delphi MRC
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Ottawa Cycling Safety Study Report

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Prepared for:

Ottawa

A report summarizing the findings from a safety evaluation of ten cycling facility sites selected by the City, and the presentation of candidate safety countermeasures that attempt to address the safety risks at each site.

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1 INTRODUCTION

1.1 Background

Cycling is one of the oldest forms of human transportation. However, while the development of our major North American transportation networks after the Second World War led to the development of sophisticated rural and urban road networks, these were largely designed to accommodate cars and trucks. It was not until the 1980's and 1990's that bicycling began to emerge as a viable and sustainable mode of travel and an alternative for motor vehicle trips in North America. Since that time this emerging awareness has blossomed into substantive policy commitments by many Canadian municipalities including the City of Ottawa to raise the priority of bicycling as a mode which must be accommodated within the urban mobility fabric.

These commitments have resulted in the development of cycling plans and both on-road and off-road facilities that encourage the use of active transportation. However, while there are well-established health benefits that result from the promotion of cycling as a viable transport mode, it is also a fact – as New Zealand Transport Agency researchers pointed out in their 2009 report on cycling safety[1] – that the risk of having a crash while cycling is typically higher than while traveling as a driver or passenger in a motor vehicle. As the authors of that report note this is of concern to cyclists, potential cyclists and organizations and agencies involved in road safety. Offsetting this concern however, is the growing body of knowledge that is helping us quantify the safety implications of accommodating bicycling both on and off the roadway proper. With this improved understanding we are developing new planning, design, and safety audit approaches that can help us improve both existing and planned cycle facilities and properly set priorities for future investments in these important sustainable transport alternatives.

Kenneth Ogden, in his seminal work on road safety engineering, further reinforces this view:

> *Pedestrians, bicyclists and other vulnerable road users require specific consideration in traffic design and management particularly from a road safety viewpoint.*[2]

1.2 The City of Ottawa context

While Ottawa has an extensive and well-used bicycling network consisting of both on and off-road facilities, as well as an active cycling community that promotes the benefits and use of this network, the City continues to strive to improve both the safety of these facilities and the levels of comfort experienced by its users. The awareness of the continuing need for such efforts was highlighted by the July 2009 incident in which 5 cyclists were struck from behind by a motor vehicle while riding in single file in a marked on-road bicycle lane.

Further reviews of bicycle safety indicate that in 2008, there were 292 collisions in Ottawa involving cyclists, of which 262 resulted in injuries[3]. This statistic in particular

[1] NZ Transport Agency. "Cycle Safety: Reducing the Crash Risks". NZ Transport Agency Research Report 389. October 2009. p.7.
[2] Ogden, KW."Safer Roads: A guide to Road Safety Engineering". Avebury Technical. Aldershot, England. 1996. p. 365.

highlights the significant vulnerability of bicycle users in such encounters, particularly when higher speeds are involved. The fact that the July 2009 collision noted above also occurred in a marked but non-separated bicycle lane also triggered heightened interest in the potential for new types of segregated bike lanes.

1.3 Goals and objectives of the project

The overall goal of the work carried out for this study is to help improve the ability of the City to deal with cycling road safety issues. The work plan that our team followed focused on two primary objectives as discussed below:

- Use a consistent, technically sound, proven, and defensible technical framework to carry out a safety assessment of a group of candidate cycling facility sites (intersections and road segments) selected by City staff.

- Specifically research the issue of relative safety performance of various types of cycling facilities and develop application criteria for various types of on-road and off-road cycling facilities including the use of segregated bike lanes.

The work carried out as part of this study provides the City with a model framework for cycling safety assessments that define the processes for office, field evaluations, diagnostics and candidate countermeasure identification. Although the candidate safety countermeasure solutions presented in this report can be applied to other similar sites within the City (if they are determined to be suitable based on a safety assessment), the reader should be cautioned they do not constitute a complete “toolbox” of solutions.

1.4 Organization of the report

The main body of this report provides a brief overview and summary of our analysis process and solutions only. More detailed, site-specific information is provided in the Technical Appendix. Following this format, the body of the report starts with this introductory Section followed by a discussion on some of the key considerations the reader must bear in mind when evaluating the cycling safety elements of a facility. Section 3 then identifies our cycling/road safety review approach. The Ottawa cycling context is then discussed in Section 4. In Sections 5 and 6 we present the evaluation methodology and the results from this process, respectively. Section 7 presents a summary of the relevant findings gleaned from the cyclist outreach program. Finally, the workshop approach to developing the candidate countermeasures and the systems of countermeasures for each site are presented in Section 8.

[3] Report to City of Ottawa Transportation Committee. Submitted by Councillor Clive Doucet. December 14, 2009.

2 KEY CONSIDERATIONS

2.1 The need for a human-centered approach

There is a growing recognition that road and cycling facility design must increasingly take into account the perceptual and cognitive needs of their users. The science that supports such efforts is called Human Factors, and it plays a particularly important role in helping us understand the driver/cyclist interactions that take place on both road segments and in intersections. Consideration of these interactions has an important impact on safety outcomes and the design approaches that can be most successfully applied in various situations. The techniques and framework used in this study explicitly accounted for the need for a human–centered approach.

2.2 Recognition of different cycling skill levels

The type of users that may be expected to use a cycle facility is an important consideration when reviewing cyclist safety. In general, cyclists are grouped into three or four main skill levels. A typical three-level categorization would include:

- Child or novice cyclists;
- Basic competency
- Experienced competency

Each of these groups uses their bicycles for different purposes, and the type of facility that is most suitable for each group will also differ. For example, early, novice or young cyclists will require facilities that are generally separated from traffic to a significant degree – except on low-volume, low-speed roadways – and this reflects their inability to cope with more complex riding conditions.

Therefore, our work plan explicitly recognized this important linkage between the likely skill levels of cyclists expected to be using a facility, and the preferred characteristics of the facility that should be provided – particularly in any aspects of the work aimed at developing criteria or warrants for specific types of facilities.

2.3 Recognizing the limitations of historical cyclist crash data

In any cycling/road safety review process, the collision history is one of the key indicators of site safety performance. However, when dealing with bicycle safety issues, typically the frequency of bicycle-related collisions is sparse. This can lead to two problems:

- A site with only one or two collisions may be ranked with an abnormally high priority (as other sites may not have any collision history);
- Due to the known randomness of collision frequencies, a high-risk site may have several years of no bicycle-related collision events at all, leading to a site with an abnormally low priority.

This is not to say that when dealing with cycling safety practitioners should ignore the collision history information that is available at a site: such data can often provide useful diagnostic information and assist in the selection of appropriate countermeasures. However, attempting to apply sparse collision data as the sole index for prioritizing investments may result in a serious misallocation of funding. The techniques and

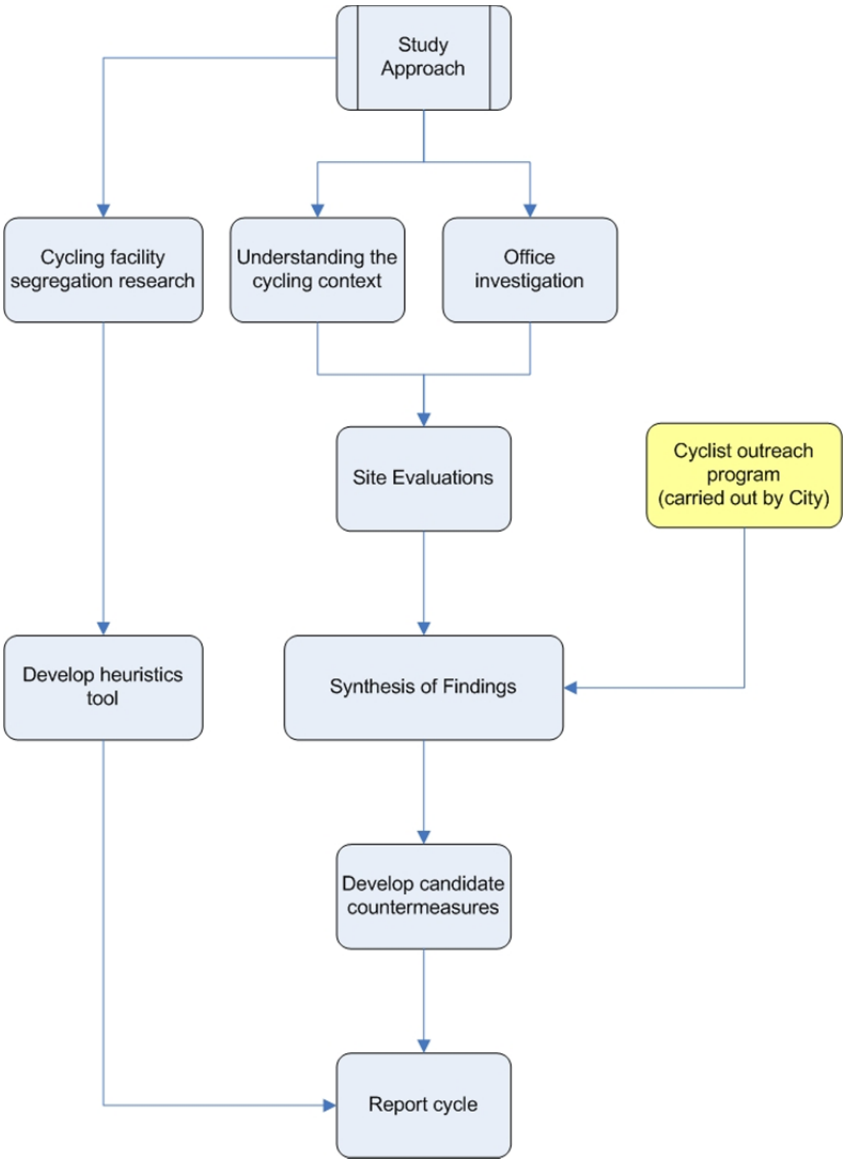
analysis framework applied in the study – and any future City of Ottawa evaluation – must consider this important reality.

3 A LINES OF EVIDENCE APPROACH

3.1 Overview

In carrying out this study, we integrated both cycling/road safety engineering considerations and operational analyses into an assessment of the existing safety performance based on a “lines of evidence” approach. This approach examines a range of factors that we know may be related to the safety performance of the facility and assesses them first individually, and then as an integrated set of factors. Where the lines of evidence overlap and point to a common conclusion regarding a particular feature or element of the cycling facility, that conclusion is strengthened by the independence of the indicators. The following Figure provides an overview of the work plan used in our analysis.

Figure 1: Our approach



3.2 Understanding the cycling context

Prior to our detailed safety evaluations, it was necessary for the project team to gain a better understanding of the Ottawa cycling context. As such a review of background material was undertaken, as well as discussions with City staff regarding the specific issues at each of the ten sites.

3.3 Office investigation & field evaluations

The detailed engineering study (DES) component of any cycling/road safety assessment requires both an office investigation and a field investigation to have a full appreciation of the "safety" context.

An office investigation typically requires the review of readily available data such as cycling flows, traffic volumes, transit routes/stops, cycling collisions, existing infrastructure (i.e. cycling provisions, if any; vehicle lane configurations, etc.). This process allows investigators to gain a better appreciation of the potential issues at each site based on historical data, and will help focus their attention during the next steps.

Once the office investigation is complete investigators will then visit the site in person - termed the field investigation. It is imperative that a multi-disciplinary team of investigators carry out this process to provide a range of perspectives and observations about the facility. The facility is traveled both as a cyclist and a driver during both peak and off-peak periods of the day as well as at night. The specific evaluation process used in this study followed the TRL methodology referred to as the Cycling Environment Review System (CERS). This is one approach that allows investigators to quantitatively and qualitatively assess each cycling facility – from a variety of important perspectives – and identify the specific concerns and risks.

3.4 Cyclist outreach program

The City initiated an online survey to gather information from cyclists who travel throughout the City. The purpose of the survey was to gather data so the City could assess existing facility conditions, understand cycling travel patterns, then develop and prioritize cycling safety issues by site. The survey was open from August 2010 to September 15th, 2010.

The findings of the survey, as they relate to the ten sites being evaluated as part of our study, were obtained from the City. The reported "problem" information associated with each site was incorporated into our work plan as an independent line of evidence supporting the observations made during the office and field investigations.

3.5 Synthesis of findings & development of candidate countermeasures

In the final analysis step, we connect the lines of evidence from each of the examinations through an integrated discussion of the commonalities and differences of the various cycling safety factors present with each of the ten study areas. The pooled results of this approach provide a strong and defensible technical basis for the development of our overall site observations and candidate solutions.

4 UNDERSTANDING THE CYCLING CONTEXT

4.1 The system of facilities

Ottawa has one of North America's largest networks of multi-use pathways, comprising more than 220km of pedestrian and cyclist paths in the Capital Region. Ottawa's downtown area is linked by a number of signed cycle routes, and bicycle parking in this area is prevalent and well used. Although motorized traffic and its infrastructure currently dominate the downtown area, at peak times there is a high volume of cyclists on and off road. This demonstrates the opportunity for increasing the visibility of cycling and its potential as the mode of first choice.

4.2 An overview of Ottawa's Cycling Master Plan

The most recent official publication relating to the future of cycling in Ottawa is the Ottawa Cycling Plan (OCP), published in January 2008. The document outlines the role of cycling in Ottawa's wider transportation plan, as well as setting the scene for Ottawa's proposed bicycle network for implementation between 2008 and 2028. It also points to wider objectives for improving conditions for cyclists in the city, including educational and outreach programs, as well as providing a body of good practice in relation to infrastructure design, policy planning and linking cycling to other modes.

A central goal of the OCP is to encourage more people to cycle more often. To help achieve this goal a hierarchy of cycling facility types was developed to appeal to a wide range of skill levels. A two-tiered network hierarchy was proposed and consists of the following two systems:

- The primary "spine" system – a system of cycling routes intended to provide direct links between major employment, residential and commercial developments and serve both commuter and recreational cyclists.

