 (62%)	
3	Madison @ Hastings St	None at times of survey	Burnaby	1	Vehicle & Ped TMC, 2002	Nearly	Yes	75 (61%)	Pedestrian countdown timers installed February 19, 2003
				2	Vehicle & Ped TMC, 2003	Yes ⁴	Yes	55 (41%)	
4	Minoru Blvd @ Richmond Centre	For Side Street Motorists	Richmond		Vehicle & Ped TMC, 2002	Yes	Yes	29 (22%)	
5	Alpha @ Hastings St	None at times of survey	Burnaby	1	Vehicle & Ped TMC, 2002	Yes	Yes	16 (18%)	Pedestrian countdown timers installed February 21, 2003
6	Westwood St @ Guildford Dr	None	Coquitlam		Vehicle & Ped TMC, 2002	No	Nearly	30 (6%)	Converted to full signal Aug 28, 2002
7	Scott Rd @ 93A Ave	None	Surrey		Vehicle & Ped TMC, 2002	No	Nearly	34 (27%)	
8	No. 2 Rd @ Garrison	For Side Street Motorists	Richmond		Vehicle & Ped TMC, 2002	No	Nearly	6 (6%)	
5	Alpha @ Hastings St	None at times of survey	Burnaby	2	Vehicle & Ped TMC, 2003	Yes ⁴	No	12 (25%)	Pedestrian countdown timers installed February 21, 2003
9	Carleton @ Hastings St	Pedestrian Countdown Timers	Burnaby	1	Vehicle & Ped TMC, 2002	Yes	No	22 (33%)	
				2	Vehicle & Ped TMC, 2003	Yes ⁴	No	27 (44%)	
10	225 St @ Lougheed Hwy	None	Maple Ridge		Vehicle & Ped TMC, 2002	Yes	No	6 (13%)	
11	120 St 90 Ave	None	Surrey		Vehicle & Ped TMC, 2002	Nearly	No	7 (14%)	
12	Vine St @ 4th Ave	None	N. Vancouver		Vehicle & Ped TMC, 2002	No	No	1 (23%)	
13	Cloverley @ Keith	None	N. Vancouver		Vehicle & Ped TMC, 2002	No	No	8 (10%)	
14	152 St @ 98 Ave	None	Surrey		Vehicle & Ped TMC, 2002	No	No	0 (0%)	
15	136 St @ 16 Ave	None	Surrey		Vehicle & Ped TMC, 2002	No	No	1 (1%)	
16	Eastwood @ Guildford	None	Coquitlam		Vehicle & Ped TMC, 2002	No	No	2 (17%)	

¹ Data collection times: 11:30 to 13:30 & 15:30 to 17:30

² 2002 data collected during Summer months, therefore school pedestrian and vehicular traffic excluded

³ Pedestrian volumes not classified unless indicated

⁴ Insufficient data collected during survey no. 2 for warrant analysis; warrant analysis result assumed same as survey no. 1

⁵ MoT "Pedestrian Crossing Control Manual for British Columbia" Method; all pedestrian EAU's assumed to be 1.0, therefore warrant compliance likely under estimated

⁶ MoT "Electrical and Traffic Engineering Manual" Method; assumed all speed limits ≤ 70 km/h

⁷ Worst case of two 2-hour periods surveyed; right turning volumes excluded

Colour Codes for Non-Compliance Rate

	0 veh/2 hrs
	1-9 veh/2hrs
	10-29 veh/2 hrs
	≥ 30 veh/2hrs

- Of the locations where full signal warrants are not met and pedestrian signal warrants are met, three of the surveys show high non-compliance and two show low non-compliance; the surveys with high non-compliance were on a very high traffic volume arterial route; and
- At the time of the surveys, only the intersection of Carleton Avenue & Hastings Street had pedestrian countdown timers in operation.

Therefore, the warrant analysis has shown that high motorist non-compliance with side street stop signs has often occurred at locations where a pedestrian signal is operating but a full traffic signal is warranted.

