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Technical Memorandum

To: Robert Grimwood
Copy: Ron Clarke
From: Kate Whitfield

Date: 14 May 2015
Project: TO3165TOA00

Re: O'Connor Street Bikeway Functional Planning Study – Evaluation of Alternative Concepts

Two bikeway options were presented at an Agency Group Consultation (ACG) Meeting and a Public Consultation Group (PCG) meeting on November 26, 2014. Using this stakeholder input, the two Alternative Concepts are being evaluated and their potential impacts assessed. The purpose of this memorandum is to summarize the evaluation criteria and the corresponding analysis.

1. Identification of Alternative Concepts

Following the June consultation meetings, the Study Team developed a set of Preliminary Cross-Sections (last version dated November 2014). Design criteria were applied to the curb-to-curb width for various cross-section options at five test site locations. A range of potential alternatives were developed to provide for northbound and southbound bike travel within a separated facility. The variables represented in the preliminary cross-sections include the following:

- Cycling facility:
  - Uni-directional (southbound and northbound or southbound only)
  - Bi-directional (west side and east side)
- On-street parking
  - Permanent (24/7) vs time restricted
- Lane widths
  - Vehicle lane
  - Cycling lane
- Buffer widths and treatments.

Based on these drawings and having considered geometric design criteria and input from the public consultation process, it became apparent that two options were appropriate candidates for more detailed analysis (i.e., two options each for south of Isabella and for north of Isabella). The Alternative Concepts are as follows:

<u>North of Isabella</u>
Option A: Uni-directional on both sides
Option B: Bi-directional on east side

<u>South of Isabella:</u>
Option A: Uni-directional on both sides
Option B: Shared lanes (narrow; parking)

2. Agency and Public Consultation

The Alternative Concepts noted above were presented at the November ACG and PCG meetings. Participants were asked to provide their feedback/preference based on the following:

- Cycling inclusiveness (range of abilities);
- Cycling safety;
- Traffic operations;
- Curbside access;
- On-street parking and loading;
- Potential for street greening;
- Co-benefits for pedestrians;
- Crossing under the Queensway.

At the ACG meeting, the discussion focused on the section north of Isabella because the southern section hinges primarily on the question of whether on-street parking can be removed to accommodate the bike lanes. For the section north of Isabella, there was a general consensus that more analysis is required before direction can provided for a preferred concept (i.e., uni-directional facilities on both sides or a bi-directional facility on the east side or a hybrid). One participant noted that a bi-directional facility was preferred on a one-way street as it would encourage a greater range of users (age and ability) based on the width of the space (i.e., strength in numbers, ability to pass). Others cited its benefits in the context of it providing a greater perceived sense of safety as compared with a single contraflow lane.

A follow-up meeting was held on December 15, 2014 with City Traffic Operations Staff and representatives from the Ministry of Transportation. At this meeting, staff acknowledged the study and endeavored to help seek solutions for the project's implementation, specifically for treatments at signalized intersections.

At the PCG meeting, working group members were more supportive of the bi-directional facility on O'Connor compared to a uni-directional one, for the primary reason that it provides better protection from the roadway. A sense of improved protection was based on the width gained for the overall cycling facility by situating two 1.5 m lanes adjacent to each other and the notion of cyclists being grouped together for improved visibility or presence. One person indicated that the uni-directional solution would be preferred if the north and southbound facilities were split between Metcalfe and O'Connor. Other comments received include the importance of keeping the bikeway on the east side of O'Connor so that unimpeded curb-side access can take place on the west side, where on-street parking would typically be located (on the right side of the street). This arrangement would provide "buffers" between the pedestrian sidewalk and moving traffic on both sides. It was also noted that consideration will have to be given to queuing space for bikes at intersections. For the Glebe section, one suggestion was for traditional bike lanes for the first two blocks south of Catherine and then shared lanes beyond that point.

Refer to the hand-outs from the November 26, 2014 meetings and the meeting records for more detailed information.

3. Evaluation Methodology and Criteria (North of Isabella)

The City of Ottawa Cycling Plan contains a tool to aid practitioners in selecting an appropriate cycling facility for a particular corridor. Figure 1 illustrates how the Facility Selection Decision Tool applies to O'Connor Street, north of Isabella. The 85th percentile speed is 46 km/hr near Laurier Street and 52 km/hr near Catherine. The AADT is 14,000+.