- The secondary "community" system – a system of cycling routes that are less direct and follow streets with less traffic and slower vehicle speeds. These routes will feed into the spine system and focus on providing service to local destinations such as parks, schools and local neighbourhoods.

4.3 The evaluation sites

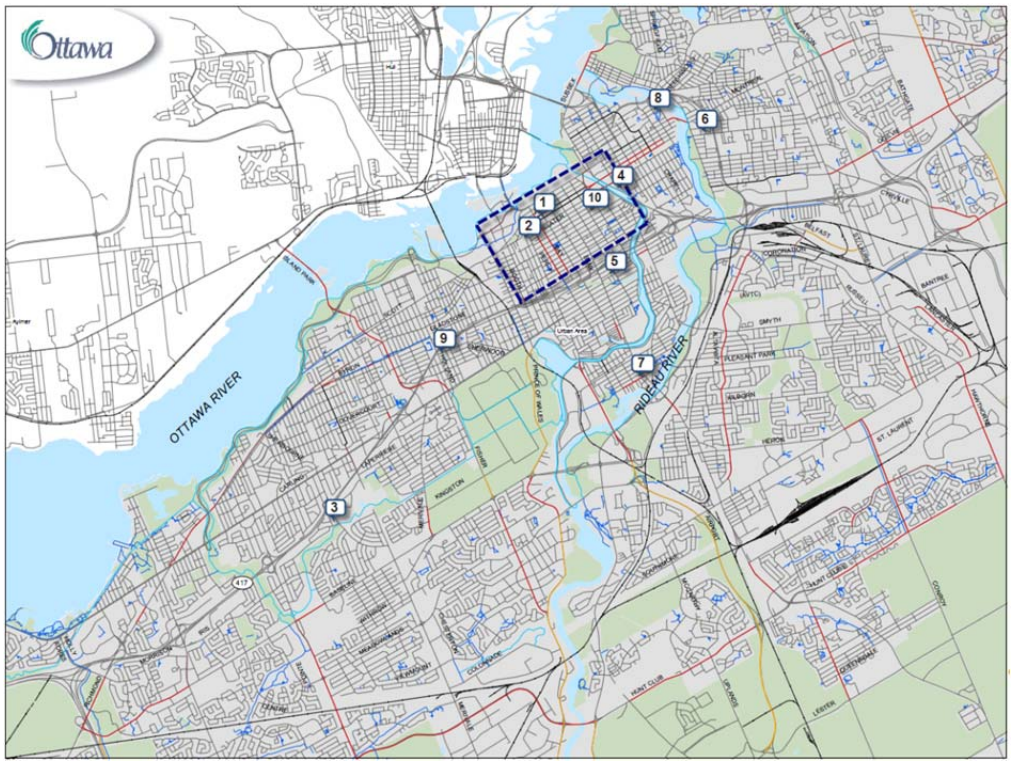
Within the OCP document there are several policy recommendations put forward for inclusion in the City's Official Plan. The policy recommendations not only focus on moving forward with the proposed cycling network, but are quite clear on the need to maintain and improve the facilities that already exist. The latter is the focus of this study.

As such, the City of Ottawa staff identified ten existing cycling facilities to be assessed. These sites were selected based on a combination of the collision history and complaints submitted to the City by cyclists and advocacy groups. Of these ten sites, seven consisted of roadway segments and the remaining three were intersection locations. Each site is described briefly in the Table 1.

Table 1: A description of the ten evaluation sites

Site No.	Name	Assessment Type	Cycle route type
1	Wellington Street at Lyon Street	Intersection	Spine
2	Proposed Pathway on Albert & Bronson	Roadway	Spine
3	Maitland Avenue at Queensway WB Ramp	Intersection	Spine
4	MacKenzie King Bridge at Waller Street	Intersection	Spine
5	O'Connor Street at Catherine Street	Roadway	Spine
6	Montreal Road (River to Cyr)	Roadway	Spine
7	Bank Street (Echo to Riverdale)	Roadway	Spine
8	St. Patrick Street / Beechwood Avenue	Roadway	Spine
9	Gladstone / Tyndall / Byron Avenue	Roadway	Spine
10	Laurier Avenue West (Metcalfe to Bridge)	Roadway	Spine

Figure 2: Site location context map



The map above shows the location of each of the sites, with the dashed box indicating the downtown core area. Three sites (#1, #2 and #10) are located within the downtown core, and a further two (#4 and #5) are located within close proximity to the downtown core. These areas tend to generate high cycling flows due to the following characteristics:

- Increased density of trip attractors such as employment nodes;
- Provision of cycle parking; and
- Good links to the greater Ottawa area using the off-street multi-use paths.

The remaining sites are located on the periphery of the downtown area. Sites #6 and #8 are both located to the north east of the downtown and both are major east-west routes that directly connect to a bridge over the Rideau River. Site #7 (Bank Street) is a major north-south travel corridor feeding the downtown core. These are part of the spine route system and are used by commuter cyclists into and out of the downtown area.

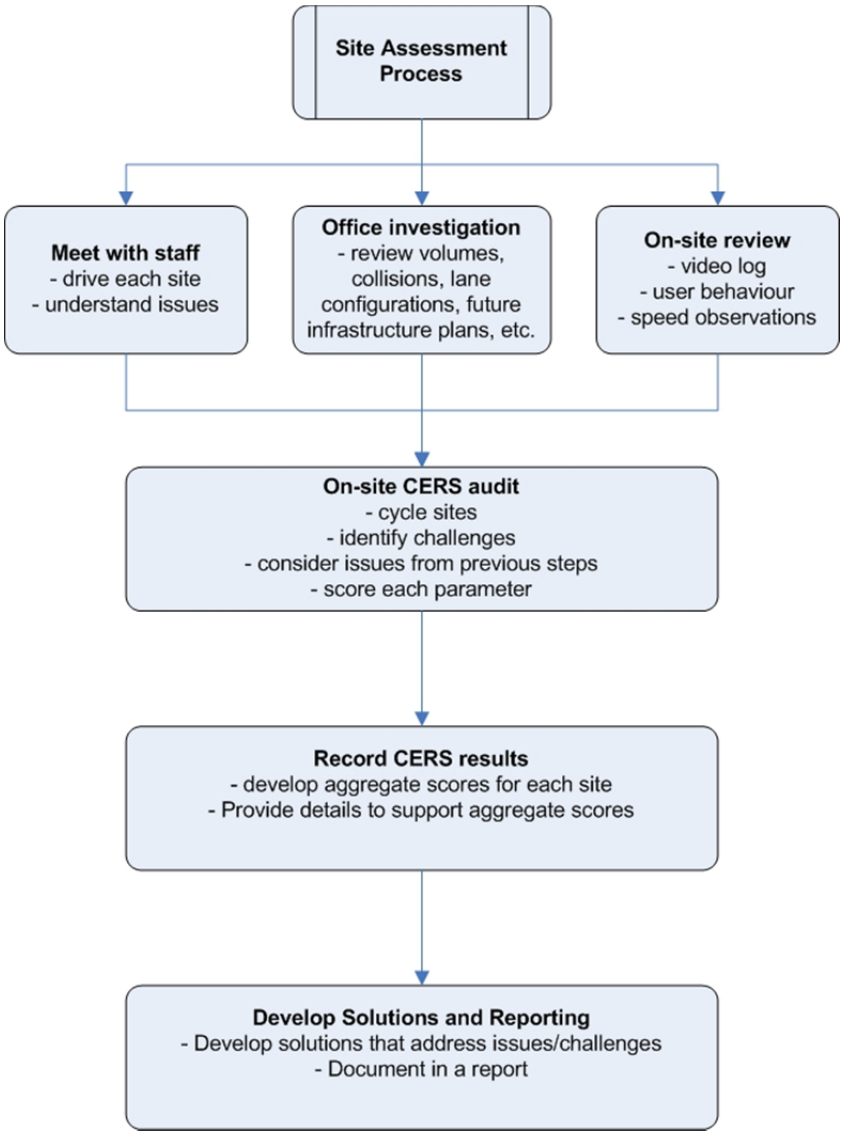
5 SITE EVALUATION METHODOLOGY

5.1 The CERS methodology

The field audits were carried out by an integrated team of investigators from Delphi-MRC and TRL using an on-street assessment process at the ten key cycling facilities. Delphi-MRC incorporated TRL's Cycling Environment Review System (CERS) methodology – adapted to the City of Ottawa context - into the cycling/road safety assessment framework. The CERS process has been developed by TRL over the last decade and has been applied around the world for cycling safety assessments such as those carried out for this study.

The Figure below illustrates the site-specific safety assessment process.

Figure 3: The site-specific safety assessment process



5.2 Understanding the CERS evaluation process

A key component to the site-specific safety assessment is the CERS field evaluation. Given that intersection cycling facilities can have different characteristics than cycling facilities on roadway segments, we developed similar but separate field audit parameters for the two general facility types. The various elements of the two CERS assessment types are presented below.

5.2.1 Intersection facilities

There are three policy areas that comprise the CERS intersection facility audit process. These include convenience, accessibility and safety, and comfort. Evaluation parameters within each policy area are contained in the following Table.

Figure 4: The CERS intersection audit parameters

Ottawa CERS Assessment – Intersection Parameter Guide		
Policy	**Parameter**	**What to assess**
1. Convenience	Cyclist Provision	• Notes any infrastructure facilities provided for cyclists to negotiate the intersection safely • Considers whether cyclists have any priority over other traffic • Considers context of intersection (e.g. traffic flows, behavior, speeds, etc) and judges whether facilities are appropriate
	Deviation from the Desire Line	• Considers the distance cyclists have to travel across the intersection • Assesses whether infrastructure allows cyclists to follow their desire line, including on approach and exit • Is the distance minimized by cycle-specific facilities?
	Legibility	• Notes legibility of any facilities, as well as overall delineation, separation and lighting • Considers whether drivers have good legibility of cyclists e.g. through signs, good sightlines, etc • Takes account of any existing cycle / traffic signs and road markings that provide directions in advance of the intersection.

Ottawa CERS Assessment – Intersection Parameter Guide - *continued*		
Policy	**Parameter**	**What to assess**
2. Accessibility / Safety	Performance	• Issues that may affect a cyclist's ability to travel through intersection in safe manner • Based on the type of intersection and facilities provided in combination with background data • Assesses degree of cyclist protection and points of conflict • Ascertained using provided traffic data, collision data and on site observations
	Capacity	• Use existing data for assessment purposes, including AADT data and bicycle counts if available. • Assesses whether capacity of the intersection and infrastructure is sufficient for peak flows • Considers whether safety of cyclists could be compromised by capacity issues e.g. standing traffic resulting in poor behavior
	Delay	• Assesses total delay incurred by cyclists moving through the intersection • Considers delays from signalization, volumes of traffic causing blocking back and total distance travelled through intersection.
	Sightlines	• Assesses sightlines on approach to and through the intersection • Notes approaching view of intersection and cross streets • Considers sightlines between cyclists and other road users on approach to, at and following the intersection

Ottawa CERS Assessment – Intersection Parameter Guide- *continued*		
Policy	**Parameter**	**What to assess**
3. Comfort	Gradient	• Make note of the gradient of the approaches and exits to determine the effort cyclists would need to make to negotiate the full intersection. • Considers gradient on approach to and at stop line, to assess whether restarting from standing would unduly expose cyclists to accelerating traffic.
	Surface Quality	• Observe quality of road surface and type, i.e. cracking, potholes, cobblestones etc. • Observe any skid / fall hazards such as catchbasin covers, manhole covers, etc. • Observe number of reinstatements and quality. • Consider whether surface defects would cause a cyclist to change speed or direction, and whether lighting is sufficient to negotiate poor surfaces on approach
	Obstructions	• Assesses number, type and frequency of obstructions on approach to and at the intersection • Observes whether location of obstructions are within main path or waiting area • If present, gauges if obstructions stand out and are marked (considers night time visibility) • Considers whether obstructions cause deviation to a cyclist, e.g. causes weaving movements into traffic
	Maintenance	• Assess current drainage facilities and whether drainage channels appear to be free from detritus and regularly swept. • Identify any areas where ponding of water is evident; large areas of standing water will deter cyclists and alter their path, a particular issue on intersections where there is no designated lane. • Assess quality and clarity of road markings – may affect vehicular paths and therefore behavior through intersections. • Provides an indication of the future score of maintenance if not addressed.

Source: TRL

5.2.2 Roadway segment facilities

There are four policy areas that comprise the CERS roadway segment facility audit process. These include convenience, accessibility and safety, comfort and attractiveness. Evaluation parameters within each policy area are contained in the following Table.

