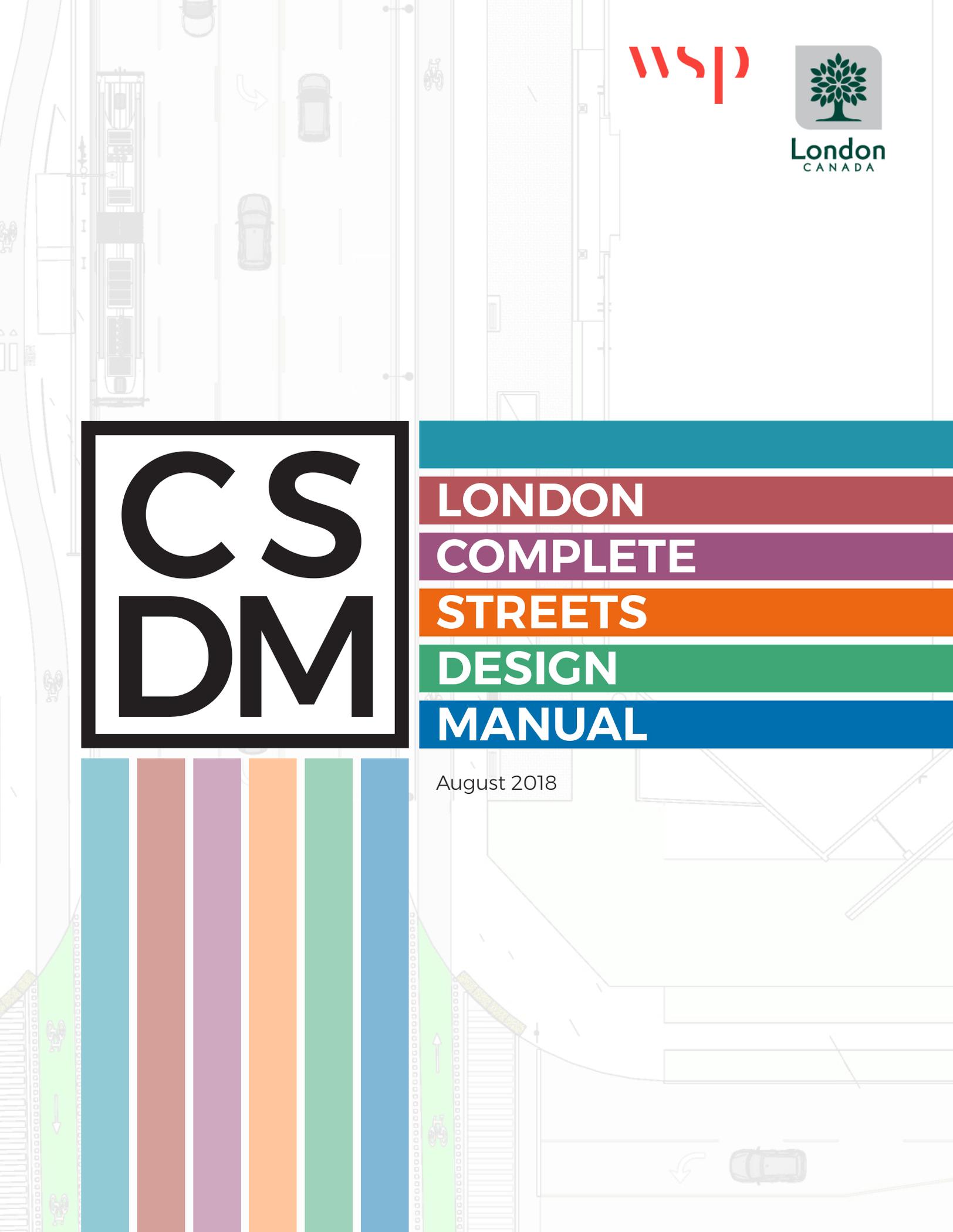




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LONDON
COMPLETE
STREETS
DESIGN
MANUAL

August 2018



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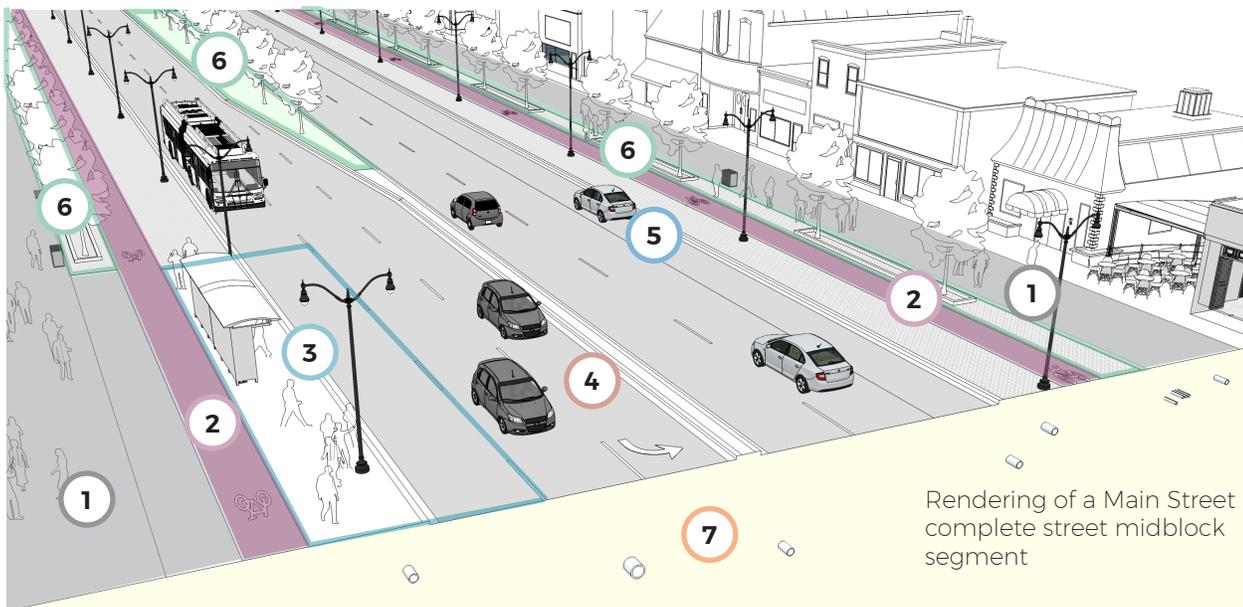
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LONDON COMPLETE STREETS DESIGN MANUAL EXECUTIVE SUMMARY

Streets are vital components of all cities. They allow us to get to work and school, run errands, participate in cultural and recreational activities, and live our daily lives. They are the connective tissue of our city and facilitate commercial and social activity. They also contribute to a beautiful cityscape and provide the pathway for an evening stroll or a morning bike ride. They must allow trucks to deliver goods to our stores, enable our fire, police and paramedic services to respond to emergencies and save lives, provide the network for London Transit Commission (LTC) buses to serve Londoners, and provide critical corridors for electricity, telecommunications, water, and natural gas utilities.

The complete streets approach is about considering the needs of pedestrians, cyclists, transit riders, and motorists and building streets that balance these needs and prioritize road safety. Beyond these mobility functions, the complete streets approach prioritizes “placemaking”, the creation of places in our streets that contribute to healthy ecosystems, social inclusion, and vibrant business activity. These priorities need to be balanced with the need to accommodate critical utilities and allow for efficient maintenance and operations.



Rendering of a Main Street complete street midblock segment

- 1 Walking**
 Greater sidewalk width where higher volumes of pedestrians are expected, higher quality design elements in the public realm, lighting and universal accessibility features to ensure ease of use
- 2 Cycling**
 Consideration of on-street cycling facilities and increased cyclist priority if on the cycling network
- 3 Transit**
 Comfort and amenities for waiting passengers as well as design elements to speed up transit service
- 4 Through-Movement (Vehicles and Freight)**
 Ensure efficient through-movement of vehicles while balancing priorities such as building a sense of place and support for all street users
- 5 Parking**
 Provision of adequate on-street parking where appropriate
- 6 Green Infrastructure**
 Design features that promote environmental sustainability
- 7 Utilities**
 Accommodation of utilities above and below ground

The role of the Complete Streets Design Manual (CSDM)

This manual is a transformative tool that will guide the way streets are designed in London. It serves as a valuable resource for integrating the various functions of our streets and has been written for all practitioners, advocates and citizens involved in the street design process.

A Citizen's Guide has been included in the CSDM. It provides an overview of what complete streets are, why London is taking this approach, supporting policies, and ways of getting involved.

Why Complete Streets?

Preparations are underway to support a new era of rapid transit and city-building and the City of London is encouraging the design and development of streets that more effectively meet the needs of a wider variety of users. Cycling, walking, and public transit are key components of this strategy, as is improving health and activity levels, reducing traffic congestion and supporting the character and legacy of London's neighbourhoods.

The City's official plan, The London Plan, as well as the transportation master plan (TMP), Smart Moves, provide clear policy direction that the planning and design of future streets, as well as the renewal of existing streets should be supportive of all road users, and be "complete." Furthermore, in 2017 the City of London adopted the Vision Zero principles, which are based on the notion that no loss of life as a result of traffic-related collisions is acceptable.

The following are key policy priority areas for complete streets:

Strive for Vision Zero

The City use an evidence-based decision-making framework to assess, guide, and improve traffic safety. The framework will take into account the interaction of all aspects of the transportation system.

Create pedestrian-friendly environments

The City will work to create neighbourhoods where residents are readily able to reach essential destinations such as grocery stores, parks, and transit stops by foot. Streets will be designed such that there is a sufficiently wide pedestrian clearway, frequent crossing opportunities, accessibility features such as audible signals and tactile walking surface indicators, and various public realm amenities such as seating, street trees, and waste receptacles.

Consider all users and functions of a street

In addition to accommodating pedestrians, cyclists, transit riders, and motorists, streets must also be designed for maintenance and snow clearing operations, curbside waste collection, and to accommodate various above and below ground utilities.

Integrate complete streets design principles into the decision-making process

Several tools were developed to ensure that all users and functions of a street are considered whenever a street is constructed, reconstructed, or rehabilitated.

Coordinate built form decisions with transportation decisions

Planning and design of streets will incorporate and be responsive to the appropriate use, intensity, and form along each street classification, as set out in The London Plan.

Engage residents and stakeholders in the Complete Streets process.

Guided by the CSDM, the City will inform and engage residents of the multi-faceted nature of street design, as well as engage stakeholders and provide practitioners and decision makers with appropriate information such that design efforts are coordinated and the City's complete streets vision can be achieved.

THE VISION FOR COMPLETE STREETS IN LONDON

London's vision for complete streets is informed by policies 211-218 of The London Plan as well as best practices in the field of complete streets planning and design. The following statement captures the overarching vision for the London Complete Streets Design Manual:

- 1** London's streets will be designed and upgraded to be more complete.
- 2** This means that streets in London will meet the needs of a wide range of users as defined by the place type, feature high-quality pedestrian environments, and integrate seamlessly with transit services, cycling networks, and automobile users.
- 3** London's streets will be designed for connectivity and support the use of active and sustainable modes of transportation, and also strongly consider the needs of utility and maintenance providers within the right-of-way.
- 4** With this balance of modes, users, and places in mind, all future construction, reconstruction, and rehabilitation projects for streets – both large and small – in London will be influenced by principles of “completeness” in both planning and design.

This vision is the foundation for the design guidance and process tools contained in this Manual. The City's core principles for complete streets build directly upon this vision.

COMPLETE STREETS DESIGN PRINCIPLES

Design principles help establish consistent decision-making parameters when undertaking complete street design activities. The City's design principles for complete streets include:

- **Prioritize safe and accessible options for people** such that on any street, regardless of the priority mode, all users should feel safe. This reflects the reality that pedestrians and cyclists are more vulnerable than vehicular road users, and that supporting active modes of transportation often results in health benefits, to both individuals and the community. Streets should be designed to be inclusive and accessible and that the various needs of users of all ages and abilities are accommodated to the maximum degree possible.
- **Ensure context sensitivity** such that land use and the adjacent transportation infrastructure are integrated where appropriate and supportive of each other. The design recommendations for each street classification recognize important neighbourhood characteristics (including established land uses and functions). This includes the consideration of the civic functions performed by different streets in London such as Gateway Streets, Rapid Transit Boulevards, and designated Heritage Conservation Districts.
- **Embed sustainability** into the design of streets through minimizing environmental impacts and emissions and supporting energy efficiency. This primarily includes prioritizing active modes of transportation such as walking and cycling. Ecological and urban resilience features such as trees, planters, vegetation, and low impact development elements that facilitate groundwater recharge should also be considered. Decisions should consider the lifespan of the street, and be cost-effective, avoiding

undue short- or long-term financial burden on the City for construction, operations, and maintenance.

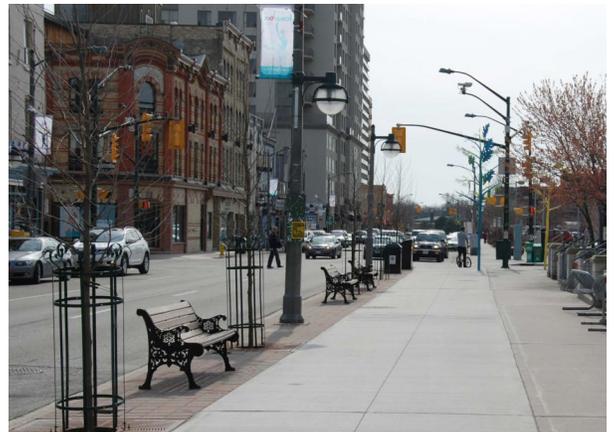
- **Prioritize connectivity** by designing complete streets and communities with block sizes, building orientations, neighbourhood configurations, and street patterns that maximize connectivity for pedestrians, cyclists, and transit users. This includes consideration of new connections and greenways that allow more residents to be within a ten minute walk of major civic and community facilities.
- **Emphasize vitality** such that new and renewed streets attract pedestrians with an enhanced sense of place, benefiting local commuters, businesses, and property owners. Whether out for a relaxing stroll, running errands, or meeting with friends, pedestrians bring economic and social activity to London's streets.

DESIGN GUIDANCE

Complete streets design features enhance the safety, comfort, and convenience of travel for each user group and support design for place-making, green infrastructure, and utilities. Readers who are less familiar with a specific aspect of street design, such as the design of pedestrian facilities for example, may find the relevant section of Chapter 2 to be a helpful introduction. For readers with more expertise in a specific area, the associated section may serve to highlight how street design is evolving to become more complete.

Pedestrian realm and place design considerations

- Accessibility, comfort, connectivity, and safety;
- Sufficient clearway widths to meet demand, provide pedestrian comfort, and enhance the public realm;
- Intersection and midblock crossing design treatments including geometric design guidance, pavement markings, signage, and lighting systems; and
- Public realm amenities such as lighting, urban tree canopy, and seating.



A variety of **pedestrian amenities** including seating, pedestrian-scale lighting, waste receptacles, and trees positioned adjacent to the pedestrian clearway in London.

Cycling facility design considerations

- Context- and user-sensitive facility types that are appropriate for adjacent motor vehicle speeds and volumes, land use, and parking, among other factors;
- Continuity and wayfinding to establish a cohesive network of cycling routes; and
- Supportive facilities such as bicycle parking, left turn queue boxes, and property access crossing treatments.



Conventional bicycle lane in London.