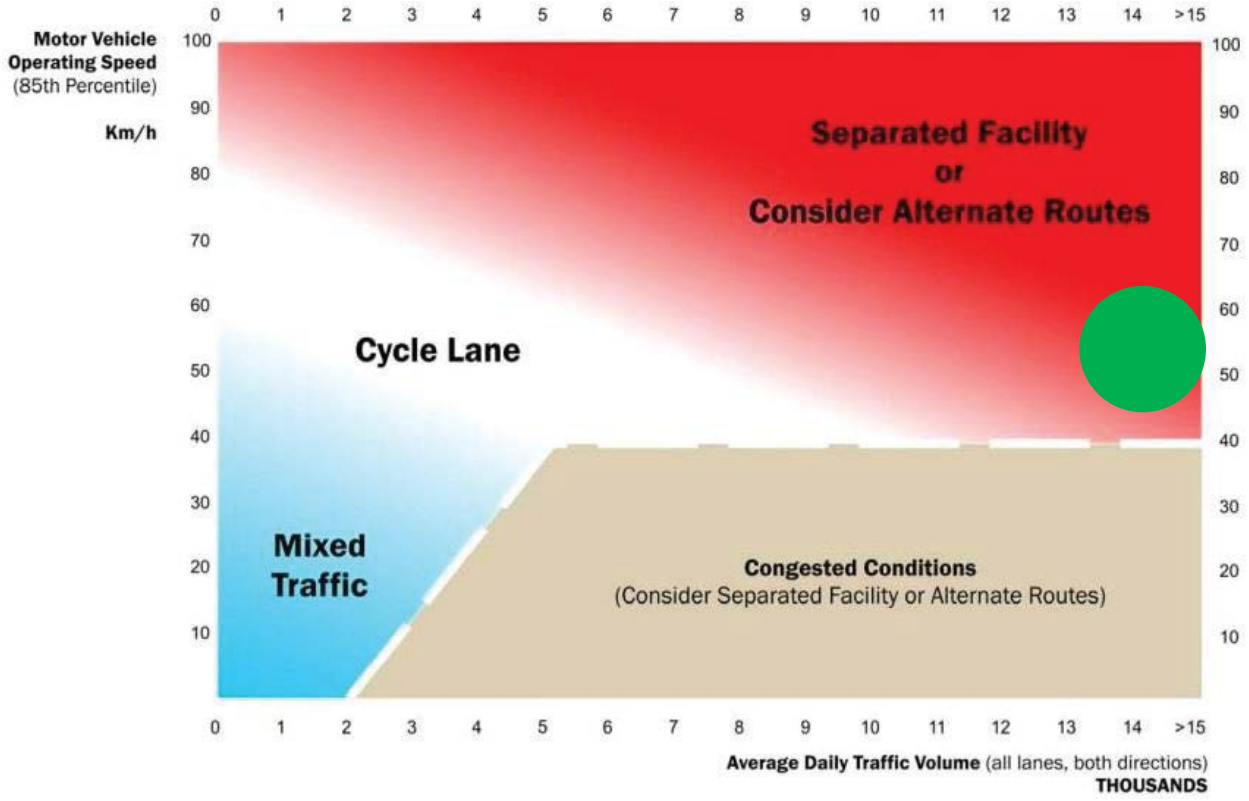

Figure 1: Facility Pre-selection Nomograph for O'Connor, north of Isabella Street

Based on the foregoing, for O'Connor Street north of Isabella, the appropriate facility for this type of roadway is a separated facility or an alternative route (refer to section 3.3 for a discussion regarding alternative routing).

In order to further develop the concept of providing a cycling facility separated from the vehicle travel lanes, evaluation criteria and indicators were applied to alternative concepts for O'Connor Street north of Isabella. The criteria are grouped into two broad categories including:

- Part A: Land Use, Urban Design and Community Sustainability
- Part B: Transportation Sustainability

The Table in Appendix A includes a list of the corresponding indicators.

Each option was evaluated based on how it performs in meeting each individual indicator ranging from 'failure' to 'performs very well', as shown in Table 1.

Table 1: Evaluation Scale and Descriptive Terms		
Assessment	Rating	Definition
Performs Very Well	4	The alternative is evaluated by subject matter experts to have a highly favourable result in regards to fulfillment of the indicator. The design is expected to result in the achievement of best design practices, benchmarks, regulatory standards, or values expressed by stakeholders and in policy and guidelines, with the performance often exceeding the benchmarks.
Performs Well	3	The alternative is evaluated by subject matter experts to have favourable result in regards to fulfillment of the indicator. The design is expected to result in the achievement of best design practices, benchmarks, regulatory standards, or values expressed by stakeholders and in policy and guidelines.
Performs Adequately	2	The alternative is evaluated by subject matter experts to have an acceptable result in regards to fulfillment of the indicator. The design is expected to result in the achievement of best design practices, benchmarks, regulatory standards, or values expressed by stakeholders and in policy and guidelines, with the performance just meeting or approach benchmarks.
Performs Poorly	1	The alternative is evaluated by subject matter experts to have an undesirable result in regards to fulfillment of the indicator. There is a risk that the design may fall short of best design practices, benchmarks, regulatory standards, or values expressed by stakeholders and in policy and guidelines.
Fails	0	The alternative is evaluated by subject matter experts to have an unacceptable result in regards to fulfillment of the indicator. The design is expected to achieve best design practices, benchmarks, regulator standards, or values expressed by stakeholders and in policy and guidelines.

The Table in Appendix A provides a discussion on how the scale was applied. While the numeric system is a useful tool in the analysis it is not intended to be used in isolation to establish a preferred alternative.

3.1 Evaluation Criteria Table and Results

An Evaluation Criteria Table for O'Connor Street north of Isabella is provided in Appendix A. For the purposes of this analysis, the options are applied to the full length (i.e., Wellington to Isabella) and does not contemplate a hybrid version.

Based solely on the unweighted numeric system represented in the attached Table, Option B with the bi-directional facility is the preferred alternative by a factor of 106 to 91.

3.2 Key Points

Both options perform well in terms of creating a bikeway linking communities and other planned cycling facilities with the potential to appeal to a range of users and therefore, increase the modal share for cycling.

Advantages of Option A: Uni-directional on both sides

- Consistent with other existing facilities in the City (i.e., familiarity);
- For the SB cyclists, this type of facility would operate with existing signals and timing (note: the contraflow lane would require new signals to accommodate NB cyclists);
- A cyclist traveling in the same direction of traffic on the right-hand side would experience easier transitions at intersections with less potential for conflict (note: however, potential for “right-hook” conflict still exists);
- Where there is sufficient space to provide on-street parking, there would be the option of it being situated on either side of the roadway.

Disadvantages of Option A: Uni-directional on both sides

- This type of facility requires more space (i.e., buffer on both sides) with the result of less potential for on-street parking*;
- Less space for cyclists to pass each other;
- Not an acceptable solution for a safe crossing underneath the Queensway between Catherine and Isabella;
- Lane widths necessary to satisfy OC Transpo guidelines are not achievable with this option.

Advantages of Option B: Bi-directional on east side

- Considered safer option for crossing beneath the Queensway (Catherine and Isabella);
- Requires less space (i.e., only one buffer) which equates to retaining a larger amount of on-street parking*;
- Requires less space which creates the potential for auxiliary turning lanes deemed beneficial to the overall functioning of the road network (note: ability to offer left turn auxiliary lanes related to loss of additional parking);
- More space for cyclists to pass each other;
- From an accessibility perspective, by concentrating the facility to the east side of the roadway there would not be a conflict with a cycling facility on the west side which corresponds with the passenger side of a vehicle (i.e., facilitates ParaTranspo and other curbside access functions).

Disadvantages of Option B: Bi-directional on east side

- Transitions at intersections are more complex;
- More complex traffic signal operations.

* There are seven blocks where Option B would allow for on-street parking where Option A would not; however, all widths would be at/near the minimum to accommodate the bi-directional facility (i.e., parking lane, vehicle travel lane, buffer, cycling facility). While on-street parking would not be possible for those seven blocks with Option A, there is the potential for the vehicle travel lane, buffer and cycling facilities widths to be more than the

minimum therefore potentially offering a benefit to both users (i.e., travel experience plus safety).