Figure 5: The CERS roadway segment audit parameters

Ottawa CERS Assessment – Roadway Parameter Guide		
Policy	**Parameter**	**What to assess**
1. Convenience	Continuity	• Any issues that may affect the continuity of a facility. • This could include change in roadway width or delay to cyclists (e.g. through signalized intersections)
	Legibility	• Issues that may affect a cyclist's ability to follow the route. • Take note of any existing cycle / traffic signs that provide directions and any landmarks.
	Directness	• Ascertain if the roadway link provides the most direct path with no delays. • Use mapping material and other data to ascertain if there is an alternative route which cyclists could use. Take into account intersections or other features that may result in delay.
2. Accessibility / Safety	Intersection Conflict Points	• Based on the type of intersection in combination with traffic flow and the size of the intersection. • Those intersections with fewer potential conflict points are awarded a greater score. • Ascertained using provided traffic data, collision data, infrastructure plans, and field observations.
	Traffic Volume	• Use available data for assessment purposes. • Those roads with a lighter traffic flows will receive a higher score.
	Traffic Proximity	• Based on mixture of traffic and width of traffic lane(s) in a single direction of travel. • A wide lane with cars only will provide a higher score than a narrow roadway which routinely accommodates buses or other large vehicles.
	Traffic speed	• Use recorded 85th percentile speeds or if unavailable estimates of speed obtained by radar. Truck and bus speeds can also be beneficial. • The lower the speed of vehicular traffic the higher the score.
	Link Conflict Points	• Includes obstructions along the route roadway surface. • Considers visibility restrictions due to roadside furniture, vegetation etc. • Considers the presence and frequency of private accesses

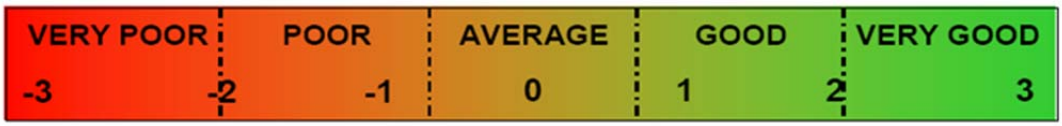
Ottawa CERS Assessment – Roadway Parameter Guide - *continued*		
Policy	**Parameter**	**What to assess**
3. Comfort	Effective width	• Assess any existing cycle lane provision. • Assess the entire width of the roadway (to include possible effect of overtaking) • Make note of parked cars; this will determine what measures may be required to remove parking or whether a cycle lane away from the edge of the roadway could be introduced.
	Surface Quality	• Observe quality of road surface and type, i.e. cracking, potholes, textured pavement, etc. • Observe any skid / fall hazards such as catchbasin covers, manhole covers, etc. • Observe number of reinstatements and quality.
	Maintenance	• Assess current drainage facilities and whether drainage channels appear to be free from detritus and regularly swept. • Identify any areas where ponding of water is evident; large areas of standing water will deter cyclists and alter their path, a particular issue on signed only routes where there is no designated lane. • Assess quality of road markings to determine clarity – will affect vehicular paths and therefore behavior through intersections and along routes.
	Effort	• Make note of the gradient of the link to determine the effort cyclists would need to make to negotiate links. • Especially problematic if cyclists are required to stop, e.g. at intersections, pedestrian crosswalks, and need to restart.

Ottawa CERS Assessment – Roadway Parameter Guide - *continued*		
Policy	**Parameter**	**What to assess**
4. Attractiveness	Personal security	• Determine whether the area around the link has litter / graffiti or evidence of vandalism. This can impact the level of cycling demand by fear of crime. • Make a note of the presence of any CCTV cameras in the vicinity. • Identify any areas of concealment adjacent to the route.
	Lighting	• Assess and observe the regularity and positioning of lighting and comment on the lighting levels at night. • Lighting should be available on cycle routes as a safety measure and to provide an additional level of personal security.
	Quality of Environment	• Determine the quality of the property frontages along the link; is this a route that cyclists would want to navigate? Are the frontages and fence lines etc of good quality and well maintained? • The presence of trees / vegetation will make the route more appealing to cyclists. Is regular maintenance likely to occur?

Source: TRL

For each of the individual policies and parameters, the auditors assigned a score using a rating scale of +3 to -3. Scores of +3 are considered best practice and scores of -3 are considered very poor. Within this range, each score value is associated with a red/amber/green colour (RAG) and is referred to as the RAG rating. A red colour identifies a poor score (i.e. -3), an amber colour means average and green indicates a good score (i.e. +3). The RAG rating allows the reader to quickly identify where a particular policy parameter score value lies within the range. The RAG rating and scoring system is illustrated in the Figure below.

Figure 6: RAG rating for the CERS scores



Source: TRL

6 THE CERS RESULTS

6.1 Overview

Following the detailed methodology presented in the previous Section, the integrated investigation team identified a CERS score for each of the policy parameters at each of the ten sites. To do this, the team considered data reviewed as part of the office investigation as well as the observations recorded during the field audit.

Following the methodology presented earlier, summaries of the CERS results are provided in two groups, the intersection sites followed by the road segment sites. More detailed descriptions of each site and its challenges and issues, are available in a Technical Appendix provided separately from this report.

6.2 Intersection evaluations

6.2.1 Overview of results

There were 3 intersection sites evaluated in total and they include:

- Site #1 – Wellington Street at Lyon Street
- Site #3 – Maitland Avenue at Highway 417 Ramps
- Site #4 – MacKenzie King Bridge at Waller Street

Given the very different site conditions at Site #4 (MacKenzie King Bridge at Waller Street) for eastbound and westbound cyclists, the study team elected to evaluate these two travel directions separately. Therefore, the eastbound and westbound directions are referred to as Site #4a and Site #4b, respectively.

As discussed in Section 5, the evaluation parameters at each site were given a score between -3 and +3. The scores assigned to each site are summarized in Table 2. The average values in the rightmost column provide an indication of how the collective group of intersections performs for each parameter. The bottom row of the Table provides a summation of scores for each site. A positive value is perceived as good and a negative value as poor.

Table 2: Summary of intersection CERS results by site

		Intersections				
		Site #1	**Site #3**	**Site #4a EB**	**Site #4b WB**	**Average**
Convenience	Cyclist provision	-2	-3	2	-2	-1
	Deviation from the desire line	1	2	2	2	2
	Legibility	-2	-3	2	-3	-2
Accessibility / Safety	Performance	-1	-3	2	-3	-1
	Capacity	-1	-1	1	-2	-1
	Delay	0	2	2	-3	0
	Sightlines	3	-2	2	-2	0
Comfort	Gradient	2	-1	1	-1	0
	Surface quality	1	-3	2	1	0
	Obstructions	2	0	3	-1	1
	Maintenance	1	0	3	1	1

The results presented in Table 2 indicate that the most common issue for all sites was associated with route legibility (i.e. poor route signage and/or cyclist positive guidance) followed by cyclist provision, performance and capacity. These parameters are associated with the convenience and accessibility/safety policies.

We discuss the findings of these intersection assessments under each of the individual policy evaluation categories beginning below.

6.2.2 Evaluation discussion: Policy issue #1 – Cyclist provisions

At Sites #1, #3 and #4b there is no formal provision, or reserved space for cyclists to ride through the intersection safely. In addition, the shared space for cyclists and vehicles is considered to be inadequate and poorly marked. These conditions are exacerbated by the poor driver behaviour – including drivers overtaking cyclists when there is insufficient space to do so.

At Site #4b (westbound direction), a notable issue included the lack of refuge space in the centre median for cyclists moving from Stewart Street to southbound on Waller Street. This situation requires cyclists to cross five lanes of conflicting traffic, travelling in both directions.

In all cases, complex intersection facilities require increased legibility, positive guidance and in some cases reserved space for all users. As complexity increases, both drivers and cyclists focus more on the task of navigating through the intersection and less on other users around them. This is an undesirable situation.

6.2.3 Evaluation discussion: Policy issue #2 – Legibility

The legibility, such as lane markings and signage, are an important component for both cyclists and drivers to negotiate a facility. For cyclists, this results in a better understanding of the safest road positioning through the intersection, particularly important for riders who have not taken part in cycling training, who lack experience with cycling in traffic, or are unfamiliar with the site. Improved legibility is also important when dealing with complex intersections or situations with high volumes of heavy vehicles (such as larger trucks) or transit buses.

The legibility of intersections was found to be poor at all sites, with the exception of the eastbound cycling movement through the signalized intersection of MacKenzie King Bridge and Waller Street. This issue is significantly linked to the fact that there is no formal provision for cyclists at these intersections. This can result in drivers who are not aware of cyclists around them as they travel through the intersection.

6.2.4 Evaluation discussion: Policy issue #3 – Performance

The performance parameter – under the accessibility and safety policy category – describes the level of conflict that exists between cyclists and other road users. Sites #3 and #4b had the poorest scores at -3 and Site #1 was marginally poor at -1.

Site #3 is where Maitland Avenue crosses the Queensway entry and exit ramps. At this location a combination of high vehicular speeds, aggressive driving and a lack of reserved space for cyclists contributed to the poor score. The fact that all cyclists observed at the time of the audit were using the sidewalk suggests that the conditions at this intersection (and approaching roadway) are perceived to be unsafe and uncomfortable.

At Site #4b (Waller Street westbound), there is a high degree of conflict that is associated with the cyclist maneuver from Stewart Street, across the northbound lanes of Waller Street to the central median – a refuge that is an inadequate width for a bicycle. In addition, cyclists must negotiate across two reserved southbound lanes (one for large trucks and another for transit buses). This situation exposes cyclists to considerable risk.

Site #1 (Wellington Street at Lyon Street) received a poor score due to the atypical vehicle lane configuration in the eastbound direction and the lack of information with respect to priority or right-of-way between cyclists and drivers. Eastbound vehicles are permitted to turn right from the central lane (as well as continue straight through the intersection) – and these right turns create a conflict with cyclists. There is a lack of positive guidance (i.e. signage or lane markings) that would otherwise:

- indicate to right-turning drivers that they must check for through-moving cyclists; and

- indicate to cyclists the proper lane positioning and action required to safely negotiate the intersection.

The recorded collision history at this intersection demonstrates the risks associated with the eastbound lane configuration.

6.2.5 Evaluation discussion: Policy issue #4 – Capacity

Cyclist capacity limitations were identified during the field audit and can be attributed to the separation distance between cyclists and drivers – and not necessarily associated with the ability to move more cyclists. When dealing with separation distance it is less of a concern for experienced/confident cyclists (as they are more likely to be undeterred by mixing with vehicles and lane changing amongst vehicles) and is more important for less experienced cyclists who prefer to avoid interaction with vehicles unless absolutely necessary. The negative scores given for this policy parameter are based on the auditors experience of riding the facility and through observations of other cyclists' behaviour. Three of the four intersection facilities were given a negative score and they are described below.

Site #4b (westbound direction through MacKenzie King and Waller Street) was given the worst score due to the inadequate centre median refuge, opposite Stewart Street. The auditors noted their bicycle wheels protruding from either side of the median gap, into the vehicle travel lanes.

At Site #1 (Wellington Street at Lyon Street), platooned vehicle flows in the eastbound direction made it difficult for eastbound cyclists to change lanes and avoid the exclusive eastbound right turn lane. Conditions at the site sometimes required cyclists to adjust their speed and make a delayed lane change at a sharp angle in close proximity to the intersection – an area of increased driver workload.

Conditions at Site #3 (Maitland Avenue) included poor pavement surface quality and presence of debris in the curb lanes. These types of conditions require cyclists to travel away from the curb and share the middle of the travel lane with vehicles. This is an undesirable situation on Maitland Avenue given the high vehicle volumes and high vehicles speeds. The combination of these issues is likely associated with the high rate of cyclists using the sidewalk and the high collision rate between vehicles and cyclists in the crosswalk.

6.3 Road segment evaluations

6.3.1 Overview of results

There were 7 intersection sites evaluated in total and they include:

- Site #2 – Albert Street and Bronson Avenue

- Site #5 – O'Connor Street at Catherine Street

- Site #6 – Montreal Road (from River Road to Cyr)

- Site #7 – Bank Street (from Echo to Riverdale)
- Site #8 – St Patrick Street / Beechwood Avenue
- Site #9 – Gladstone / Tyndall / Byron
- Site #10 – Laurier Avenue (from Metcalfe to the Bridge)

As discussed in Section 5, the policy parameters at each site were given a score between -3 and +3. The scores assigned to each site are summarized in Table 3. The average values in the rightmost column provide an indication of how the collective group of roadway sections perform for a given evaluation parameter. The bottom row of the Table provides a summation of scores for each site – a positive value is perceived as good and a negative value poor.

Table 3: Summary of roadway segment CERS results by site

		Roadway Segments							
		Site #2 Modified	Site #5	Site #6	Site #7	Site #8	Site #9	Site #10	Average
Convenience	Continuity	2	-2	-3	-1	-3	-3	-2	-2
	Legibility	-1	1	-2	-1	-1	-3	-1	-1
	Directness	-1	2	1	2	1	-3	2	0
Accessibility / Safety	Worst intersection conflict	-1	-3	-3	0	-2	-2	-2	-2
	Traffic volume	0	-3	-3	-3	-3	-3	-3	-3
	Traffic proximity & mix	2	-3	-1	-3	0	0	0	-1
	Traffic speed	2	0	-1	2	-3	0	-1	0
	Link conflicts	0	-3	-3	-3	-3	-2	-2	-2
Comfort	Effective width	1	-3	-2	-3	-3	1	-1	-2
	Surface quality	-2	-2	-2	2	-2	-3	-2	-2
	Maintenance	-1	-2	1	1	1	1	1	0
	Overall effort	-2	3	2	-2	0	3	1	1
Attractiveness	Personal Security	1	-1	0	2	2	2	2	1
	Lighting	2	1	2	2	3	0	0	2
	Quality of the environment	1	-2	-2	1	2	2	1	0

It should be noted that Site #2 was evaluated in a different manner relative to the other road segments and therefore, caution should used when comparing the results of this site to the other study area sites. Based on the direction provided by the City, it was assumed that Site #2 had a separated cycling facility already in place along Bronson Avenue, between Albert and Queen Streets. All the other road segments were evaluated based on the existing conditions observed during the field reviews.

We discuss the findings of all the road segment assessments under each of the individual policy evaluation categories beginning below.

6.3.2 Evaluation discussion: Policy issue #1 – Continuity

Continuity receives a poor result due to the fact that a consistent cycling facility is not currently provided along the length of any of the routes reviewed. This can lead to cyclist delays and deviation into traffic at inappropriate locations. One of the main safety concerns along the routes evaluated as part of this study is the effect of on-street parking and the associated maneuvers (i.e. lane changes, lack of buffer zone between parked cars and the adjacent lane).

The other key issue noted on two of the routes is the short sections of reserved bicycle lanes that terminate unexpectedly. The field observations identified cycle lane terminations that required cyclists to merge with traffic in an area of vehicle weaving and lane changing, or where visibility was limited and traffic speeds were high. These are undesirable conditions for cyclists and increase the risk of collision.