Transit facility design

- Prioritization of transit vehicles on all transit routes within the Primary Transit Area (PTA) through dedicated lanes, queue jump lanes, and transit signal priority; and
- A comfortable user experience at stops through the integration of seating, lighting, shelter, and information.

Motor vehicle and freight facility design

- Selection of an appropriate design vehicle and design speed based on context and consideration for vulnerable road users; and
- Appropriate design parameters such as lane width, curb radii, intersection control, curbside parking and loading, and traffic calming.

Green infrastructure considerations

- Treatments to reduce, delay, and treat stormwater runoff, mitigate the urban heat island effect, and support sustainable transportation choices; and
- Appropriate integration of street trees and other plantings.

Utilities and municipal services considerations

- Integrating surface-level priorities and uses with below- and above-grade utility requirement; and
- Facilitating access to below-grade utilities.

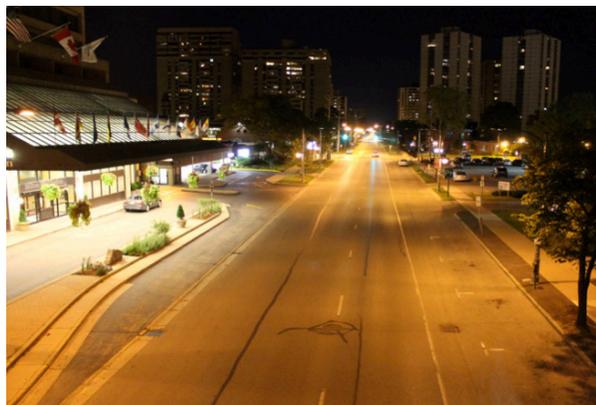
Design guidance for pedestrian, cycling, transit, and motor vehicle facilities is provided in Chapter 2 of the CSDM. Chapter 2 also contains a review of green infrastructure design and utility integration.



An LTC bus crossing a **raised intersection**.



A **planted median** provides aesthetic and stormwater management benefits.

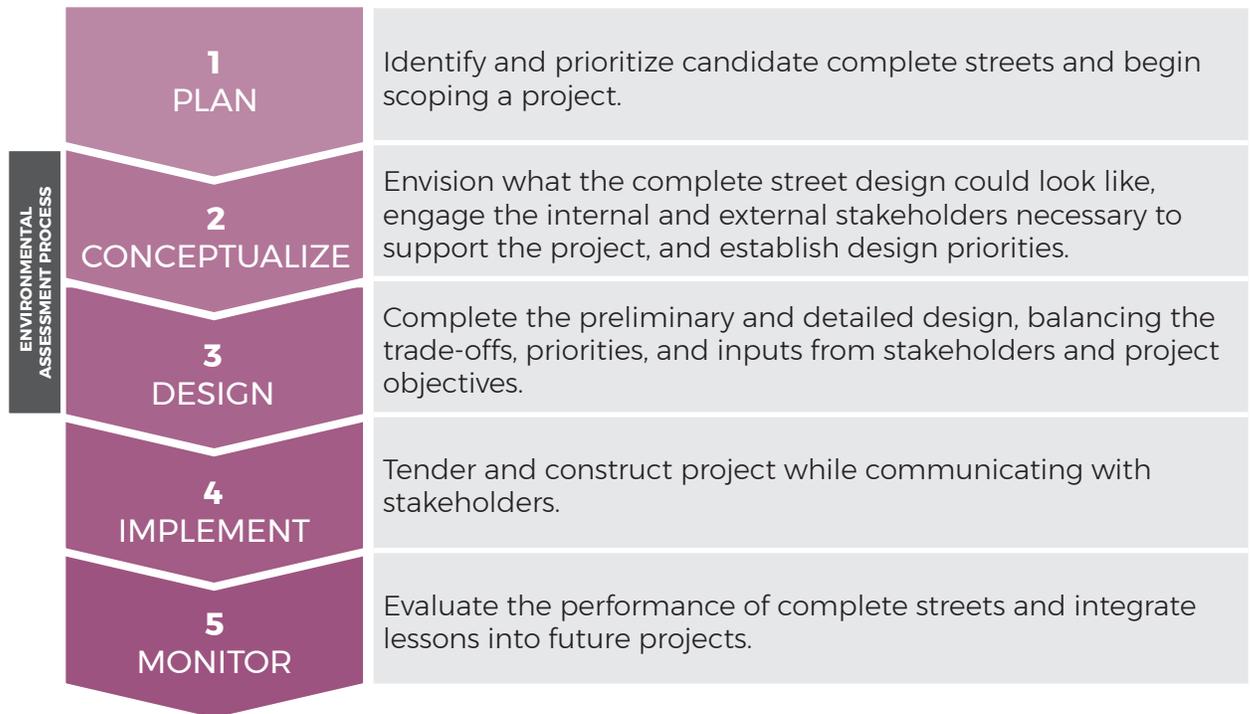


Before/After LED lighting upgrade shown (King St in London). LEDs are more energy efficient and provide better quality lighting.

THE DESIGN PROCESS

Achieving the City's complete streets vision requires a comprehensive process that spans from the initial planning and prioritization stage to project implementation and monitoring. City staff and engineering consultants will be incorporating complete streets elements into capital projects for new construction, reconstruction or rehabilitation.

The following workflow summarizes how staff and consultants will integrate complete streets into each stage of the planning, design and implementation process. This workflow draws on existing processes such as the Capital Coordinating Committee (C3) Process and the Environmental Assessment process and indicates how a complete streets lens can be applied at each stage.



Street design projects that are led by developers are subject to the City's File Manager review process for development applications. This process ensures that complete streets design principles are incorporated into new development sites and subdivisions. The five-stage complete streets design process (summarized above) and the File Manager review process for development applications (included in Chapter 3) have been integrated at key review milestones to ensure that new development plans embrace complete streets principles.

Chapter 3 includes several tools to assess the relative completeness of a street, scope street improvement projects, make design decisions in constrained corridors, review conceptual complete street designs, and engage stakeholders. Practitioners can use this chapter to ensure that complete streets considerations are integrated at the appropriate project stage and to understand expectations for the review process.

An example assessment using the Complete Street Audit tool is shown below. This tool allows staff and designers to assess existing or proposed conditions of a corridor based on the relative priority of each use for the particular street classification.

STREET CLASSIFICATION | Neighbourhood Connector

- Rapid Transit Boulevard
- Main Street
- Urban Thoroughfare
- Civic Boulevard
- Neighbourhood Connector
- Neighbourhood Street
- Rural Thoroughfare
- Rural Connector

Priority Level 5

Current Conditions (user input) 2

Exceeds (+) / Fails (-) to Meet Prio

- 5
- 4
- 3
- 2
- 1

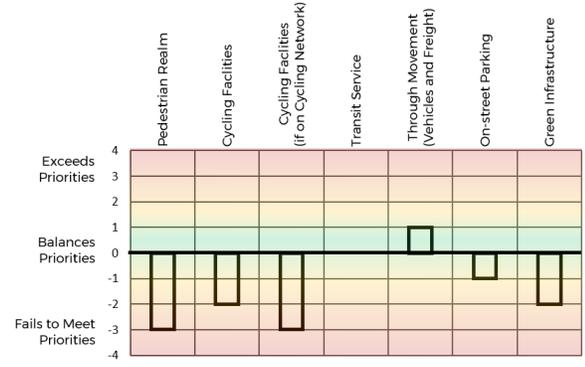
1 Select street classification

2 Rate street elements

STREET CLASSIFICATION | Neighbourhood Connector

	Pedestrian Realm	Cycling Facilities	Cycling Facilities (if on Cycling Network)	Transit Service	Through Movement (Vehicles and Freight)	On-street Parking	Green Infrastructure
Priority Level	5	3	4	3	2	3	4
Current Conditions (user input)	2	1	1	3	3	2	2
Exceeds (+) / Fails (-) to Meet Priorities	-3	-2	-3	0	1	-1	-2

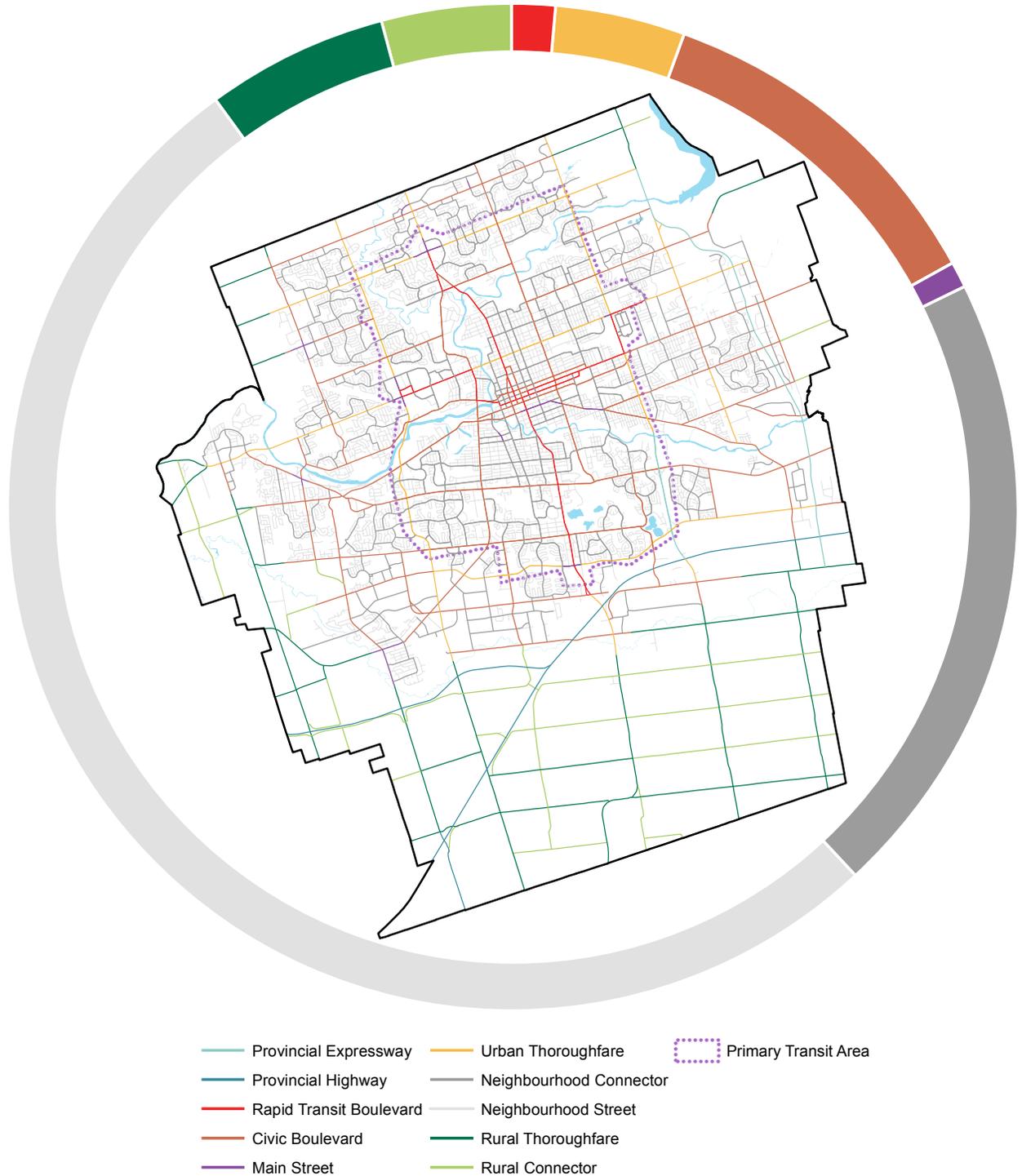
3 Results for Neighbourhood Collector



TYPES OF COMPLETE STREETS

Streets provide both a mobility function and a place function. The mobility function is about moving people whereas the place function is about attracting people. The relative importance of these two functions varies for each street.

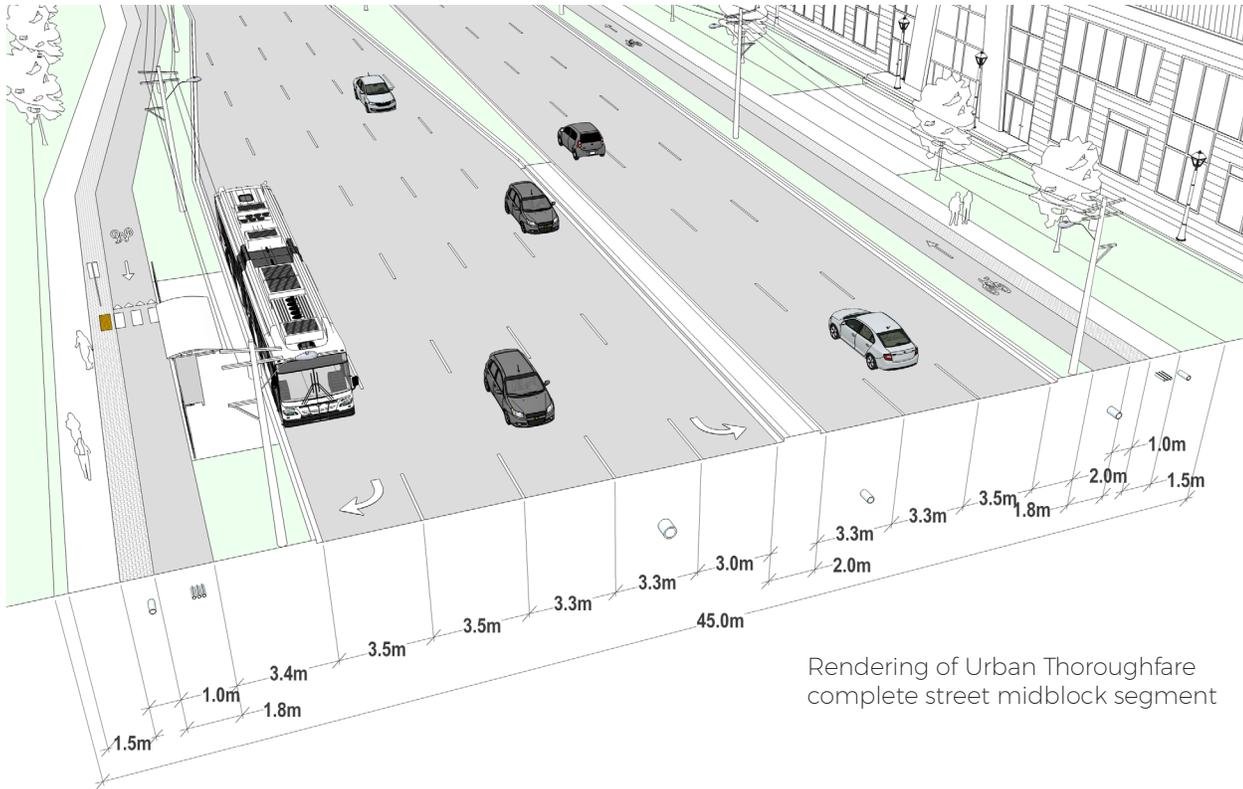
The London Plan designates the street classification for each street in the city.



Map of street classifications in the City of London.

Note: This figure was draft at the time this manual was prepared and is subject to appeal and revision.