3.3 Discussion regarding a Hybrid Option or Alternative Routing

Option B from Isabella to Argyle with Option A from Argyle to Wellington:

- Achieves acceptable approach to crossing under the Queensway;
- Does not achieve benefit of additional on-street parking in blocks where curb to curb width is limited and where parking is in higher demand (between Somerset and McLeod);
- Introduces the complexity of a transition between uni-directional and bi-directional; Argyle Street selected as the transition point due to potential for additional space available near Museum of Nature. Alternative option not available until Lisgar;
- No significant change in signalization requirements between Option A and Option B at Albert Street where the World Exchange Plaza exit is located. Small benefit in terms of crossing distance;
- Lane widths necessary to satisfy OC Transpo guidelines are not achievable with this option (between Queen and Slater);
- Less desirable transition to planned cycling facility on Wellington Street (i.e., bi-directional facility).

Option B from Isabella to Laurier with SB on O'Connor and NB on Metcalfe from Laurier to Wellington:

- Achieves acceptable approach to crossing under the Queensway;
- Achieves benefit of additional on-street parking in blocks where curb to curb width is limited and where parking is in higher demand (between Somerset and McLeod);
- Potential space limitations for accommodating transition from bi-directional facility south of Laurier and single SB uni-directional facility north of Laurier;
- No impact to signalization at Albert where World Exchange Plaza parking garage is located; however, no potential benefit to garage users who would gain dedicated green phase with other options;
- No gain of maintaining police and taxi zone in block between Queen and Albert by only providing SB uni-directional cycling facility (due to space limitations).
    - For example, 1.5 m cycling facility + 0.5 m buffer + 2.2 m police zone + 3 m vehicle travel lane + 3 m vehicle travel lane = 10.2 m > 10.18 m available curb to curb and all widths would be at the minimums which does not accommodate the bus lane width request of 3.5 m, or even 3.25 m);
- Achieves OC Transpo guidelines for lane widths between Queen and Slater;
- Less desirable transition to planned cycling facility on Wellington Street (i.e., bi-directional facility).
- "Detours" cyclists off O'Connor Street and encourages cycling NB in the single lane intended to be for SB cyclists thus creating unsafe conditions for all modes.
- Introduces disruptions along a second corridor (i.e., Metcalfe) which has already undertaken lane reductions.

3.4 Recommendation

Based on the discussion noted above, Option B is recommended between Isabella and Wellington Street (i.e., bi-directional on the east side).

4. Evaluation Methodology and Criteria (South of Isabella)

For O'Connor Street south of Isabella, the Facility Selection Decision Tool from the City of Ottawa Cycling Plan has been applied (refer to Figure 2). The 85th percentile speed is 40 km/hr and the AADT is 400.

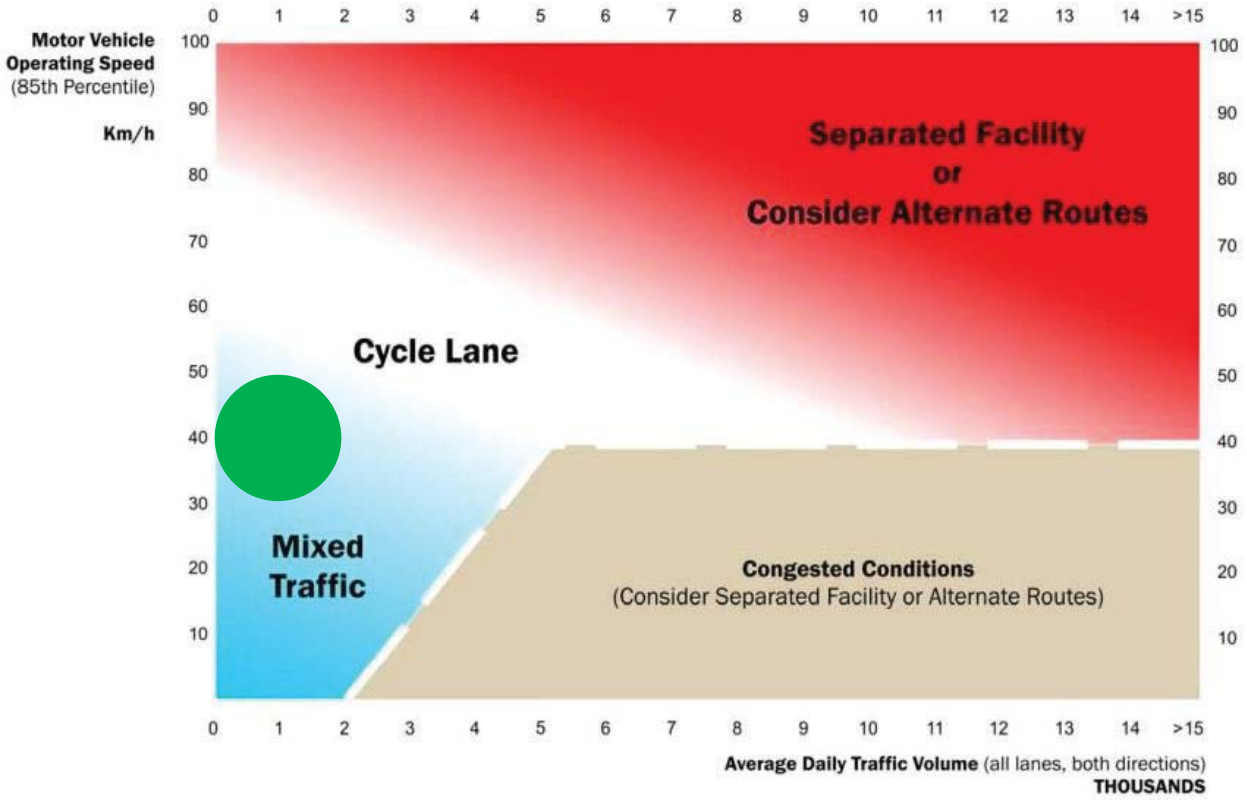

Figure 2: Facility Pre-selection Nomograph for O'Connor, south of Isabella Street

Based on the foregoing, for two-way street between Glebe and Strathcona the options include:

- Option A: Uni-directional on both sides
- Option B: Mixed traffic (also known as Shared lanes)

The basis for the remainder of the evaluation of the alternative concepts south of Isabella is the Cycling Facility Selection Design Support Tool & User City (City of Ottawa, May 2011). This process builds upon the facility pre-selection nomograph in Figure 2.

