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Cycling in the Capital

Laurier Avenue Segregated Bicycle Lane Pilot Project - Ottawa, ON

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ABSTRACT

In 2010, the City of Ottawa initiated a planning and feasibility study for a segregated bike lane pilot project in the downtown core. Although segregated bicycle lanes have been widely used in Europe and have only recently been introduced in some Canadian cities, they are a new feature in Ottawa. The City of Ottawa retained McCormick Rankin Corporation, a member of MMM Group, to identify the most appropriate corridor for the pilot project and prepare detailed designs and a tender package for construction. Following numerous public meetings, an international best practice review, and third party input from cycling experts at Vélo Québec, a final corridor was selected in November 2010. The final detailed designs were prepared based on a best practice review of other cities, as well as a review of the Vélo Québec Planning and Design for Pedestrians and Cyclists and draft TAC Bikeway Traffic Control Guidelines for Canada.

The 1.4 km pilot bicycle facility will be implemented from summer 2011 until fall 2012 along Laurier Ave., an urban street running through Ottawa's downtown core. The following paper details the design features that were included in the pilot project, and tracks the challenges that were overcome through the design process. Key technical challenges included issues relating to a constrained right-of-way in the downtown core and addressing safety considerations at intersections and access points along the busy corridor. The pilot project will help shed light on design options, potential challenges, and active transportation benefits associated with introducing segregated bicycle lanes in Ottawa, and the lessons learned can be extended to other Canadian urban centres.

INTRODUCTION

Like many Canadian cities striving to promote sustainable transportation behaviours, the City of Ottawa has adopted a set of cycling policies and supporting infrastructure programs that aim to increase the number of trips within the City made by bicycle. The City's current Official Plan (OP) and Transportation Master Plan (TMP), which govern land uses and transportation investments in the City, both point towards prioritizing cycling as a transportation mode in order to realise a set of social, environmental, and economic benefits. These advantages include: the health benefits associated with providing opportunities for physical activity; the economic benefits of improving access to local businesses; the environmental benefits associated with minimizing carbon emissions due to transportation; and the social benefits associated with promoting an inexpensive and widely accessible form of transportation.

The TMP is in turn supported by the City's 2008 Ottawa Cycling Plan (OCP), which aims to develop a "visible and connected cycling network of on-and off-road facilities that is used by all types of cyclists" (OCP, 2008). Specifically, the OCP notes the east-west movement through the downtown core as a priority area for investment, because the existing network consists of only signed routes that remind motor vehicle drivers of their responsibility to share the road with cyclists. One of the direct outcomes of the 2008 approval of the OCP was the decision to initiate a feasibility study regarding the implementation of segregated bike facilities on an east-west street through the downtown core.

A segregated bicycle lane is a designated on-street bicycle lane that is physically separated from motor vehicle traffic through the use of barriers such as parked cars, curbs, delineators, or other street treatments. In European cities where the cycling mode-share often exceeds 20% (e.g. Copenhagen, Amsterdam, The Hague), these types of physically separated lanes are commonplace. In North America, segregated lanes have been successfully implemented in New York, Montreal, Vancouver, and Portland where they promote cycling as an effective transportation mode by better connecting cyclists to their destinations, improving the comfort and perceived safety of cyclists, and attracting a broader group of residents to cycling. As such, the City of Ottawa initiated a pilot project in order to gauge how segregated bike lanes might help to make Ottawa "the premier cycling capital of Canada" (OCP, 2008), while helping to increase the number of person-trips made by bicycle and helping to make cycling safer for cyclists of all skill and age levels.

It is important to note that proposed segregated bike lanes are intended to target residents who might not otherwise feel comfortable cycling along busy urban streets. The existing vehicular cyclists, who are comfortable sharing the road as they do today, are not the target user for the segregated lanes. These vehicular cyclists will have the option to remain in mixed traffic, or use the segregated bike lane.