Some streets, such as Neighbourhood Streets, provide a quiet environment where neighbours get to know each other on the sidewalk and kids can play or learn to ride a bike. Other streets, such as Rapid Transit Boulevards or Main Streets, are bustling with activity, lined with shops and businesses, draw tourists, and offer a broad range of amenities. Still other streets, such as Urban or Rural Thoroughfares, connect different parts of the City and give priority to the mobility function. While each street is unique, many streets share common features, and a street typology is a useful way of thinking about streets with similar mobility and place functions.



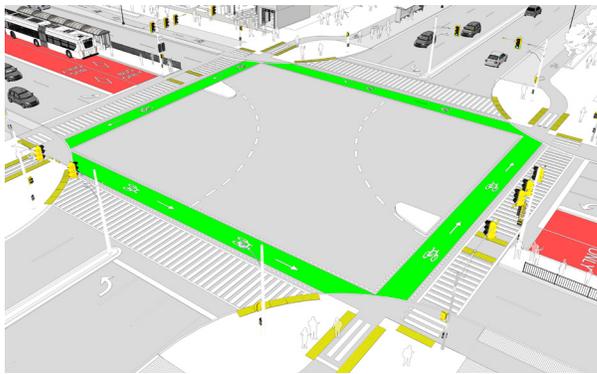
Rendering of Urban Thoroughfare complete street midblock segment

Chapter 4 provides guidance for each specific street classification, as defined in The London Plan. In each section of this chapter, typical configurations, design treatments and amenities are illustrated with a three-dimensional rendering, such as the Urban Thoroughfare above. This chapter incorporates the general guidance from Chapter 2 and indicates how it may be applied for a specific street classification. This rendering acts as a starting point for complete street conceptualization and design, showing how the space in the right-of-way should be allocated and how individual street elements are integrated to form a complete street. These diagrams include both the above ground features of a street that Londoners are readily familiar with, and subsurface utilities which, while less visible, are an important consideration in the design of a complete street. The accompanying text provides design parameters and considerations for pedestrians, cyclists, transit, motorists and freight, green infrastructure and utilities. Context is provided on why specific design elements were selected and when it may be appropriate to consider an alternate configuration. Practitioners find this to be a useful starting point in the early stages of a street design when typical cross sections are being developed.

COMPLETE INTERSECTIONS

Intersections connect streets and allow users to navigate through the street network. They can serve as hubs, gateways, and transfer points and allow adjacent land uses to benefit from the connectivity to multiple corridors. Due to the overlapping paths of the various movements and modes, intersections also have greater potential for conflict than mid-block locations. With eight different street classifications in London, and many more contextual factors that affect intersection design, each individual intersection is unique.

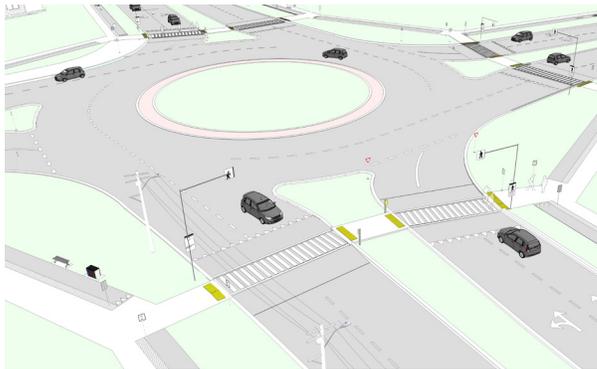
Chapter 5 provides guidance on the design of intersections. The first part of this chapter outlines several principles for improving safety and overall operation of intersections. Since there are many possible combinations of street classifications at intersections, five representative examples are illustrated in the subsequent sections of the chapter. The examples address different forms of intersection control including roundabouts, signalized intersections, and stop controlled intersections. Practitioners will find the principles and examples in this chapter to be a helpful resource when undertaking intersection design or assessing potential operational improvements for intersections.



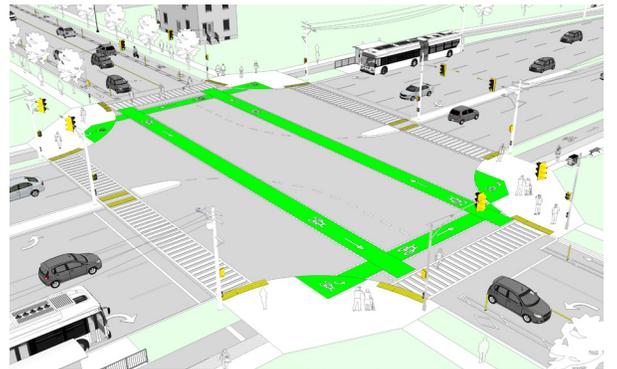
Rapid Transit Boulevard Intersecting a Main Street



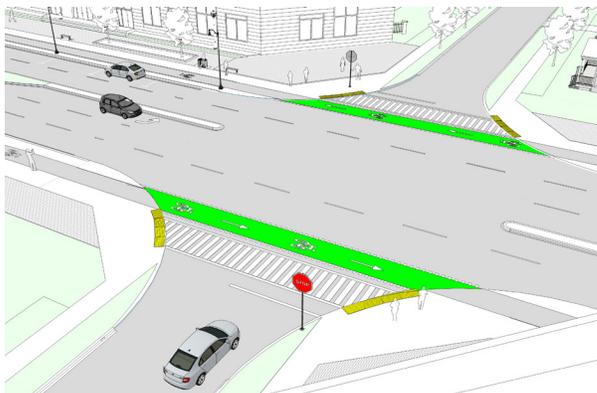
Urban Thoroughfare intersecting a Civic Boulevard (Signalized)



Urban Thoroughfare Intersecting a Civic Boulevard (Roundabout)



Urban Thoroughfare Intersecting a Neighbourhood Connector



Civic Boulevard intersecting a Neighbourhood Street

MONITORING

The complete streets process is informed by data and thorough review of existing and proposed conditions. Baselines can be established for existing streets to determine how they are performing and how they can be improved. The usage pattern of a street should be explored to inform existing, potential, and unmet demand. As the City moves forward with various complete streets projects, key lessons should be captured and integrated into future projects as appropriate. Metrics and monitoring activities are recommended along the key themes of mobility, connectivity, vitality, safety, accessibility, and sustainability. These monitoring activities include.

- Measuring performance through **multi-modal level of service (LOS)** analyses for intersections, street segments, and facility corridors;
- Measuring connectivity with **spatial analysis tools**;
- Measuring vitality by studying **public life** and tracking **retail sales**;
- Monitoring safety through **network screening** and **road safety assessments**;
- Reviewing accessibility and universal design elements of London's street network such as tracking **progress in implementing accessible curbs or transit stops**; and
- Tracking London's resilience and response to sustainability challenges through **emissions models**, tracking **non-auto modal share**, tracking **stormwater retention capacity and facilities**, and monitoring **tree canopy coverage**.

Chapter 6 in the CSDM focuses on monitoring. Practitioners should refer to this chapter during the preliminary planning phase of a project to determine appropriate baseline data collection strategies, and again after a project has been implemented to evaluate its performance.





1

COMPLETE STREETS: VISION AND PRINCIPLES

1.1 WHAT ARE COMPLETE STREETS?

Streets are vital components of any city. They allow us to get to work and school, run errands, and live our daily lives. Streets can enable commercial activity, facilitate social interaction, contribute to a beautiful cityscape, and provide the pathway for an evening stroll or a morning bike ride. They allow trucks to deliver goods to our stores, enable our fire, police, and paramedic services to respond to emergencies and save lives, and provide the network for LTC buses to serve Londoners. Streets are also where the utilities that allow us to use electricity, internet, water, and natural gas are located, although they may not be visible on the surface. Streets must also be operated (traffic signals, street lighting), maintained (line painting, resurfacing, swept, cleared of snow), and designed. The design process must consider all of these dimensions in order to create a complete street that works well for everyone. This manual is about how London will do that.

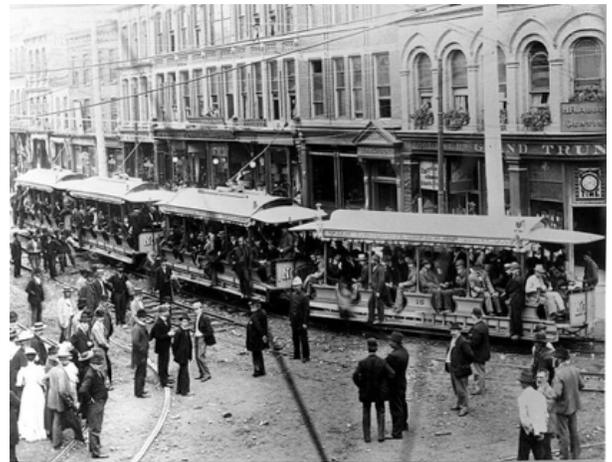
Today, as London prepares to usher in a new era of rapid transit and city-building, the City is encouraging the design and development of streets that more effectively meet the needs of a wide variety of users. Cycling and walking are key components of this strategy, and the City is building infrastructure including sidewalks, bike lanes, and cycle tracks to encourage walking, cycling, and other forms of active transportation. Improving health and activity levels, reducing traffic congestion and supporting the character and legacy of London's neighbourhoods are the objectives of these initiatives.

In this context, the City of London is planning, designing, and implementing transportation improvements within a framework of "complete streets". The London Plan provides the following definition for this term:

"Complete streets are those that are designed to support many different forms of mobility. Complete streets provide physical environments that make all forms of mobility safe, attractive, comfortable, and efficient. Complete streets also provide a positive physical environment that supports the form of development that is planned for, or exists, adjacent to the street. In some cases, complete streets may also incorporate corridors for wildlife movement (p. 449)".

Regardless of age, ability, and confidence, London's streets and public realm should be accessible and appropriate for the needs of all users. Depending on the corridor in question, different user groups will receive priority to ensure that the street functions efficiently. While some user groups may be

prioritized on certain corridors, most street design projects will seek to accommodate multi-modal travel and mitigate risk exposure to all road users, particularly for pedestrians, cyclists, and mobility device users, who are most vulnerable.



London's streets have a long and rich history. Top: Inauguration of London's Electric Streetcar Service in 1895. Lower: A Rapid Transit Boulevard in London.

1.2 WHO IS THIS MANUAL FOR?

It is important not only that streets are designed for all users, but that the principles and methods by which they are designed are accessible and well-understood by those who work, play, and travel along London's streets. This includes City staff tasked with implementation and maintenance, utility providers whose critical infrastructure shares rights-of-way and corridors with travel lanes, as well as Londoners with a passion for improving the character of their community. This manual has been written with this variety of readers in mind – it provides technical, design-based guidance on specific elements of complete streets in a “readable” format.

While the recommendations in this manual focus on the public right-of-way, the ideas in the Manual will support the creation of great places. Places are defined by the character, form, and use of space. A complete streets approach seeks to integrate surrounding development to create great places within the right-of-way public realm.

This document guides the decision-making process for street design as London continues to grow and evolve. While current and future projects are expected to be consistent with the principles and design guidance in this Manual, it should be noted that achieving London's Complete Streets vision will take time, and the extent to which existing streets in the City are consistent with this Manual varies.

For a concise and citizen-focused overview of the processes and design elements that appear in this document, please refer to the Citizen's Guide to Complete Streets Design in London (Appendix A). A glossary of key terms has also been provided in Appendix B, to help make the Manual more accessible to a broad range of readers.



City staff and technical stakeholders contribute to a complete streets workshop.

1.3 THE LONDON PLAN AND OTHER POLICY SUPPORT

Adopting a complete streets approach to transportation planning and design in London is supported by a number of policies at the provincial and municipal level. These policies provide the direction for the vision, goals, and objectives of the Complete Streets Design Manual. This section identifies and analyzes the most relevant existing policies that have informed and influenced the development of the Manual. More detailed information about policy support at each level is provided in Appendix C.

Provincial Policy Support

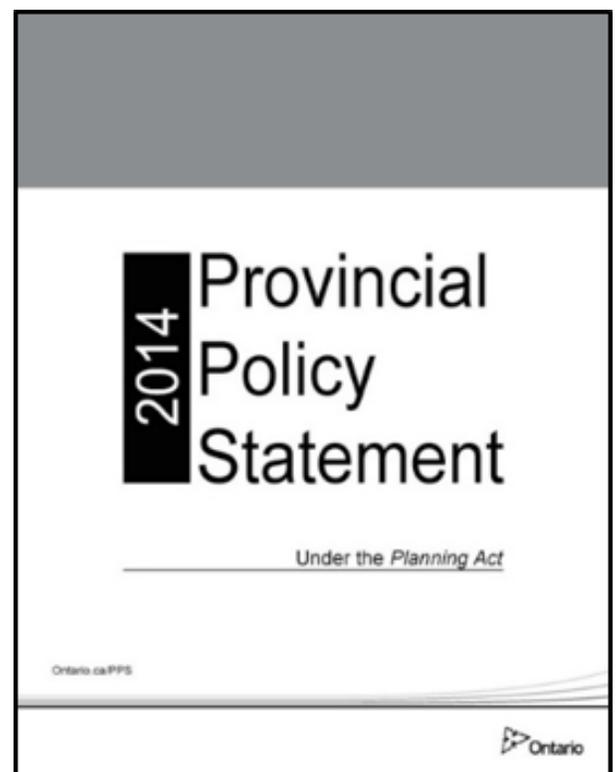
The provincial government provides a broad and supportive framework for the development of complete streets in Ontario's cities. The Provincial Policy Statement (2014) contains a number of supportive elements which outline guiding principles and policy directions for transportation planning and development in Ontario. These policies outline the importance of using planning and design measures to provide viable transportation options beyond single occupant motor vehicle travel.

The Ontario Ministry of Transportation (MTO) Cycling Strategy (2013) explicitly addresses the need to implement complete streets throughout the province, linking the provision of more space for cyclists on our streets to better environmental and economic outcomes and the attraction of more cyclists to key routes. This document supports the integration of land-use and transportation considerations along corridors identified for complete streets improvements. The objective is to ensure that users of all modes of transportation are considered appropriately in light of adjacent land uses.

The Ontario Traffic Manuals (OTM) provide guidance on signage, pavement markings, traffic signals, and various design treatments for streets within the province. OTM Book 15 Pedestrian Crossing Treatments and Book 18 Cycling Facilities are references for design elements of complete streets.

The Accessibility for Ontarians with Disabilities Act (AODA, 2005) also has bearing on the implementation of complete streets, and the Integrated Accessibility Standards (2012) issued under the AODA legislation is particularly relevant. Part IV of this regulation provides specific requirements for the design of

transportation infrastructure to ensure accessibility for users with disabilities and vulnerable users. These requirements will be reflected in all aspects of the Complete Streets Design Manual.



Local Policy Support

At the local level, policy support for complete streets is found in a number of documents, including The London Plan (the City's Official Plan), London's Transportation Master Plan (TMP), and London ON Bikes (London's Cycling Master Plan).

The London Plan outlines a multi-modal vision for the City's street network, establishes 10 distinct street classifications and identifies corresponding design considerations, which are integrated into this Manual. The City's TMP also outlines a number of objectives, including the enhancement of active modes and transit via policy, programming, and complete streets design. Other documents and initiatives that provide policy support for the Complete Streets Design Manual include the City's Strategic Plan, Our Move Forward: London's Downtown Plan, Design Specifications and Requirements Manual, various City By-Laws (such as by-law S1 Part 2.12 restricting cycling on sidewalks) London's Rapid Transit Master Plan, the City of London Urban Forest Strategy, and the Vision Zero London Road Safety Strategy.