4.1 Key Points

4.1.1 One-way Street between Isabella and Strathcona

While an AADT of 400 and a 85th percentile speed of 40 km/hr would group the two blocks between Isabella and Strathcona with the remainder of the streets south of Isabella, the fact that it is a one-way roadway is an important consideration. In order to accommodate northbound and southbound travel within these two blocks, a mixed traffic option is not possible.

Existing Conditions between Isabella and Pretoria:

- One-way street;
- Driveways only on the east side;
- Stop-control at Pretoria;
- Existing on-street parking on east side (some time restrictions);
- Not a bus route;
- 11.5 m available between the curbs.

Existing Conditions between Pretoria and Strathcona:

- One-way street;
- Driveways on both sides;
- Not stop-controlled at Strathcona;
- Existing on-street parking on east side (some time restrictions);
- Existing bus route (from Pretoria turning onto O'Connor);
- 9.66 m available between the curbs.

Key Considerations:

- The position of the facility north of Isabella as it transitions south of Isabella;
- The provision of both a NB and SB cycling facility within this corridor;
- The existing curb-to-curb width;
- Maintaining on-street parking to the greatest extent possible;
- OC Transpo guidelines for lane widths for the block between Pretoria and Strathcona;
- The position of the facility south of Strathcona as it transitions to a two-way roadway;
- The fact that a stop sign does not currently exist at the intersection of O'Connor and Strathcona.

Based on the above, the preferred option for this two block segment is as follows:

- Between Isabella and Pretoria: Bi-directional on the east side
- Between Pretoria and Strathcona: Uni-directional on both sides (i.e., contra flow on east side)

The transition between the two types of facilities is possible at the O'Connor/Pretoria intersection because it is stop-controlled. A cross-ride would be included in the design in order to accommodate the transition for SB cyclists.

As noted above, consideration is not given to a mixed traffic scenario as the roadway is one-way and the cycling spine route is for NB and SB travel.

The existing on-street parking would be maintained for both blocks, with the potential for additional on-street parking between Isabella and Pretoria. OC Transpo guidelines for lane widths is also achieved.

4.1.2 Two-Way Street between Strathcona to Glebe

With the change from a one-way street to a two-way street for O'Connor at Strathcona comes a new set of options for the preliminary concepts. A bi-directional facility was no longer under considerations as it is not a recommended approach for two-way streets. Considering the results of the pre-selection nomograph noted above, for the two-way street between Glebe and Strathcona the options include:

- Option A: Uni-directional on both sides
  - Minimum 9.5 m curb to curb: 1.5 m SB bike lane, SB travel lane at 3.25 m, NB travel lane at 3.25 m and 1.5 m NB contraflow bike lane (no buffers)
  - No on-street parking
- Option B: Mixed traffic (also known as Shared lanes)
  - Minimum 9.5 m curb to curb: SB travel lane at 3.5 m, NB travel lane at 3.5 m and 2.5 m parking (one side)
  - On-street parking provided

Option A and B correspond with Arrangement A and B represented in the Preliminary Cross-Sections package (dated November 2014). The details are as follows:

Table 2 provides a summary of existing conditions for this four block section. All four blocks are a bus route with two blocks having bus stops. Existing on-street parking is only available between Patterson and Monkland.

As represented in Table 2, all of the road segments have sufficient curb-to-curb width to accommodate Option A or Option B. The limited width does require a trade-off, however, in terms of on-street parking. Further to this, it is not possible to add a buffer to Option A by further reducing vehicle lane widths as O'Connor is a bus route in this location and OC Transpo guidelines seek 3.5 m lane width.

Table 2: Existing Conditions South of Isabella (Strathcona to Glebe) and application of Option A and B

Road Segment		Existing Conditions			Result of Arrangement A[1]	Result of Arrangement B
		Curb to curb width (m)	Bus route?	Parking?		
Strathcona	Patterson	9.53	Yes with bus stop	None	At minimum required width	At minimum required width; option to add parking
Patterson	Monkland	10.28	Yes (no bus stop)	East side (time limited)	Loss of parking; option for inclusion of buffer	Maintain parking; need for tools to facilitate mixed traffic
Monkland	Clemow/ Linden	10.45	Yes (no bus stop)	None	Option for inclusion of buffer	Option to add parking; additional space to be allocated
Clemow/ Linden	Glebe	10.28	Yes with bus stop	None	Option for inclusion of buffer	Option to add parking; additional space to be allocated

[1]Note: The existing bulb-outs would need to accommodate the construction of uni-directional facilities on both sides

To achieve parking with a uni-directional facility (both sides), it would require a minimum 12.2 m curb to curb width assuming that a buffer would be required (i.e., 1.5 m SB bike lane, 0.5 m buffer, SB travel lane at 3.0 m, NB travel lane at 3.0 m, 2.2 m parking lane, 0.5 m buffer and 1.5 m NB contraflow bike lane (note: smaller travel lane width)).

On this basis, the analysis is further refined to include Option A: Uni-directional on both sides (no parking) and Option B: Shared lanes (narrow; with parking).

The next step of the Facility Selection process requires a more detailed look at key design considerations. The Table in Appendix B summarizes the criteria and applies it to O'Connor Street south of Isabella (Strathcona to Glebe).

Considering the function of the route within the bicycle facility network, the level of bicycle use and the anticipated users in terms of skill and trip purpose, Option A is recommended south of Isabella (Strathcona to Glebe) when applying the City of Ottawa facility selection process. Should Option B be pursued in order to maintain on-street parking, design features would need to be incorporated to ensure a low speed environment.

4.2 Recommendation

Based on the discussion noted above, Option A is recommended between Strathcona and Glebe (i.e., uni-directional bike lanes on each side).