METHOD OF CORRIDOR SELECTION

Stage 1 Evaluation : Screening

The study area for the pilot project focused on the neighbourhoods north of Highway 417 (a provincial multi-lane east-west highway), and extended from Preston St. in the west to Elgin St. in the east, bordering Ottawa's downtown core. In this study area, all east-west streets were identified as preliminary candidates for the pilot project (totalling 33 preliminary corridors). Next, the potential corridors were narrowed down to a set of 12 candidate corridors, based on the following evaluated strengths: identification as a cycling route in the Ottawa Cycling Plan (2008); contribution to forming a continuous cycling route; formation of convenient connections to destinations to the east and west of the study area; and, for safety purposes, the provision of traffic signals at main crossings.



Figure 1 – Study Area

Stage 2 Evaluation: Impact Assessments

These 12 candidate corridors were further evaluated based on the following criteria:

- preferred locations for cyclists;
- safety considerations for cyclists;
- impact on transit;
- impact on automobile traffic;
- impact on local businesses;
- impact on pedestrians; and,
- relative capital cost.

In the technical evaluation of the 12 corridors, it became evident that the local routes with low automobile traffic offered the least impacts in regards to implementation. However, the local routes did not necessarily benefit from segregation from motor vehicles (e.g. cyclists already felt safe along these slower routes) and also did not provide connections to common destinations, because these routes were often along residential streets removed from Ottawa's downtown core.

In contrast, cyclists using the main collector and arterial roads that travel through the downtown core would benefit from physical separation from busy and fast-moving traffic. In addition, these main urban roads lead right to the central business district in Ottawa's downtown core, which boasts one of the highest employment densities in the City, thereby better connecting cyclists to their destinations. However, the impacts on other road users (i.e. parking, traffic, access points etc.) were considerably larger than the impacts encountered on local roads.

There was no single solution that emerged from the analysis as a clear "winner". It was in this stage that four public meetings were held to introduce the project, identify local issues, solicit feedback on the proposed corridor evaluation criteria, examine options for facility development, and gather insights on the benefits and challenges associated with each of 12 east-west corridors under consideration. Based on the outcome of the evaluation and feedback from public consultation, three preferred corridors were brought forward for further more detailed analysis.

Stage 3 Evaluation: Impact Assessments with Mitigation Measure Considerations

The City of Ottawa retained Vélo Québec in order to provide an independent expert peer review and to help select a final corridor for the pilot project. Vélo Québec is a non-profit organization that has extensive experience in the planning and design of bike lane facilities in Québec, and has published a number of technical manuals regarding bike lane design. Vélo Québec acted as a peer reviewer of the preliminary evaluation, best practices research, and other initial work completed by the study team. Vélo Québec deemed the preliminary evaluation criteria as relevant and appropriate, and suggested a set of additional criteria for use and application in the final corridor evaluation work.

The final criteria were based on the themes set out in the Stage 2 evaluation, but this time, considered the ease of which mitigation strategies could be implemented. The criteria are as follows:

- the extent of current bicycle traffic;
- the potential for additional bicycle traffic;
- linkages to surrounding areas;
- linkages to other bike facilities;
- vehicle travel speed and the associated merit of segregation;
- the potential for transit stop conflicts;
- the impact on automobile traffic;

- the impact on curb side garbage collection;
- the impact on parking; and,
- the impact on the retail environment.

Based on these criteria, Laurier Avenue, a busy urban arterial street, was selected as the most appropriate corridor for the segregated bike lane pilot project.

Public Consultation

During the corridor evaluation stage, the study team consulted widely in order to ensure the needs of cyclists were being met and on the potential implications a segregated bike lane may have on local businesses and residents along the corridor. In addition, the study team worked with various City staff to characterize the impacts of implementing a segregated cycling lane along Laurier on the broader transportation network and to explore compatibility with other planned infrastructure projects in the downtown core.

The consultation plan included two sets of public open house sessions. The first set of public open houses introduced the study and sought feedback on the decision criteria that would be used to choose a suitable corridor for the pilot project. The second public open house presented functional designs along the preferred corridor, in order to gain public input regarding the proposed design features. All businesses and residents along the preferred corridor were sent an information flyer in advance of the second public open house.

During the course of the corridor evaluation and design work, the study team met individually with a number of community associations in the area. In addition, a Technical Advisory Committee and Public Advisory Committee were formed in order to strengthen project communication and provide opportunity for feedback from various stakeholders. The design features in the section which follows reflect the ideas and suggested modifications from the City's various advisory committees (e.g. roads and cycling advisory committee, business advisory committee, environmental advisory committee, utility coordination committee), as well as the input from business associations and property owners along the preferred corridor.