Additional Reference Documents

In preparing this manual, the project team reviewed complete streets policies and design guidance from many sources. This review focused on guidance from other comparable mid-sized cities and innovative practice from across North America on complete streets process and design. Specific documents reviewed include:

- Niagara Region Complete Streets Design Guidelines (2017)
- City of Waterloo Complete Streets Policy (2011)
- City of Toronto Complete Streets Design Guideline (2016)
- City of Dallas Complete Streets Design Manual (2016)
- Transportation Association of Canada Geometric Design Guide for Canadian Roads (2017)
- ITE Handbook: Implementing Context Sensitive Design on Multimodal

Thoroughfares (2017)

- NACTO Design Guides (Urban Streets, Bikeway, Transit)
- Highway Capacity Manual (6th edition, 2016) Multi-Modal Level of Service (see Chapter 6 for further information)

While many of these guidelines do not have formal jurisdiction in London, they embody best practices and have helped to inform this manual. These documents may also provide practitioners with a useful point of reference.



Complete Streets Policy Priorities in London

The City has identified the following complete streets policy priorities:

Strive for Vision Zero

In 2017, the City of London adopted the Vision Zero principles, which are based on the notion that no loss of life as a result of traffic-related collisions is acceptable. The City will use an evidence-based decision-making framework to assess, guide, and improve traffic safety. The framework will take into account the interaction of all aspects of the transportation system. Vision Zero promotes a culture shift and questions current attitudes toward road fatalities and injuries. Changing infrastructure and traffic-safety culture takes time, however, and the focus of this Manual is to ensure that the principles of Vision Zero are integrated into both planning processes such as project prioritization and the detailed design aspects of all City projects.

Create pedestrian-friendly environments

Walking is the most universal means of travel, an important form of exercise and an enjoyable recreational activity. All Londoners are pedestrians, which include individuals who are walking or using a mobility device. A pedestrian-friendly environment provides direct routes, minimizes risks, and provides a comfortable experience for pedestrians of all ages and abilities. The City will continue to create pedestrian-friendly environments by providing a sufficiently wide pedestrian clearway, frequent crossing opportunities, accessibility features such as audible signals and tactile walking surface indicators, and various public realm amenities such as seating, street trees, and waste receptacles. The City will also work to create neighbourhoods where residents are readily able to reach essential destinations such as grocery stores, parks, and transit stops on foot.

Consider all users and functions of a street

In addition to accommodating pedestrians, cyclists, transit riders, and motorists, streets must also be designed for maintenance and snow clearing operations, curbside waste collection, and to accommodate various above and below ground utilities. These utilities include communications, hydro, street lighting, gas mains, watermains, and sanitary and storm sewers. A complete street fosters safe and efficient operation for all users and functions.

Integrate complete streets design principles into the decision-making process

Chapter 3 includes tools to ensure that all users and functions of a street are considered whenever a street is constructed, reconstructed, or rehabilitated. These tools are based on the street classifications defined in The London Plan and will provide greater context-sensitivity, consistency, and accountability in the decision-making process.

Coordinate built form decisions with transportation decisions

The London Plan identifies the appropriate use, intensity, and form along each street classification. Although the focus of this manual is street design within the City right-of-way, the built form and land use policies and priorities included in The London Plan are reflected in this manual.

Engage residents and stakeholders in the Complete Streets process

This manual will help residents, stakeholders and staff from all City departments to appreciate the multi-faceted nature of street design. Street design affects all Londoners, from their ability to get to work, to the safety of children getting to school, to the enjoyment of a stroll to the park. This Manual is intended to inform and engage residents and stakeholders while also guiding practitioners and decision makers so that together we can achieve the City's complete streets vision.

1.4 THE VISION FOR COMPLETE STREETS IN LONDON

London's vision for complete streets is informed The London Plan as well as best practices in the field of complete streets planning and design. The following statement captures the overarching vision for the London Complete Streets Design Manual:

- 1 London's streets will be designed and upgraded to be more complete.
- 2 This means that streets in London will meet the needs of a wide range of users as defined by the place type, feature high-quality pedestrian environments, and integrate seamlessly with transit services, cycling networks, and automobile users.
- 3 London's streets will be designed for connectivity and support the use of active and sustainable modes of transportation, and also strongly consider the needs of utility and maintenance providers within the right-of-way.
- 4 With this balance of modes, users, and places in mind, all future construction, reconstruction, and rehabilitation projects for streets – both large and small – in London will be influenced by principles of “completeness” in both planning and design.

This vision is the foundation for the design guidance and process tools contained in this Manual. The City's core principles for complete streets build directly upon this vision.

1.5 DESIGN PRINCIPLES FOR COMPLETE STREETS

Principles help establish consistent decision-making parameters when undertaking complete street design activities. The City's design principles for complete streets include:

Prioritize Safe and Accessible Options for People

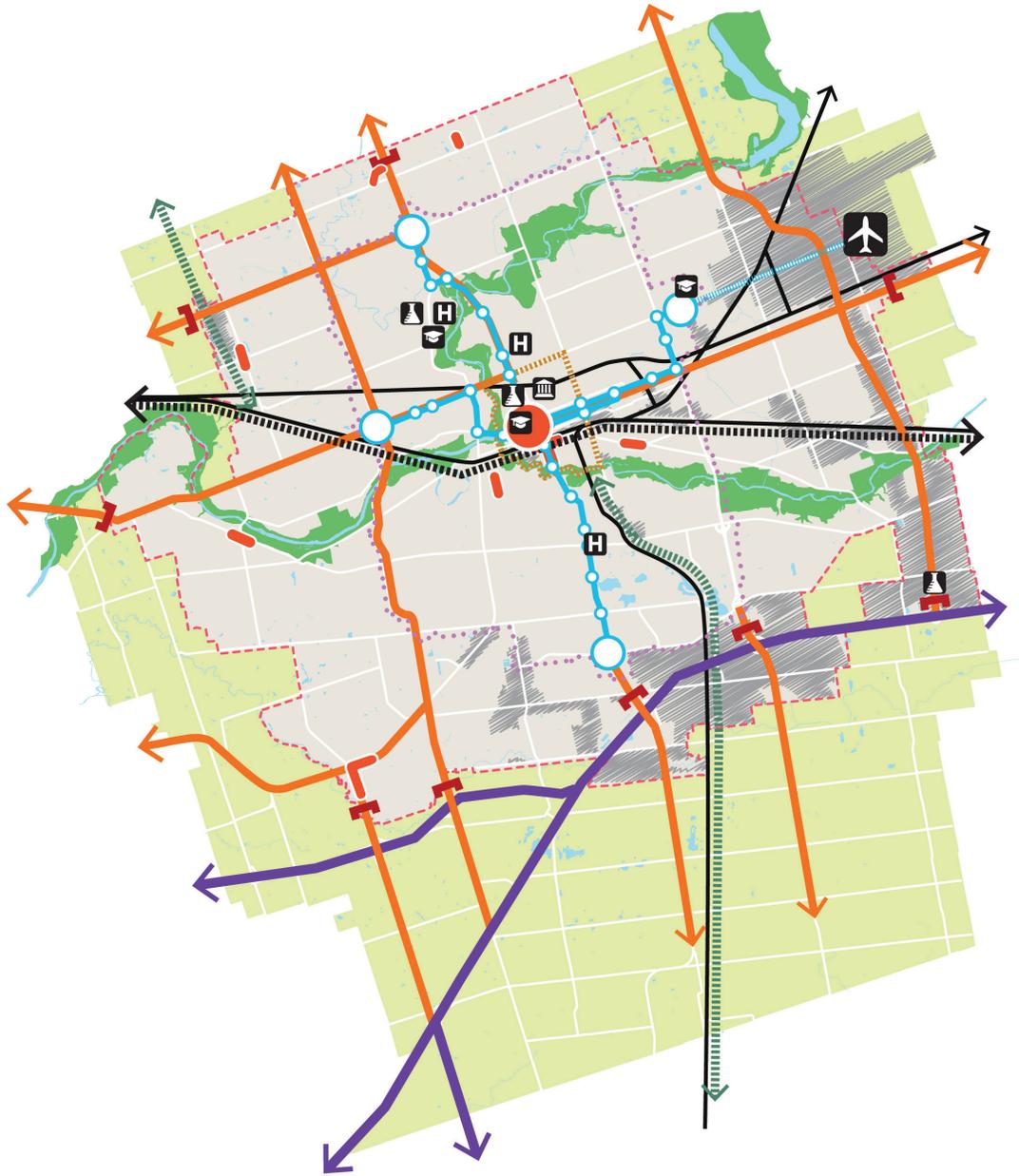
The safety and mobility needs of all users are a priority in any street design exercise. While the hierarchy of modes will differ depending on the street classification, it is important that the needs of pedestrians, cyclists, transit users / vehicles, and motorists are fairly evaluated and considered in the planning and design process as well as in the operation and maintenance of facilities. This means that on any street and regardless of the priority mode, all users should feel safe.

Adopting this approach reflects the reality that pedestrians and cyclists are more vulnerable than vehicular road users. This emphasis is important so that streets function not only as links for users to reach their destination, but also as appealing and vibrant places in which Londoners gather, meet, conduct business, and enjoy the city. The promotion of healthy and active living is also reflected in this principle, as choosing active modes of transportation more often results in a number of health benefits, both individually and for the community. (Reflects policies 211, and 242-251 in The London Plan.)

City Structure Plan

The City Structure Plan indicates Major Gateway Streets in orange. These gateways have a distinct civic image function compared to other streets in the City and are held to a higher standard of streetscape and urban design in order to heighten the prominence and character of the public realm (source: The London Plan, p. 51).

Note: this figure was draft at the time the manual was prepared and is subject to appeal and revision.



Legend

- | | | | |
|------------------------|--------------------------------|-----------------------|--------------------|
| River and Creek System | Gateways | Trail Connections | University/College |
| Thames Valley Corridor | Highway | Central London | Hospital |
| Downtown | Major Gateway Streets | Primary Transit Area | City Hall |
| Transit Villages | Rail Network | Urban Growth Boundary | Research Centre |
| Employment Lands | High Speed Rail | | Airport |
| Main Streets | Rapid Transit Corridors | | |
| Rural London | Future Rapid Transit Corridors | | |

Ensure Context Sensitivity

When undertaking streetscape planning and design, it is important that the design recommendations for each street classification are flexible enough to allow for the influence of important neighbourhood characteristics (including established land uses and functions). This includes the consideration of the civic functions performed by different streets in London. For instance, the Major Gateway Streets identified in the City Structure Plan in the The London Plan have a heightened “civic image” function within the broader cityscape compared to other streets, and should be designed with consideration for this important local function. Heritage designations and associated design criteria, as identified in London’s Heritage Conservation District plans, should be incorporated. This means that design for these areas fosters a sense of pride and appreciation for London’s urban character through high-quality urban design (reflects policies 146 and 197-200 in The London Plan).

Embed Sustainability

Streets should be designed to minimize environmental impacts and maximize the lifespan of physical infrastructure. The design of streets should promote low emission and energy efficient travel modes such as walking, cycling, transit and carpooling. Wherever feasible, streets should promote ecosystem diversity through trees, planters and vegetation, include low impact development features to facilitate groundwater recharge, maximize solar reflectivity to reduce the urban heat island effect, and make use of low impact construction techniques and materials. This principle also suggests that complete streets planning and design should be economically sustainable. Decisions should be cost-effective and not place undue short- or long-term financial burden on the City for street construction, operations, and maintenance. (Reflects policies 52, 62, 65, and 216 in The London Plan.)

Prioritize Connectivity

New complete streets should be designed with block sizes, building orientations, neighbourhood configurations, and street patterns that maximize connectivity for pedestrians and cyclists and facilitate transit service. Opportunities to enhance connectivity for pedestrians and cyclists should be explored for existing streets by adding pedestrian and cycling connections where the street pattern has limited connectivity. Prioritizing connectivity also means that neighbourhood amenities (greenspace, basic retail, community facilities, and transit connections) should be accessible within a ten minute walk for as many residents as possible. (Reflects policies 211, and 213-218 in The London Plan).

Emphasize Vitality

Streets that attract pedestrians enhance urban vitality. Whether out for a relaxing stroll, running errands, or meeting with friends, pedestrians bring economic and social activity to London’s streets. Supporting social vitality requires that streets be designed to be inclusive and accessible and that the various needs of users of all ages and abilities are accommodated to the maximum degree possible. Supporting economic vitality means that streets should be planned and designed so as to maximize the economic opportunities available to their users, including commuters, building owners, and businesses (among others). (Reflects policies 55 and 60-62 in The London Plan). Together with the City’s vision for complete streets, these five principles frame the guidance and recommendations that appear in the following chapters.



2

ELEMENTS OF COMPLETE STREETS

2.1 PEDESTRIAN REALM AND PLACE DESIGN

Walking is the most basic and essential form of transportation, with virtually every trip beginning and ending with a walk. Not only is walking a healthy, climate-friendly, and affordable form of mobility, it is also a social activity, allowing people to engage with each other and enliven the streetscape.

Street design plays a critical role in creating a pedestrian environment that is vibrant, accessible to all pedestrians, and mitigates pedestrians' risk exposure.

This section outlines the principles and design features that support a high quality public realm on London's streets. Further guidance can be found in the Design of Public Spaces Standards under the Ontario Integrated Accessibility Standards regulations, OTM Book 15: Pedestrian Crossing Treatments, and the National Association of City Transportation Officials' (NACTO) Urban Street Design Guide.

Design Principles for the Pedestrian Realm

- **Prioritize safety:** Pedestrians are vulnerable to injury or death in a collision because they are not protected within a vehicle. Street design should provide designated crossing facilities where crossing desire lines are observed. On streets with high volume and high speed motor vehicle traffic, the pedestrian clearway should be set back from any adjacent motor vehicle lane. Providing dedicated cycling facilities can increase safety for pedestrians.
- **Design for accessibility:** The term pedestrian encompasses a broad range of users varying in age and ability, including those who are using a walker, crutches, a wheelchair or an electrically powered mobility device as well as individuals with a visual impairment. Appropriately wide pedestrian clearways, audible pedestrian signals, tactile walking surface indicators (TWSIs), visually contrasting surface treatments and amenities such as seating should be used to accommodate all of London's pedestrians.
- **Create a comfortable environment:** An attractive public realm increases quality of life, equity, community, economic competitiveness and business activity. Supportive design features include shade, shelter, planters, seating, sidewalk cafes, publication boxes and waste receptacles as well as building frontages adjacent to the sidewalk.
- **Provide connectivity:** As the slowest mode of transportation, pedestrians have the greatest sensitivity to route directness. Where the street pattern limits connectivity, pedestrian connections should be provided. Intersections that do not accommodate pedestrian crossings on all legs are discouraged.

Clearway

- The pedestrian clearway refers to the portion of the sidewalk that is free of obstructions and intended for pedestrian through movement. In many cases, such as most Neighbourhood Streets, the entire sidewalk is a pedestrian clearway. In other cases, the sidewalk may include space along building frontages, patios, street furniture, and snow storage areas in addition to the pedestrian clearway.
- The pedestrian clearway is typically 1.5 m wide in areas with low pedestrian activity and as wide as 4.0 m in areas with high pedestrian activity. The clearway width should be designed to accommodate peak pedestrian flow and anticipate future development in the area that may contribute to pedestrian traffic. Snow storage should be accommodated adjacent to (and not within) the clearway.
- Sidewalks are typically constructed with concrete, though unit pavers constructed on a concrete base can also be considered in special circumstances to enhance the streetscape. In areas with



The **pedestrian clearway** with street furniture and poles in the adjacent unit paver area.



