

Traffic Safety Plan

Second Avenue

April 2017

City of Greater Sudbury
Roads & Transportation Services Division



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1.0 Project Overview

Second Avenue north is a two lane secondary arterial road that generally runs in a north-south direction from Bancroft Drive to the Kingsway (Municipal Road 55), through a section of the Minnow Lake community. The study limits for the Second Avenue capital project are from Donna Drive in the north to First Avenue in the south.

The reconstruction of Second Avenue addresses the existing and forecast capacity constraints, while enabling improvements to be made to promote cycling, walking and transit use, and providing an opportunity for the City to construct and showcase a truly complete street. The City has identified Second Avenue for multimodal improvements, including cycle tracks and sidewalks on both sides of the road and other enhancements to promote public transit. The most vulnerable road users, pedestrians and cyclists, have been considered first and foremost in the design of improvements to Second Avenue.

2.0 Pedestrian Safety

2.1 Current Infrastructure

Infrastructure built for pedestrians helps enhance pedestrian safety along roadways. This infrastructure can come in several different forms with the most common types including sidewalks, controlled crossings (ex. pedestrian crossovers or traffic signals) and illumination.

The existing pedestrian infrastructure within the project limits includes the following:

- Sidewalk along the east side of Second Avenue from Donna Drive to Scarlett Road
- Sidewalk along the west side of Second Avenue from the Morel Family Foundation Park to Bancroft Drive
- A midblock pedestrian traffic signal in front of the Morel Family Foundation Park

Currently, pedestrians walking outside of the areas identified above are required to walk on the gravel shoulders along the side of Second Avenue.

2.2 Planned Improvements

Many improvements for pedestrian safety are being implemented as part of the reconstruction of Second Avenue. A list of improvements is presented below with references to subsequent sections where a complete description of the improvement can be located within this document.

- Sidewalk installed along the east side of Second Avenue from Donna Drive to Kenwood Drive (2.3.1)
- Sidewalk installed along the west side of Second Avenue from Donna Drive to First Avenue (2.3.1)
- Multiuse path along the east side of Second Avenue from Kenwood Drive to First Avenue (2.3.2)

- Full traffic signals at the intersection of Second Avenue and Scarlett Road (2.4.1.1)
- Intersection pedestrian signal at the intersection of Second Avenue and Kenwood Drive (2.4.1.2)
- Pedestrian traffic signal timing at traffic signals based on a 1.0 metre per second walking speed (2.4.1.3)
- Pedestrian countdown signal head at traffic signals for all crosswalks across Second Avenue (2.4.1.4)
- Accessible pedestrian signals at both traffic signals (2.4.1.5)
- Tactile warning surface indicators at all pedestrian crossings (2.4.1.6)
- Ladder crosswalk pavement markings at traffic signals (2.4.1.7)
- Sidewalk illuminated to the IESNA American National Standard Practice for Roadway Lighting (RP-8) (2.5)

2.3 Pedestrian Facilities

2.3.1 Sidewalks

Sidewalks provide many benefits to the local community, including increased safety for pedestrians, improved mobility and improving public health. Sidewalks provide pedestrians with dedicated and physically separated space from motor vehicles and bicycles to travel within the right-of-way. This physical separation is typically provided by construction of a barrier curb. Sidewalks separated from the roadway are the preferred accommodation for pedestrians in urban transportation corridors such as Second Avenue. Sidewalks will be constructed along the entire west side of Second Avenue from Donna Drive to First Avenue and along the east side of the corridor from Kenwood Street to Donna Drive.

2.3.2 Multiuse Path

Multiuse paths are designed to accommodate various types of uses simultaneously and may be used as a solution where not enough space is available to provide separate dedicated facilities for pedestrians, individuals waiting for public transit and cyclists. The minimum recommended width for a multiuse path for pedestrians and cyclists is 3.0m. Due to property and utility constraints in the corridor, a 3.0m wide, paved, one-direction multiuse path will be installed on the east side of Second Avenue from Kenwood Street to First Avenue (Figure 1).

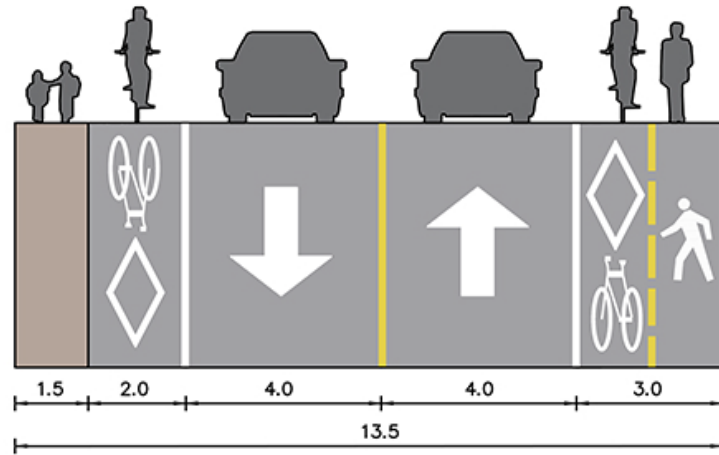


Figure 1. Cross-section of Second Avenue south of Kenwood Street

2.3.2.1 Pavement Markings

Pavement markings will be used to delineate space for pedestrians from space allocated to cyclists. A white pedestrian symbol will be used to indicate where pedestrians may walk or wait for public transit. Like on a sidewalk, pedestrians may travel in both the southbound and northbound direction, whereas cyclists will only be permitted to travel in the northbound direction on the multiuse path. A dashed yellow line will be painted down the centre of the multiuse path to further demarcate the space, and indicate that passing is permitted when it is safe to do so.

2.3.2.2 Pathway Organization Signage

With a multiuse path, segregation of cyclists and pedestrians, particularly on the approach to intersections is important for ensuring the safe use of crossing facilities. On Second Avenue, it is necessary to delineate the multiuse path using 'Pathway Organization' signs (Figure 2), as transit users will require space separated from cyclists to wait for transit vehicles). This separation will also guide pedestrians and cyclists to use the appropriate facilities north of Kenwood Street, where the multiuse path becomes a raised cycle track for cyclists and a sidewalk for pedestrians.