DESIGN FEATURES

A detailed review of segregated cycling facilities in Canada, the United States and Europe was carried out to develop the proposed detailed design for the pilot project. Consideration was given to the recommended practices in other cities relating to planning, design, and maintenance of segregated bicycle lanes.

Uni-Directional and Bi-Directional Segregated Bicycle Facilities

There are currently two types of segregated cycling facilities in use in other cities, uni-directional and bi-directional. A uni-directional bicycle lane is typically on the right-hand side of the road and allows cyclists to travel in one direction. A parallel bicycle lane in the opposite direction is provided on the other side of the road or on an adjacent parallel road. Bi-directional bicycle lanes provide a bicycle lane travelling in both directions on one side of the road. Examples of these two types of facilities are shown in Figure 2 and Figure 3.



Figure 2 – Uni-directional Bicycle Lane (Photo Rendering, City of Ottawa)



Figure 3 – Bi-Directional Bicycle Lanes (Montreal)

The City of Ottawa staff consulted bicycle design manuals and also contacted a number of city staff in municipalities which currently have had experience with segregated bicycle lanes. The result of the discussion and research regarding the use of uni- or bi-directional cycling lanes was a consistent recommendation not to use bi-directional facilities. The main factor contributing to this recommendation was the heightened safety risk to cyclists at intersections and driveways with a bi-directional facility. Drivers are not accustomed to cyclists on their right travelling in both directions and therefore may not anticipate approaching cyclists when turning at intersections. With a uni-directional segregated bicycle lane, all cyclists will approach an intersection on the same side of the road as they would use if no cycling facilities were provided. This uni-directional design reduces the potential for conflict between cyclists and drivers and improves the overall safety of the facility. For the pilot project, it was decided to consider only unidirectional segregated bicycle lanes for use in the downtown core.

Bicycle Lane Width

Municipalities contacted generally had different design guidelines and requirements for segregated cycling facilities. The minimum lane widths vary between 1.5 m to 2.5 m for a uni-directional bicycle lane. To ensure adequate space to accommodate Ottawa's maintenance vehicles (i.e. snowplows, street cleaners) the lanes must be at least 1.8m wide. To provide adequate space for cyclists to pass one-another, a two metre lane width is generally recommended. Due to the constrained right-of-way in downtown Ottawa's streets, the minimum allowable width of 1.8m was selected for a one-way segregated bicycle lane. This lane width restricts passing opportunities; but given that there are many competing interests for road space in downtown, it was decided that the segregated cycling facility was to be designed to improve safety for cyclists while considering the needs of all road users.

Buffer Zone

The buffer zone is best described as an area which provides a physical separation between the cycling lane and the vehicle travel lane. Examples from Canada and around the world included a wide variety of possible materials and designs for the buffer zone. Some of the most common treatments include a wide painted buffer, delineators, curbs, a raised bike lane, parked cars, or planter boxes.

The buffer treatment selected for Ottawa's pilot project is a combination of precast curbs and delineators as shown in Figure 4. The precast curb acts as a barrier to prevent vehicles from being illegally parked in the bicycle lane and prevents maintenance vehicles from unintentionally removing the delineators during snow clearing operations. The curbs also provide guidance for motor vehicles to ensure proper placement in the travel lanes when approaching an intersection. The delineators will be very visible to drivers of motor vehicles and intuitively recognizable as the boundary between the bicycle lane and the motor vehicle lanes. Along loading zones, the pre-cast curb will be removed and replaced with line painting and delineators at 5m spacing. This will allow delivery staff unimpeded access to the sidewalk and businesses.

Buffer zones in other cities can be as narrow as 0.05m but can also be very wide depending on the available space. A buffer zone of 0.5m provides adequate space to accommodate most types of buffers and allows some manoeuvrability to maintenance vehicles during snow clearing operations. While a 0.5m buffer zone was adopted early in the planning process, it is noted that a 0.3m buffer zone was considered acceptable and applied in areas with constrained cross-sections.