While a 1.0 m minimum offset from the curb is preferred, **sidewalks that abut the curb** are appropriate in constrained areas and retrofit applications where the 1.0 m offset is infeasible.

on-street parking or high pedestrian traffic, the areas adjacent to the clearway may also be constructed with a hard surface.

- Maintenance holes and utility grates should be avoided in the pedestrian clearway due to the increased slip hazard associated with metal surfaces, especially in wet conditions.
- Multi-use pathways which accommodate pedestrians and cyclists are typically constructed of asphalt and should only be implemented in locations with good sightlines and low pedestrian volumes.
- The clearway should be set at least 1.0 m back from the curb in order to facilitate snow storage. While this configuration is preferred for new streets and streets being retrofitted with sidewalks, a sidewalk may be constructed to abut the curb in a Neighbourhood Street / Neighbourhood Connector retrofit context, where obstructions such as mature trees prevent the 1.0 m setback.
- A straight clearway alignment provides maximum accessibility and also facilitates snow clearing. Shifting the alignment of the clearway at intersections or in order to accommodate sidewalk patios or trees should be discouraged wherever possible.
- The running slope of the clearway is typically the same as the running slope of the roadway. It should not exceed 5% if at all feasible. In some instances the roadway may have a running slope of up to 8%, and strategies to reduce the slope of the sidewalk to 5% should be considered. A typical 2% cross slope is provided for drainage purposes.
- A sidewalk should be provided on both sides of all streets. Exceptions may be made for existing streets where conditions such as mature trees, right-of-way widths, or infrastructure impede the installation of sidewalks.

Crossings

- Tactile walking surface indicators must be provided in the sidewalk at both ends of all controlled crossings.
- The alignment of a pedestrian crossing should seek to minimize the crossing distance and also to maintain a straight alignment with the clearway at both ends of the crossing in order to accommodate slower moving pedestrians and maximize accessibility.

Intersection Crossings

- A ladder pavement marking should be considered for stop controlled, signal controlled, roundabout or right turn channel crossings that are located in areas with significant pedestrian activity or where the potential for conflict between pedestrians and motorists has been observed to be high.
- A default pedestrian walk phase should be considered in signal operation unless it can be demonstrated that crossings are infrequent and would contribute significantly to motor vehicle delay.
- Pushbuttons are provided at all pedestrian crossings and serve as an auditory and tactile accessibility aid and also allow pedestrians to receive a walk indication at signals that require actuation and are not operated on a fixed timing plan. Newly installed pushbuttons must be AODA compliant and installed / positioned as per AODA requirements.
- Channelized right turns should be discouraged. Where they exist, stop control, yield control or a Level 2 Type D Pedestrian Crossover (PXO) should be considered (see OTM Book 15).
- Roundabouts should be controlled with a Level 2 PXO, preferably Type B or C (see Section 5.4 of this Manual and Figure 28 of the 2016 OTM Book 15). In a Neighbourhood Street context, a Level 2 Type D PXO or simple crosswalk may be appropriate.
- Raised crossings or raised intersections provide a vertical deflection in the roadway that reduces the speed of motor vehicle traffic and also increases the visibility of the crossing and pedestrians using it. They should be considered at all intersections where traffic calming



Ladder pavement markings and **tactile walking surface indicators** enhance visibility and support accessibility.



An **AODA compliant push button**.



A Level 2 Type B **pedestrian crossover (PXO)** in London.



A variety of **pedestrian amenities** including seating, pedestrian-scale lighting, waste receptacles, and trees positioned adjacent to the pedestrian clearway in London.

is desired and where the associated modifications to drainage can be accommodated.

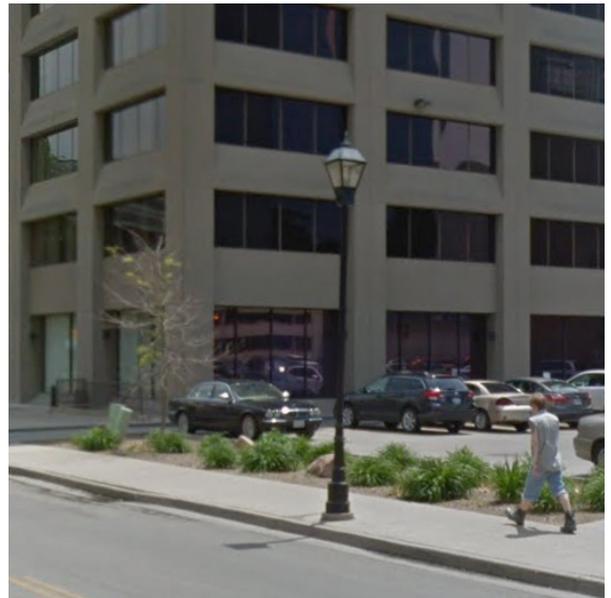
Mid-block Crossings

- Mid-block pedestrian crossings should be considered as per the criteria in OTM Book 15 including the distance between controlled crossings and pedestrian crossing demand / evidence of a pedestrian desire line.
- Formal pedestrian crossing treatments include pedestrian signals and four PXO configurations (see OTM Book 15 for details).
- Consideration should also be given to accommodating pedestrians at uncontrolled pedestrian crossings. At these locations, pedestrians must wait for a gap in traffic. Pedestrians may benefit from a centre median or pedestrian refuge island in order to divide the crossing into two separate movements. While this approach may benefit some pedestrians, it should be noted that not all pedestrians will feel comfortable using uncontrolled crossings.

Amenities

- All objects in the boulevard should be positioned outside of the pedestrian clearway. Typically, poles, bicycle parking, and parking meters / pay stations are located between the roadway and the pedestrian clearway. Seating, trees, waste receptacles, wayfinding elements, and transit stops may be located on either side of the pedestrian clearway.
- All street furniture and related objects in the right-of-way should be standard products that conform to the City's engineering standards and are selected for durability, user experience and aesthetics. Heritage appropriate street furniture may also be considered within Heritage Conservation Districts, and should be selected with input from Heritage, Road Operations, Solid Waste Management and BIA representatives.
- Street lighting should be provided in accordance with the Illuminating Engineering Society Recommended Practice #8 (IES RP-8).

- Pedestrian scale lighting can be used to improve illumination in the boulevard, enhance aesthetics and mitigate shading from street trees (see additional considerations in Section 2.6: Street Lighting).
- Street lighting poles should be able to accommodate banners, hanging baskets, and decorative elements such as holiday wreaths and lights, where appropriate.
- Seating enhances both comfort and accessibility and should be provided at all transit stops (space permitting), in areas with significant pedestrian activity and near seniors' residences and hospitals. Both benches and seatwalls can be used to provide seating.
- Shade increases pedestrian comfort, reduces the urban heat island effect and may be provided via awnings/overhangs from buildings or from street trees.
- Pedestrian wayfinding should be coordinated with bicycle and motorist wayfinding. Pedestrian specific wayfinding typically includes information/map kiosks and destination directional signage.
- Sidewalk patios contribute to a vibrant public realm, encourage more outdoor dining, and support commercial activity and are therefore generally encouraged. They may be configured along the curb, along the building, in an alleyway, at a corner, in line with permanent on-street parking (parklets) or any combination of these configurations. Patios also occupy significant space within the pedestrian realm and it is important that the width and alignment of the pedestrian clearway is maintained. The City regulates sidewalk patios and provides detailed guidance in the Downtown Design Manual and Urban Design Guidelines.



Heritage style **street lighting** in London.



Pedestrian-scale lighting and a pole with a banner in London.

2.2 CYCLING FACILITY DESIGN

Cycling is a healthy, climate-friendly, and affordable form of transportation that can enhance the vitality of a corridor and help reduce the overall dependency on private automobiles. Many individuals are reluctant to cycle, however, because they do not feel comfortable cycling in mixed traffic with motor vehicles.

Street design plays a central role in creating a more comfortable cycling environment, mitigating user risk exposure and making cycling a viable travel option for Londoners.

This chapter outlines principles and design features that support a comfortable cycling environment and mitigate risks for all road users. Further guidance is available in the City of London Cycling Master Plan, OTM Book 18: Cycling Facilities, NACTO Bikeway Design Guide, and the FHWA Separated Bike Lane Design Guide. In this manual, the term “cycling” means “bicycling” as it is referred to in the Ontario Highway Traffic Act.

Design Principles for Cycling Facilities

- **Make context-sensitive design decisions:**

The most appropriate cycling facility type and design features for a street vary based on motor vehicle speeds, motor vehicle volumes, cyclist volumes, surrounding land uses, motor vehicle parking demand, intersection and driveway frequency, and intersection control. Cyclist characteristics such as age and ability are also important considerations, and facilities in close proximity to schools, retirement centres, and similar land uses should consider the particular needs of the anticipated users. Each street requires a comprehensive evaluation and unique design. OTM Book 18: Cycling Facilities provides a comprehensive facility selection process, in addition to the direction that is provided in this manual.

- **Provide continuity and guidance:**

Pavement markings and signage should be used to provide cyclists with intuitive guidance for their correct path of travel. This guidance should mark a continuous path for cyclists along a corridor, including at intersection approaches and crossings to reduce the potential for conflict between users. Where multi-use trails outside the ROW intersect with cycling facilities or provide an alternative route, the design of on-street facilities should consider how to best integrate these facilities into the network.

- **Prioritize vulnerable users:** Pedestrians

and cyclists are more vulnerable than transit riders and motorists in a collision because they are not protected within a vehicle. Prioritizing vulnerable users means providing separation between motor vehicles and pedestrians and cyclists where appropriate and designing intersections to mitigate conflicts between these users.

- **Provide convenient cycling-supportive facilities:**

In order to make cycling a viable mode of transportation, bicycle parking must be available, conveniently located, and reasonably secure at the trip origin and destination, which in many cases may involve bicycle parking within the street right-of-way. Additional amenities such as shower rooms and lockers within a building are also important supportive amenities.

Facility Types

Cycle Tracks

- Are delineated with some form of physical separation from the roadway. Many forms of physical separation are possible such as flex bollards, pre-cast concrete curbs, planters, cast-in-place concrete curbs (barrier, semi-mountable, fully mountable), concrete medians or concrete short wall barriers. The cycle track itself may be constructed at the elevation of the roadway, the sidewalk, or an intermediate elevation.
- May be positioned between the motor vehicle lane and the sidewalk, or a motor vehicle parking lane and the sidewalk; if the cycle track is adjacent to the motor vehicle

parking lane, a 1.0 m buffer in the door zone should be provided. The width of this buffer may be reduced to 0.7 m in constrained locations.

- Should be separated from the sidewalk with a minimum 0.6 m wide buffer zone, to separate pedestrians and cyclists and facilitate maintenance.
- Light standards may be positioned on either side of the cycle track.
- Typically accommodate one-way bicycle operation, though two-way bicycle operation is also possible.
- Typically are 1.8 m wide (one-way operation) with a 0.5 - 1.0 m buffer zone. The minimum cycle track width is 1.5 m with a 0.3 m buffer. Snow clearing typically requires a 1.8 m clear way with no obstructions or barriers. Snow storage should be a consideration in determining the width of the buffer zone.
- Should be marked with a diamond, bicycle stencil and directional arrow and designated bicycle lane signs.
- Appropriate for streets with moderate to high motor vehicle speeds and volumes.
- Should maintain separation from the roadway at intersections until the motor vehicle turning radius begins. On-street parking should be restricted on the approach to intersections to provide sightlines between cyclists and motorists.
- Can typically be swept and cleared of snow with sidewalk maintenance equipment.

Multi-use Pathways

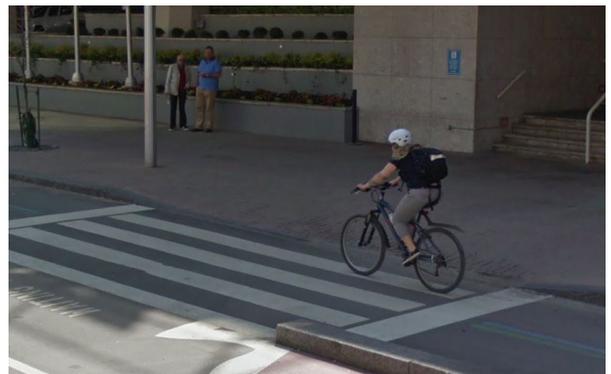
- Accommodate both pedestrians and two-way cycling. The two-way cycling operation requires special consideration at intersections such as additional queuing space for turning cyclists where appropriate and signage and pavement markings are provided to alert all road users of the two-way bicycle traffic.
- Should only be considered when pedestrian and cyclist volumes are low. Otherwise, a one-way or two-way cycle track and a sidewalk should be provided.
- Typically are 3.0 - 4.0 m wide. In some constrained locations, 2.4 m may be acceptable depending on context and



One-way cycle track with crossside in London.



Cycle track with separation maintained up to the intersection in London.



A **marked pedestrian crossing of a two-way cycle track** in Toronto.



Buffered bicycle lane in London.



A **contraflow bike lane** accommodates two-way bicycle operation on a one-way street in Toronto.



Conventional bicycle lane in London.

anticipated user volumes; above a 4.5 m width, consideration should be given to providing a separate sidewalk for pedestrians.

- Should be positioned at least 1.0 m from the curb. Where children are anticipated to be among the user groups and motor vehicle speeds and volumes are high, a physical barrier to prevent cyclists from entering the roadway should be considered.
- Should be marked with pedestrian and bicycle stencils and directional arrows.
- Can often be maintained using standard equipment.

Bike Lanes

- Provide designated space for cyclists between a motor vehicle lane and the curb, or between a motor vehicle lane and a motor vehicle parking lane.
- Accommodate one-way bicycle operation.
- May have a painted buffer separating the bike lane from motor vehicle traffic or from the motor vehicle parking lane and open motor vehicle doors. Where there is high turnover parking, the buffer in the door zone should take precedence over the buffer adjacent to the motor vehicle travel lane.
- Can provide two-way bicycle operation on streets with one-way motor vehicle operation through the use of a contraflow bike lane; this requires additional signage and designated bicycle signals at signalized intersections.
- Are typically between 1.5 and 1.8 m wide, with buffer zone widths between 0.5 m and 1.0 m.
- Should be marked with a diamond and bicycle stencil and designated bicycle lane signs.
- May feature a solid lane line or a skip pattern lane line on the approach to an intersection, depending on the desired turning behaviour.
- Are appropriate for streets with moderate or low motor vehicle speeds and volumes.
- Are typically maintained through regular street maintenance.

- May require enforcement measures to deter motorists from driving, stopping or parking in the bike lane.

Neighbourhood Greenways

- Are signed routes where specific measures are implemented to manage motor vehicle volumes and speeds. Cyclists share space with motor vehicles.
- Typically require traffic calming measures to manage motor vehicle speeds and volumes such as speed cushions, mini-roundabouts, turn or entrance restrictions for motor vehicles, diverters, and islands or medians that physically restrict motor vehicle movements (See Section 2.4 Traffic Calming for further information).
- Should be designed to maximize cycling connectivity by crossing arterial streets at intersections with signals or other crossing design treatments such as pedestrian/cyclist refuge islands.
- Should be designed to minimize frequent stops for cyclists.
- Should include wayfinding for cyclists with signage and sharrow markings, including directional sharrows.
- Can provide a comfortable cycling environment for all users.