6.3.3 Evaluation discussion: Policy issue #2 – Worst intersection conflict point

During an assessment of a roadway section the auditors identified the most problematic conflict point in the corridor. Typically this occurs at major intersections where there are high traffic flows, increased lane changes, vehicle/cycle weaving or where slip lanes exist.

Some examples of the observed issues include:

- the termination of cycle lanes approaching a major intersection with no positive guidance (i.e. a continuous cycle lane or conflict sharrows) through the problem areas such as channelized right turn lanes;
- Where the designated cycle route changes directions and requires cyclists to make a left turn across multiple lanes of traffic; or
- Signal timing issues including clearance times that are inadequate for cyclists.

6.3.4 Evaluation discussion: Policy issue #3 – Traffic volume

The traffic volume scores for all links are consistently poor along the routes due to the relatively high vehicle volumes. Given that the majority of the sites being evaluated as part of this study are along arterial roadways feeding the downtown core, simply reducing the volume of traffic will be difficult to achieve and may cause vehicle congestion elsewhere on the road network. Thus careful consideration is required to identify effective candidate cycling safety countermeasures that address this significant issue.

6.3.5 Evaluation discussion: Policy issue #4 – Link conflict points

The majority of the roadway segments that were evaluated had a poor rating with respect to the number of conflict points along the route. Conflict points can be in the form of intersections, pedestrian crosswalks, private accesses and parked vehicles. Given the difficulty of removing intersections or consolidating accesses, there may be opportunities to limit or relocate on-street parking as means of reducing the number of conflict points.

6.3.6 Evaluation discussion: Policy issue #5 – Effective width

The effective width of the travel lanes, for cyclists, was a general concern at the majority of sites. This situation is exacerbated at sites where on-street parking is provided. This type of situation increases the risk for cyclists as they may cycle closer to the centre of the roadway to avoid the risk of dooring. This has the potential to reduce the space between cyclists and vehicles, decreasing the overall comfort level for cyclists.

6.3.7 Evaluation discussion: Policy issue #6 – Surface quality

Roadway surfaces at all sites were very poor – particularly along the outside edge of the travel lane. This has the potential to force cyclists towards the middle of the travel lane, and thus reduces the space between cyclists and vehicles. This effectively decreases the overall comfort level and increases the level of risk for cyclists using these facilities.

We also noted that a number of catch basins were not flush with the roadway surface. This poses a possible “tripping” hazard for cyclists, or conversely if avoided by the cyclist, then it requires swerving away from the curb – possibly into the path of adjacent or following vehicles.

7 CYCLIST OUTREACH PROGRAM

7.1 Background

A cyclist outreach program was carried out by the City of Ottawa in the form of an online survey. The intent of the survey was to gather input from cyclists regarding the type of cycling they do (i.e. commuting, recreational, etc.), where they travel, problem sites, the perceived problem at these sites and potential solutions. The online survey was open to cyclists from August to September 15th, 2010.

Our study used a subset of the data collected through the online survey and focused on the problem sites and their perceived problems. All of the problem sites were filtered and sorted to glean the information as it related to the 10 sites being evaluated. A summary of the comments at each site is provided below.

7.2 Summary of problem statements

7.2.1 Site #1 - Wellington Street at Lyon Street

The majority of the comments submitted for this site were associated with the following:

- The eastbound right-turning traffic from the central lane and the conflict between cyclists and drivers;
- Narrow travel lanes, with numerous buses and bus stops, no room for cyclists;
- Aggressive drivers;
- Discontinuity in cycle facilities between Portage Bridge and downtown; and
- Wellington Street is unsafe for cyclists and requires cycling on sidewalk or through parking lots.

7.2.2 Site #2 – Albert Street and Bronson Avenue

There were only a few comments submitted for this site and were associated with the following:

- The abrupt termination of the existing multi-use path at Commissioners Street; and
- Cyclists not comfortable using (the westbound) bus-only curb lane on Albert Street.

7.2.3 Site #3 – Maitland Avenue at Queensway westbound ramps

There were a limited number of comments submitted for this site and were associated with the following:

- Sightline restrictions on the intersection corners made it difficult to see pedestrians/children/other cyclists; and
- Cyclists traveling on the sidewalk.

7.2.4 Site #4 – MacKenzie King Bridge at Waller Street

There were only a few comments submitted for this site and all were associated with the following:

- The bicycle signal indication at the MacKenzie King / Waller Street intersection is short and cars often ignore the bicycle phase; and
- The eastbound bike lane on the bridge does not continue onto Waller Street.

7.2.5 Site #5 – O'Connor Street at Catherine Street

The submitted comments for this site all focused on the reserved cycle lane in the middle of the street. The comments described the difficulty in moving from the curb lane, across two lanes of vehicle traffic to the reserved lane – particularly during peak travel periods of the day.

7.2.6 Site #6 – Montreal Road (from River Road to Cyr)

The comments submitted for this site focused on the following:

- Lack of a reserved space for cyclists and narrow travel lanes;
- Right and left turning vehicles cut-off cyclists;
- Transit buses do not share bus/taxi-only lanes with cyclists;
- Limited visibility with cars, cyclists, pedestrians and buses all sharing the same space.

7.2.7 Site #7 – Bank Street (from Echo to Riverdale)

The majority of the comments submitted for this site were associated with the following:

- Narrow lanes and drivers that do not respect cyclists' space;
- No buffer separating on-street parking and cyclists (potential for dooring);
- Numerous turning vehicles;
- Poor pavement surface quality.

7.2.8 Site #8 – St. Patrick Street / Beechwood Avenue

The comments submitted for this site focused on the following:

- Discontinuity in reserved bike lanes (terminate abruptly);
- Very high vehicle speeds across bridge;
- No provision for westbound cyclists turning left to Cobourg Street;
- Conflict for eastbound cyclists on bridge weaving with right turning cars onto Vanier Parkway;
- Beechwood has narrow lanes and on-street parking is a hazard for cyclists.

7.2.9 Site #9 – Gladstone / Tyndall / Byron

The majority of the comments submitted for this site were associated with the following:

- The bike route through this area is direct but avoided by cyclists due to challenges;
- Cyclists are required to change lanes and weave among vehicles when traveling to/from Byron Avenue and Tyndall Avenue via Holland;
- Eastbound cyclists have difficulty turning left from Tyndall onto Parkdale given the high volume of vehicle traffic on Parkdale.

7.2.10 Site #10 – Laurier Avenue (from Metcalfe to Bridge)

The comments submitted for this site focused on the following:

- Discontinuity in reserved bike lanes (terminate abruptly), westbound lane ends at the gore area of a merging lane – an area of vehicle weaving;
- The Elgin Street intersection has poor pavement conditions, and experiences high volumes of turning vehicles.

7.2.11 Common systemic issues

In addition to the site-specific issues identified through the survey, there were also system-wide issues common to most sites. We refer to these as systemic issues and two common issues gleaned from the survey data include:

- The sudden termination of cycling pathways and bike lanes with no indication where cyclists should proceed (i.e. poor navigational aids); and
- The poor road surface conditions such as potholes or uneven pavement.

8 RECOMMENDED CANDIDATE COUNTERMEASURES

8.1 Overview

In order to address the site-specific issues identified through our lines of evidence approach, it was necessary to undertake a process that linked the individual lines of evidence with potential candidate countermeasures. This process is discussed in the following Sections.

8.2 Workshop

Given the number of sites and the substantial amount data available for each, we felt that an appropriately structured technical workshop involving all of our key team members would provide a strong foundation for the development of appropriate candidate countermeasures to address the identified challenges at each site.

The workshop was 2 days in duration and each site was discussed individually. Working through the list of ten sites, the key issues and challenges at each were presented based on the findings of the office investigation, the results of the CERS field evaluation, and the comments gleaned from the online survey. As noted above, the ultimate goal of the workshop was to develop appropriate candidate countermeasures to address the identified challenges at each site.

Attending the workshop were road safety specialists from Delphi-MRC, cycling facility specialists from TRL and a CANBIKE national instructor. The cross-section of backgrounds and perspectives provided meaningful discussions among the team members about the issues at each site and strengthened the quality of candidate solutions that were ultimately developed.

During the course of the 2-day workshop numerous potential candidate safety countermeasures were identified. However, only those treatments that were previously applied or identified by the City of Ottawa (i.e. in the City's Cycling facilities design guidelines document) and those that have been proven through research were considered for application. In addition, follow-up operational analyses were carried out by Delphi-MRC for a limited number of sites to confirm the reasonableness of the system of safety measures, given the site-specific context. For example, additional traffic operational analyses were carried out at two intersections to quantify the impacts associated with proposed lane configuration changes.

8.3 Summary of candidate safety countermeasures

Following our workshop discussions, concept sketches were developed for each of the ten sites to illustrate the system of candidate safety countermeasures. The following is the summary list of all of the candidate safety countermeasures that were considered for all of the ten sites.

Table 4: Summary list of candidate countermeasures

Category		Candidate Countermeasure Description	Implementation Cost Estimate
Pavement markings	1	Provide sharrow markings along a road	$
	2	Provide bicycle lanes on a road	$$ / $$$
	3	Provide coloured bicycle lanes	$$
	4	Provide coloured bicycle lanes at conflict zones (e.g. slip lanes)	$
	5	Provide supplemental sharrow markings at conflict zones (e.g. slip lanes)	$
	6	Install conflict sharrows to indicate a recommended lane change	$
	7	Install enhanced pavement markings at intersections where cycle paths cross streets	$
	8	Improve pavement markings at intersections (positive guidance for all road users)	$
Facility design	9	Introduce "advance stop line" (ASL) or "bike box" at a signalized intersection	$
	10	Provide "indirect left turn" or "hook turn" treatment at a signalized intersection	$
	11	Change the assignment of vehicle turning movements or lane configuration at intersections	$ / $$
	12	Limit the length of conflict zones between cyclists and vehicles	$
	13	Provide curb cuts to facilitate bicycle movements onto/off the street	$
	14	Convert sidewalks to multi-use paths	$$ / $$$
	15	Convert sidewalks to segregated pathway	$$ / $$$
	16	Narrow the centre travel lanes of a roadway to provide wider outside curb lanes	$
	17	Widen curb lane to provide space for reserved cycle lanes	$$ / $$$
	18	Reduce the number of traffic lanes on a road to provide space for reserved cycle lanes	$ / $$
	19	Relocate, restrict, or eliminate on-street parking	$ / $$
	20	Provide buffer zone between cycle lanes and on-street parking	$ / $$
	21	Relocate bus stops to reduce conflicts with cyclists	$
	22	Provide a physical barrier to discourage unsafe movements	$ / $$
	23	Improve illumination	$ / $$
Traffic signals	24	Restrict right-turn-on-red vehicle movements	$
	25	Increase amber and all-red times to provide adequate time for cyclists to cross wide intersections	$
	26	Install bicycle signals and provide exclusive bicycle phase	$$
	27	Improve visual distinction between bicycle signals and other traffic signals	$$
	28	Improve detection of cyclists at traffic signals	$$ / $$$
	29	Adjust signal timing of adjacent traffic signals to provide more gaps in traffic for cyclists at unsignalized intersections along bicycle routes	$
Signage	30	Improve/provide regulatory/warning signage related to cyclists	$
	31	Improve/provide overhead lane designation signs	$
	32	Improve/provide wayfinding and bicycle route signage	$
Maintenance	33	Trim vegetation to improve sightlines	$
	34	Improve roadway maintenance (debris, pavement conditions adjacent to curb, manholes and catch basins)	$ / $$
Education & encouragement	35	Encourage and develop alternate routes	$ / $$
	36	Encourage/provide training opportunties for cyclists through CANBIKE	$
	37	Encourage/provide training opportunties for OC transit bus operators through CANBIKE	$
Policy	38	Improve the provision of bicycle parking	$
	39	Introduce pay & display on-street parking in lieu of free on-street parking	$$
Access management	40	Restrict the width of accesses to control vehicle movements and turning speed	$$
	41	Consolidate accesses to reduce the number of conflict points	$$

This list of countermeasures is not intended to be comprehensive - it only contains potential solutions identified to address the issues at our ten sites. Despite not being comprehensive, it does represent a list of current and appropriate solutions that can be readily applied to sites throughout the City. It is of course necessary to consider site-specific traffic and operational conditions at each site to ensure appropriate countermeasures are selected, and that they are designed appropriately to address issues associated with a particular site.

Using this summary list of candidate countermeasures, we have prepared a suggested system of countermeasures for each of the ten sites. We have developed concept sketches to better articulate each of the system of candidate countermeasures and these are provided in the following Section. It should be noted that these sketches are for discussion purposes only and do not represent design drawings.