To implement a physical buffer along an existing roadway required additional consideration to the existing drainage. The precast concrete curbs selected for the pilot project will be evenly spaced with small gaps to allow water to drain towards the sewers.

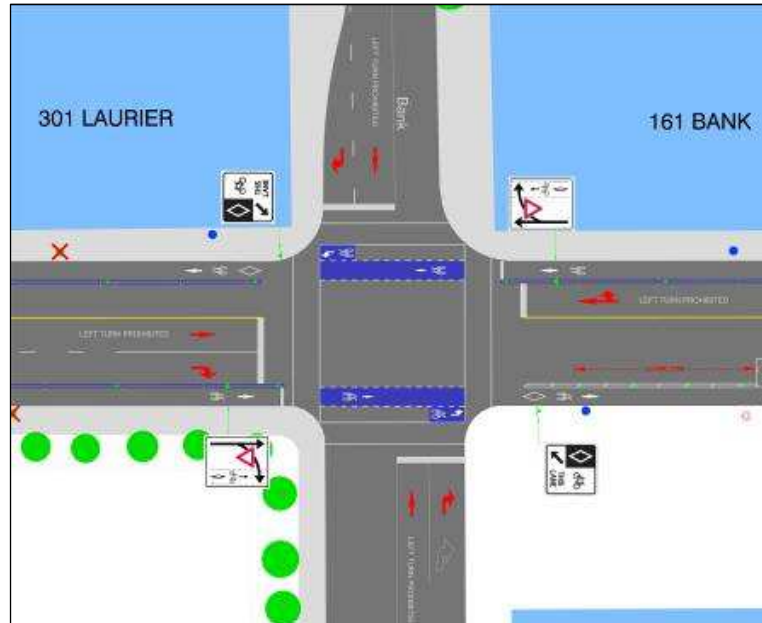


Figure 4 – Rendering of Laurier Avenue Bike Lane Design

Left-Turn Bicycle Boxes

When approaching an intersection in a segregated bicycle lane it is very difficult for bicycles to make a left turn. On a corridor without segregated lanes, cyclists are expected to move into the left-most lane to make their turn, when safe to do so. However, bicycles travelling in a segregated bicycle lane can no longer move into the left-most lane. A safe left turn therefore requires a two-stage manoeuvre (similar to the 2-stage crossing of pedestrians), where cyclists first proceed straight through the intersection and then wait in a designated bike waiting area (or “bike box”) for the green signal on the cross-street (as shown in Figure 5). This approach has been adopted successfully in Vancouver, Portland and many European cities. In downtown Ottawa the traffic signal cycle lengths are limited to a maximum of sixty seconds and therefore cyclists would not typically be delayed by more than one minute to perform a left-turn. The City of Ottawa has therefore agreed to pursue this two-stage left turn for cyclists to enhance safety for all road users. However, this intersection treatment also requires banning right-turn-on-red for all motor vehicles along the cross-street, in order to prevent right-turning vehicles from blocking the bike box.

Figure 5 – Example of proposed two-stage bicycle left-turn using a bike box



Motor Vehicle Right Turns

When approaching an intersection on a bicycle, there is always the potential for conflict with right-turning vehicles. A segregated facility minimizes potential vehicular conflicts with cyclists along the corridor, but proper care and attention is still needed at intersections where cyclists become vulnerable. When cyclists

are approaching an intersection on a segregated facility it is very important that adequate signage or traffic signal phasing exists to allow cyclists and right turning vehicles to easily determine who has the right-of-way and react accordingly. This is the first pilot project for segregated bicycle lanes in Ontario and consequently the Ontario Highway Traffic Act currently does not provide guidelines for segregated cycling facilities. Therefore, in the absence of formal standards, the design of the right-turn treatments for vehicles included careful consideration to the practices in other jurisdictions as well as the opinions of the City of Ottawa's transportation engineers, legal counsel, and correspondence with the Ontario Ministry of Transportation.

There are three common approaches to alleviating right-turn conflicts. The first provides a separate bicycle green phase to ensure bicycles and vehicles are never given a green light at the same time. This approach significantly reduces the risk of conflict, but creates very high delay to both cyclists and drivers.