Paved Shoulders (applies to Rural Connectors and Rural Thoroughfares)

- Paved shoulders are an appropriate facility type in rural areas. The preferred pavement width beyond the motor vehicle edge line is 1.5 - 2.5 m, depending on the speed and volume of motor vehicle traffic.
- A painted 0.5 - 1.0 m wide buffer with two longitudinal lines and hatching, typically spaced at 10 - 20 m in a rural context, can be included where motor vehicle speeds and volumes are high or where a significant volumes of cyclists are expected, such as near schools or rural hamlets.
- Parking and stopping is often permitted in rural paved shoulders, though demand for this is typically very low.



A **mini roundabout** reduces the number of stops on a cycling route in Toronto.



Coat hanger style bicycle rack parking in London.



Bicycle wayfinding signs in London.



Bicycle wayfinding signs in Kitchener.



Intersection crossing markings in Toronto.



A driveway crossing with elephant feet and a bicycle stencil in London.

Additional Design Features

Bicycle Parking

- Within the right-of-way, bicycle parking is typically provided with bike posts, various rack styles (such as coat hanger racks), and bicycle corrals which are located in one or more on-street parking spaces.
- The position and configuration of bicycle parking should not intrude on the pedestrian clearway, cycling facilities, motor vehicle parking lanes (with the exception of corral parking) or motor vehicle travel lanes.
- The amount of bicycle parking provided should be sufficient to meet peak demand.
- Bicycle racks should provide direct contact at two points to the bicycle frame to ensure the bicycle is held upright without putting stress on the wheels. Racks should be located in a well-lit area and visible from the roadway or cycling facility and the pedestrian realm to maximize passive surveillance.
- Further guidance can be found in the Essentials of Bike Parking guide by the Association of Pedestrian and Bicycle Professionals.

Bicycle Wayfinding

- Novice, recreational, and touring cyclists often cycle in new and unfamiliar areas and rely on wayfinding to find their route or reach their destination.
- Wayfinding signage and pavement markings should be clear and consistent. Turns on key routes should ideally be marked with two cues (2 signs or a sign and a wayfinding sharrow). Confirmation signs should be located every 200 – 800 m depending on the context and frequency of intersections. Resources and suggested standards are available in the 2016 City of London Cycling Master Plan, Technical Appendix A.

Driveway and Intersection Crossings

- Where multi-use pathways, cycle tracks or bike lanes with a buffer zone cross a moderate or high volume driveway, it should be marked with elephant feet on both sides of the crossing as well as a bike stencil and directional arrow (two-

way facilities should be marked with stencils and arrows in each direction); high volume driveways may also be marked with green pavement markings.

- Where a bicycle lane or cycle track crosses an intersection adjacent to the motor vehicle travel lane, the intended path of cyclists should be marked with chevrons and skip lines.
- At intersection crossings of in-boulevard paths, a crossride should be implemented that is consistent with OTM Book 18 and the configuration of the in-boulevard paths.

Left Turn Design Treatments

- For neighbourhood greenways and bike lanes on low volume, single lane streets, cyclists typically make direct left turns by merging into the motor vehicle lane and turning left from there.
- At signalized intersections where there are high volumes of cyclists, a bicycle box can be implemented with the motor vehicle stop bar positioned 3.0 m further from the intersection. This provides motorists with better visibility of cyclists and can facilitate cyclist access to the left turn lane, if one exists. A cyclist stop bar, bicycle stencil, green surface treatment and signage should be implemented to communicate the appropriate stopping position for cyclists and motorists. "No Right Turn on Red" signs are typically used in this context to restrict motorists from turning right and occupying the bicycle box.
- For bike lanes and cycle tracks on streets with more than one lane of motor vehicle traffic in each direction as well as in-boulevard paths, left turn queue boxes should be considered at intersections where both streets have cycling facilities and / or high volumes of cyclists.
- Left turn queue boxes may either be constructed in the boulevard or marked on the pavement, typically between the bicycle crossing and the crosswalk. Right turn on red movements are typically restricted for on-street queue boxes unless there is sufficient space for a motorist to turn right without encroaching on the queue box.



A **bike box** increases the visibility of cyclists and facilitates bicycle left turns in London.



An **in-boulevard left turn queue box** in Markham.



A **marked on-street left turn queue box** in Toronto.



A **buffered bike lane and right turn lane approach** in Newmarket.

Intersection Approaches

- Cycle tracks should maintain separation on an intersection approach to the farthest point possible where the motor vehicle right turn radius begins, regardless of whether a dedicated right turn lane is present.
- Where a dedicated right turn lane exists on a street with a conventional bicycle lane, the bicycle lane should be positioned between the through lane and the right turn lane. Where the right turn lane is initiated, it should be marked with green pavement markings and skip lines, and right turning motorists must merge across this lane when it is safe to do so.
- At signalized intersections with conventional bike lanes or cycle tracks, consideration should be given to positioning the motor vehicle stop bar 1.5 m behind the bicycle stop bar to improve motorists visibility of cyclists.

2.3 TRANSIT FACILITY DESIGN

Transit is an environmentally responsible, efficient, and congestion mitigating mode of transportation. Passengers are typically able to travel greater distances than they could by walking or cycling, can use their time for other activities such as reading or using a mobile device and do not face the same age, ability, and financial restrictions associated with automobile use. To be a viable travel option for Londoners, transit service must be efficient, reliable, user friendly, and provide access to all urban areas of London.

Street design plays an important role in the City's / London Transit Commission's (LTC's) ability to deliver high quality transit service.

This section outlines principles and design features that will support high quality transit service on London's streets. Further guidance can be found in the Ontario Ministry of Transportation's (MTO) Transit Supportive Guidelines, the National Association of City Transportation Officials' (NACTO) Transit Street Design Guide, and London's transit plans and systems.

Design Principles for Transit Facilities

- **Minimize delay / give transit priority:** The movement of transit vehicles should be prioritized on all transit routes within the Primary Transit Area (PTA). Typical strategies include stop design, location, and spacing; designating travel lanes for transit vehicles; applying parking restrictions; or implementing signal priority measures at intersections.
- **Mitigate conflicts with vulnerable users:** Transit operation frequently involves pedestrians, cyclists, and buses sharing space. Buses often need to move into bike lanes to reach a stop, while in other contexts, pedestrians must cross a cycling facility to board or alight a transit vehicle. Pedestrians also frequently cross the street at a transit stop, which may result in a conflict between buses and pedestrians. Typical strategies include implementing stop designs that mitigate cyclist-bus conflict, providing clear guidance with respect to the desired path of travel and yielding / stopping behaviour for all users, accommodating pedestrian desire lines, maximizing pedestrian visibility at crossing locations, and providing sufficient space for peak passenger waiting volumes.
- **Plan for multi-modal travel:** Most transit trips begin and end with a walking trip, and occasionally a cycling trip. A multi-modal transportation system should provide easy connections to transit stops for active modes, include bicycle parking at or near stops, bicycle racks

on buses and comfortable street crossing opportunities in close proximity to the stop.

- **Provide a comfortable user experience:** Making transit attractive to Londoners requires attention to the full user experience. Strategies, in addition to those noted above, include: designing stops that are attractive, accessible, well-lit and easy to maintain, incorporating planters, trees or other shade strategies into the stop design, providing a transit shelter and seating wherever feasible, facilitating common transfer movements, and providing customer information such as maps, schedules, and fare information.



A **secure bike parking facility** at a rapid transit station in Montréal.



A **centre median platform stop** in Markham.



A **boulevard island stop** in Seattle.

Stops

Centre Median Platform Stop

- The platform is typically positioned between a dedicated transit lane and a through or left turn motor vehicle lane at signalized crossings.
- Supports efficient and high capacity transit operations.
- Eliminates conflict between buses and cyclists and effectively mitigates conflict between cyclists and pedestrians moving to and from the transit platform since they cross the cycling facility (if present) at a signalized crossing.
- The desired width of the platform is 3.0 – 3.5 m; the minimum pedestrian clearway width of the platform is 1.5 m plus the length of the ramp extending from the bus or 2.0 m where level boarding is provided. Transit shelters should either be canopy shelters with no side walls or positioned such that they do not conflict with ramp operation.

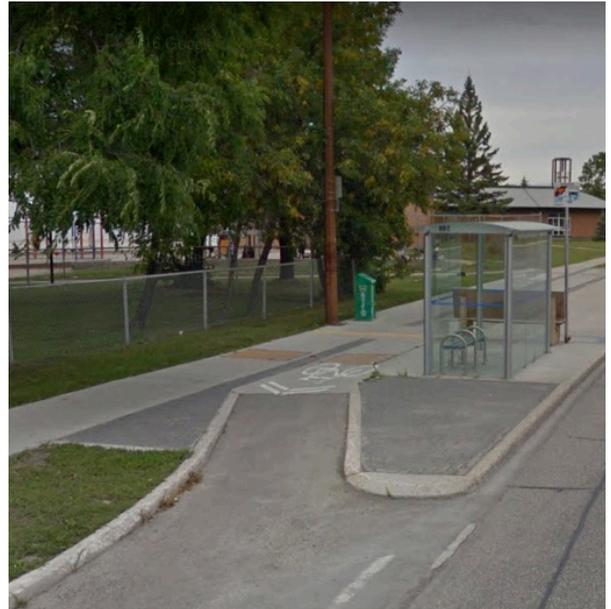
Boulevard Island Stops

- The platform is positioned in the boulevard but separated from the sidewalk by a cycling facility.
- Supports efficient and high capacity transit operations.
- Eliminates conflict between buses and cyclists and effectively mitigates conflict between cyclists and pedestrians moving to and from the transit platform since they cross the cycling facility at a location marked with tactile walking surface indicators, zebra stripes, sharks teeth, and a “Cyclists Yield to Pedestrians” sign. Locations with high volumes of cyclists or transit boardings / alightings should include a railing to channel pedestrians to designated crossing locations. A 0.5 m clear distance should be provided between the cycle track and any railing or shelter that is provided on the platform.

- Where the platform and the cycle track are separated with a curb or a railing, the desired width of the platform is 3.0 – 3.5 m; the minimum pedestrian clearway width of the platform is 1.5 m plus the length of the ramp extending from the bus or 2.0 m where level boarding is provided. Transit shelters should either be canopy shelters with no side walls or positioned such that they do not conflict with ramp operation.
- Where a permanent motor vehicle parking lane exists, the island stop can be aligned with the motor vehicle parking lane to provide additional passenger queuing space and reduce transit delay.

Integrated Cycle Track Platform Stops

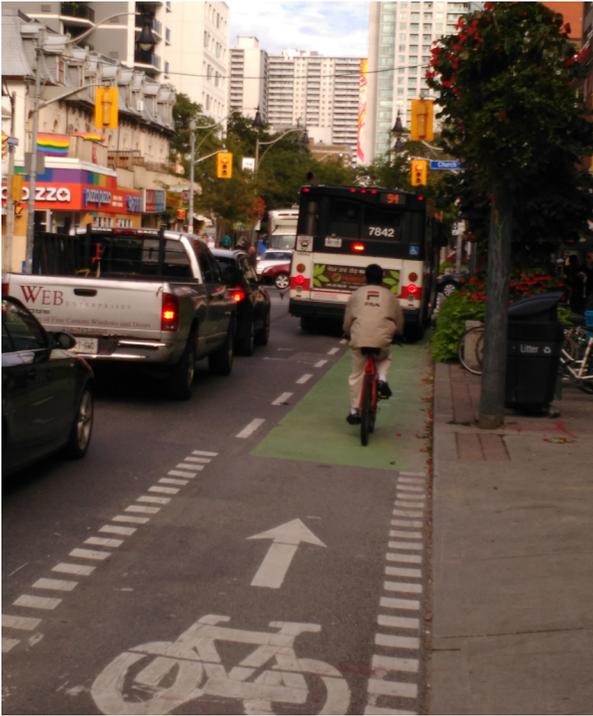
- The cycle track is integrated into the platform typically due to right-of-way constraints.
- When no transit vehicle is present, passengers wait behind the cycle track, and cyclists are not required to stop. When passengers are boarding or alighting from a transit vehicle, cyclists must stop and wait behind the stop. Yellow tactile strips on all three sides of the platform as well as “Do Not Pass Open Doors” signage and pavement markings, and a bicycle stencil with directional arrow provide guidance for all users.
- Eliminates conflict between buses and cyclists and mitigates conflict between cyclists and pedestrians in environments with moderate cycling volumes and moderate transit boardings / alightings. An educational campaign should be undertaken when this design is first introduced.
- The cycle track should be 2.0 m wide and separated from the sidewalk by a 0.5 m buffer area.
- A transit shelter may be positioned between the sidewalk and the cycle track or between the sidewalk and the edge of the right-of-way.



A **boulevard island stop** in Winnipeg.



An **integrated cycle track platform stop** in Toronto.



A **shared space stop** in Toronto.

Shared Space Stops

- Buses are permitted to pull into parallel cycling facilities for passenger boarding / alighting.
- To warn cyclists that buses may encroach into their lane, a skip lane line and green paint should be used in these mixing zones.
- During boarding, buses partially occupy the motor vehicle travel lane and do not need to merge to re-enter the flow of traffic, increasing the efficiency of transit operations. Motorists and cyclists must either wait behind the bus or merge into the adjacent lane to overtake the bus if it is indicating a right turn signal.
- The interaction between cyclists and buses increases complexity for bus operators and reduces comfort for cyclists and therefore alternative designs should be considered where there is a high volume of cyclists.
- A shelter and other amenities may be positioned on either side of the sidewalk.
- Where a permanent motor vehicle parking lane exists, the transit platform can be aligned with the motor vehicle parking lane to provide additional passenger queuing space and reduce transit delay.



A right turn lane serves as a bus bay stop in **Newmarket**.

Bus Bay Stops

- Buses pull out of a through lane and a cycling lane (if present) to reach the platform.
- This configuration is preferred only at stops that operate as a layover, have high boarding/alighting volumes, or have frequent boardings/alightings by passengers using mobility devices that require ramp deployment and where significant impact on traffic operation is expected.
- Buses are required to merge into the traffic lane when departing from the stop, which can add delay and unpredictability to transit operations.
- Motorists and cyclists are able to overtake a bus, thereby improving traffic flow. Many cyclists are uncomfortable performing this manoeuvre however, as it may position them between a motor vehicle and a bus.

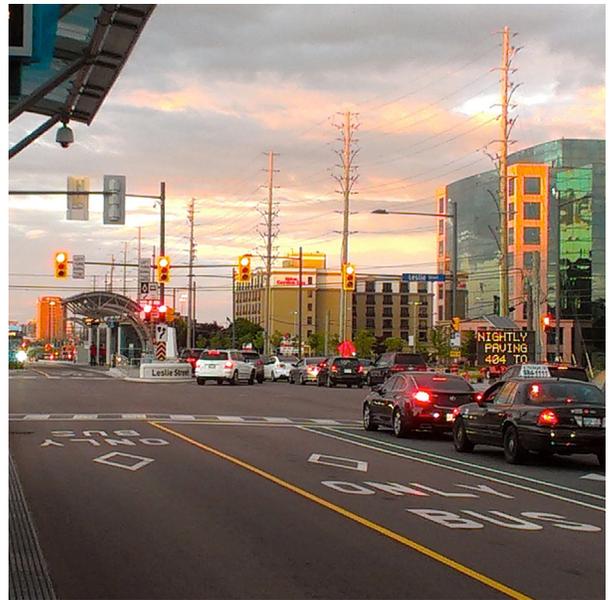
- Nearside stops at intersections with dedicated right turn lanes function as bus bay stops, since buses must merge back into traffic when departing from the stop. Where through traffic queuing adds more delay than right turn queuing, this configuration can improve transit operations since the right turn lane may have the same effect as a queue jump lane. However, where right turn queuing adds more delay than through traffic queuing, this configuration can have a negative impact on transit operations and a farside stop should be considered.
- A shelter and other amenities may be positioned on either side of the sidewalk.
- This configuration requires additional space in the boulevard that may not be available in all contexts.