6.3 Safety Analysis

6.3.1 British Columbia Claims Data Analysis

TABLE 6.4 summarizes the available B.C. pedestrian related collision statistics from 1999 to 2002. The data is summarized by Province, Greater Vancouver Regional District and by municipality.

TABLE 6.4
SUMMARY OF PEDESTRIAN RELATED COLLISION STATISTICS
IN BRITISH COLUMBIA

YEAR	1999	2000	2001	2002	COLLISION RATE (ped-vehicle per 10000 pop)
	FREQUENCY	FREQUENCY	FREQUENCY	FREQUENCY	
BC	2569	2301	2409	N/A	6.00
Greater Vancouver	1234	1107	1133	N/A	5.63
Burnaby	N/A	82	93	100	4.55
Coquitlam	N/A	40	36	45	3.41
Maple Ridge	N/A	24	21	24	3.47
North Vancouver	77	77	87	N/A	6.21
Surrey	N/A	32	46	62	1.28
Vancouver	345	417	412	N/A	6.95

For the municipalities, the City of Vancouver had the highest frequency of pedestrian collisions resulting in an average rate of 6.95 pedestrian-motor vehicle collisions per 10,000 population. Conversely, the City of Burnaby had an average rate of 4.55 while the City of Surrey has the lowest rate of 1.28. These rate variations appear to reflect the level of pedestrian activity in municipalities, and thus the pedestrians risk exposure to a potential collision with a motorized vehicle, as the City of Vancouver has significantly more pedestrian activity than the other municipalities.

TABLE 6.5 summarizes the available pedestrian related collision data by location of occurrence (i.e. at an intersection or not). On average 50% of all pedestrian related collisions occurred at intersections. The rest were mid-block, in parking lots, at driveways, in lanes or at unknown locations.

TABLE 6.5
SUMMARY OF WHERE PEDESTRIAN COLLISIONS OCCURRED
BY BRITISH COLUMBIA MUNICIPALITY

MUNICIPALITY	# PEDESTRIAN COLLISIONS	AT INTERSECTION	OTHER LOCATIONS
Burnaby	295	133	162
Coquitlam	131	53	78
Maple Ridge	69	34	35
North Vancouver	241	133	108
Surrey	140	76	64
Vancouver City	1174	595	579

A review of the contributing factors for pedestrian related collisions at intersections determined the following:

- 45% were caused by vehicles turning left in conflict with a pedestrian;
- 30% were caused by vehicles turning right in conflict with a pedestrian; and
- 25% were caused by vehicles going straight through the intersection.

As well, a review of the type of traffic control in place at the time of the collisions was also undertaken and the results are as follows:

- 55% of the intersections were signalized (full or pedestrian);
- 45% of the intersections were unsignalized. Of this, 15% had a marked crosswalk; and 30% did not have a marked crosswalk.

Unfortunately for those locations that were signalized, the collision data could not be further broken down by traffic signal type (i.e. at a full signal, pedestrian signal, etc.). Finally, a review of the collision details for the past three years at the fourteen surveyed intersections in Greater Vancouver for this project (See Section 6.1) showed no significant trend of pedestrian related collisions. All intersections recorded low number of collisions as compared with the top crash sites in each municipality.

Based on the review of the available data, it was concluded that the collision data did not identify any apparent safety concerns for intersections operating under pedestrian signal control.

6.3.2 Edmonton, Alberta Safety History

The City of Edmonton began installing pedestrian signals in the mid 1960's and at latest count, had 223 of these devices in operation. The primary purpose for their installation was to enhance the crossing protection level for pedestrians at both intersections and mid-block locations with significant pedestrian activity. Most locations had a signed and marked crosswalk with pedestrian actuated flashing beacons prior to the installation of the pedestrian signal.