The second approach requires right-turning vehicle traffic to merge with the segregated cycling facility and through the use of pavement markings highlight the area as a shared zone. This enables cyclists and drivers to merge in a reduced risk environment (rather than right at the intersection), but this approach defeats the advantages of segregation. Additionally, with high volumes of right turning vehicles in downtown, the bicycle lane may become blocked by vehicles and make it difficult for bicycles to continue through the intersection. Examples of this type of treatment, which is used in New York City and shown in the proposed TAC Bikeway Traffic Control Guidelines for Canada, are shown in Figure 6 and Figure 7.



Figure 6– Example of right-turn treatments used in New York City (Google Streetview)

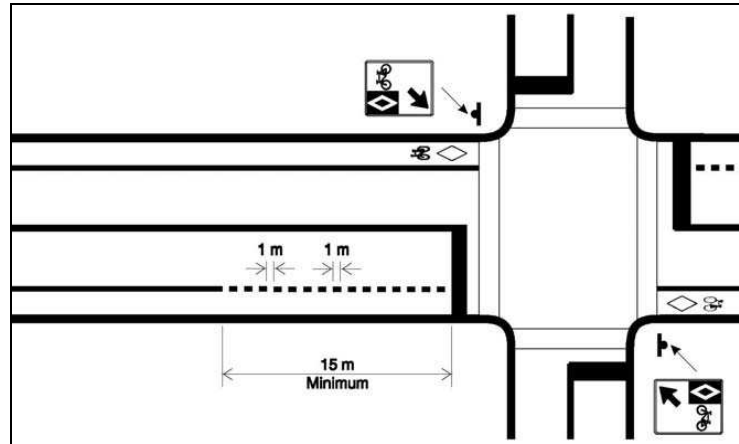


Figure 7 – Example of one right-turn treatment proposed in the draft TAC Bikeway Traffic Control Guidelines for Canada

The third approach uses signage at the intersection to make right turning drivers aware that they must yield to cyclists continuing straight through the intersection. Signage currently used in Copenhagen includes the use of blue bike lanes through the intersection. Montreal also uses bike symbols and sharrow markings that form a continuous marked crossing through the intersection. Examples of intersection signage used in Montreal as well as a road sign recommended in the proposed Transportation Association of Canada (TAC) Bikeway Traffic Control Guidelines for Canada are shown in Figure 8 and Figure 9.



Figure 8 – Example of intersection signage used in Montreal

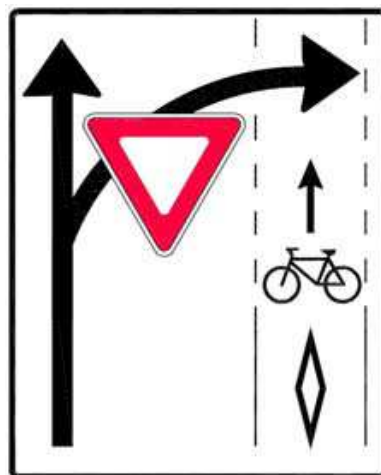


Figure 9 – Proposed signage in the draft TAC Bikeway Traffic Control Guidelines for Canada

Ottawa has adopted a combination of the first and third approaches to be used in the Ottawa Segregated Bike Lane Pilot Project. Blue pavement marking treatment and bicycle symbols will be used through the intersection and the proposed TAC sign shown in Figure 9 will be used to alert drivers to yield to cyclists. An advanced stop bar will be provided for cyclists 2-2.5m ahead

(closer to the intersection) of the stop bar for motor vehicles to make the cyclists more visible to vehicles during the red phase. In addition to the intersection signage, cyclists will receive a five second advanced green arrow prior to turning vehicles.

While a cycling specific signal was initially preferred (shown in Figure 10), the standard green arrow will reduce the cost of the traffic signal modifications during the pilot project, reduce motor vehicle delay, and prevent cyclists from attempting an unsafe single-staged left turn during the advanced green phase. All right-turn-on-red movements along Laurier Avenue will be banned to prevent right-turning vehicles from turning during the five second advanced green for cyclists. This approach will provide continuous segregation between cyclists and vehicles and does not provide high delay to cyclists or vehicles. An example of the intersection design proposed for the segregated bicycle lane pilot project is shown in Figure 11.