Appendix A

Evaluation Criteria Table (North of Isabella)

O'Connor Bikeway: Evaluation Criteria – O'Connor Street (North of Isabella)

Evaluation Scale and Descriptive Terms		
Assessment	Rating	Definition
Performs Very Well	4	The alternative is evaluated by subject matter experts to have a highly favourable result in regards to fulfillment of the indicator. The design is expected to result in the achievement of best design practices, benchmarks, regulatory standards, or values expressed by stakeholders and in policy and guidelines, with the performance often exceeding the benchmarks.
Performs Well	3	The alternative is evaluated by subject matter experts to have favourable result in regards to fulfillment of the indicator. The design is expected to result in the achievement of best design practices, benchmarks, regulatory standards, or values expressed by stakeholders and in policy and guidelines.
Performs Adequately	2	The alternative is evaluated by subject matter experts to have an acceptable result in regards to fulfillment of the indicator. The design is expected to result in the achievement of best design practices, benchmarks, regulatory standards, or values expressed by stakeholders and in policy and guidelines, with the performance just meeting or approach benchmarks.
Performs Poorly	1	The alternative is evaluated by subject matter experts to have an undesirable result in regards to fulfillment of the indicator. There is a risk that the design may fall short of best design practices, benchmarks, regulatory standards, or values expressed by stakeholders and in policy and guidelines.
Fails	0	The alternative is evaluated by subject matter experts to have an unacceptable result in regards to fulfillment of the indicator. The design is expected to achieve best design practices, benchmarks, regulator standards, or values expressed by stakeholders and in policy and guidelines.

The following assessment applies to the segments of O'Connor Street north of Isabella for Option A and Option B.

Part A: Land Use, Urban Design and Community Sustainability			**Option A: Uni-directional on both sides**	**Option 2: Bi-directional on east side**
Criteria		**Description**		
A1	Official Plan (OP)	A street that best enables pursuit of the City's vision for the Central Area and O'Connor Street as a Spine Route.	2	2
			Equally preferred as both achieve the OP (i.e., adequately achieves role as spine route); deemed adequate due to space constraints; to achieve the next rating would require more than segregated bike lane (i.e., cycle track); one level below would correspond to a painted bike lane.	
A2	Transportation Master Plan (TMP)	A street that achieves objectives of TMP regarding modal shares for cycling.	2	3
			Achieves getting a large number of people cycling on it.	Achieves getting a large number of people cycling on it; more potential impact on modal share due to preferred in terms of appealing to wide range of users (i.e., through side by side cycling, passing and increased comfort as similar to a pathway; removes the issue of cyclist traveling the wrong way in the cycling facility.
A3	Ottawa Cycling Plan (OCP)	A street that implements directions of the OCP which designates O'Connor Street as a Cross-Town Bikeway.	3	3
			Performs well as links long distances, join communities; to achieve the next rating would require a rebuild of the roadway (i.e., everyone's wish list).	
A4	Downtown Moves	A street that is consistent with Downtown Moves which designates O'Connor Street as a Segregated Facility. Note: A painted bike lane qualifies as a segregated facility in terms of definition used in this specific study.	2	2
			Adequately meets the vision but not higher rating as only meeting minimum requirements for segregation between cyclists and motor vehicles.	
A5	Centretown Community Design Plan (CDP)	A street that enables pursuit of CDP vision for cycling which includes: reallocating space to dedicated cycling lanes; implementing proposed cycling infrastructure within the community; and prioritizing cycling links across barriers such as the Queensway.	4	4
			Performs very well as meets aspiration (i.e., reallocating space); assumes appropriate signalization solution.	
A6	Commercial/ Institutional On-Street Parking and Loading	A street that supports a successful business environment and that encourages investment and property development including: (i) provision of off-peak parking and loading; and (ii) provision of all-day parking and loading.	(i) 1 (ii) 1	(i) 2 (ii) 3
				The result of situating both bikeways on one side of the street is that the buffer between the bikeways and the motor vehicle lane would be shared and therefore more space is available for the buffer, the motor vehicle lane(s) and/or on-street parking. On this basis, the rating is higher for Option B. At present, parking permissions vary for different periods of the day. Should parking be provided at a lane width less than 3.0 m then it would be permanent 24 hour parking.
			Where there is sufficient space to provide on-street parking, there would be the option for it to be situated on either side of the road.	An outcome of Option B is that all on-street parking and loading would be situated on the west side of the road. An attempt would be made to accommodate existing loading, hotel and taxi zones on the east side to side streets. From one perspective this may be deemed a negative outcome; however, from an accessibility perspective the result is that there would not be a conflict