Figure 2. 'Pathway Organization' sign

2.4 Pedestrian Crossings

The Ontario Traffic Manual (OTM) is a series of traffic engineering and traffic control reference manuals produced by the Ministry of Transportation of Ontario (MTO) for use by municipalities in Ontario. The purpose of OTM Book 15 – Pedestrian Crossing Facilities, is to provide practical guidance and application information on the planning, design, and operation of pedestrian roadway crossings and to promote uniformity of approaches across Ontario. All pedestrian crossings on Second Avenue conform to standards outlined in OTM Book 15 – Pedestrian Crossing Facilities.

Contributing factors that influence the level of safety within the context of pedestrian roadway operations may include:

- The degree of pedestrian-vehicle interaction
- Vehicle speeds
- Road users' expectancy
- Road users' perception (visual acuity and visual contrast)
- Road users' awareness (positive guidance and driver workload)
- Road users' ability (mobility, vision, hearing and cognition)
- Road users' understanding of the rules of the road

Each factor above contributes to the overall level of safety of a crossing location and represents part of the considerations for selecting pedestrian crossing controls.

Pedestrian crossing control includes various types of signs, devices and pavement markings designed to regulate the flow of vehicles and pedestrians and to minimize risks associated with conflicting traffic movements. The application of pedestrian crossing controls for Second Avenue is consistent with the *Highway Traffic Act*, which governs the control of the roadway.

2.4.1 Controlled Pedestrian Crossings

A controlled pedestrian crossing is where vehicles are required to stop or yield to traffic legally in the intersection, which includes pedestrians (OTM Book 15). Controlled crossings manage the interaction between pedestrians and vehicles, and present operational benefits to pedestrians by providing priority over vehicles either at all times or for allocated periods of time. This priority can provide a sense of security for pedestrians, encourage pedestrians to cross at the controlled location and limit the number of locations where pedestrian crossings occur. All side street pedestrian crossings on Second Avenue between First Avenue and Donna Drive will be controlled pedestrian crossings with controlled crossings of Second Avenue at the locations in Table 1, below.

Intersection with Second Avenue	Type of Controlled Crossing
Donna Drive	Traffic Signals
Scarlett Road	Traffic Signals
Kenwood Street	Intersection Pedestrian Traffic Signals

Table 1. Types of Controlled Pedestrian Crossings

Implementing pedestrian crossing control under the appropriate conditions could potentially facilitate crossings and increase safety by consolidating and delineating the desired paths of pedestrian crossings, thereby reducing the number of conflict points on the roadway. Implementing crossing controls may also assist in managing gaps and controlling the flow of traffic through the use of standard signs, devices and pavement markings to minimize risks associated with conflicting movements.

2.4.1.1 Traffic Signals

The function of a traffic control signal is to alternate the right-of-way between conflicting streams of vehicular traffic, or conflicting movements between vehicular traffic and pedestrians crossing a road, safely and efficiently. Traffic control signals assign right-of-way to road users by displaying instructions through light emitted indications using standard colour and signal as regulated in the *Highway Traffic Act*. Traffic is alternately directed to stop and proceed through a sequence of indications in each cycle. In this process, dedicated time is allotted to specific movements of traffic, or to modes of traffic that include motor vehicles, transit vehicles, pedestrians and cyclists.

To better manage the flow of traffic on Second Avenue and provide pedestrians a controlled crossing across Second Avenue, traffic signals are being installed at the intersection with Scarlett Road.

2.4.1.2 Intersection Pedestrian Signals

Intersection pedestrian signals manage the interaction between pedestrians and vehicles, and present operational benefits to pedestrians by providing priority over vehicles at all times. This priority may provide an enhanced sense of security for pedestrians, encourage pedestrians to cross at the controlled location and limit the number of locations where pedestrian crossings occur.

Traffic control signal systems that are dedicated primarily to providing traffic gaps for pedestrian right-of-way may be installed either at intersections (Intersection Pedestrian Signals) or between intersections (Midblock Pedestrian Signals). Pedestrian signal indications are used for crossing the main street and regular traffic control signals are used on main roadway approaches for motor vehicles. For intersection pedestrian signal crossings, the side road must be controlled with a stop control sign. Intersection pedestrian signals require that a standard crosswalk be marked in accordance with practice for traffic signals and also requires that the near side stop line be set back a minimum of 15 metres from the primary signal head. The pedestrian signals are activated by a pedestrian pushing a pedestrian push button.

The Intersection Pedestrian Signal located at the entrance to the Morel Family Foundation Park on Second Avenue was originally installed to accommodate students crossing Second Avenue from the

former Heritage High School. It is now being relocated to Kenwood Street to provide improved pedestrian crossing opportunities for residents living on the west side of the corridor.

2.4.1.3 Pedestrian Traffic Signal Timing

Pedestrian signal heads are installed for all legs of an intersection that are controlled by traffic signals. These signal heads provide pedestrians wanting to cross the road with an indication of when to begin and complete crossing. The pedestrian crossing time at traffic signals is calculated based on a designated walking speed of pedestrians and the length of the actual crosswalk. Currently, provincial standards recommend using a walking speed of 1.2 metres per second for a typical adult, and a walking speed of 1.0 metre per second for crosswalks frequented by children, seniors and persons with a disability.

In 2014, City staff conducted a walking speed study to determine what walking speed should be used in the City of Greater Sudbury so that the majority of residents could comfortably use a crosswalk to cross a roadway. It was determined that a walking speed of 1.0 metre per second would provide 95 percent of all residents within the City of Greater Sudbury sufficient time to comfortably cross a roadway. These results were similar to a study completed by the Transportation Association of Canada which found that 90 percent of Canadians would be accommodated by a walking speed of 1.0 metre per second. As a result of these studies and a literature review of other completed studies, the City currently uses a walking speed of 1.0 metre per second when calculating pedestrian timing at intersections with traffic signals.