8.4 Candidate safety countermeasure concept drawings

8.4.1 Site #1 - Wellington Street at Lyon Street

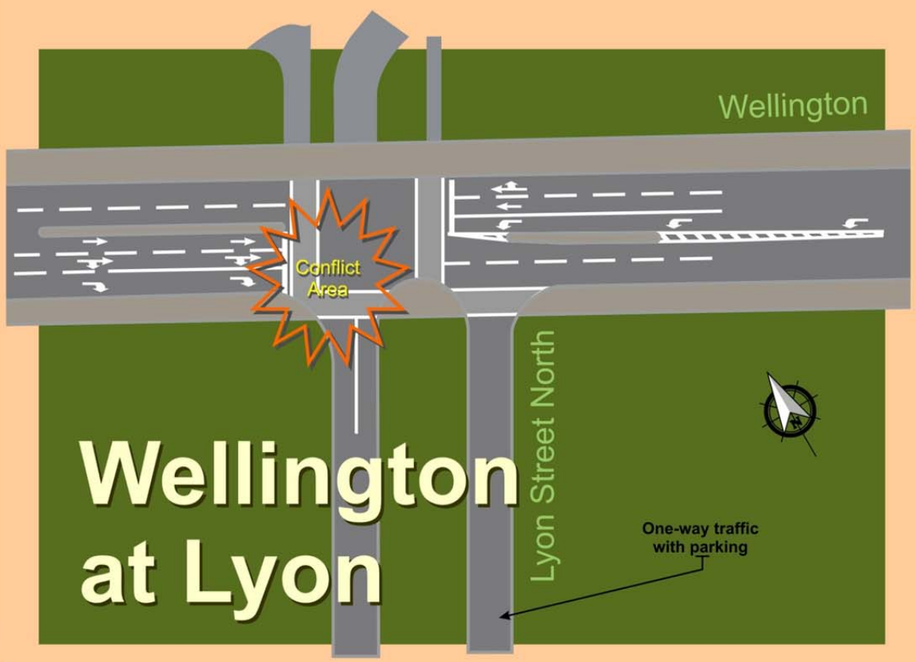
Existing

Observations

- Cyclists using sidewalks & crosswalks
- Traffic flows in platoons
- High-use bus corridor (especially westbound)
- Northbound Lyon Street very low volume (stop controlled right-turn only)
- High demand for Eastbound right turn (motorists)
- Southbound queues on Lyon St (both lanes) periodically extend to Wellington Street

Challenges

- Busses in curb lanes leave little space for cyclists
- Conflict between cyclists and motorists at double right-turn lane
- Weaving in traffic can be difficult due to queues or high speeds



Proposed

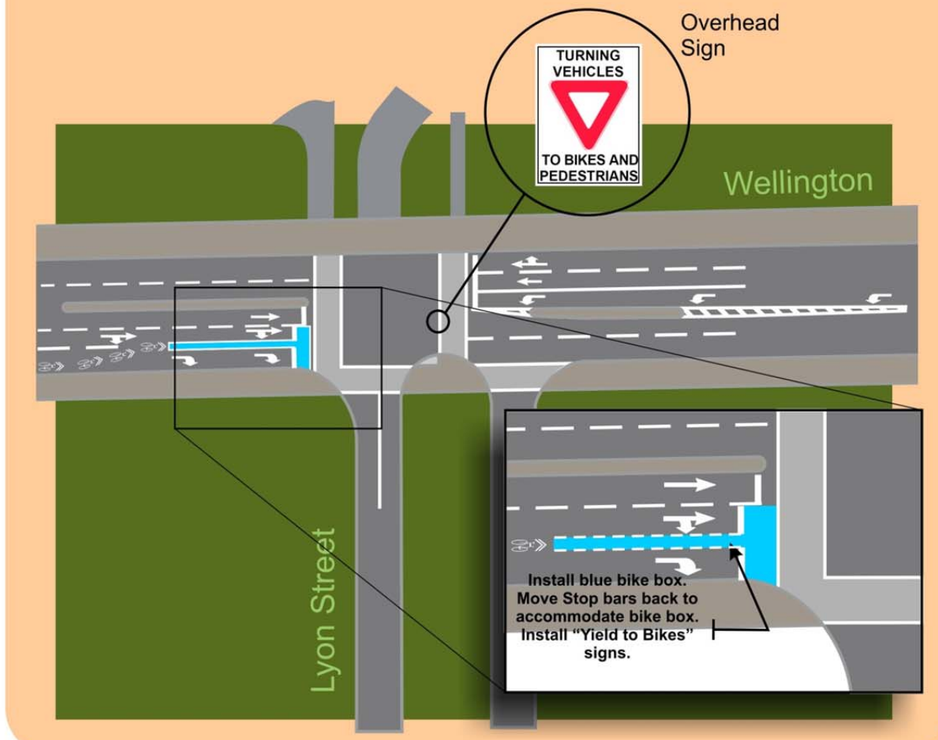
Short Term

Eastbound:
- Add sharrows
- Install blue bike box
- Move stop bars back to accommodate bike box
- Install “yield to bike” sign(s)

Westbound:
- Maximize width of curb lane (by redistributing lane widths)

Long Term

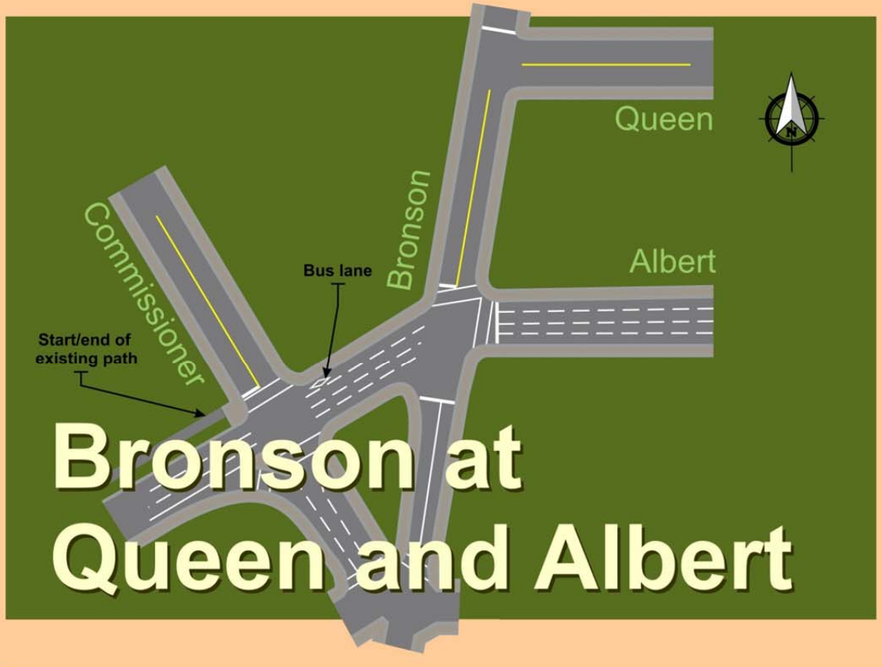
- Provide segregated path on north side of Wellington St
- Connect segregated path to off-road-pathways (NCC)
- Bikes to use north portion of path due to pedestrian/transit activity on south side of existing sidewalk



8.4.2 Site #2 – Albert Street and Bronson Avenue

Existing

Observations
- New off-road path west of Commissioner St.
- Many cyclists currently use sidewalk of proposed pathway
- Circuitous on-road connection from eastbound Albert Street to northbound Bronson Avenue
- High-speed busses very close to sidewalk
- Commissioner St. provides informal connection to Ottawa River Pathway (NCC)

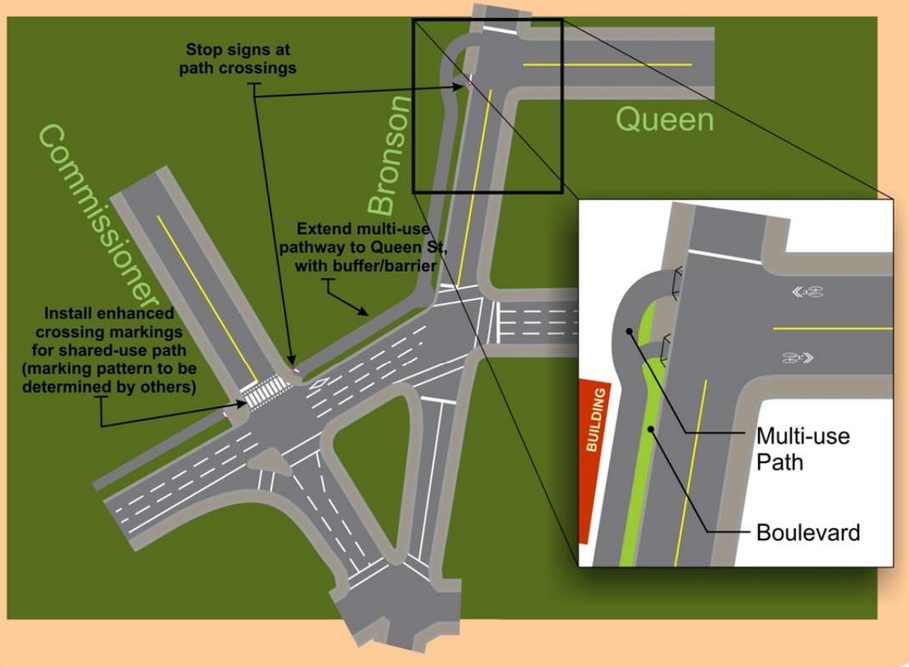


Proposal

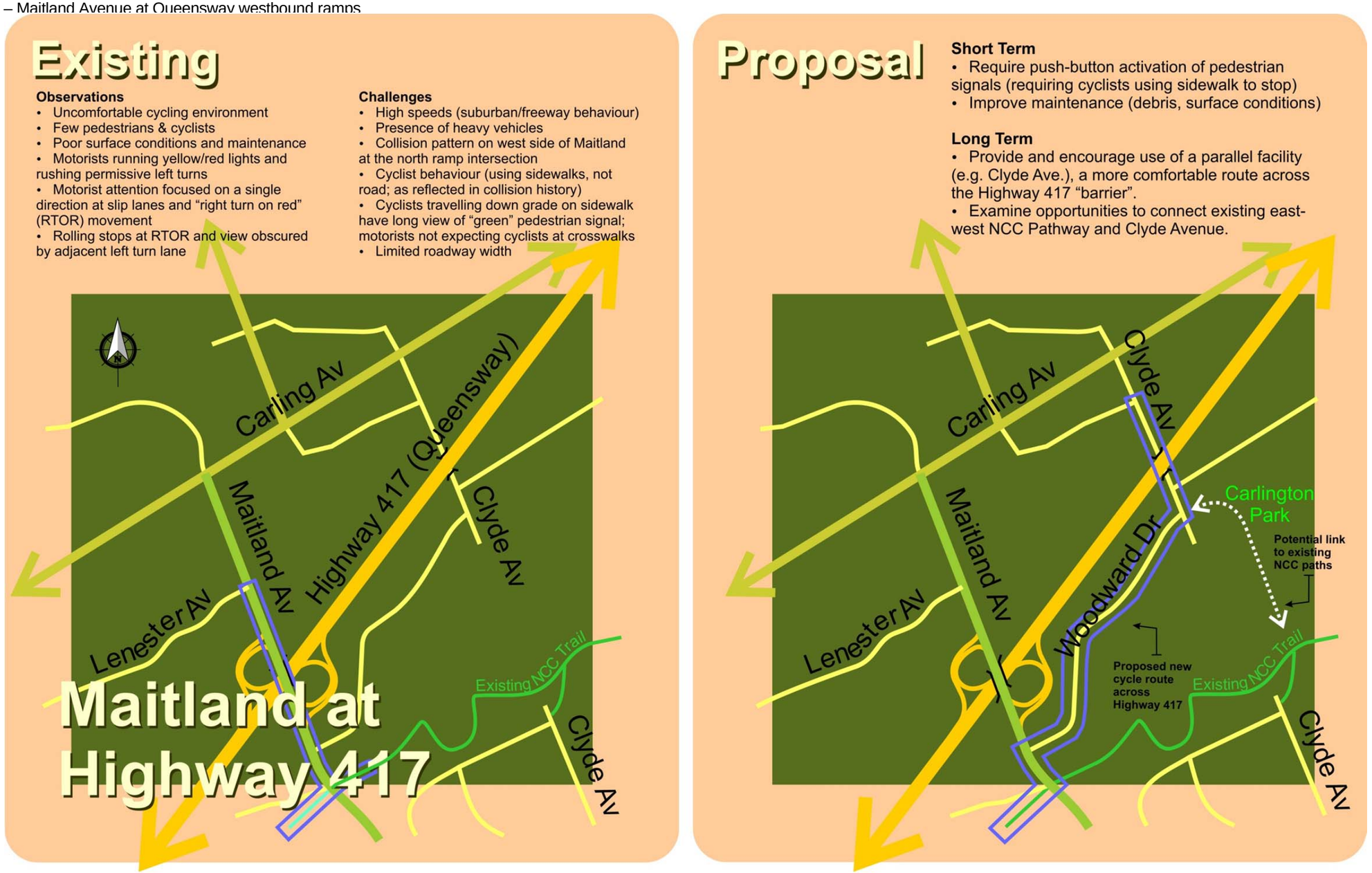
Short Term (not shown)
- Designate Commissioner St. as alternative route to Ottawa River Pathway (would complement proposed segregated pathway on north side of Wellington St.)
- Resurfacing on Commissioner St. required

Long Term (below)
- Convert existing sidewalk to shared-use path between Commissioners St. and Queen St.
- New pathway will require buffer/barrier to separate cyclists from vehicular traffic

Design Challenges
- Sidewalk/path width
- Location of utility poles
- Path corner radius at Albert St / Bronson Ave
- Barrier and/or buffer requirements
- Maintaining pedestrian movements
- Access to Juliana Place surface parking lot on Bronson Ave