				with a cycling facility on the west side which corresponds with the passenger side of a vehicle (i.e., facilitates ParaTranspo and other passenger drop-offs).
			Both options provide for future consideration of off-peak parking if it is deemed appropriate to reduce O'Connor to one-way during certain time periods. Both options would require this off-peak parking lane to be situated between a vehicle travel lane and the cycling facility thus placing regulatory signage within the buffer zone.	
A7	Residential On-Street Parking and Loading	A street that provides street-fronting residences on-street parking including: (i) provision of off-peak parking; and (ii) provision of all-day parking.	(i) 1 (ii) 1 Note: Refer to discussion under item A6.	(i) 2 (ii) 3 Note: Refer to discussion under item A6.
A8	Visual Environment and Greening	A street with pleasing visual environment including: (i) views to and from locations for all users within and beside the corridor; and (ii) space for visual streetscape elements.	(i) 2 (ii) 2	(i) 2 (ii) 3
			Visual environment improvement before/after (i.e., four travel lanes to two); limited due amount of signage that will be required; improvement for Option B under (ii) due to potential for additional space (refer discussion under A6).	
A9	Cycling access to adjacent land uses	A street that maximizes cycling access to adjacent land uses (i.e., commercial, institutional residential).	3	2
			Higher rating due to better cycling access to both sides of the roadway.	The issue is southbound access to west side businesses; mitigated in part by the option available to travel SB by a cyclist "taking the lane."
Part B: Transportation Sustainability			**<u>Option A</u>: Uni-directional on both sides**	**<u>Option 2</u>: Bi-directional on east side**
Criteria		**Description**		
B1	Pedestrian Safety at Intersections	A street that provides for safe pedestrian crossing including: (i) short pedestrian crossing distance; (ii) space for waiting at crosswalk; and (iii) minimized conflicts with cyclists.	(i) 2 (ii) 2 (iii) 2	(i) 2 (ii) 2 (iii) 2
			For (i) Option B has less impact on the crossing distance as by having a bi-directional facility, there is less need for bike boxes to facilitate turning movements which result in the shifting back of crosswalks. For (ii) as the existing curb locations are not being shifted, the waiting space should be the same with the introduction of a bikeway. For (iii), Option B would result in less conflict with cyclists as the facility is concentrated to one side of the roadway.	
B2	Pedestrian Comfort	A street that provides for comfortable walking environment where pedestrians are separated from moving vehicles.	3	3
			Shares the buffer each side and both sidewalks out of splash zone.	Larger buffer on one side, less the other.
B3	Accessibility and Mobility	A street that provides that considers accessibility and mobility for all users. For example, the existence of physical barriers at mid-block locations for crossing the street or at drop-off locations).	2	2
			By concentrating the cycling facility to one side of the roadway, it both places a limitation on access to the east side but also provides for there being no conflict on the west side. Whether or not there is a physical barrier to crossing the street or at drop-off locations depends on the type of separate technique selected which could apply to either option (i.e., concrete curb versus painted buffer with bollards).	
B4	Connectivity to Cycling Network (General)	A street that provides for cycling network connectivity including: (i) consideration for distance and directness of route; and (ii) connectivity to planned east-west cycling facilities (Wellington Street).	(i) 4 (ii) 2	(i) 4 (ii) 3
B5	Continuity to cycling network north/south of Highway 417	A street that provides for continuity and safety of the cycling facility between Catherine Street and Isabella Street.	0	2
			MTO has deemed Option A unacceptable for the crossing under the Queensway. It would require a right turn lane between the curb and the cycling facility on the approach to the Catherine Street intersection or a green phase solely for cyclists to move through the intersection safely to avoid conflict with the right turn onto Catherine and/or the on-ramp to the Queensway. At the Isabella intersection, a green phase solely for cyclists travelling SB would also be required. This condition is not considered safe and the mitigation measures would have too great an impact on signal timing throughout the corridor.	In order to be deemed acceptable from a safety perspective a bi-directional facility would be situated on the west side for the Catherine Street intersection and the east side for the Isabella Street intersection. This is based on a more appropriate signal timing configuration and the availability for waiting areas. The rating of adequate is based on the requirement for two stage crossings for cyclists and complex signalization (i.e., SB cyclists with a red while SB vehicles proceed at Isabella intersection).
B6	Cyclist Separation	A street where cyclists are well segregated from: (i) moving vehicles; and (ii) dooring hazards.	(i) 2 (ii) 2	(i) 3 (ii) 2
			Adequate performance for segregation from dooring hazards as space limitations will necessitate the application of minimum buffer treatments.	

B7	Cycling Facility Consistency and Familiarity	A street that accommodates cycling in a manner that is consistent and familiar to all users.	2	1
			Uni-directional SB is consistent with Laurier with some contraflow NB already in existence in the City. Limited bi-directional in operation. Will require new signals for contraflow lane and in some cases may require cyclists waiting and not proceeding on initial green (i.e., left turn protected at Slater or thru at Isabella). Vehicles will need to develop understanding of how movements from contraflow lane are to be accommodated/anticipated.	Use of bi-directional on east side appropriate due to fact that it is a one-way street. Will require all modes to develop understanding of how movements from cycling facility are to be accommodated/anticipated. Less consistent with other facilities in Ottawa. Requires significant amount of new signage, etc.
B8	Cycling Facility Ease of Signalization	A street that can be converted to accommodate northbound cycling with traffic signalization provided in the most cost-effective manner.	1	1
			Capital costs will be incurred to provide signalization for northbound movements.	
B9	Cycling Safety at intersections	A street that provides for safe cycling crossing at intersections including: (i) intuitive cyclist movements; (ii) space for waiting for turning movements; and (iii) minimizing of potential cyclist and vehicle conflicts.	(i) 3 (ii) 2 (iii) 2	(i) 2 (ii) 2 (iii) 2
			Limited space for waiting for turning movements; however, not two cyclists travelling in different directions in one area. “Right hook” potential conflict exists with Option A.	Crossing a bike lane to access a bike box is not intuitive; space for waiting for turning movements requires accommodation. Option B mitigates the problem associated with “right-hook” conflicts between vehicles and cyclists.
B10	Cycling Safety between intersections	A street that provides for safe cycling between intersections.	3	3
			Both options provide buffered, physical separation from vehicle traffic.	
B11	Cycling Comfort and Service	A street providing a comfortable and convenient cycling environment including: (i) space for bike racks and supportive street furnishings; and (ii) smooth, uninterrupted riding surface.	(i) 2 (ii) 2	(i) 2 (ii) 3
				As the existing curb locations are not being shifted and the catch basin locations are fixed, the result is that cyclists in the northbound lane will not travel over catch basins.
B12	Off-Peak Period Vehicle Travel Performance	A street where passenger move efficiently through the corridor in the off-peak period.	2	2
B13	Peak Period Vehicle Travel Performance	A street where passenger vehicles move efficiently through the corridor in the peak period.	2	2
			Option B provides greater potential for improved travel time through the corridor through the inclusion of auxiliary lanes at specific intersections (due to more available space); however, it is neutral as signalization is more complex.	
B14	Vehicle Safety	A street with safe driving conditions including: (i) speed; (ii) regularity of lane alignment; and (iii) protected turning movements.	(i) 2 (ii) 2 (iii) 1	(i) 2 (ii) 2 (iii) 2
			Both options result in narrow vehicle lanes depending on the road segment and therefore, lower speeds. While Option B requires less space, the vehicle lanes are narrow to accommodate parking. For Option A, lane alignment is less regular in the area of the World Exchange Plaza garage exit ramp and at the Catherine Street intersection. For both options, protected turning lanes are only maintained at the south end of the study area (i.e., every right turn is also a through) with the exception of a few intersections: • Recommended right: Somerset (not possible for either option unless ROW widening) and Catherine (only possible Option B) • Optional right: Laurier (either option but left turn trade-off); Gloucester (only Option B); Lisgar (only Option B) • Recommended left: Slater and Laurier (either if loss of parking in this and adjacent blocks); Nepean (Option B if loss of parking in this and adjacent blocks)	
B15	Transit	A street that can accommodate existing or future southbound transit service. Note: Buses travel southbound on O’Connor between Queen and Slater (no bus stops).	1	2
			The vehicle travel lanes would be 3.0 m wide between Queen and Slater and according to OC Transpo, 3.5 m is required.	The additional space in Option B allows for the curb lane to be 3.0 m wide and the inboard vehicle lane to be 3.5 m in the blocks between Queen and Slater.