The City of Edmonton regularly reviews pedestrian collision activity trends since installation of these devices began. The most recent safety review identified that the rate of pedestrian-motor vehicle collisions declined 40% between 1989 and 2000. In 1989, the rate of pedestrian-motor vehicle collisions was 7.74 per 10,000 population and in 2000 the rate was 4.59 pedestrian-motor vehicle collisions per 10,000 population, which is significantly less than that for Greater Vancouver (i.e 5.63 pedestrian-motor vehicle collisions per 10000 pop). The collision review was not specific to pedestrian signal locations, however the majority of pedestrian / vehicle collisions in the City of Edmonton are occurring at intersections and therefore this trend is partially reflected in the increased level of crossing protection provided by pedestrian signals.

6.3.3 Hamilton, Ontario Safety History

The City of Hamilton, Ontario recently conducted a safety review of 25 pedestrian signals located at either "T" or full intersections. Collision data prior to and after signal installation was compiled for all 25 pedestrian signals. The before-period covered five years before signal installation. However, due to the fact that the City of Hamilton started to install pedestrian signals only 10 years ago, some of the later installations do not have an equivalent five-year after-period for comparison. An intersection was included in this review only if it had been

operating for more than one year. A review of the data determined that the post-pedestrian signal installation period ranged between fifteen months and five years.

TABLE 6.6 summarizes the data compiled and the following are the key results:

1. 17 of the 25 intersections had lower collision rates after pedestrian signal installation.
2. All intersections experienced no increase in pedestrian collisions after pedestrian signal installation.
3. The average collision rates before and after pedestrian signal installation was 0.30 and 0.23 per Million Entering Vehicles (MEV), respectively.
4. The average pedestrian collision rates before and after pedestrian signal installation was 0.03 and 0.01 per MEV, respectively.

The study indicated that the installation of pedestrian signals improved overall intersection safety as the pedestrian collision rates were reduced by installation of the device at all locations. However, some locations showed increased numbers of collisions not involving pedestrians