Lanes

- Dedicated transit lanes may be positioned in the centre of the right-of-way with motor vehicle traffic on either side or between travel lanes and the boulevard, both of which are included in London’s Rapid Transit Master Plan. These lanes can use signage, red pavement, diamond and “bus only” pavement markings, or physical barriers to keep other traffic out. Emergency and maintenance vehicles are permitted to use these lanes and consideration should also be given for how buses will enter or exit these lanes, particularly if short-turn service or integration with other lanes is anticipated.
- Queue Jump Lanes provide buses with a short, dedicated facility on the approach to an intersection to allow buses to bypass queued traffic. Right turning traffic presents a challenge for queue jump lanes and should be assessed for each application context. Where there is significant right turn demand and associated delay, the provision of a dedicated right turn lane in addition to a queue jump lane or various signal options (right turn green phase or various transit prioritization strategies) should be considered.
- High Occupancy Vehicle (HOV) and Time Restricted Lanes prioritize transit by limiting the use of a lane to certain vehicle types such as transit vehicles,



A **high occupancy vehicle and time restricted transit lane** in Toronto.



A **dedicated transit lane in the centre of the right-of-way** in Markham.



A **queue jump lane** in Toronto.



Transit signal priority in London.



An LTC bus crossing a **raised intersection**.

vehicles with a minimum number of occupants, motorcycles, bicycles, and taxis. These restrictions may or may not apply outside of peak travel times. A diamond symbol and overhead signage should be applied on the far side of all intersections and typically at 100 m intervals thereafter.

Intersections

- Transit Signal Priority (TSP) strategies can improve transit efficiency at congested intersections. TSP typically compliment other transit priority measures, such as dedicated transit/HOV lanes or queue jump lanes. Conditional TSP can be used to assist transit vehicles only when experiencing delays, or unconditionally to promote transit efficiency and time-competitiveness with other modes. Several options can be applied to signal phases, depending on aspects such as stop locations at the intersection or right-turn traffic volumes. For example, extended greens can help buses clear intersections and reach far side stops.
- Curb radii and stop bars should accommodate transit vehicles. Recessed stop lines can facilitate transit vehicles temporarily using two lanes of traffic to navigate tight turn radii in smaller intersections. Curb aprons can also be applied to maintain a narrower motor vehicle travel lane and tighter turn radii for smaller vehicles (to introduce traffic calming), while providing extra space for the swept path of transit vehicles; pavement markings should clearly warn pedestrian that curb aprons are not extensions to the sidewalk.

2.4 MOTOR VEHICLES

The motor vehicles considered in this section include personal vehicles, taxis, and ridesharing vehicles, trucks, and other large vehicles, and emergency services vehicles. Ensuring the efficient movement of goods, enabling rapid responses to emergencies and providing Londoners with the option to travel by car are important priorities for the City. While the use of private vehicles may be the only viable option for some individuals, and offers greater convenience to others, single occupancy vehicle travel is less efficient than travel by other modes of travel. A heavy reliance on single occupancy vehicle travel results in pollution, congestion, costly infrastructure expansion, a significant proportion of land being devoted to parking, an undesirable public realm, greater risk to vulnerable road users and reduced viability of other travel modes. From a street design perspective, the need to accommodate motor vehicles must therefore be balanced with the need to provide sufficient space for other modes of travel and the desire to create an attractive public realm.

Further guidance is available in the 2017 TAC Geometric Design Guide for Canadian Roads (Chapter 2), NACTO Urban Street Design Guide and the FHWA Speed Concepts: Informational Guide.

Design Principles for Motor Vehicles

- Select an appropriate design speed:** The design speed refers to a designated speed that engineers use to determine appropriate lane widths, roadway curvatures, signage, pavement markings, intersection control, and other design parameters. Many motorists determine their travel speed based on what they perceive to be the maximum speed at which they can safely operate their vehicle. Higher design speeds therefore often lead to higher operating speeds. In an urban environment where motorists are typically travelling in close proximity to pedestrians, cyclists, schools, and neighbourhoods, lower operating speeds are more desirable in order to mitigate the risk and severity of a collision. The design process should therefore begin with the desired speed for motor vehicle traffic. A design speed and posted speed should then be selected balancing the need for forgiving design and the desire to discourage inappropriately high travel speeds.
- Select an appropriate design vehicle:** The design vehicle refers to the physical properties of the vehicle (such as vehicle length, turning radius, and stopping distance) that the roadway is designed to accommodate in normal operating conditions. Using a design vehicle that is too small can make it difficult for large vehicles to manoeuvre and may result in conflict between road users, increased congestion, and increased risk exposure for all road users. However, using a design vehicle that is too large results in increased pedestrian crossing distances and can enable motorists driving smaller vehicles to take advantage of the wider lanes and larger curb radii and travel at higher speeds, both of which also increase risk exposure. As a result, street designers should identify both a design vehicle based on the largest vehicle that must be routinely accommodated and a control vehicle, which must also be accommodated, but much less frequently. In most cases it is acceptable for a control vehicle to make a turn at a slower speed and / or use an adjacent lane to complete a turn movement. Determining a design and control vehicle should be based on the street classification, place type, and observed counts of different vehicle classes.
- Consider induced demand when determining capacity:** Most thriving cities routinely experience congestion. This results in a frustrating user experience, inefficient use of infrastructure and pressure to expand street infrastructure. The notion, however, that expanding street infrastructure is an effective means to reduce congestion is not supported by research and has been widely discredited. Many cities have therefore come to accept a level of congestion and have focused their resources on providing alternatives to single occupancy motor vehicle travel. From a street design perspective, practitioners should carefully consider the Multi-Modal Level of Service that they find

acceptable and consider the implications of induced demand and the opportunity costs associated with increasing roadway capacity.

Lanes

- On streets with multiple lanes in the same direction, curb lanes are typically wider than inner lanes due to snow storage, the operation of trucks and buses in the curb lane and accommodation of cyclists (if there is no dedicated cycling facility).
- The typical width of a curb lane where the design vehicle is a truck or a bus is 3.5; a wider lane may be considered if it is not possible to provide a dedicated cycling facility.
- The typical width of an inner lane on a street with multiple lanes in the same direction is 3.3 – 3.5 m.
- The typical width of a turn lane is 3.0 m.
- On Neighbourhood Streets servicing less than 45 units and that have low parking utilization, the combined lane width may be reduced to 6.5 m.
- A barrier curb (OPSD 600.110 or 600.040 for example) should be used at the outer limit of the roadway on all streets (except specially designed flex streets). Motor vehicle parking lanes or on-street cycling



A roundabout, such as this one in Aurora, can be effective at managing travel speeds but also requires special consideration for pedestrian and cyclist crossings.

facilities are considered to be part of the roadway in this context. This approach helps to deter vehicles from entering the boulevard. Curb cuts should be provided at all driveways and pedestrian / cyclist crossings.

Traffic Control

- The movement of vehicles through intersections can be controlled with yield control, two-way or all-way stop control, a traffic signal, or a roundabout.
- The determination of the most appropriate form of intersection control for a specific location requires comprehensive analysis of the local context. Considerations include:
 - Multi-modal capacity and user delay;
 - Ability to prioritize emergency and transit vehicles;
 - Ability to manage the speed of traffic along a corridor;
 - Available space (especially for roundabouts);
 - Reducing the frequency and severity of collisions; and
 - Ability to provide pedestrian and cyclist crossings that accommodate all users.
- Further guidance can be found in London's Design Specifications & Requirements Manual, OTM Book 12 and 12A, the 2017 TAC Geometric Design Guide for Canadian Roads (Chapter 9: Intersections) and the 2017 TAC Roundabout Design Guide.

Parking and Loading

- The length of an on-street parking stall is 6.0 m.
- The width of an on-street motor vehicle parking lane should be 2.2 – 2.5 m wide including the width of the gutter, depending on the frequency with which delivery vehicles occupy the parking or loading area. If additional street space is available, it should either be allocated to an adjacent motor vehicle travel lane or a cycling facility rather than widening the motor vehicle parking lane.
- A hard surface boulevard should be provided adjacent to dedicated motor vehicle parking lanes unless parking

utilization is consistently low.

- On-street parking restricts sightlines at driveways and intersections limiting the visibility of motorists, cyclists and pedestrians in the boulevard, in a driveway or on a cross street. Typically, parking is restricted for 30 m from the curb line at both signalized intersections and stop controlled intersections and 2-5 m at major driveways. Where a cycling facility is positioned behind the motor vehicle parking lane, sightlines are of greater importance and higher values should be considered for upstream parking restrictions (such as 6 - 10 m at major driveways).
- On-street parking can provide a traffic calming effect as it adds a measure of unpredictability to the street, encouraging motorists to reduce their speed. On residential streets where parking can be accommodated on one side of the street, the parking lane may alternate from one side of the street to the other in 30 - 60 m intervals to maximize the traffic calming effect.
- Cycling facilities are often located adjacent to parking lanes on either the sidewalk or motor vehicle travel lane side. A 1.0 m buffer between the cycling facility and the parking lane is strongly preferred, in order to mitigate the risk of cyclists being doored. While the width of this buffer may be reduced somewhat in constrained locations, reducing it below 0.7 m is not recommended if the cycling facility is positioned between the parking lane and the sidewalk.
- Accessible on-street parking should be considered in accordance with AODA minimums. These parking spaces should have a 1.5-2.5 m longitudinal buffer at both ends of the parking space. A hard surface must be provided in the adjacent boulevard. If there is a cycle track between the parking lane and the sidewalk, a 1.8 m buffer between the accessible parking space and the cycle track is preferred. Opportunities to shift the alignment of the cycle track and / or to narrow the cycle track should be explored in this context. A marked pedestrian crossing of the cycling facility should be provided.
- Angle parking is not recommended in any context due to the limited sightlines and associated potential for conflict between reversing motorists and motorists or cyclists in the motor vehicle travel lane.
- Parking meters and pay stations should be positioned adjacent to the parking lane with a 0.5 m offset from the face of the curb.
- Loading of goods typically occurs in laneways or outside of the ROW. Where these options are not available, loading typically occurs in a motor vehicle parking lane. Requests to provide or improve loading options should be addressed on an individual basis and are typically accommodated by implementing either time based or permanent 'No Parking' by-laws. A curb cut and designated crossing of any cycling facility positioned between the loading area and the property line should be provided.
- Laybys provide space for passenger pick up and drop off, can accommodate some freight deliveries, and offer temporary commercial space for food trucks. Several ongoing and future trends, such as the increased volume of package deliveries, greater usage of ride-hailing apps, and the introduction of automated vehicles, suggest that demand for layby space is likely to increase. Opportunities to include laybys should be explored in front of key destinations such as residential towers, office buildings, public venues, and parks.

Traffic Calming

- Traffic calming refers to a suite of strategies for managing the speed and volume of motor vehicles. These strategies are typically applied on Neighbourhood Streets and Neighbourhood Connector Streets and other street classifications in school zones to mitigate risk exposure for all road users and create a more enjoyable pedestrian realm.
- Traffic calming measures can be grouped into two categories: passive and physical. Passive traffic calming involves measures to change motorists' perception of the street to achieve a reduction in travel speed. These measures include road diets (reducing lane widths) or using surface treatments such as unit pavers



A **hard surface** such as unit pavers is desirable adjacent to on-street parking spaces in urban areas with high parking utilization and turnover.



A **diagonal diverter** manages traffic volume but allows for pedestrian and cycling connectivity in London.



A sidewalk level **cycle track** in Ottawa with a bicycle friendly curb extension that includes bicycle parking and street trees.

(constructed on a concrete base) or imprinted asphalt.

- Physical traffic calming measures include physical obstructions such as:
 - diverters, medians, or raised islands, entrance / turn restrictions;
 - vertical deflections such as speed cushions, raised intersections, and raised crossings;
 - and horizontal deflections such as mini-roundabouts, or on-street parking that alternates between two sides of the street (see Section 2.4: Parking and Loading).
- Speed cushions should extend across the entire street width to avoid erratic vehicle diversion around them.
- Traffic calming measures should be selected and designed to avoid negative impacts to transit operations or cyclist comfort.
- Consideration should be given to mitigating any negative impact to emergency vehicle response time, particularly on primary emergency response routes.
- The implementation of traffic calming measures is always context sensitive, and involves balancing needs and priorities.
- Further guidance on traffic calming, and requirements for consultation when measures are implemented on existing streets can be found in the City's Traffic Calming Practices and Procedures for Existing Neighbourhoods Guide.

Driveways/Access

- Driveways allow vehicles to move between the ROW and private property and play a critical role in providing access. When high volume driveways are spaced too closely together the movements into and out of driveways can conflict with each other and increase risk exposure. Frequent movements onto and off of the roadway also have a negative impact on roadway capacity. The appropriate distance between driveways varies by The London Plan street classification and place type, and guidance is provided in Chapter 4.
- On streets with high volumes of motor vehicles, it may be difficult to turn left into or out of a driveway during the

peak period. Designated left turn lanes can reduce risk exposure for these movements, however, when sufficient gaps in the flow of motor vehicle traffic are anticipated to be infrequent, left turns should be restricted. The preferred approach to this is through the implementation of a centre median.

- Channelized turns allow motorists to make a turning movement at a greater speed. Due to the increased risk to pedestrians and cyclists associated with increased speed during a turning movement, channelized turns are generally discouraged. For the same reason, the width of all driveways should be minimized to the extent possible.
- Further Guidance can be found in the City of London Access Management Guidelines. Restrictions and requirement for private driveways can be found in City of London Property Standards By-law - CP-16.

Curb Radii

- The curb radius is the measure of how far the roadway intrudes into the boulevard at a corner. The radius of the curb at a corner determines the speed at which motorists can perform a turning movement.
- The determination of an appropriate radius depends on the design vehicle, the number and width of receiving lanes and desired turning speed. For any given design vehicle, there is also a minimum radius that is required to complete a turn, regardless of speed (see Section 2.4: Select an Appropriate Design Vehicle).
- Within the Primary Transit Area, the smallest possible radius should be selected, based on the considerations noted above.
- Where a designated on-street cycling facility exists on one of the intersecting streets, the radius should be configured based on the edge of the motor vehicle lane.
- Where large trucks must be accommodated in areas with significant pedestrian or cyclist activity, truck aprons should be considered. These aprons establish two separate curb radii – a smaller radius for cars which is delineated with a semi-mountable curb,

and a larger radius for trucks which is delineated with a barrier curb.

- Further guidance can be found in the City's Design Specifications and Requirements Manual.



A **channelized turn entrance / exit** in London.



An appropriate motor vehicle **curb radius** is achieved through a curb extension, which also shortens the crossing distance and increases space for green infrastructure.



A **truck apron** in Burlington reduces the speed of motor vehicles making a right turn, but still accommodates large trucks.