8.4.3 Site #3 – Maitland Avenue at Queensway westbound ramps



8.4.4 Site #4 – MacKenzie King Bridge at Waller Street

Existing

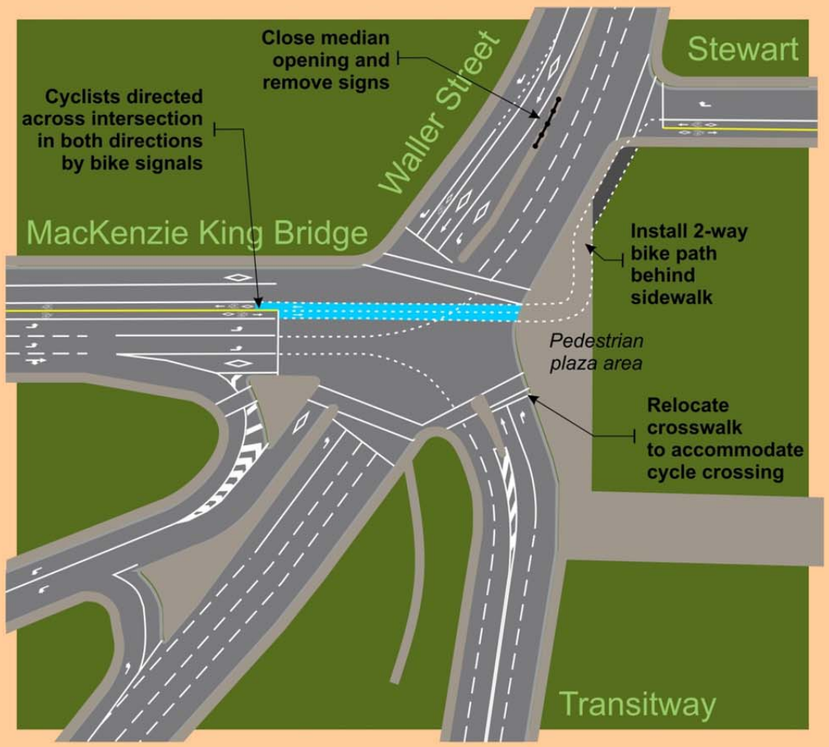
Observations
- Median cycle lanes (curb lanes reserved for transit - busy Rideau Centre terminal)
- Bicycle signals and advance phases
- Westbound cycle lane markings on Stewart Street not currently installed
- High pedestrian volumes – U of Ottawa and Rideau Centre nearby

Challenges
- Getting into median cycle lanes (across bridge)
- High-risk westbound movement from Stewart St to MacKenzie King Bridge
- Many trucks and busses present
- Few appropriate route alternatives

Proposal

Eastbound
- Improve distinction between bicycle signals and traffic signals
- Bicycle phase length extension (to reflect demand)
- Advance bicycle detectors (to minimize delay)
- Improve signage directing cyclists along bike route

Westbound
- Close gap in median (physical barrier)
- Implement segregated path from Stewart St to MacKenzie King & Waller intersection (behind sidewalk)
- Exclusive bike phase to cross intersection & access cycle lanes on bridge

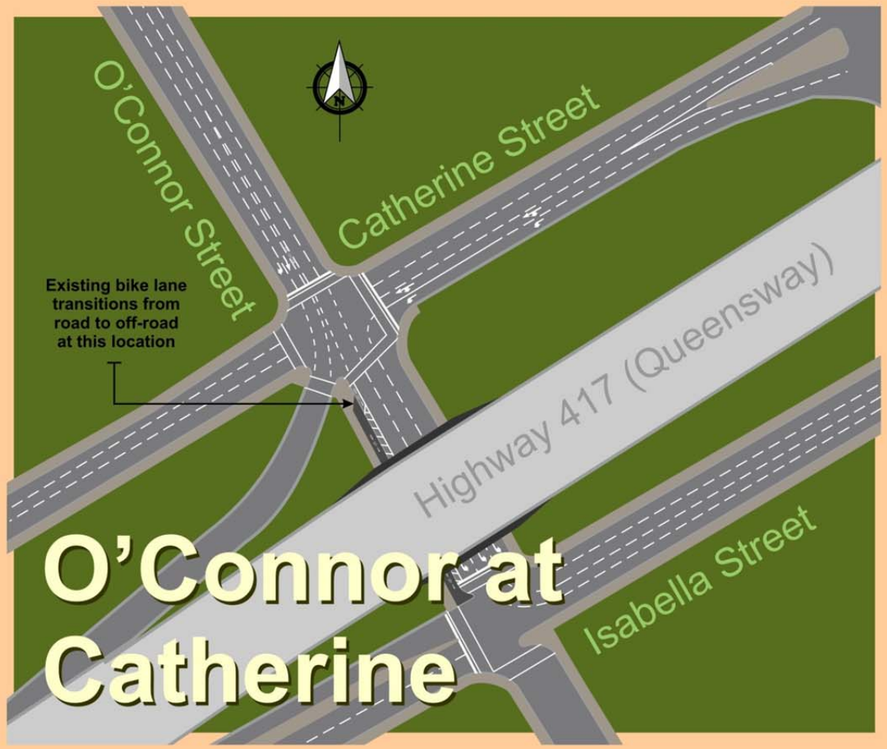


8.4.5 Site #5 – O'Connor Street at Catherine Street

Existing

Observations
- High information load approaching intersection
- Platoon vehicle flows on O'Connor Street
- Difficult to differentiate right turn lanes to Catherine St. & 417 ramps
- Bicycle signals at O'Connor & Isabella
- Potential conflict with "right turn on red" from Isabella
- Potential conflict with pedestrians (non-compliance)

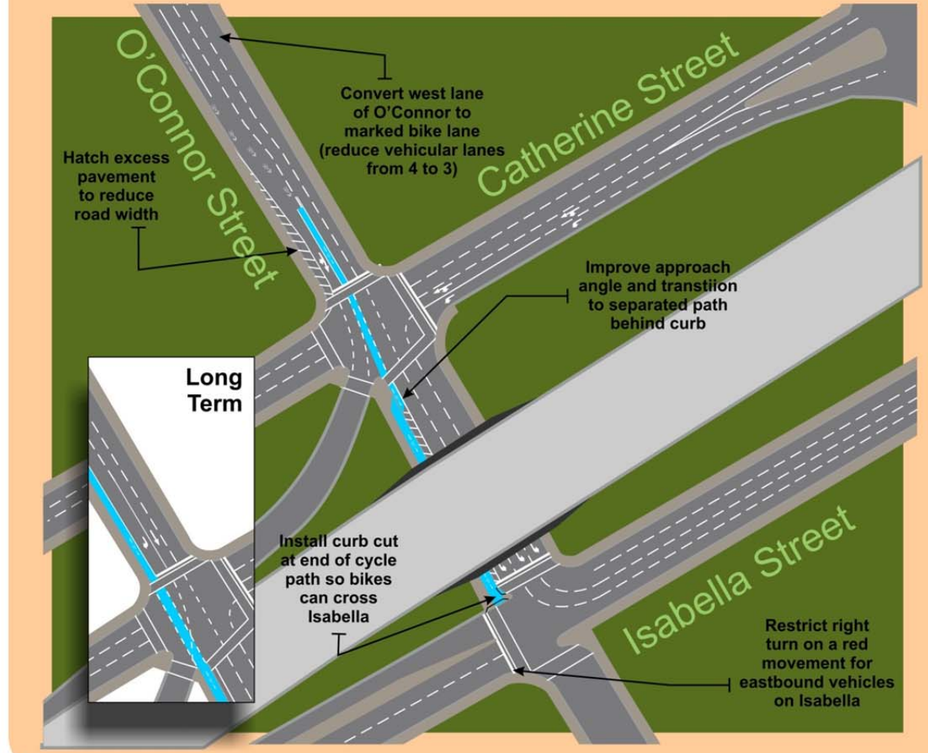
Challenges
- Getting into centre bike lane; short, difficult weave (vehicle queues or high speed are issues)
- Curb cut under bridge has poor approach angle
- Lack of curb cut at Isabella St. for southbound cyclists



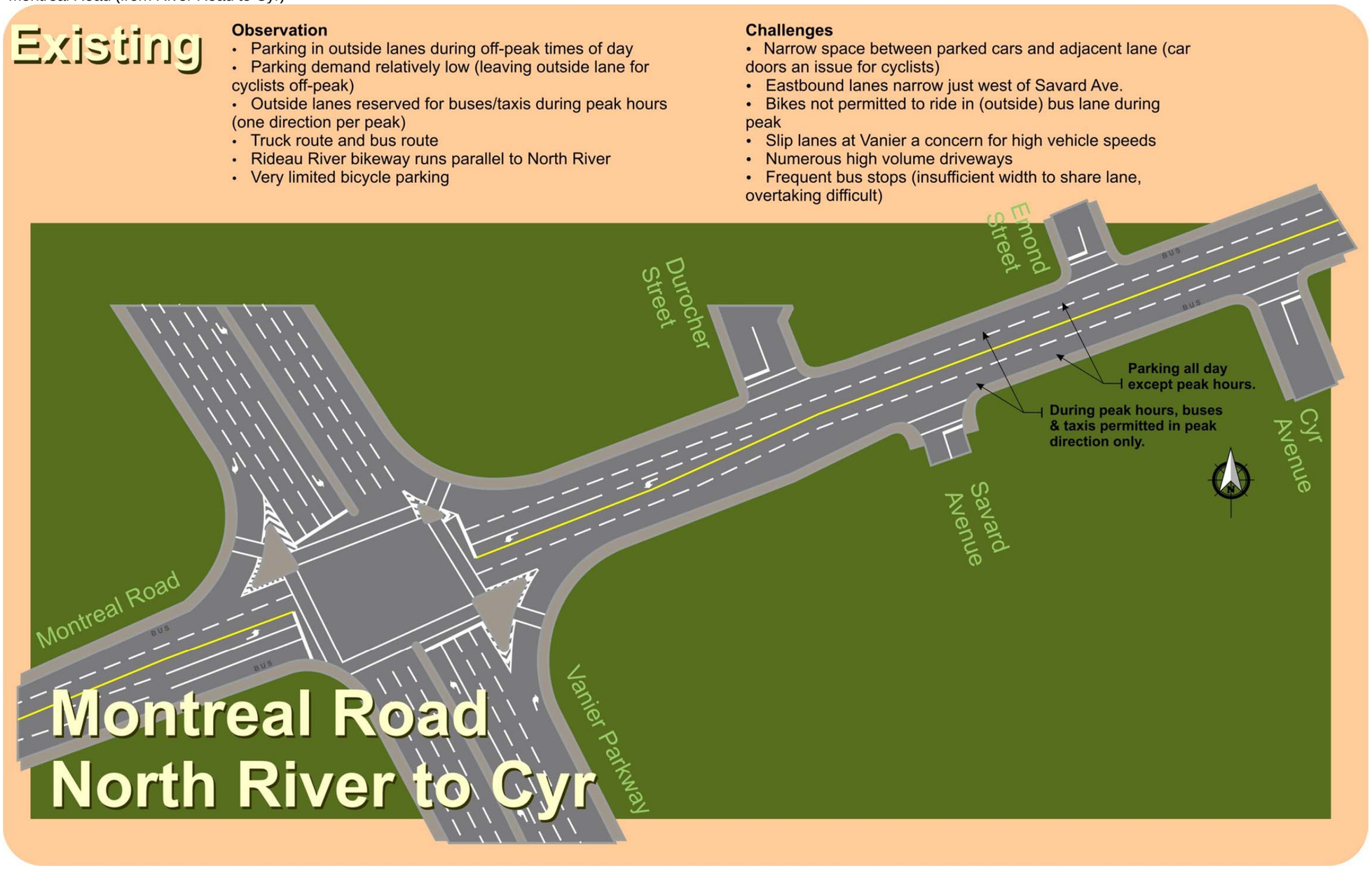
Proposal

Short Term (low cost; below)
- Color surfacing of centre bicycle lane
- Reduce southbound lanes on O'Connor Street from 4 lanes to 3 by combining the 2 right turn lanes
- Provide curb cut at Isabella Street for southbound cyclists
- Resurface bike lane under bridge and improve transition to separated path under bridge
- Restrict "right turn on red" movement from Isabella to southbound O'Connor St.

Long Term (higher cost; inset)
- Provide bike lane adjacent to curb and cross cyclists under a protected phase using bicycle signals at Catherine Street

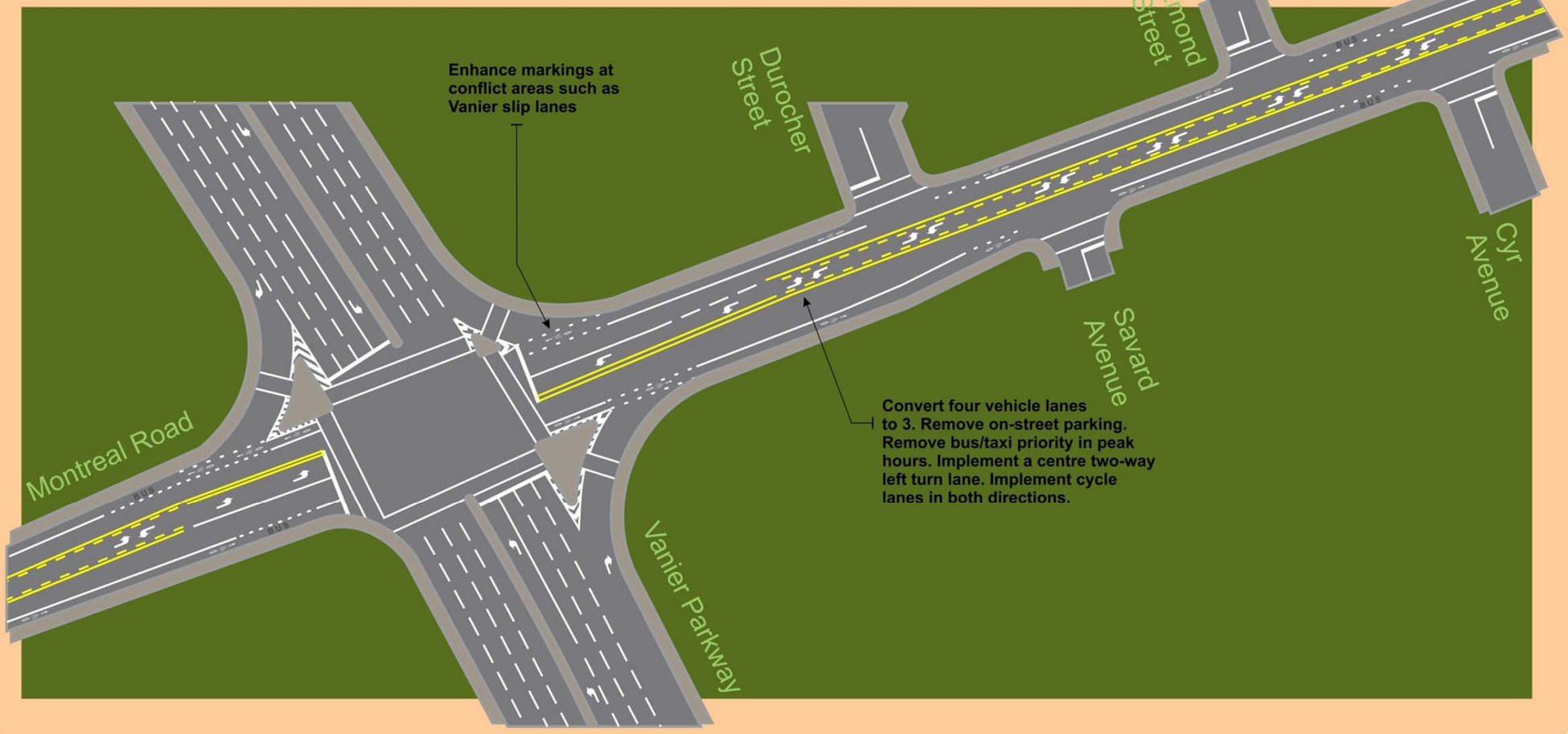


8.4.6 Site #6 – Montreal Road (from River Road to Cyr)



Proposal

- Convert 4 vehicle lanes to 3 vehicle lanes
- Add bicycle lanes along the curb in both directions
- Remove on-street parking
- Provide additional bicycle parking
- Improve maintenance (debris and surface quality)
- Increase amber (or all-red) phase time at Vanier signal
- Improve sightlines and enhance cycle lane markings at Vanier slip-lanes and other conflict areas