The Ontario Traffic Manual further recommends between five to seven additional seconds for the pedestrian 'Walk' signal and that timing for the 'Flashing Don't Walk' signal be determined according to the pedestrian crossing distance. To maximize the time available for pedestrians to cross a given street, while balancing safety and traffic flow efficiency, the City uses seven seconds for the pedestrian 'Walk' signal and 1.0 metre per second walking speed to determine the length of the 'Flashing Don't Walk' signal.

2.4.1.4 Pedestrian Countdown Signal Head

A common concern raised by pedestrians crossing intersections with traffic signals is the uncertainty of the time remaining to cross once the 'Flashing Don't Walk' display begins. In response to this concern, the traffic signal industry developed the Pedestrian Countdown Signal (PCS) head. The PCS is an enhanced pedestrian signal head which displays the amount of time remaining to complete crossing the intersection.

The PCS begins a descending numerical countdown in seconds once the 'Flashing Don't Walk' signal starts and indicates how many seconds are available for pedestrians to safely cross the intersection before the amber vehicle signal will appear. PCS heads have been installed on the main street crossing of all traffic signalized intersections throughout the City of Greater Sudbury. Pedestrian countdown signal heads will be installed at the intersections of Second Avenue with Scarlett Road and Kenwood Street to ensure pedestrians know how much time is available to cross Second Avenue.

2.4.1.5 Accessible Pedestrian Signals

An accessible pedestrian signal is a device that communicates audible, tactile and vibrotactile to provide crossing information to people who have vision disabilities. Different audio tones are emitted for the

east-west and north-south directions at the intersection crosswalks. The signals come equipped with a pushbutton locator tone. The tone is a repeating sound that informs approach pedestrians that a pushbutton to activate pedestrian timing or receive additional information exists, and enables pedestrians with visual disabilities to locate the pushbutton. For pedestrians to locate the appropriate pushbutton, tactile arrows are located on the pushbutton, have high visual contrast (light on dark or dark on light), and are aligned parallel to the direction of travel on the associated crosswalk. To the extent possible, pedestrian poles are to be located 1.5 metres from the road to shorten the distance for persons with visual disabilities to travel and orient themselves to cross the road. Accessible pedestrian signals will be installed for all legs of the traffic signalized intersections at Second Avenue and Scarlett Road and at the intersection pedestrian traffic signal at Second Avenue and Kenwood Street.

2.4.1.6 Tactile Warning Surface Indicators

Tactile warning surface indicators provide persons with visual disabilities with a textured ground surface indicator that is detectable under foot when walking to indicate they are entering an area with a potential hazard, such as moving vehicles or bicycles. Tactile warning surface indicators also provide a high tonal contrast to adjacent surfaces, which may assist all pedestrians, regardless of visual abilities. These are panels with a pattern of truncated domes on the surface which are typically made from composite materials and are wear and slip resistant. Tactile warning surface indicators are typically installed on the slopes of pedestrian curb cuts/curb ramps and at the edge of transit platforms and are typically set back between 150 mm and 200 mm from the curb edge on roadways.

While conducting regularly scheduled maintenance of curbs and sidewalks throughout Greater Sudbury, the City has been installing tactile warning surface indicators where required. For Second Avenue, tactile warning surface indicators will be installed across each break in the pedestrian walking surface or anywhere there may be a potential conflict between pedestrians and motor vehicles or cyclists, which includes signalized intersections, unsignalized intersections with minor roads, and at commercial driveways, thereby improving crossings for not only people with visual disabilities but for all pedestrians.

2.4.1.7 Ladder Crosswalk Pavement Markings

Standard crosswalk markings define and delineate the path for pedestrians to cross the roadway. Ladder crosswalk markings are enhanced pavement markings that incorporate longitudinal stripes to enhance the delineation of pedestrian crosswalks (Figure 3). Ladder style crosswalks are a combination of zebra pavement markings aligned perpendicularly to the pedestrian direction of travel together with standard parallel crosswalk lines. The contrast of the markings provides enhanced visibility of the crosswalk and thereby increases drivers' awareness of potential conflicts with pedestrians. The width of the crosswalk must be at least 2.5 metres wide and crosswalks are generally aligned with sidewalks and connect with dropped curbs which allow for pedestrians to more safely navigate mounting the curb to reach the sidewalk.

Traffic signalized intersections at Second Avenue and Scarlett Road and at Second Avenue and Kenwood Street will be demarcated by 3.0 metre wide ladder markings for pedestrian crosswalks. Crosswalk markings conform to guidance provided by OTM Book 11 – Pavement, Hazard and Delineation Markings and the Manual Uniform Traffic Control Devices for Canada guide.

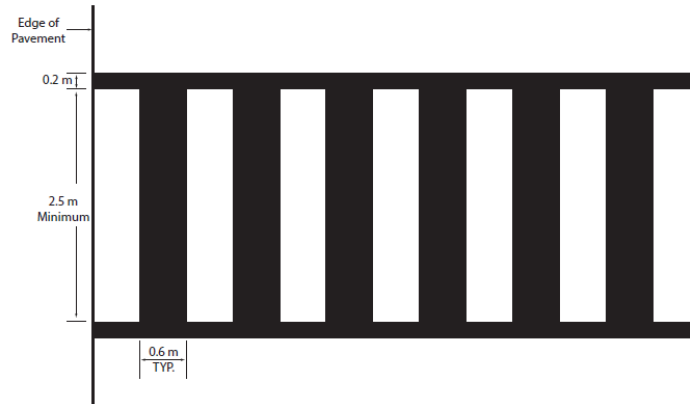


Figure 3. Pavement Marking for Ladder Crosswalk

2.5 Sidewalk Illumination

Illumination is an important component which provides an adequate visual environment for road users to safely use the road system during hours of darkness. Studies have proven that roadway lighting substantially decreases night-time collisions.