			In order to have a left turn auxiliary lane at Slater Street, on-street parking in this block and the SB block would have to be removed. Signalization may include a dedicated green phase to facilitate SBL and SBT movements at Slater (i.e., SB and NB cyclists held).	
B16	Passenger pick-up and Para Transpo service	A street that provides comfortable and convenient pick-up and drop-off access including (i) passenger pick-up (hotel and taxi); (ii) Para Transpo; and (iii) police zone.	(i) 2 (ii) 2 (iii) 1	(i) 2 (ii) 3 (iii) 1
				Para Transpo vehicles load on the right and therefore would not have a conflict with a bike lane if it was bi-directional and on the east side of the roadway.
			Both existing hotel zones are on the east side and a bi-directional facility would be on the east side. The Best Western has a lay-by on their own property and therefore would remain. The Sheraton hotel zone may have to be relocated (either option).	
B17	Emergency Vehicle Service	A street where emergency service vehicles can operate efficiently including: (i) ease of service to sites along the corridor; and (ii) travel time through the corridor.	(i) 2 (ii) 2	(i) 2 (ii) 2
			By concentrating the cycling facility to one side of the roadway, it both places a limitation on access to the east side but also provides for there being no conflict on the west side. Option B provides greater potential for improved travel time through the corridor through the inclusion of auxiliary lanes at specific intersections (due to more available space); however, it is neutral as signalization is more complex.	
B18	Commercial Vehicles	A street where commercial vehicles can operate efficiently including: (i) ease of service to sites along the corridor; and (ii) travel time through the corridor.	(i) 2 (ii) 2	(i) 2 (ii) 2
			Refer to the discussion in B17.	
B19	Traffic Diversion (Municipal Roads)	A street that minimizes the likelihood of traffic diversion including: (i) minimize risk of cut-through traffic on local streets and collectors within the study area; and (ii) minimize likelihood of traffic diverting to other Arterial Roads.	(i) 2 (ii) 2	(i) 2 (ii) 2
			Both options impact left turn capabilities (i.e., bi-directional or contraflow lane).	
B20	Maintainability including winter maintenance	A street that can be efficiently maintained including provisions for snow management along the road edge.	2	3
				Combined width of two-way better facilitates sweeping and winter maintenance.
B21	Capital Cost	A street that can be converted to accommodate a bikeway provided in the most cost-effective manner.	2	2
			Less complicated signalization requirements; however, with the contraflow lane, additional signal heads remain a requirement.	Option B results in less impact to intersections as the facility is concentrated to one side (i.e., less impact of bike boxes because not required with bi-directional at certain intersections).
		Total	91	106

Appendix B

Cycling Facility Selection Design Support Tool
Step 2 – A More Detailed Look
O'Connor (Strathcona to Glebe)

* = applicble to the O'Connor Street project (Strathcona to Glebe)