**TABLE 6.6 - COLLISION EXPERIENCE AT INTERSECTIONS WITH PEDESTRIAN SIGNALS
HAMILTON, ONTARIO**

Location	Before Signal Installed					After Signal Installed				
	Period	Total of all Coll.	Ped Coll.	Intersection Collision Rate (/MEV)	Ped Coll. Rate	Period	Total of all Coll.	Ped Coll.	Intersection Collision Rate (/MEV)	Ped Coll. Rate
Aberdeen & Chedoke	01/02/91 - 01/01/96	3	0	0.07	0.00	05/01/96 - 04/30/01	1	0	0.02	0.00
Barton & Smith	06/02/88 - 06/01/93	17	3	0.81	0.14	11/01/93 - 10/31/98	15	2	0.71	0.09
Campell & Ottawa	05/02/91 - 05/01/96	9	1	0.37	0.04	09/03/96 - 09/29/01	6	0	0.24	0.00
Balmoral & Cannon	07/02/89 - 07/01/94	10	1	0.52	0.05	11/01/94 - 10/31/99	5	0	0.26	0.00
Charlton & Hughson	05/02/91 - 05/01/96	17	0	1.01	0.00	10/01/96 - 09/30/01	7	0	0.42	0.00
Churchill & Upper James	05/02/91 - 05/01/96	3	0	0.06	0.00	09/01/96 - 08/31/01	2	0	0.04	0.00
Concession & East 22nd	01/01/94 - 12/31/98	0	0	0.00	0.00	04/01/99 - 04/09/03	2	0	0.09	0.00
Concession & Henderson Hospital	05/02/91 - 05/01/96	21	0	0.78	0.00	09/30/96 - 09/29/01	13	0	0.48	0.00
Crockett & East 36th	11/01/93 - 10/31/98	7	0	0.46	0.00	01/30/99 - 04/09/03	2	0	0.16	0.00
Hwy. 5 & Riley	07/01/96 - 06/30/01	5	0	0.15	0.00	10/31/01 - 04/09/03	2	0	0.21	0.00
East 24 & Fennell	09/01/96 - 08/31/01	3	0	0.08	0.00	12/31/01 - 04/09/03	1	0	0.10	0.00
East 15 & Fennell	07/01/91 - 06/30/96	3	0	0.09	0.00	10/31/96 - 10/30/01	3	0	0.09	0.00
Fennell & High	05/01/91 - 04/30/96	3	0	0.13	0.00	08/31/96 - 08/30/01	7	0	0.31	0.00
Franklin & Upper Sherman	07/01/88 - 06/30/93	6	1	0.17	0.03	10/31/93 - 10/30/98	9	1	0.25	0.03
King & Maple	11/01/92 - 10/31/97	12	0	0.49	0.00	02/01/98 - 01/31/03	14	0	0.57	0.00
Ferguson & King	11/01/94 - 10/31/99	9	3	0.43	0.14	02/01/00 - 04/09/03	5	1	0.37	0.07
Fairfield & Main	05/01/91 - 04/30/96	13	1	0.25	0.02	08/31/96 - 08/30/01	6	3	0.12	0.06
Main & Paisley	07/01/94 - 06/30/99	4	0	0.06	0.00	10/31/99 - 04/09/03	5	0	0.11	0.00
Mohawk & Terrace	05/31/91 - 05/30/96	7	2	0.19	0.05	09/30/96 - 09/29/01	5	0	0.14	0.00
Munroe & Wentworth	04/02/91 - 04/01/96	0	0	0.00	0.00	08/01/96 - 07/31/01	1	0	0.12	0.00
James & Picton	07/02/95 - 07/01/00	4	2	0.31	0.16	11/01/00 - 04/09/03	0	0	0.00	0.00
Garth & Sanatorium	01/01/91 - 12/31/95	18	2	0.48	0.05	04/30/96 - 04/29/01	16	0	0.42	0.00
James & Simcoe	07/02/89 - 07/01/94	3	0	0.29	0.00	11/01/94 - 10/31/99	2	0	0.20	0.00
Southbend & Upper Wellington	04/02/93 - 04/01/98	0	0	0.00	0.00	08/01/98 - 04/09/03	0	0	0.00	0.00
Courtland & Stone Church	05/02/92 - 05/01/97	5	1	0.27	0.05	09/01/97 - 08/31/02	4	1	0.22	0.06
TOTAL				7.47	0.75				5.65	0.31
AVERAGE (/ Intersection)				0.30	0.03				0.23	0.01

7.0 COMMITTEE DISCUSSION

In addition to the analysis of the traffic control device, the compliance data, the warrant assessment and review of available collision data, a discussion of the issues of consistent design and operation of pedestrian traffic signals across Canada was also undertaken.

The following suggestions for improving the sketch of a typical pedestrian signal layout included in the *TAC Pedestrian Crossing Control Manual* and the *Pedestrian Crossing Control Manual for British Columbia* (shown as **FIGURE 2.1** in this report) were developed:

- “No Pedestrian Xing” signage can be added on the unmarked major street crossing of the intersection (where there is no marked crosswalk) or add a second major street crosswalk; and
- The symbols for the “secondary” signal poles and heads could be interpreted to be “overhead” mounted signal heads. They should be symbolized to indicate a pedestal mounting arrangement.

The following inconsistencies and variations in the design and operation of Pedestrian Signals in Canada were identified:

- Some jurisdictions have placed vehicle detection loops on the Main Street to allow for the intersection to operate with minimal delay to both the pedestrians and vehicles. This allows for establishing a Minimum Green time (per conventional actuated intersections) with Green Extension capabilities based on vehicle demand.
- Some jurisdictions have placed Side Street vehicle queue detection that is used to place a Pedestrian Call if the Side Street is queued to a certain point or for a pre-determined amount of time resulting in significant delay to the Main Street by the forcing the full WALK/Don't WALK time allocation. This allows the Side Street traffic to enter the intersection on the Pedestrian Phase (stopping the Main Street traffic), hence reducing the delay to the Side Street vehicular traffic.
- The use of Pedestrian “Count-down” timer signal heads at these intersections (as also used at other standard signalized intersection) has increased. This may promote the Side Street vehicle drivers to pay more attention to the count-down indications as opposed to the Stop Sign control for their direction;
- Additional detection for the Side Street, by means of placing a false Pedestrian Call, as used for Transit Detection to allow buses access to cross or enter the Main Street – may result in significant delay to the Main Street by forcing the full WALK/Don't WALK time allocation.

- Some jurisdictions have pedestrian signals that have all the traffic control signal indications installed on one of the intersection and prohibit pedestrians from using the other side.
- The “rest state” of the signal controller is different in British Columbia than in the rest of Canada as B.C. uses a “Flashing Green” display as opposed to the solid green display.
- Within British Columbia, the signal display sequence is different between most municipalities and the City of Vancouver. The majority of British Columbia’s municipalities sequence from the “Flashing Green” indication to a “Solid Green” interval, then to “Yellow” and then to “Red” on the Main Street, whereas the City of Vancouver transitions directly from “Flashing Green” to “Yellow” to “Red”.

8.0 TECHNICAL REVIEW FINDINGS

1. Pedestrian signals have been in use in Canada since 1967, primarily in large metropolitan areas. Road authorities are governed by their representative Provincial Motor Vehicle Acts in the operation of pedestrian signals. As well, some Provinces such as British Columbia have prepared separate manuals regarding the design and operational parameters of pedestrian signals which supersede any national documents.
2. The operation of pedestrian signals in Canada is uniform with the exception of British Columbia where the “rest state” of the traffic controller is a flashing green ball display as opposed to a solid green ball display.
3. A review of TAC’s *Pedestrian Crossing Control Manual* and British Columbia’s *Pedestrian Crossing Control Manual for British Columbia* has determined that the following material should be considered for inclusion in the next editions:
 - i. Update the illustration for a typical pedestrian signal layout by indicating that the second crosswalk across the main street should either be delineated with pavement markings and the provision of pedestrian signal heads, or signed as being closed.
 - ii. Make reference to the suitability of installing a pedestrian signal at a mid-block location.
 - iii. Provide an illustrative example of a pedestrian signal at either a T-intersection or a mid-block location.
4. In the British Columbia Motor Vehicle Act, the flashing green ball display indicates a pedestrian signal to approaching main street motorists and that all movements on the main street are permissive, including left turns from the main street. Conversely in the Ontario Traffic Manual, the flashing green ball display, albeit at a faster flash rate, indicates a protected left turn phase. Therefore, the actions a motorist may take when faced with such a signal display are not uniform in Canada.
5. The primary reason for the use of the flashing green ball display in British Columbia is to inform oncoming motorists of the presence of a pedestrian controlled signal and that the motorists may encounter vehicles entering the main street from the side street during the green signal interval.
6. The flashing green ball display in Ontario is currently being phased out and replaced with a flashing green left turn arrow. A number of large municipalities have already completed the conversion but many smaller municipalities in Ontario still use the current display due to the costs of upgrading to arrow displays and competing budget priorities.