The American National Standard Practice for Roadway Lighting (RP-8) was developed by the Illuminating Engineering Society of North America (IESNA). IESNA has been the technical authority on illumination for over 100 years. The current guideline, RP-8 has evolved from earlier documents and considers the latest research, internal standards, and experience and equipment technology. The primary purpose of the guideline is to serve as the basis for design for fixed lighting for roadways, adjacent bikeways, and pedestrian ways. In 2014, the City of Greater Sudbury adopted RP-8 as the standard for right-of-way light only to be applied to new roadways and capital projects which involve the widening of the roadway. Through the use of the RP-8 guideline, roadways and sidewalks throughout the City will be brighter and more evenly lit. A brighter and more evenly lit roadside environment will enhance pedestrian visibility and increase pedestrian comfort levels.

Illumination will be provided on Second Avenue as per the RP-8 standard.

3.0 Cyclist Safety

3.1 Current Infrastructure

Infrastructure built for cyclists helps enhance cyclist safety along roadways. This infrastructure can come in several different forms with the most common type being dedicated bicycle facilities.

Currently there is no cycling infrastructure on Second Avenue. Cyclists using this road are required to share roadway space with motor vehicles.

3.2 Proposed Improvements

Many improvements for cyclist safety are being implemented as part of the reconstruction of Second Avenue. A list of improvements is presented below with references to subsequent sections where a complete description of the improvement can be located within this document.

- Raised cycle track along the east and west side of Second Avenue from Donna Drive to Kenwood Drive (3.4)
- Multiuse path along the east side of Second Avenue from Kenwood Drive to First Avenue (3.5)
- Designation of on-road bicycle lane along the west side of Second Avenue from Kenwood Drive to First Avenue
- Two-stage left turn queue box for southbound cyclists on Second Avenue to make a left turn eastbound onto Scarlett Road (3.5)
- Crossrides are being installed at each intersection of a minor road with Second Avenue (3.6)
- Tactile warning surface indicators are being installed in the raised cycle track in advance of transit stops to alert cyclists to potential conflicts with transit users (3.7)

3.3 Bicycle Facility Type Selection

The Ontario Traffic Manual (OTM) is a series of traffic engineering and traffic control reference manuals produced by the Ministry of Transportation of Ontario (MTO) for use by municipalities in Ontario. The purpose of Book 18 - Cycling Facilities (December 2013) is to provide practical guidance on the planning, design and operation of cycling facilities in Ontario. It applies to on- and off-road facilities within the right-of-way. In determining which type of cycling facility is best suited for Second Avenue, staff followed the three-step selection process outlined in OTM Book 18, which provides a consistent framework for decision-making and uses readily-available data sources.

3.3.1 Step 1: Facility Pre-Selection

Using the data from traffic studies previously completed on Second Avenue, the nomograph from OTM Book 18 was used to pre-select an appropriate bicycle facility type for the corridor.

The north end of Second Avenue experiences an annual average daily traffic (AADT) volume in excess of 15,000 vehicles per day, while at the south end of the Second Avenue, the AADT volume is approximately 10,500 vehicles per day. This equates to an average AADT of approximately 12,750 vehicles per day along the length of the corridor. The 85th percentile motor vehicle operating speed for the corridor is 62km/h.

Using these values, the nomograph indicates that a physically separated cycling facility is recommended for Second Avenue (Figure 4).

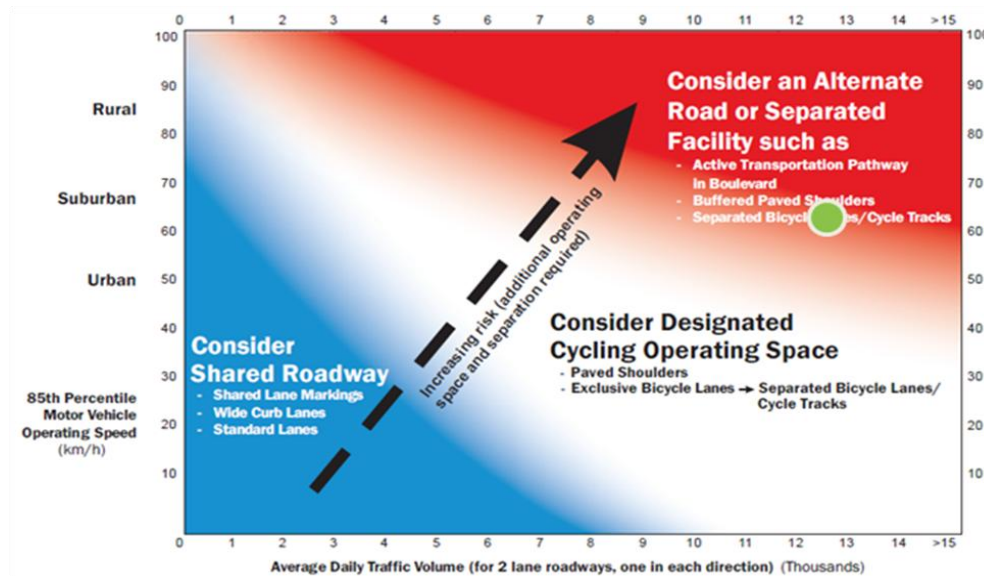


Figure 4. Desirable Cycling Facility Pre-Selection Nomograph (OTM Book 18, p. 30)

3.3.2 Step 2: Analysis of Site-Specific Conditions and Facility Type Selection

A set of application heuristics or knowledge-based rules, have been developed as part of OTM Book 18 to link specific site conditions to appropriate cycling facility types and supplementary design features. After examining the primary characteristics of the Second Avenue corridor, a physically separated cycling facility is the preferred approach to accommodate cyclists. As the primary characteristics strongly point to the same recommendation as the pre-selection nomograph, secondary characteristics were not required to be examined. A summary of this analysis is presented in Table 2.