Roadway Characteristics		Rules / Considerations
Motor vehicle operating speeds (85th percentile)		
Very low (less than 30 km/h)		Bicycles and motor vehicles operate at approximately the same speed. Formal bicycle facilities may not be necessary.
Low (30 to 50 km/h)	*	Speed differential between bicycles and motor vehicles is within 20 km/h, suggesting integration of the two modes as mixed traffic (in standard or wide curb lanes) may be appropriate.
Moderate (50 to 65 km/h)		Exclusive operating space for both bicycles and motor vehicles, in the form of wide curb lanes, cycle lanes, or separated facilities is recommended. Traffic calming and enforcement may be considered to manage motor vehicle volume and speed.
High (65 to 80 km/h)		Speed differential between bicycles and motor vehicles exceeds 40 km/h, suggesting physical separation of the two modes is most appropriate (i.e.
Very high (greater than 80 km/h)		Typical of rural highways and major urban thoroughfares, separated facilities with a buffer between the roadway and the bicycle facility are most appropriate. Alternatively, a parallel bicycle route should be explored.
Motor vehicle volumes		
Low (two-way daily average volume less than 3,000 vpd)	*	Mixed traffic may be appropriate if vehicle speeds are also low. Curb lanes should be as wide as possible.
Moderate (two-way daily average volume 3,000 to 10,000 vpd)		Some level of formal bicycle facility (cycle lanes or separated facility) is recommended.
High (two-way daily average volume greater than 10,000 vpd)		Physical separation of motor vehicle and bicycle traffic (i.e. separated facility) may be most appropriate.
Hourly one-way volume in the curb lane exceeds 250 vph		Some level of formal bicycle facility (cycle lanes or separated facility) is recommended.
Function of street/road/highway		
Access (local roads, residential streets)	*	Mixed traffic may be appropriate if speeds and volumes are low. Curb lanes should be as wide as possible.
Mobility (arterials, major collectors)		Some level of formal bicycle facility (cycle lanes or separated facility) is appropriate.
Both mobility and access (many collectors, other roads and streets)		Some level of formal bicycle facility (cycle lanes or separated facility) is appropriate.
Motor vehicle commuter route		Separated bicycle facilities should be considered to minimize conflicts with aggressive drivers on the roadway.
Vehicle mix		
More than 30 trucks or busses per hour are present in a single outside lane		Separated bicycle facilities may be preferred by many cyclists. If wide curb lanes or cycle lanes are considered, additional width should be provided as a
Bus stops are located frequently along the route	*	Facilities should be designed to minimize and clearly mark conflict areas between cyclists and busses/pedestrians at stop locations.
On-street parking		
Parallel on-street parking is not permitted		Opportunities to provide wide curb lanes or cycle lanes, as well as their appropriateness should be explored.
Parallel on-street parking is permitted in localized areas along the route		Consistent cycle lanes may prove difficult to provide as available roadway width is likely to change where parking is provided. Wide curb lanes may be an acceptable solution.
Parallel on-street parking is permitted but demand is low		Opportunities to remove, restrict, or relocate parking in favour of providing cycle lanes should be considered.
Parallel on-street parking is permitted but turnover is low	*	Cycle lanes may be appropriate. Additional buffer space between bicycle and parking lanes should be provided.
Parallel on-street parking is permitted; turnover and demand is high		Separated bicycle facilities or alternate routes may be most appropriate. Cycle lanes are not desirable in this situation due to frequent conflicts with parking
Perpendicular or diagonal parking is permitted		On-road facilities are not appropriate unless parking is reconfigured or removed. Alternate routes or opportunities to provide a separated facility should be
Intersection/access density		
Limited intersection and driveway crossings are present along the route		Separated facilities or cycle lanes are well suited to routes with few driveways and intersections.
Numerous low volume driveways and/or unsignalized intersections are encountered	*	Wide curb lanes or cycle lanes may be more appropriate than separated facilities as motorists are more likely to be aware of cyclists on the roadway than adjacent to the road.
Numerous high volume driveways and/or unsignalized intersections are present along the route		Separated facilities are generally not preferred in this situation; cycle lanes or wide curb lanes may be more appropriate. Crossings should be designed to minimize conflicts; additional positive guidance/warning measures should be considered to warn cyclists and motorists of conflicts.
Major intersections with high speed and traffic volumes are encountered		Consider provision of cycle lanes, advance stop lines, and exclusive bicycle signal phases at major intersections; consider hook/indirect left turn treatments if there is significant bicycle left turn demand conflicting with through motor vehicle traffic. If a separated facility is being considered, crossings should have bicycle traffic signals with exclusive phases and conflicts should be clearly marked.
Collision history Note: 1 bicycle/car collision in 2010 and 1 reported in 2012 in this section of O'Connor; remainder vehicle/vehicle collisions		
Bicycle collisions are relatively frequent along the route		A detailed safety study is recommended. Alternate routes should be considered. Separated facilities may be appropriate to address midblock conflicts. If on-road facilities are considered, the operating/buffer space provided to cyclists should be enhanced.
Bicycle collisions are relatively frequent at specific locations		Localized design improvements should be considered to address contributing factors at high-collision locations (often near intersection and driveway
Noticeable trends emerge from bicycle collisions		Proposed facility and its design should attempt to address noticeable collision trends (refer to the FHWA's BIKESAFE as one potential source of safety countermeasures).
Conflicts exist between cyclists and other modes (i.e. motor vehicles, pedestrians)		Facilities and crossings should be designed to minimize conflict between different types of users and the conflict area should be clearly marked.
Available Space		
Sufficient curb-to-curb width exists to adequately accommodate motorists and cyclists		Redistribute roadway space to accommodate cycle lanes or wide curb lanes by narrowing/eliminating parking lanes, narrowing travel lanes, eliminating unnecessary turn lanes, etc.
Sufficient curb-to-curb width exists, but pinch points are created where turn lanes are developed at intersections		Cycle lanes may be discontinued (with appropriate positive guidance/warning measures) upstream of intersections to encourage cooperative merging of cyclists and motorists into a single traffic lane through intersections. Sharrow markings can be used to denote desirable cyclist path through narrow intersections. Refer to TAC Bikeway Traffic Control Guidelines for Canada for design recommendations.
Physical barriers are created by steep grades, rivers, freeways, railways, narrow bridges, etc.		Separated facilities should be considered to bypass or overcome barriers.
Curb-to-curb width is not adequate to provide adequate operating space for both motorists and cyclists	*	Provide separated facilities adjacent to the roadway or within independent right-of-way, widen roadway platform to accommodate cycle lanes or wide curb lanes, or examine alternate routes. If on-street parking is present, explore opportunities to eliminate or reduce parking.
Sight distance is limited at intersections, crossing locations, or where cyclists and motor vehicles share limited road space		Improve sightlines by improving roadway geometry or removing/relocating roadside furniture and vegetation; provide adequate space for cyclists either on or off the roadway. Design intersection crossings to minimize and clearly mark conflicts and restrict parking in close proximity to intersections.
Anticipated users (skill, trip purpose)		
Experienced/advanced cyclists (commuters/utilitarian)	*	This group generally prefers direct, continuous facilities with minimal delay as is generally provided by the arterial road network. Wide curb lanes may be
Basic/novice cyclists (recreational)	*	This group generally prefers routes on residential, neighborhood streets with light traffic and low speeds. Wide curb lanes, cycle lanes, and separated facilities should be considered.
Child cyclists	*	This group generally requires separated facilities free of conflicts with motor vehicle traffic. Separated facilities should be considered near schools, parks, and neighborhoods.
Level of bicycle use		
Presently low bicycle volumes (< 10 per hour)		Wide curb lanes may be adequate.
Presently high bicycle volumes (>50 per hour)		Cycle lanes may be appropriate. Provided width should accommodate bicycle volumes during peak periods both mid-block and at intersections.
Significant bicycle traffic generators are nearby	*	Latent bicycle demand may exist if there are employment centres, neighborhoods, schools, colleges, parks, recreational and shopping facilities along the route. Cycle lanes and separated facilities should be considered to accommodate anticipated levels of cyclists.
Function of route within bicycle facility network		
Parallel bicycle routes already exist with bicycle facilities present		Redundancy of bicycle routes may provide an opportunity to provide different types of bicycle facilities within the same travel corridor, providing options for cyclists with different skill levels and trip purposes.
New route provides a connection between adjacent existing facilities	*	Facility selection should provide continuity with adjacent bicycle facilities to the extent possible.
New route provides district level access to a neighbourhood, city region, suburb, etc.	*	Cycle lanes and separated facilities should be considered to encourage cycling for all users.
Type of Roadway Improvement Project		
New construction		Appropriate bicycle facilities should be planned and integrated with design and construction of new roads and communities.
Reconstruction		Major roadway reconstruction provides an opportunity to improve provisions for cyclists through increased roadway width or off-road space with considerable cost savings.
Retrofit	*	Affordable solutions may be limited to redistributing existing road space.
Costs/Funding		
More than one type of bicycle facility appears appropriate	*	Benefit/cost analysis of alternatives should be conducted. Refer to NCHRP Report 552 - Guidelines for Analysis of Investments in Bicycle Facilities.
Funding levels are not available to provide preferred type of facility		Consider alternate routes or focus on cost-effective improvements to existing facilities such as improved maintenance, pavement/drainage rehabilitation, and removal of barriers. Poorly designed or constructed facilities may result in increased safety risks for cyclists and are unlikely to encourage additional