7. Pedestrian signals are in use in the United States as well. However, they are not as prevalent as in Canada and the majority of them are located at mid block locations in large urban metropolitan areas. The *U.S. Manual on Uniform of Traffic Control Devices* prohibits the use of stop signs at signalized intersections for side streets or driveways unless the volumes are so low that an extremely low potential for conflict exists. Of note, the flashing green ball display is not recognized as a valid signal display in the United States.
8. The *U.S MUTCD 2003 Edition* prohibits the placement of mid-block pedestrian signals if they are located within 90 metres (300 feet) from the nearest traffic signal unless the progression of traffic is not impeded. As well, the document provides guidance that road authorities should not signalize mid-block crosswalks within 30 metres (100 feet) from side streets or driveways controlled by stop or yield signs in order to reduce potential conflicts between pedestrians and vehicles.
9. From a national survey of Canadian road authorities that operate traffic signals, none of the survey respondents indicated that the warrant procedures for a pedestrian signal were problematic or required adjustments. Most of the survey respondents expressed that they will continue to deploy pedestrian signals.
10. Based on the survey results, the greatest concentration of pedestrian signals is in British Columbia (58%) and Alberta (28%). The four-legged intersection is the most common location to install pedestrian signals as 55% are installed at them, 31% at T-intersections, and the remaining 14% at mid-block locations. However, it was noted that installation of pedestrian signals at intersections is more popular in Western Canada than in Eastern Canada where the mid-block location is preferred. The one known exception to this in Western Canada is the City of Kelowna where their preference is to install the devices at mid-block locations.
11. Based on the results of the ICBC motorist survey, 74% of the British Columbia motorists polled stated that they did not experience any confusion when approaching a British Columbia pedestrian signal. As well, 76% of the pedestrian users stated that they did not experience any confusion when using a British Columbia pedestrian signal. However, when asked what the definition of the flashing green ball display was, 16% of the survey respondents stated that they did not know the meaning and another 4% stated “don’t know/refused”.
12. Given that pedestrian signals in British Columbia have been in operation since 1967 and the average number of years that the ICBC motorist survey respondent lived in British Columbia was 32.6 years, it can be concluded that British Columbia residents are familiar with this

traffic control device and their operation. However, up to 20% of the survey respondents were unsure what the flashing green ball display actually meant. It is unknown though how this percentage compares to motorist comprehension of other traffic control devices in British Columbia and whether the 20% is significant or not.

13. The Vancouver Police Department is generally supportive of pedestrian signals as a viable traffic control device. However, when the pedestrian phase is active, motorists on the side streets are regularly observed by the police to simply drive past the stop signs without stopping which can be a safety issue for the pedestrians crossing the main street during the WALK signal.
14. A review of surveyed stop sign violation rates for left and through movements on the minor street indicated that pedestrian signal locations with high main street volumes and high side street volumes show higher stop sign violation rates by minor street motorists. However, a comparison of the stop sign violation rates with those from a typical 2-way or 4-way stop controlled intersection could not be done within the scope of this project. Such a comparison could allow the determination of whether a pedestrians' exposure to risk increases, decreases or has no change at a pedestrian signal.
15. The warrant analysis has shown that high motorist non-compliance with side street stop signs has often occurred at locations where a full traffic signal is warranted but a pedestrian signal is in operation.
16. Collision details for the past three years at the fourteen surveyed intersections in Greater Vancouver showed no significant trend of pedestrian related collisions. As well, each intersection recorded a low number of collisions when compared with the top crash sites in each municipality (full or pedestrian).
17. The City of Edmonton regularly reviews pedestrian collision activity trends since installation of these devices began. The most recent safety review identified that the rate of pedestrian-motor vehicle collisions declined 40% between 1989 and 2000.
18. A recent safety review of collision data for 25 intersection pedestrian signals in Hamilton, Ontario determined that the average total collision rates decreased after installation of the pedestrian signals. However, some locations showed increased numbers of collisions not involving pedestrians, which may be attributed to the increased numbers of vehicles being required to stop and the resulting increased exposure to rear end type crashes.

19. Design variations and operational inconsistencies with respect to pedestrian signals could lead to motorist and pedestrian confusion as the device may no longer convey a “clear and simple meaning”.
20. The result of the national review indicated that pedestrian signals are an appropriate traffic control device provided that they are designed properly and that the road authority monitor their usage to ensure that the design continues to be appropriate for each location. Warrant analysis should be reviewed regularly after the installation of a pedestrian signal to ensure that the operational conditions continue to meet the technical warrant criteria.

9.0 REFERENCES

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