Table 2. Summary of Site Characteristic Analysis for Second Avenue Cycling Facility Selection

Primary Criteria	Second Avenue Characteristic	OTM Book 18 Recommendation
85 th Percentile Motor Vehicle Operating Speeds	62 km/h	Exclusive operating space in the form of paved shoulders, bicycle lanes or separated facilities is recommended.
Motor Vehicle Volumes	12,500 AADT	Physical separation of motor vehicle and bicycle traffic may be most appropriate.
Function of the Street	Secondary Arterial	Some level of formal bicycle facility such as a bicycle lane or separated facility is appropriate.
Vehicle Mix	Full Day Average is 3% HVs AM Peak Period is 6% HVs	Separated bicycle facility may be preferred by many cyclists.
Collision History	No reported cyclist collisions	Conflict areas may exist between cyclists and motor vehicles or 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	Curb-to-curb width is not adequate to provide sufficient operating space for both motorists and cyclists	Provide separated facilities adjacent to the roadway or within an independent right-of-way, provide paved shoulders, widen roadway platform to accommodate bicycle lanes.

3.3.3 Step 3: Develop Rationale

After investigating site conditions and the appropriate application heuristics in Step 2, results were deemed compatible with the bicycle facility type identified by the pre-selection nomograph in Step 1. Where the results from Steps 1 and 2 are congruent, no further analysis is required, as the recommended facility type is clearly identified.

3.4 Raised Cycle Track

A raised cycle-track is a cycling facility adjacent to and vertically separated from motor vehicle travel lanes. A raised cycle track may be designed for one-way or two-way travel and is designated for the exclusive use by cyclists and is distinct from the sidewalk (OTM Book 18). Raised cycle tracks are typically implemented on high volume arterial roads and are typically curb-separated to the level of the adjacent sidewalk. This type of cycling facility is appropriate for both experienced and casual cyclists

The optimum width for a curb-separated bicycle facility is 2.0m. The segment of Second Avenue between Donna Drive to Kenwood Street will be constructed with a 2.0m wide raised cycle track on both sides of the street (Figure 5 and Figure 6).

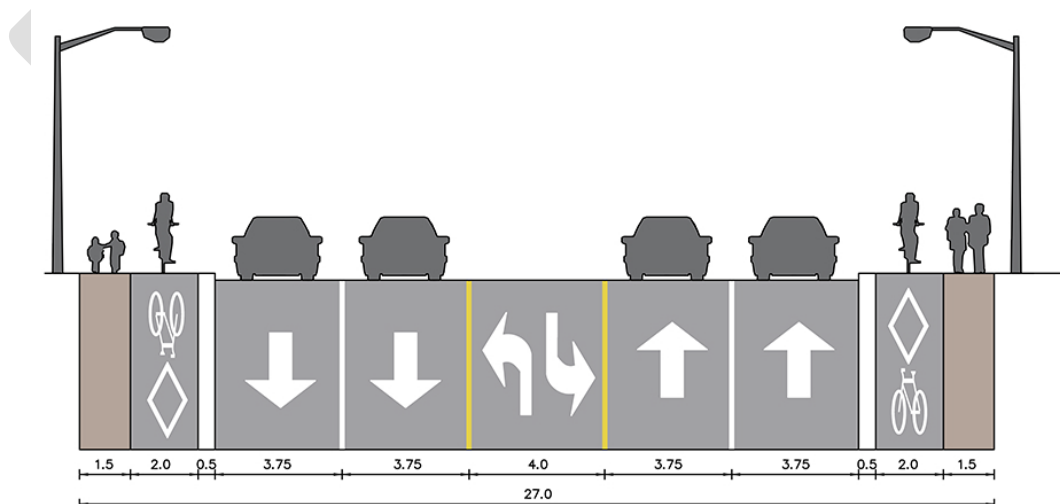


Figure 5. Cross-section of Second Avenue from Donna Drive to 100m north of Camelot Street

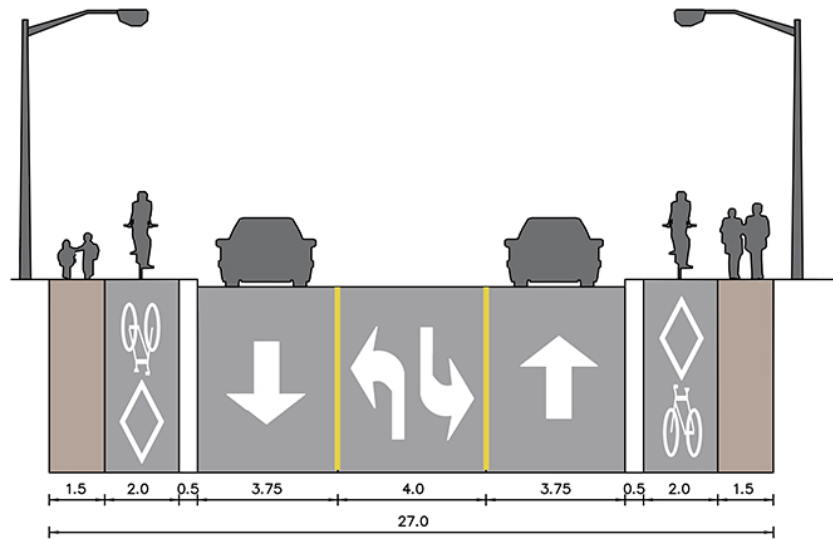


Figure 6. Cross-section of Second Avenue from 100m north of Camelot Street to Kenwood Street

3.4.1 Pavement Markings

One-way raised cycle tracks are marked by a white diamond symbol, a white bicycle symbol and an optional directional arrow (Figure 7). Directional arrows reinforce the direction of travel for cyclists, which on a one-way facility, should be in the same direction of travel as for motor vehicle traffic in the adjacent lane. These pavement markings must further be used in conjunction with 'Reserved Bicycle Lane' signs (Figure 8a). These pavement markings will be placed at appropriate intervals along the length of the raised cycle track on Second Avenue, as required.