Figure 10 - Example of Bicycle Signal Head
(Gouvernement du Quebec, Ministère des Transports, 2011)



Figure 11 – Proposed Intersection Design for Laurier Avenue

Driveways and Entrances

Driveways and entrances create conflict zones between cyclists and motor vehicles. Most of the entrances along Laurier Avenue are accesses to large underground parking lots and loading docks. Most of these entrances allow vehicles to enter and exit in a forwards direction, but have high volumes of vehicles entering and exiting throughout the day. To raise awareness of these potential conflict zones, bicycle symbols with a directional arrow will be painted at all entrances (shown in Figure 4) to alert both vehicles and cyclists to be cautious as they approach the conflict zone.

On-Street Parking

On-street parking is currently permitted all-day on Laurier Avenue on both sides of the street, outside of the AM and PM peak periods. To accommodate segregated bike lanes in the existing Laurier Ave. right-of-way required the elimination of approximately 75% of the on-street parking along the corridor. Because the availability of on-street parking is very important to both businesses and residents in the area, mitigation measures have been pursued in order to minimize the impact of the pilot on the current activities along the corridor. Additional on-street parking will be added on two parallel streets located within 150m of Laurier Avenue, amounting to no net change in on-street parking supply in the area. In addition, it is expected that the off-street parking facilities can accommodate some of the additional parking demand along the corridor. Off-street parking is currently provided in both private and publicly owned and managed lots. A 2005 parking study found that within two block of Laurier Avenue there were approximately 12,300 off-street parking spaces, of which 6,250 are available to the general public.

The remaining on-street parking on Laurier Avenue will be used as a segregation feature between the vehicle travel lanes and bicycle lanes, which will require drivers to cross the bicycle lane to pay for the on-street parking. The City of Ottawa has recently installed pay & display machines which will require drivers to pay at a machine located on the sidewalk and then display the receipt in their vehicle window. The new pay & display machines will mean that drivers will actually cross the bicycle lane four times; once to pay for their parking, once to put their parking receipt in their car, a third time to reach the sidewalk and continue to their destination; and a fourth to return to their vehicle. When pedestrians are crossing between parked cars and the sidewalk there is a risk of collision between cyclists and pedestrians. To reduce the risk of collisions, the pavement in the bicycle lanes near parked cars will be painted with bicycle symbols (closely spaced) to alert pedestrians to watch for cyclists. The physical barrier curb located between the parking area and the cycling lane also works to remind pedestrians they are crossing a bike lane.

Maintenance Considerations

The choice to provide a year-round cycling facility or to remove the facility during the winter months was thoroughly reviewed and the City of Ottawa to maintain the segregated cycling facility through the winter as part of the pilot project. A major part of their rationale is that the

cost of removing the cycling facilities exceeded the cost of winter maintenance, and changing the roadway operations twice each year would create additional confusion for all road users. Additionally, as this is a pilot project, there was a strong interest in monitoring the impact a segregated cycling facility may have on encouraging winter cycling.

Specially Designated Parking and Stopping Zones

There are currently a variety of loading, taxi, school bus, and hotel zones along Laurier Avenue which will be maintained in approximately the existing locations but moved away from the curb to the buffer area between the cycling lane and the vehicle travel lanes. This will require additional care by those loading and unloading at these locations to be attentive to approaching cyclists. Closely spaced cycling symbols and directional arrows will alert pedestrians to the bicycle lane and to be aware of the potential for cyclists.

Three additional designated loading zones have been added to the corridor in areas where traffic operations staff have frequently observed vehicles stopping illegally. This is aimed at alleviating the potential impact on businesses when the on-street parking is reduced along the corridor.

Transit Operations

Bus stops create a potential conflict zone between transit passengers and cyclists using a segregated bicycle facility. The Laurier Avenue corridor does not have regular transit service and therefore the facility did not have to be designed for transit stops. However, transit stop design was reviewed in the preliminary stages of the project when other corridors were being considered. It should be noted that Laurier Avenue is used as a detour route for the Bus Rapid Transit (BRT) service through downtown Ottawa, so the bicycle facility design was reviewed by the local transit planning staff.