8.4.7 Site #7 – Bank Street (from Echo to Riverdale)

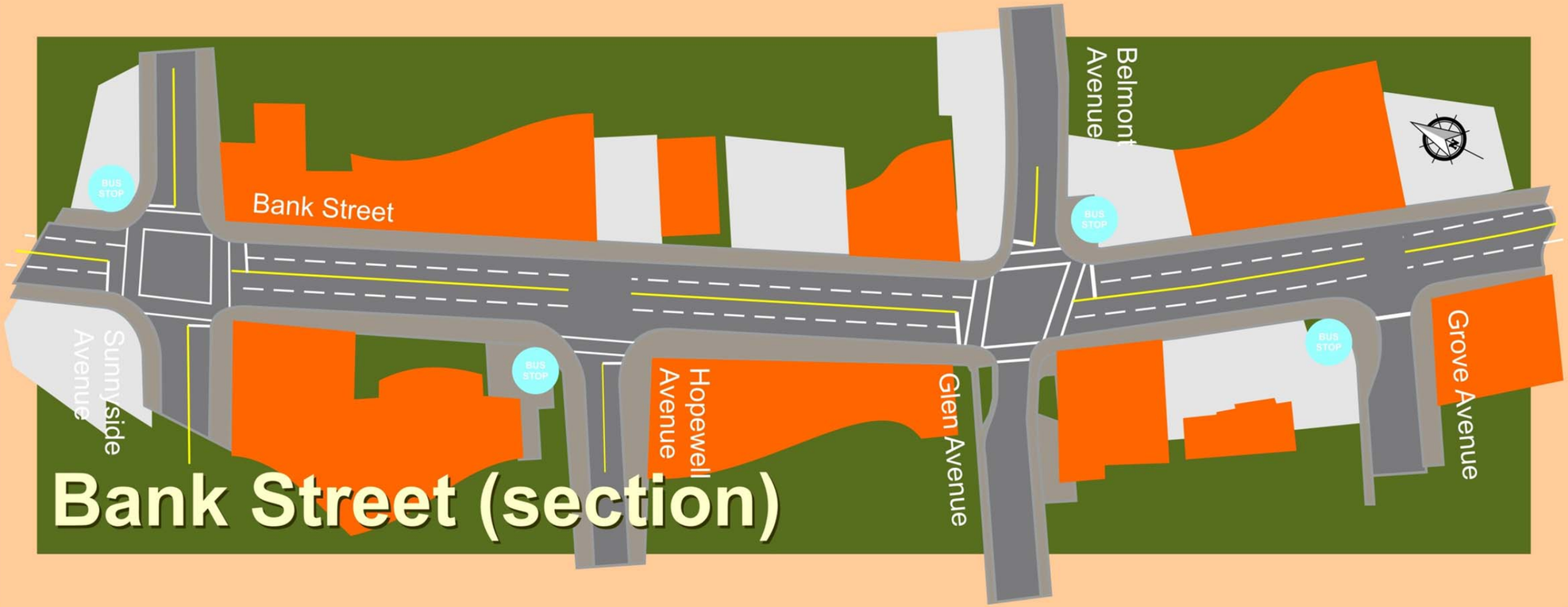
Existing

Observations

- Parking in outside lanes at certain times of day
- Parking demand very high
- Numerous driveways, although most low volume
- Bus route

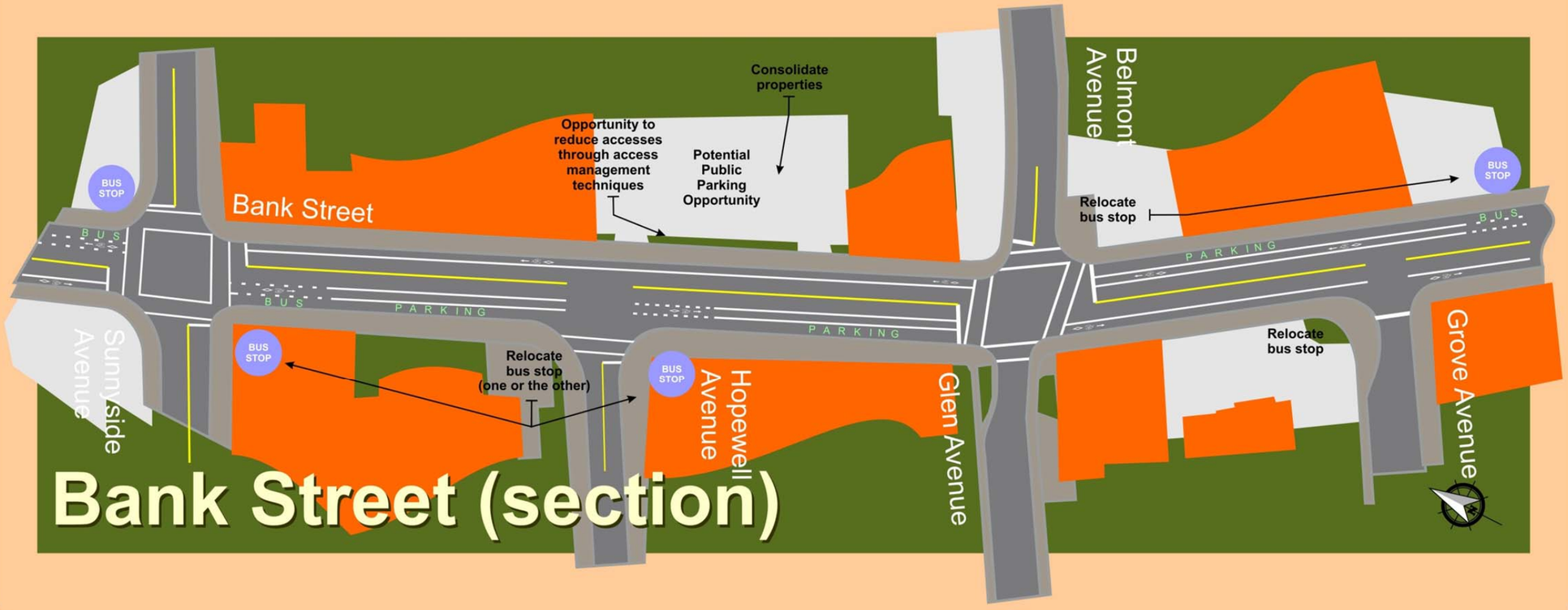
Challenges

- Relatively narrow space between parked cars and adjacent lane (car doors an issue)
- Frequent bus stops (insufficient width to share lane, overtaking difficult)
- Only continuous north-south cycling route to downtown

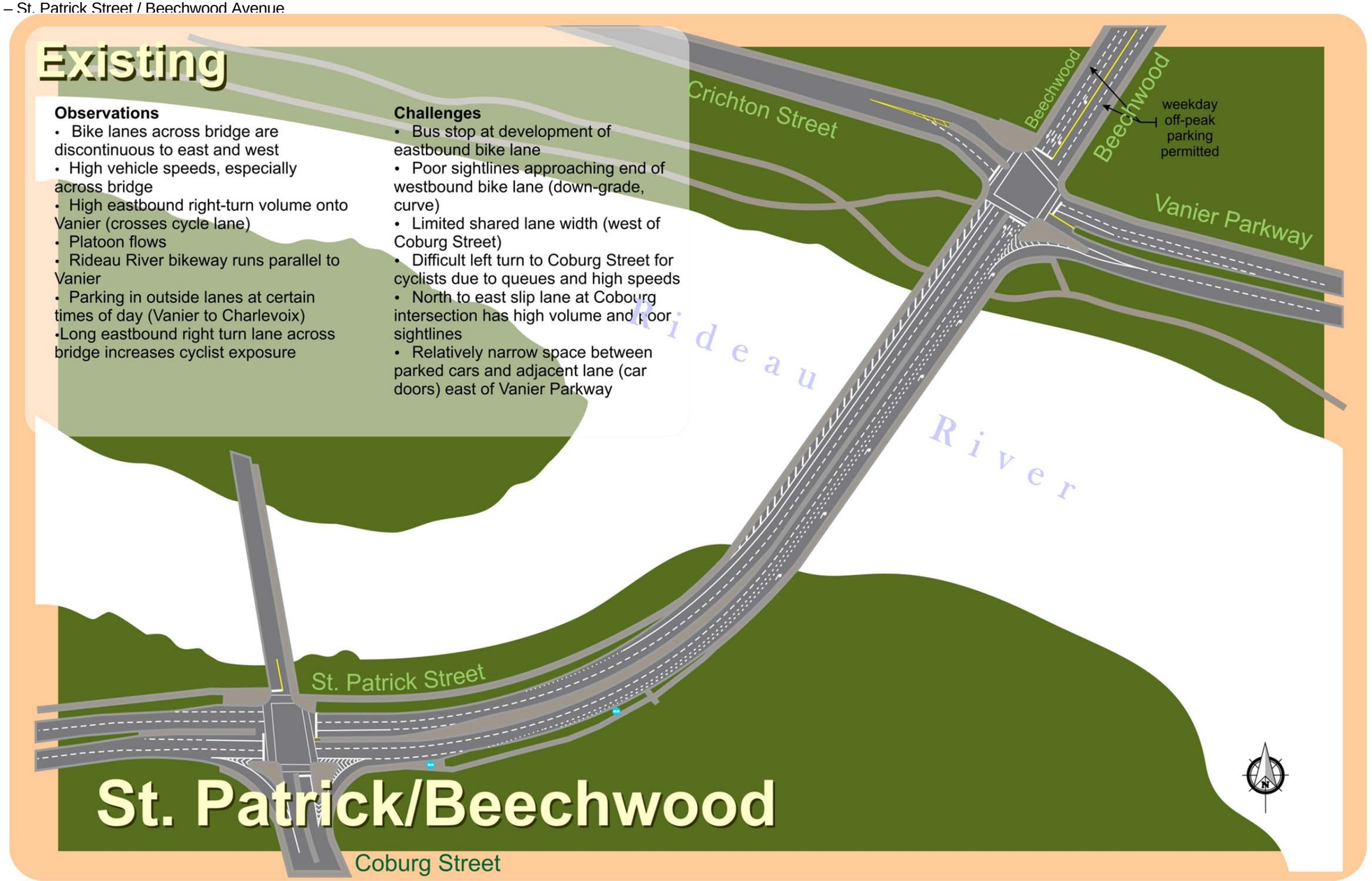


Proposal

- Convert 4 lanes to 2 vehicle lanes, 2 bike lanes and 1 parking lane
- Convert periodic, time of day parking to all-day parking on one side of the street
- Examine opportunities to remove/restrict parking on alternate sides of street; look for off-street parking opportunities
- Provide buffered bike lanes between parking and travel lanes (typically 0.5m buffer is provided)
- Relocate bus stops to far side of intersections and on same side of street as parking lane
- Consider provision of ASL (advance stop line) at signals to help mitigate bus/bike weaving conflicts upstream of bus stops
- Consider paid parking (currently free) to influence parking demand and trip mode
- Provide additional bike parking