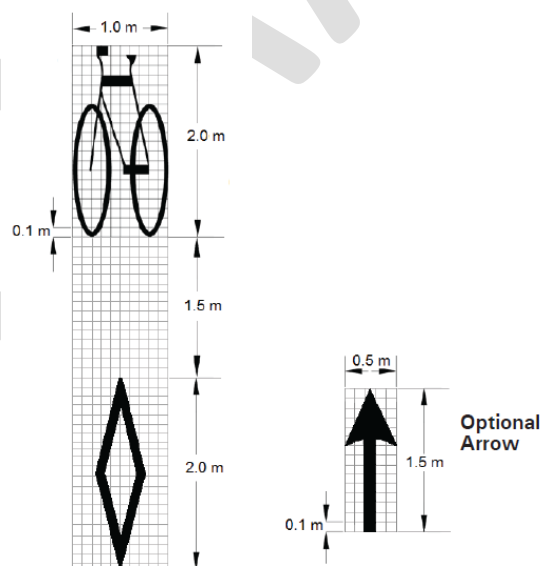


Figure 7. Bicycle Facility Pavement Markings (OTM Book 18)

3.4.2 Signage

All signs used on Second Avenue conform to standards outlined in OTM Book 5 – Regulatory Signs (March 2000) or TAC Bikeway Traffic Control Guidelines for Canada – 2nd Edition (January 2012).

3.4.2.1 Reserved Bicycle Lane

A 'Reserved Bicycle Lane Sign' (Figure 8a) must be used to designate a lane for the exclusive use of cyclists. This sign will be placed at appropriate intervals along the length of the Second Avenue, as required. Appropriate 'Begins' and 'Ends' tabs will be installed on the first and last 'Reserved Bicycle Lane Signs'.

3.4.2.2 Turning Vehicles Yield to Bicycles

A 'Turning Vehicles Yield to Bicycles' (Figure 8b) sign are to be used at potential conflict zones, where motorists are required to cross a cyclist facility and are required to yield to the cyclist. The sign will be installed on the approach to the intersection of Second Avenue and Scarlett Road and in the northbound direction at the intersection of Second Avenue and Kenwood Street.

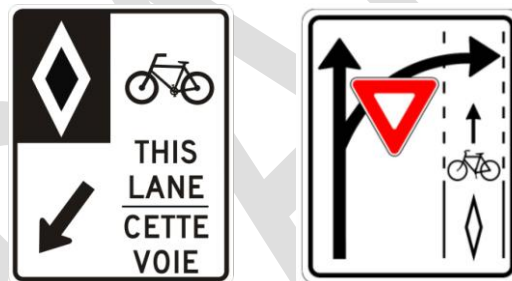


Figure 8. 'Reserved Bicycle Lane' sign (a) and 'Turning Vehicles Yield to Bicycles' sign (b)

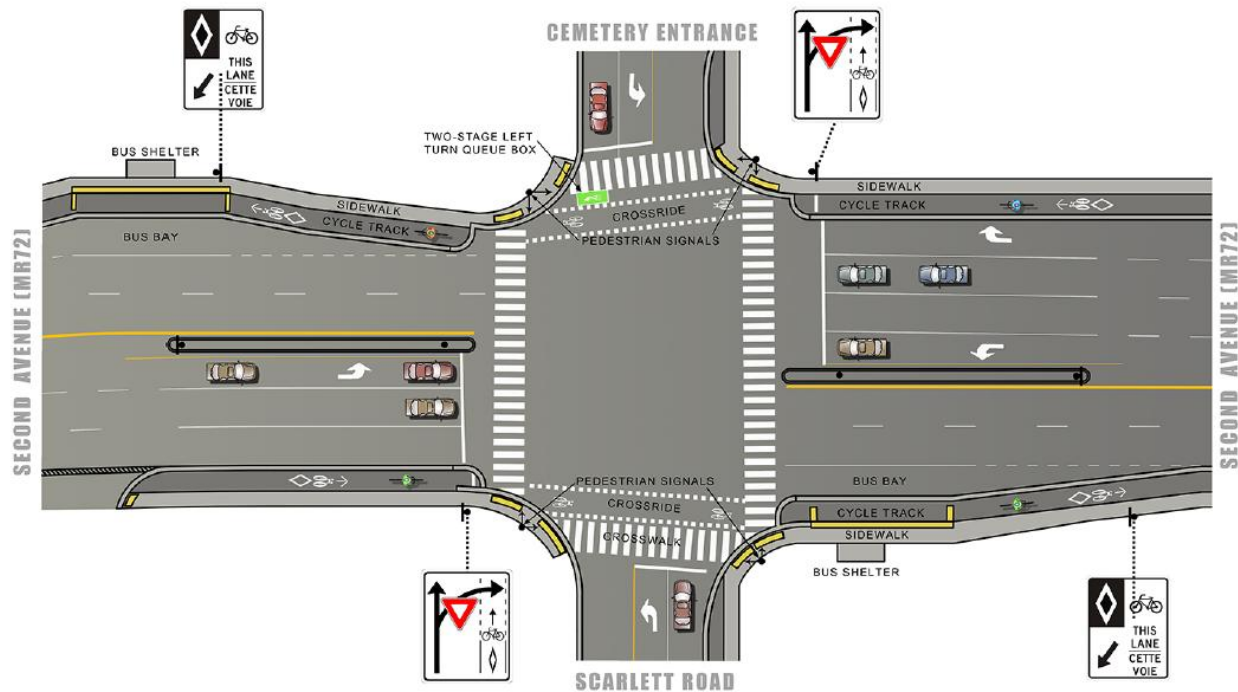


Figure 9. Pavement Markings and Signage at Intersection of Second Avenue and Scarlett Road

3.5 Multiuse Path

Multiuse paths are designed to accommodate various types of uses simultaneously and may be used as a solution where not enough space is available to provide separate dedicated facilities for pedestrians and cyclists. The minimum recommended width for a multiuse path for pedestrians and cyclists is 3.0m. Due to property and utility constraints in the corridor, a 3.0m wide, paved, one-direction multiuse path will be installed on the east side of Second Avenue from Kenwood Street to First Avenue (Figure 10).