The CROW Design Manual for Bicycle Traffic recommends providing a small island (preferably of at least 2m width) for pedestrians to safely board and alight the bus without having to cross the bicycle lane. This type of design allows passengers to board and alight from the transit vehicles without having to immediately check for approaching cyclists. Transit users can wait on the transit island and cross the cycle track when there is an acceptable gap between cyclists.

The City of Montreal requires cyclists to yield to transit passengers boarding and alighting the buses. The bike lane is not blocked by the transit vehicles but cyclists are expected to yield to any passengers crossing the bicycle lane. Signage to alert cyclists to slow down and be attentive when approaching transit stops include narrowing the bicycle lanes, providing raised or grooved pavement, pavement markings and street signs. Figure 12 shows an example of a Montreal bus stop where the cycling lane is raised to the level of the sidewalk and a painted crosswalk alerts cyclists of a pedestrian crossing.



Figure 12 – Cyclists yield to transit passengers at bus stops

While it is preferable to provide an island for transit passengers, under constrained conditions in a downtown area there is infrequently adequate space to accommodate this type of design. An alternative design is to remove the physical buffer between the vehicle and bicycle lane for a short distance to allow transit vehicles to pull into the bicycle lane and block the bicycle facility while passengers board and alight the bus onto the sidewalk; from a cyclist perspective this is not preferred.

Para Transpo

Para Transpo provides door-to-door transportation services within the City of Ottawa for persons with disabilities. There is currently only one Para Transpo Loading zone on Laurier Avenue although passengers can request to be dropped off or picked up at any location. It should be noted that currently both curbs are blocked by on-street parking which can prevent easy access to the sidewalk to pick-up and drop-off passengers.

The opportunity to provide Para Transpo zones in-line with on-street parking spaces (between the cycling and vehicle travel lanes) or along the sidewalk (blocking the bicycle lane) was reviewed. However due to the width of the cycling lanes, the Para Transpo vehicles must pull up to the sidewalk in order to use the side ramps on the vehicles. For Para Transpo vehicles to access the sidewalk would require removing the physical separation between the bicycle lanes and the vehicle lanes and thereby allowing the Para Transpo vehicles to block the bicycle lane entirely. This alternative is undesirable because it will force bicycles out of the bicycle lane and into mixed traffic. On corridors within the Central Business District (CBD) there are currently couriers and delivery trucks which currently stop illegally in vehicle travel lanes. If adequate space is provided to allow Para Transpo vehicles to stop along the curb and block the cycling lane, it is likely that many delivery and courier vehicles would also take advantage of this break in the physical separation. Following discussions with transit staff, cross-streets or parallel roads were identified that could be used to provide Para Transpo direct access to buildings on Laurier Avenue, with fewer conflicts with other road users exist.

Motor Vehicle Travel Time Impacts

The introduction of segregated cycling lanes along Laurier Avenue required the roadway to be reduced from four vehicle travel lanes to two travel lanes. A traffic analysis was carried out using Synchro, a traffic analysis and signal timing software tool, to identify the impact of these changes on motor vehicles along the Laurier Avenue corridor and adjacent parallel roads. The

expected impact to vehicles along Laurier Avenue is an increase in travel time of less than one minute during the AM and PM peak hours. The existing travel time is approximately 4 – 5 minutes to travel along the entire 1.4km corridor. The intersections will all continue to operate with a volume to capacity ratio of less than one, as required by the City of Ottawa's Transportation Impact Assessment Guidelines.

To achieve an acceptable Level of Service and reasonably small increases in overall travel time required some mitigation measures along the corridor. A left-turn movement was banned at one intersection during peak periods. With frequent one-way streets in downtown and numerous existing turning restrictions, this is expected to cause some initial driver frustration as frequent drivers adjust to the changes. At the eastern limit to the facility, two westbound lanes will merge into a single through lane. To alleviate some of the through traffic demand, the westbound left-turn movement will be permitted where it had previously been banned during the PM peak period. At the same intersection, the cycle length has also been increased to improve the operating capacity of the intersection. The new traffic rules are planned to become a key element in the parallel communications strategy that will introduce the pilot project to the public.