8.4.8 Site #8 – St. Patrick Street / Beechwood Avenue



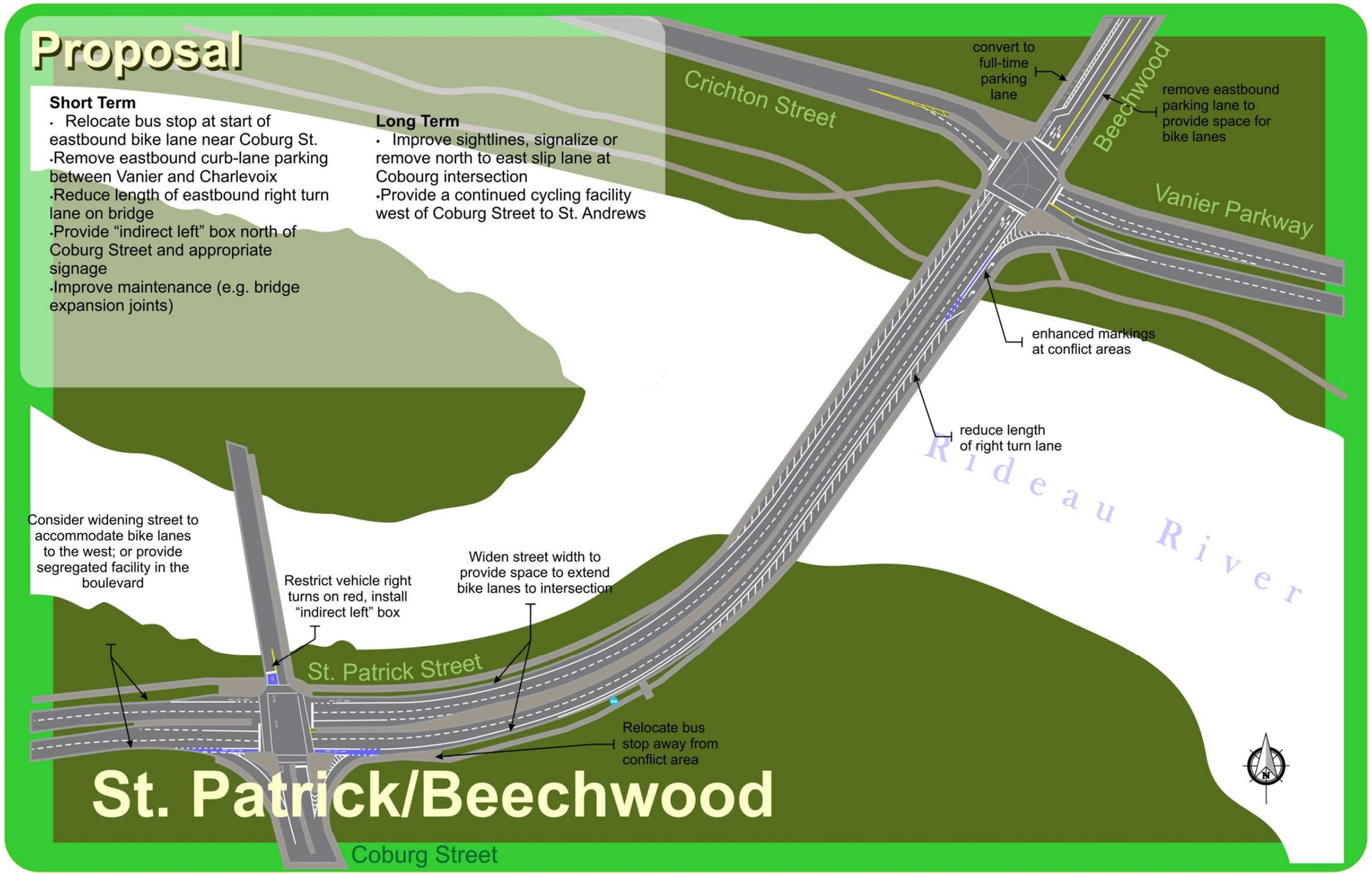
Proposal

Short Term

- Relocate bus stop at start of eastbound bike lane near Coburg St.
- Remove eastbound curb-lane parking between Vanier and Charlevoix
- Reduce length of eastbound right turn lane on bridge
- Provide “indirect left” box north of Coburg Street and appropriate signage
- Improve maintenance (e.g. bridge expansion joints)

Long Term

- Improve sightlines, signalize or remove north to east slip lane at Cobourg intersection
- Provide a continued cycling facility west of Coburg Street to St. Andrews



8.4.9 Site #9 – Gladstone / Tyndall / Byron

Existing

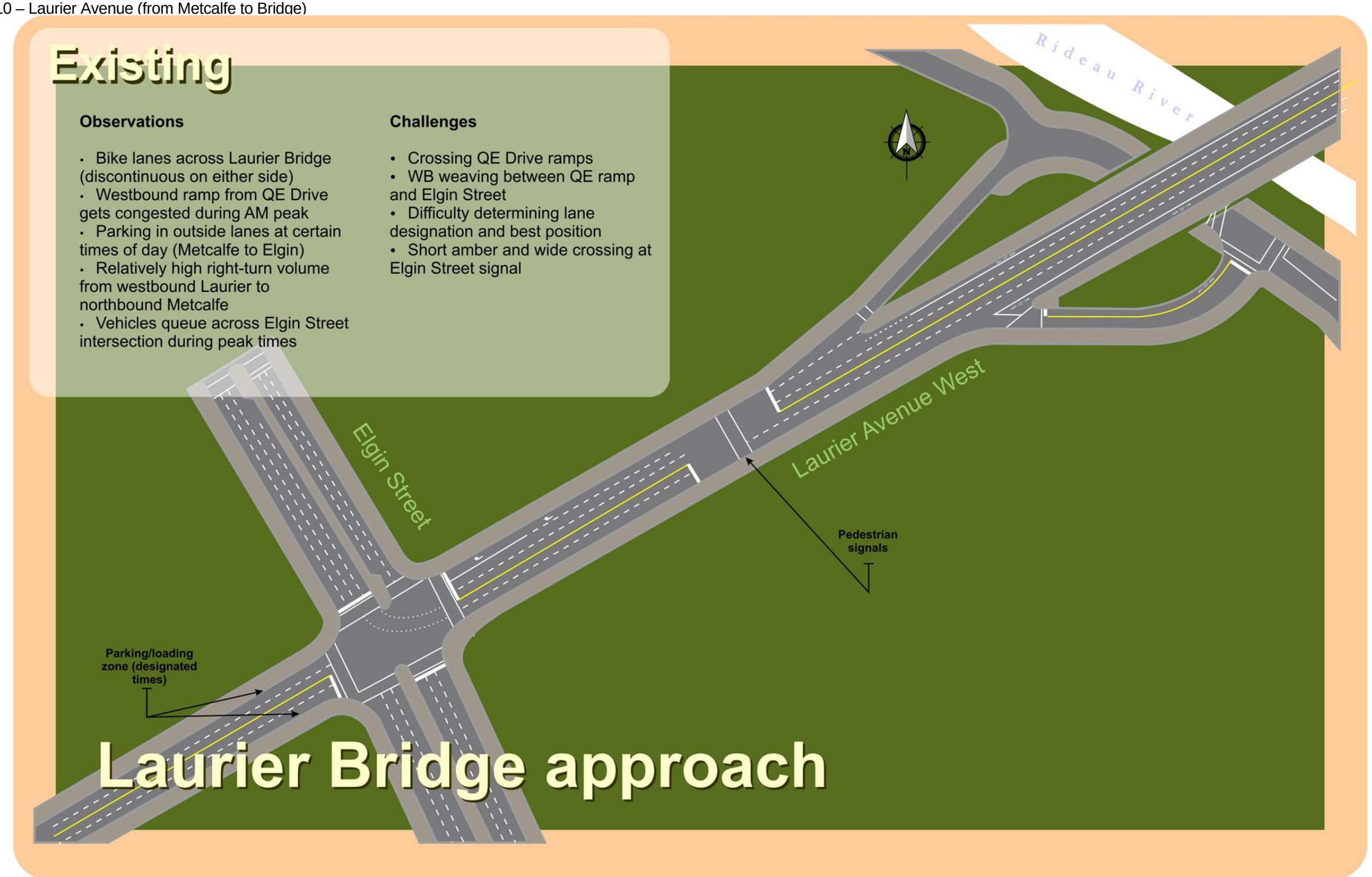
Observations
- Parking permitted on south side of Tyndall and Byron
- Many all-way stops along route (residential neighbourhoods
- Relatively low volumes, except along Parkdale and Holland
- Large truck movements on Parkdale
- Bus route

Challenges
- Poor sightlines and long delays at intersections (especially eastbound)
- Traffic signals on Parkdale do not provide sufficient gaps for turning cyclists
- Congestion on Parkdale and Holland during peaks
- Short weaving movement required on Holland Avenue

Proposal

Short Term
- Designate Sims Avenue and Beverley Avenue as alternative cycle route
- Improve bike route signage
- Improve surface quality on Byron Ave
- Consider enhanced markings and signage for weave movements on Holland and Parkdale

8.4.10 Site #10 – Laurier Avenue (from Metcalfe to Bridge)



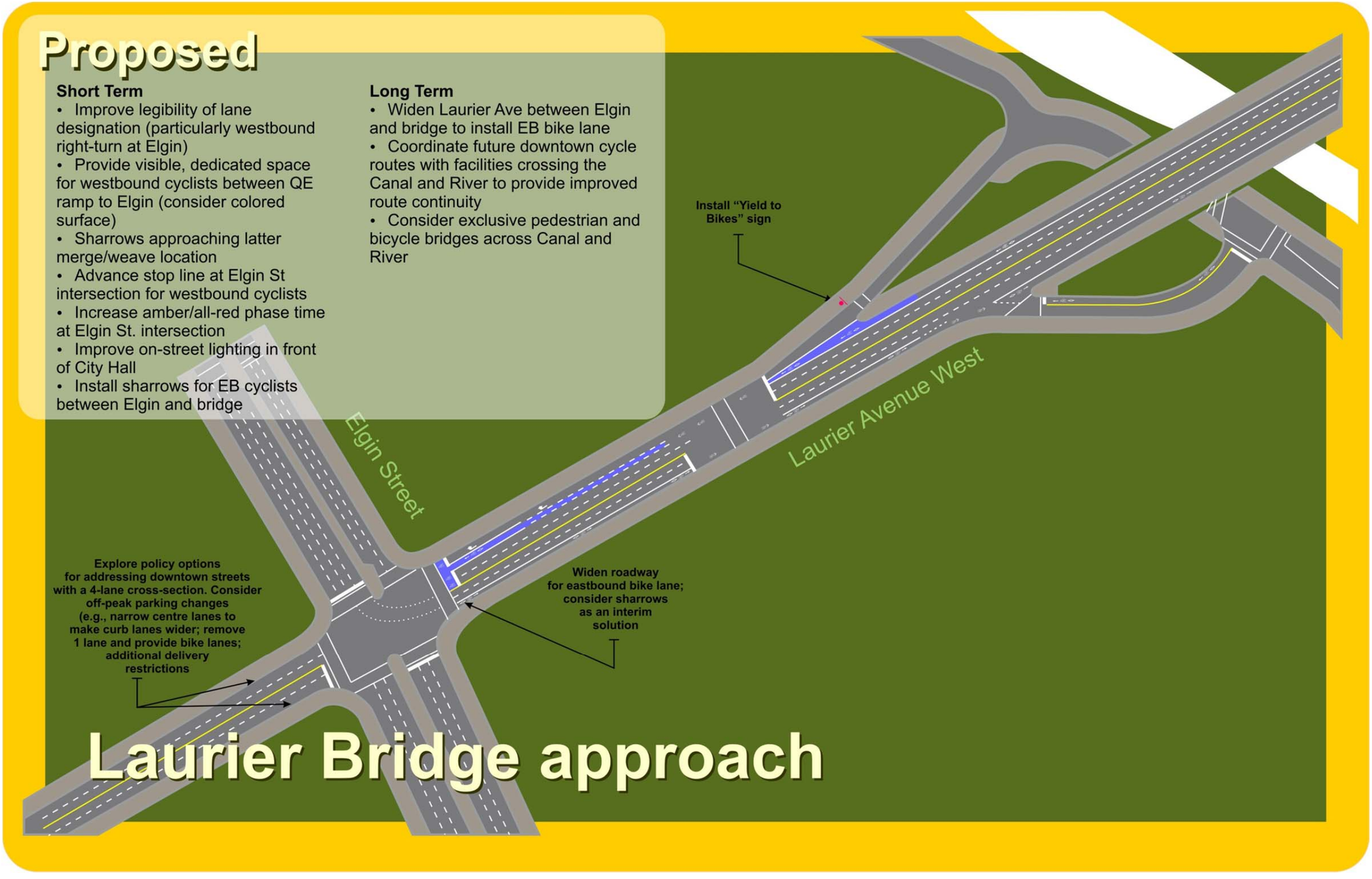
Proposed

Short Term

- Improve legibility of lane designation (particularly westbound right-turn at Elgin)
- Provide visible, dedicated space for westbound cyclists between QE ramp to Elgin (consider colored surface)
- Sharrows approaching latter merge/weave location
- Advance stop line at Elgin St intersection for westbound cyclists
- Increase amber/all-red phase time at Elgin St. intersection
- Improve on-street lighting in front of City Hall
- Install sharrows for EB cyclists between Elgin and bridge

Long Term

- Widen Laurier Ave between Elgin and bridge to install EB bike lane
- Coordinate future downtown cycle routes with facilities crossing the Canal and River to provide improved route continuity
- Consider exclusive pedestrian and bicycle bridges across Canal and River



Laurier Bridge approach

8.5 Concluding thoughts

8.5.1 The candidate countermeasures

We have presented candidate road safety countermeasure strategies for each of the ten sites that address the risks identified through our safety evaluations. We underline the fact that these may not be the only options available, but that they do attempt to address key safety risks that were identified in the course of our review. Regardless of the countermeasure scheme that is ultimately selected for implementation, it should focus on the same key safety risks discussed in this report.

8.5.2 Project Monitoring

Project monitoring is a critical component of any safety management system. Monitoring the results flowing from the system informs us of two key things: Whether or not the system is providing valid and appropriate prioritization results; and the effectiveness of the countermeasures being deployed.

Without the validation of appropriate monitoring of system performance, a valuable learning opportunity will be lost, past errors will be propagated forward, and confidence in the system will be lost. Monitoring activities are not only intended to identify the negative however; they also provide us with a valuable opportunity to single out successes and justify investments in safety improvements, with a longer term view to maintaining and increasing budget allocations based on those success stories.

Unfortunately, because of their relative scarcity, monitoring safety performance for cycling-involved collisions cannot usually be done through a statistical analysis. Quite simply, adequate sample sizes are not available to allow defensible statistical assertions to be made. Rather, selective and tightly focused studies of both cyclists perceptions of safety, and proxy measures of safety performance (for example, conflict studies or user surveys) may be useful indicators of satisfaction with the system.