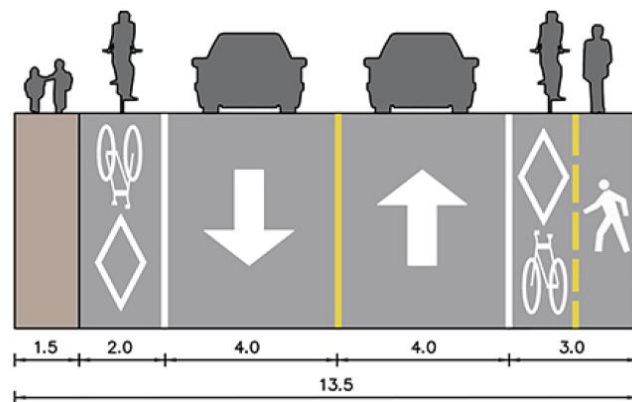


Figure 10. Cross-section of Second Avenue from Kenwood Street to First Avenue

3.4.1 Pavement Markings

Pavement markings will be used to delineate space for pedestrians from space allocated to cyclists. A white diamond symbol, a white bicycle symbol and a directional arrow will be used to inform cyclists of the intended location and direction of travel. Like on a sidewalk, pedestrians may travel in both the southbound and northbound direction, whereas cyclists will only be permitted to travel in the northbound direction on the multiuse path. A dashed yellow line will be painted down the centre of the multiuse path to further demarcate the space, and indicate that passing is permitted when it is safe to do so.

3.4.2 Signage

3.4.2.1 Pathway Organization

With a multiuse path, segregation of cyclists and pedestrians, particularly on the approach to intersections is important for ensuring the safe use of crossing facilities. On Second Avenue, it is necessary to delineate the multiuse path, as transit users will require space separated from cyclists to wait for transit vehicles using 'Pathway Organization' signs (Figure 11a). This separation will also guide pedestrians and cyclists to use the appropriate facilities north of Kenwood Street, where the multiuse path becomes a raised cycle track for cyclists and a sidewalk for pedestrians.

3.4.2.2 Turning Vehicles Yield to Bicycles

A 'Turning Vehicles Yield to Bicycles' (Figure 11b) sign will be used at potential conflict zones, where motorists are required to cross a cycling facility and are required to yield to cyclists. The sign will be installed on the northbound approach to the intersection of Second Avenue and Kenwood Street.



Figure 11. 'Pathway Organization' sign (a) and 'Turning Vehicles Yield to Bicycles' sign (b)

3.5 Two-Stage Left Turn Queue Box

Since cyclists are expected to stay within the separated bicycle lane on the approach to an intersection, cyclists intending to make a left turn at an intersection have to complete this movement in two stages. The two-stage left turn queue box is a designated area within the signalized intersection, which is aligned with the cross-street. Cyclists waiting in the left turn queue box are situated in front of the stop bar of the cross street to improve visibility. The queue box may also be marked by green surface treatment to further enhance the visibility of cyclists.

A two-stage left turn queue box (Figure 9) is being installed at the intersection of Second Avenue and Scarlett Road to provide cyclists with an opportunity to make a safe turning movement from the separated cycling facility onto a cross street. The queue box is positioned to enable southbound cyclists travelling on Second Avenue to make a left turn eastbound onto Scarlett Road. As is recommended in OTM Book 18, the queue box will be marked by green surface treatment. At this time, it is not anticipated that demand would warrant a queue box being installed on the opposite side of the intersection. If in the future, it is determined that cyclists are frequently making this turning movement from Second Avenue into the Civic Memorial Cemetery entrance, a two-stage left turn queue box could be installed at that time.

3.6 Crossrides

Under the *Highway Traffic Act*, at a crosswalk, cyclists are required to dismount and cross as a pedestrian by walking their bicycle. Where a crossride is provided instead of or in addition to a crosswalk, cyclists may ride their bicycle within the crossing without dismounting.

At the intersection of Second Avenue and Scarlett Road, a separate crossride is being installed (Figure 9). This type of configuration provides separate space for cyclists and pedestrians and is appropriate for where pedestrians and cyclists are segregated into exclusive facilities on the approach to the crossing. The crossride will be aligned with the raised cycle track, while the crosswalk will align with the sidewalk.

At the intersections of Second Avenue and Camelot Drive, Kenwood Street and First Avenue, combined crossrides are being installed. This type of configuration is more appropriate at the intersection of a major and minor road, with no traffic signals. A combined crossride provides adequate width and separation for pedestrians and cyclists at minor intersections.

3.7 Transit Stop Tactile Warning Surface Indicators

Tactile warning surface indicators will be installed at all transit stops between Donna Drive and Kenwood Street. Tactile panels will be positioned along the length of the edge of the sidewalk for the transit stop, where it meets the raised cycle track to alert pedestrians to the potential conflict with moving cyclists. This will provide pedestrians with visual disabilities with a safe place to wait for transit vehicles without being directly in conflict with other users of the corridor. Tactile panels will also be installed perpendicularly across the cycle track before and after transit stops to alert cyclists to the potential for conflicts with pedestrians boarding or alighting transit vehicles at the stop.

4.0 Motorist Safety

4.1 Current Infrastructure

Second Avenue is a two lane secondary arterial road that generally runs in a north-south direction from Bancroft Drive to the Kingsway (Municipal Road 55), through a section of the Minnow Lake community.

The current road safety features on Second Avenue within the project limits include the following:

- Full traffic signals at intersection of Second Avenue and Donna Drive

- Left turn lane at Scarlett Road for southbound vehicles on Second Avenue
- Left turn lane at dog park entrance for northbound vehicles on Second Avenue
- Gravel shoulders on both sides of the road from the Civic Memorial Cemetery driveway entrance to the Morel Family Foundation Park
- Gravel shoulders on the east side of the road from the Morel Family Foundation Park to First Avenue

4.2 Proposed Improvements

Many improvements for motorist safety are being implemented as part of the reconstruction of Second Avenue. A list of improvements is presented below with references to subsequent sections where a complete description of the improvement can be located within this document.