LESSONS LEARNED

This project brought to the forefront the on-the-ground realities of trying to implement infrastructure changes needed to assist the City of Ottawa's policies to encourage the shift in modal shares towards more sustainable transportation behaviours. In order to actually realize an increase in overall trips made by bicycle in the region, there will inevitably be mode vs. mode conflicts in constrained urban environments where different road users are competing for the same space and investment dollars. When cycling infrastructure is being introduced to an existing "driver-centric" road network, it is unlikely that the existing parking supply and traffic movements will remain unaffected. Similarly, the businesses that operate along cycling corridors will often face operational and/or access changes due to the new infrastructure.

After the preliminary designs for the pilot project were presented to the public, the local condominium associations along the preferred corridor voiced their concerns about the project. The most prominent issue was that 122 on-street parking spaces were being removed along Laurier Avenue in order to accommodate the segregated bicycle lanes in the constrained right-of-way. As previously discussed, to offset the loss of parking spaces the study team recommended that additional spaces be added along the two parallel streets immediately south of Laurier Avenue. However, because parking spaces were being removed directly in front of the existing condominium buildings on Laurier Avenue, the affected condominium boards remained in opposition to the pilot project.

Similarly, a local Business Improvement Association were opposed to the pilot project because of on-street parking impacts, increased motor vehicle congestion, traffic diversion impacts, safety concerns, and changes to on-street loading zones, which are all factors that contribute to the success of the businesses in the area today. For reference, the Business Association opposed to the project is a commercial mainstreet in Ottawa's downtown core that intersects with Laurier Avenue around the mid-point of the pilot project extents. The study team has continued to meet regularly with the business groups to minimize these impacts, but the Business Association remains in opposition to the pilot project.

The pilot project was brought forward to the City of Ottawa's Transportation Committee in February, 2011. As the Committee meeting approached, there was significant public dialogue in local newspapers, radio shows, and blogs about the merits of segregated facilitates, safety concerns, and the suitability of the preferred corridor. Approximately 40 delegations spoke both in favour and against the project at the Transportation Committee meeting, and the pilot project passed unanimously. The project received Council approval in February and will be constructed in summer 2011.

Due to the nature of the pilot project, where the City has decided to introduce cycling infrastructure within a heavy traffic and constrained downtown urban centre, parking and traffic impacts were inevitable regardless of which corridor was chosen as the preferred location for the pilot project. Based on our experience, these issues seem universal in the design of segregated bicycle lanes in Canadian urban centres. The key challenge in this pilot project was to frame these impacts alongside the City's strategic direction to promote cycling:

by providing cycling infrastructure, the City aims to reduce traffic congestion, provide a healthy alternative to driving in the downtown core, increase accessibility for cyclists, stimulate economic development in cycling-related businesses, and reduce emissions in the downtown core (City of Ottawa, 2011). Because of the behavioural changes to the way pedestrians, cyclists, and drivers will navigate in the downtown core and the broader societal shifts towards promoting more sustainable transportation modes in Ottawa, thorough consultation programs and communications strategies became fundamental aspects of the pilot project.

As this pilot project is the first application of segregated bicycle lanes in Ottawa and will impact all road and sidewalk users in the downtown core, an extensive communication strategy is planned in concert with the technical design and construction of the bike lanes. The City of Ottawa has developed a communication plan that targets cyclists, pedestrians, transit riders, and drivers, as well as tourists and businesses and promotes the bike lane through the lens of public safety. The communications objectives (City of Ottawa, 2011) are to:

- Ensure public safety;
- Educate cyclists, drivers, and pedestrians on how to negotiate the bike lane and surrounding areas;
- Raise awareness of new procedures during construction and operation;
- Provide information on how to provide feedback on the project;
- Build partnerships with downtown employers including federal and provincial governments, NCC, and hotels; and,
- Promote advantages of increased cycling and reduced motor vehicles.

In terms of next steps, the City will proceed with preparing tender documents and constructing the facility in the summer of 2011. The City will develop a monitoring plan to gauge the success of the pilot which will track the number of cyclists using the lanes at two different sample locations and will monitor the impacts along the corridor through cyclist surveys and ongoing discussions with business owners and residents. Frequent traffic impact assessments will be undertaken to ensure the facility operates safely and efficiently. One of the key technical challenges that remain is working with other municipalities in Ontario and the Ministry of Transportation to determine acceptable signal and signage for the proposed infrastructure.

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