- The combining and realignment of the Civic Memorial Cemetery entrance and dog park entrance across from Scarlett Road (4.3)
- Full traffic signal installation at the intersection of Second Avenue/Scarlett Road/Civic Memorial Cemetery and the dog park (4.4)
- Dedicated left turn lanes for both northbound and southbound vehicles on Second Avenue at the intersection of Scarlett Road (4.5)
- Advanced left turn signal for southbound vehicles on Second Avenue turning eastbound onto Scarlett Road (4.6)
- Two-way centre left turn lane from Donna Drive to Kenwood Street (4.7)
- Superelevation added to the horizontal curve on Second Avenue north of Scarlett Road (4.8)
- Roadway illuminated to the IESNA American National Standard Practice for Roadway Lighting (4.9)

4.3 Realignment of Civic Memorial Cemetery and Dog Park Entrances

Each driveway entrance on a road increases the number of potential conflict points between users of the road. On arterial roads, the City actively tries to reduce the number of driveway entrances in order to reduce these conflict points.

The driveway entrances to the Civic Memorial Cemetery and the City dog park are located on the west side of Second Avenue near Scarlett Drive. These two driveway entrances are separated by less than 50 metres. By combining these driveway entrances and aligning them across from Scarlett Road, overall safety on Second Avenue and functionality of the entrances to these sites will be improved.

4.4 Second Avenue at Scarlett Road Traffic Signals

The function of a traffic control signal is to alternate the right-of-way between conflicting streams of vehicular traffic, or conflicting movements between vehicular traffic and pedestrians crossing a road, safely and efficiently. Traffic control signals assign right-of-way to road users by displaying instructions through light emitted indications using standard colour and signal as regulated in the *Highway Traffic Act*. Traffic is alternately directed to stop and proceed through a sequence of indications in each cycle. In this process, dedicated time is allotted to specific movements of traffic, or to modes of traffic that include motor vehicles, transit vehicles, pedestrians and cyclists.

With the realignment of the driveway entrances to the Civic Memorial Cemetery and the dog park and the expected future traffic growth from Scarlett Road, traffic volumes at the intersection of Second Avenue and Scarlett Road meet the requirements for traffic signals and are being installed.

4.5 Second Avenue at Scarlett Road Dedicated Left Turn Lanes

Consideration for the installation of a left turn lane occurs when the number of left-turning vehicles at an intersection is such that it creates a hazard and reduces capacity for other road users. A left turn lane separates turning vehicles from through vehicles and provides a safe area for left turning vehicles to wait while waiting for a gap in opposing traffic. In addition, based on the expected number of left turning vehicles and their arrival rate, sufficient storage must be provided so the queue of left turning vehicles does not spill back into the adjacent through lane.

Currently on Second Avenue, there is a short left turn lane which only has enough storage to store approximately two or three vehicles. During peak hours it is not uncommon for the queue of left turning vehicles to spill back into the through lane. Over the past three years, there have been two collisions reported at this intersection where a left turning vehicle was rear ended while waiting for a safe gap in traffic. The proposed improvement will extend the left turn lane storage to approximately 50 metres. This is sufficient storage for approximately seven vehicles. In addition, the two way centre left turn lane extends to Donna Drive and can provide additional vehicle storage when needed.

4.6 Advanced Left Turn Signal

Advanced left turn signals provide left turning vehicles an opportunity to proceed prior to any other vehicles or pedestrians at an intersection. Advanced left turn signals are not provided at all traffic signals. The need for an advanced left turn signal depends on a number of factors including: vehicle volume, number of left turns, collisions, delay, signal timing and intersection geometry. Left turn arrows increase delay for all other movements of traffic and should only be installed when warranted.

The Ontario Ministry of Transportation has provided a method to calculate the number of vehicles that can turn left during the green and amber phase. This method incorporates the opposing traffic volume, number of lanes that must be crossed and the signal timing of the intersection. The City uses an even more conservative value than recommended by the province.

Based on the vehicle volumes and the number of left turning vehicles, an advanced left turn signal will be provided for southbound left turning vehicles at the intersection of Second Avenue and Scarlett Road.

4.7 Two-Way Centre Left Turn Lanes

Two way centre left turn lanes provide a lane in the centre of the road exclusively for left turning vehicles from either direction. They are best used on roads with frequent, closely spaced driveways and have been shown to reduce all collisions types by approximately 20% and rear-end type collisions by almost 40%.

A two-way centre left turn lane will be provided from Donna Drive to Kenwood Street as part of the safety improvements for Second Avenue.

4.8 Superelevation

Superelevation is provided on horizontal curves to counteract the effect of centrifugal force on vehicles. As a vehicle travels around a horizontal curve, the centrifugal force pulls the vehicle towards the outside of the curve and will cause the vehicle to overturn or skid.

Since 2012, there have been two reported collisions on Second Avenue where a vehicle lost control on the horizontal curve north of Scarlett Road. Superelevation will be provided on this horizontal curve to help improve road safety.

4.9 Roadway Illumination

Roadway illumination is an important component which provides an adequate visual environment for road users to safely use the road system during hours of darkness. Studies have proven that roadway lighting substantially decreases night-time collisions.

The American National Standard Practice for Roadway Lighting (RP-8) was developed by the Illuminating Engineering Society of North America (IESNA). IESNA has been the technical authority on illumination for over 100 years. The current guideline, RP-8 has evolved from earlier documents and considers the latest research, internal standards, and experience and equipment technology. The primary purpose of the guideline is to serve as the basis for design for fixed lighting for roadways, adjacent bikeways, and pedestrian ways. In 2014, the City of Greater Sudbury adopted RP-8 as the standard for right-of-way light only to be applied to new roadways and capital projects which involve the widening of the roadway. Through the use of the RP-8 guideline, roadways and sidewalks throughout the City will be brighter and more evenly lit. A brighter and more evenly lit roadside environment will enhance roadside safety.

Illumination will be provided on Second Avenue as per the RP-8 standard.