2.5 GREEN INFRASTRUCTURE

In the context of complete streets, green infrastructure refers to street elements that support the ecological and hydrological systems in the city. Green infrastructure can improve stormwater management, air quality, biodiversity, and help mitigate the urban heat island effect. Green infrastructure features enhance the aesthetic and comfort of the streetscape, improving physical and mental health outcomes for residents, making walking and cycling more attractive, and reducing perceived wait times for transit riders. Green infrastructure features such as street trees and planted curb extensions in a permanent motor vehicle parking lane can also have a traffic calming effect.

Beyond supporting more livable, complete street design, green infrastructure plays an important role in the City's overall sustainability goals. This section outlines the principles and design features for integrating green infrastructure into the right-of-way. Further guidance can be found in the NACTO Urban Street Stormwater Guide, the City of London Urban Forest Strategy, and the Low Impact Development Stormwater Management Planning and Design Guide developed by the Credit Valley and Toronto Region Conservation Authorities.

Design Principles for Green Infrastructure

- **Reduce, Delay, and Treat Stormwater Runoff:** Stormwater runoff is water that cannot be absorbed into the ground during rainfall, snow, and ice melt events. Stormwater needs to be managed to prevent flooding, downstream erosion, and water quality degradation. In a road corridor, stormwater is traditionally managed by storm sewers to convey runoff away from the road. Green infrastructure such as low impact development (LID) can be implemented along with traditional storm sewers to meet today's stormwater management objectives of promoting infiltration, reducing stormwater volumes, and treating polluted runoff. A variety of LIDs can be utilized within complete streets such as rain gardens and infiltration trenches to infiltrate, temporarily hold and filter stormwater runoff from streets, parking lots, and other hard surfaces. All road projects are invited to consider LIDs in the pre-design phase, especially when median planters are being considered. LID median treatments prevent the need for costly irrigation systems while providing the same aesthetics benefits.
- **Mitigate the Urban Heat Island Effect:** Solar thermal energy can be absorbed or reflected in varying proportions by surfaces. Surfaces such as black asphalt absorb a high proportion of solar radiation which increases the ambient

temperature on sunny days. Parking lots, streets, and other large areas with predominantly low-reflectivity, dark surfaces contribute to higher temperatures in urban environments, making them less comfortable on hot summer days and increasing peak hour electricity demand from air conditioning. Vegetation and high reflectivity surfaces such as concrete or light coloured unit pavers reflect a much larger proportion of solar energy and mitigate the urban heat island effect. Street trees further reduce this effect through shade and evaporative cooling. Light coloured, high reflectivity surface materials and street features such as planting strips, green boulevards, and street trees should be used wherever possible to mitigate the urban heat island effect. Where trees are in the centre median, irrigation should be provided.

- **Complement Sustainable and Active Transportation:** Providing greenery and healthier streetscapes is important to encourage Londoners to walk or cycle more often. Greenery can make the built environment more stimulating for all street users and more inviting for pedestrian activity. Additionally, transit service can be supported with greenery around station locations to make stops more visually appealing and help reduce perceived wait times. Street trees, planted features, and other attractive green infrastructure can also encourage slower motor vehicle speeds and should

be used to improve pedestrian and cyclist safety. When choosing locations for street trees and larger planting beds that may obstruct sightlines, the safety of pedestrian and cyclists should be considered.

Street Trees

- In addition to their environmental benefits, street trees make communities safer, healthier, and more walkable. Well designed and maintained treescapes can increase property values and commercial sales.
- Street trees may be planted directly into soil in the boulevard where there is a continuous 2.0 m or wider strip of soft surface (>3.0 m is preferred). To decrease the impact of salting and snow storage in the landscape strip, trees should ideally be located >2 m from the face of curb. Trees planted <2 m from the face of curb should be salt tolerant species. Where trees are planted in a centre median, the median should have a minimum curb-to-curb width of 3.5 m and irrigation should generally be provided.
- Where there is no structure immediately at the property line, the preferred positioning is typically between the sidewalk and the property line in order to maximize root space, mitigate subsurface utility conflicts with roots, above ground hydro wire conflicts with foliage, and to minimize blockage of street lighting.
- In locations where the boulevard is primarily constructed of hard surfaces, various strategies can be implemented to promote healthy street trees. These include soil cells, soil corridors, and root bridges. Trench and soil cell systems should include a perforated PVC watering pipe and all systems should include drainage.
- Appropriate soil volumes for the eventual mature size of the tree should be provided, which includes a minimum soil depth of 1.0 m. Trees can be planted in groupings so soil volumes are shared.
- In selecting a species and planning for a tree, the "right tree, right place" best practices should be applied. Large stature, native species, and a diversity of species should be selected where conditions permit. Tolerance to road salt,



Street trees can be planted on both sides of the sidewalk where space permits.

drought, and structure/form are also important characteristics that should be considered. If tree planting locations are restricted due to very limited space (above and below ground), small trees and shrubs in above ground planters may be considered.

- Tree canopy coverage can provide a pleasant pedestrian environment, enhanced aesthetics, cooling to adjacent buildings, improved air quality, and habitat for urban wildlife. The selection and positioning of street trees should therefore be done to avoid any conflicts with the mature canopy of the tree.
- Placement of street trees should not obstruct the pedestrian clearway or sightlines at intersections.
- When construction in or near the boulevard is planned, the layout and grading of the design should seek to retain and incorporate mature trees, which help define the character of a community and provide the most ecosystem benefits.
- Where conditions do not permit the planting of trees within the ROW, off-site and private tree planting opportunities in the vicinity should be explored.

Surface Materials

- Soft surfaces such as grassy boulevards, planted curb extensions in a permanent motor vehicle parking lane, planters, and planting beds are rain garden



A **planted median** provides aesthetic and stormwater management benefits.



A **rain garden design** that allows stormwater from the road to enter into the depressed area.



A **rain garden design** on Waterloo St., London

features that provide stormwater and urban heat island benefits and should be implemented in all medians and boulevards, where space is available. These medians and boulevards should include inlets to allow stormwater runoff from adjacent impervious surfaces into the features and be designed to provide

stormwater control.

- Consideration should be given to the use of surface materials that are light in colour and reflect a greater proportion of sunlight. Standard concrete has relatively high reflective properties and special mixes are available to enhance this effect.

Stormwater Management Features

- ‘Rain garden’ is a general term used by the City to describe any LID feature where stormwater runoff flows to a depressed, sodded or landscaped area. Rain gardens can be designed in many shapes and sizes, providing stormwater runoff storage. The term rain garden may be used to describe LID features such as planter boxes, gardens, grassed swales, bioswales, and bioretention cells, where the specific design details vary, but all share in common the ability to receive and infiltrate surface runoff from the surface.
- Many standard landscaped features and boulevards can be designed as rain gardens if consideration for grading is given early in the design progress. Road and other hard surface grading should promote stormwater runoff to be conveyed to planters and landscaped areas. Inlet openings in curbs or other barriers are required at suitable locations (i.e. upstream of catchbasins) to convey runoff into the rain garden. Appropriate vegetative species that can tolerate wet and dry conditions, as well be tolerant to salt should be selected for plantings. The rain garden should be designed to drain within 1-3 days after a heavy rainfall event and should be equipped with an overflow system.
- Subsurface infiltration systems tools, such as perforated pipes or third pipe systems, and infiltration galleries are underground LID systems. Subsurface infiltration could be considered where the boulevard is constrained or where maintaining a landscaped feature would not be suitable. At a minimum, for roadway reconstruction where there are no existing stormwater management controls, traditional SWM controls such as an Oil-Grit Separator should be considered.

2.6 UTILITIES AND MUNICIPAL SERVICES

Utilities include electrical and communications infrastructure, and natural gas mains. Municipal services include watermains and hydrants, storm sewers, sanitary sewers, and street lighting. These utilities and municipal services are essential for our daily lives and must be accommodated within the public road allowances. Street design plays an essential role in coordinating the location and design of these utilities and municipal services in a way that improves safety, maximizes infrastructure life cycles, facilitates repair access, mitigates the impacts of extreme weather, enhances efficiency, and supports the desired right-of-way functions at street level. Further information can be found in the City's Utility Coordinating Committee (UCC) Orientation Manual, UCC Standard Utility Locations Drawing, Design Specifications and Requirements Manual, and various City Standard Drawings.

Utility Design Principles

- **Follow the UCC process:** Utility and municipal service design is a complex process that involves many stakeholders and a broad range of considerations. The City has developed the Utility Coordination Committee (UCC) process to coordinate stakeholders and ensure that decisions are based on a comprehensive understanding of the specific context of a roadway project. The UCC meets biweekly and reviews Municipal Consent Applications (MCAs) which are required by any party seeking to construct within the municipal right-of-way or within a right-of-way that will be assumed by the City. The MCA and UCC seek to achieve consistency using standard utility locations wherever possible.
- **Facilitate access to underground utilities:** Wherever possible, utilities and municipal services (with the exception of sewers) should be positioned beneath a soft surface area, which provides easier access and restoration than concrete or asphalt. Utilities and municipal services should generally be separated horizontally and vertically as much as possible to avoid interfering with one utility while accessing another one. Various communication and electrical utilities should, however, be consolidated into a single duct bank, where possible. Separation should also be provided from trees to the greatest extent possible.
- **Street-level design should be driven by surface uses, not utilities:** While underground utilities are as important as street level elements, the lateral placement of underground utilities is

often more flexible than surface street elements. Street-level design should therefore be determined first and foremost by the needs of pedestrians, cyclists, transit users, and motorists, as well as various operational considerations. Utilities and municipal services should be coordinated to fit into this design, and should only determine street level design where specific constraints exist.

- **Consider aesthetics:** Above ground utilities should be designed with due consideration of the surrounding streetscape, particularly in Heritage Conservation Districts. Decisions such as whether to have electric and communication utilities above ground or below ground, pole and light fixture specifications, and art on utility boxes are examples of how aesthetic considerations can be integrated into utility design.

Watermains

- Watermains are pipes that provide Londoners with drinking water and also supply water to fire hydrants. Most streets only have a single watermain on one side of the street.
- The City has over 1,550 km of watermain in its drinking water network and seeks to rebuild 1% of this network each year.
- Since watermains are under constant pressure, they do not need to maintain a specific slope. Rather, the depth of a watermain relative to the surface should always be greater than 1.7 m to avoid freezing and always less than 1.9 m to facilitate access for emergency repairs.
- Emergency access is an important consideration in determining the preferred placement of a watermain.

When a break occurs, adjacent properties lose water service and localized flooding may occur. Flooding can also trigger the formation of sinkholes resulting in significant damage to the roadway and potential safety risks. Facilitating rapid emergency access and minimizing the cost to restore the surface after a repair has been made are therefore important considerations.

- The standard position for watermains is 4.9 m from the property line and watermains are typically the closest utility to the roadway curb. Locating the watermain in a soft surface area is preferred in order to facilitate emergency access. Where this is not achievable, positioning the watermain beneath a motor vehicle parking lane, cycling facility, or sidewalk is preferred.
- Valves are required at specified distances along the watermain network and at every connection to a property or a hydrant and should be visible / accessible from the surface. Shut-off valves at each property are located 0.3 m from the property line, inside the right-of-way.
- In order to provide a valve between the watermain and the fire hydrant, hydrants should be positioned between 1.0 m and 10.0 m perpendicular to the watermain.

Storm Sewers

- Storm sewers collect precipitation runoff from the street, boulevard, and adjacent properties. Runoff enters the storm sewer via a catch basin at the edge of the roadway and a pipe (catch basin lead) that connects the catch basin to the storm sewer. Many buildings also have a foundation drain that connects to the



Catch basin positioned outside of the wheel path of vehicles and bicycles in London.

storm sewer.

- The sewer pipe and all connections to it must all be constructed with a minimum slope (varies depending on size and flow rate) in order for water to flow through the system to the appropriate receiving outlet.
- The minimum depth of a storm sewer is 1.5 m from the finished surface to the top of the sewer. Sewers are typically located underneath the roadway offset 1.5 m from the centreline of the road. Where there is a median in the roadway, the sewer is typically positioned 1.5 m from the edge of the median. The minimum separation between the storm sewers and the sanitary sewers is 3.0 m.
- Maintenance holes and frame covers are located in the roadway but should ideally be positioned to avoid the typical wheel path of vehicles and bicycles (positioned in the centre of the lane or between lanes).
- The vertical clearance between a sanitary and storm sewer, where they cross, is 230 mm. Note that this dimension is to the outside of both pipes. The thickness of the pipes must be considered in determining minimum clearances.
- The pavement surrounding a catch basin is more susceptible to degradation than other parts of the roadway and an apron design (such as OPSD 705.002) is preferred to position the catch basin outside of the wheel path of the curb lane.
- Herringbone catch basin grates (or similar designs) which have openings that are not parallel to the path of travel are preferred, as they reduce the risk of a cyclist wheel becoming caught in the gap.
- The vertical clearance between a storm sewer and the crown of a watermain must be 0.5 m, as stated in MOECC F-6-1 Procedure 5.

Sanitary sewer

- Sanitary sewers collect water that has been used in sinks, tubs, toilets, and other appliances in residential, commercial or industrial buildings. This water may contain human waste, detergents, and other chemicals which are treated before being discharged into a receiving body of water.

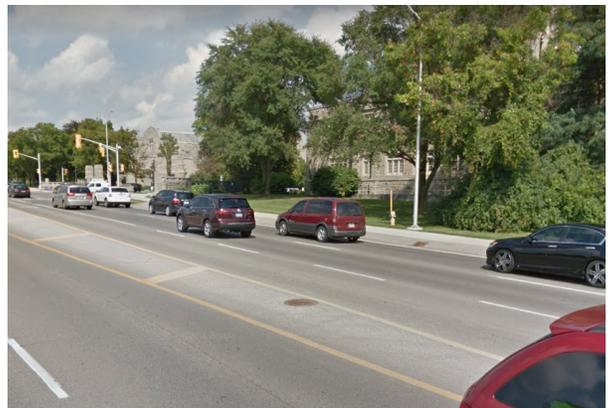
- The sewer pipe and all connections to it must all be constructed with a minimum slope (varies depending on size and flow rate) in order for water to flow through the system to the appropriate treatment facility.
- The minimum depth of a sanitary sewer is 2.4 m from the finished surface to the top of the sewer. Sewers are typically located underneath the roadway offset 1.5 m from the centreline of the road. Where there is a median in the roadway, the sewer is typically positioned 1.5 m from the edge of the median. The minimum separation between the storm and the sanitary sewers is 3.0 m.
- Maintenance holes and frame covers are located in the roadway but should ideally be positioned to avoid the typical wheel path of vehicles and bicycles (positioned in the centre of the lane or between lanes).
- The vertical clearance between a sanitary and storm sewer, where they cross, is 230 mm.
- The vertical clearance between a sanitary sewer and the crown of a watermain must be 0.5 m, as stated in MOECC F-6-1 Procedure 5.

Overhead Electrical and Communications Utilities

- Advantages of providing electrical and communication utilities overhead include implementation cost effectiveness and much easier access for maintenance purposes.
- Challenges of providing electrical and communication utilities overhead include the vulnerability of wires to damage caused by ice and falling tree branches in a storm, conflict with street trees, and a negative impact on the streetscape aesthetic.
- Higher capacity transmission lines are typically overhead rather than underground.
- Communications infrastructure includes telephone, TV cable, and fibre optic networks and are privately owned utilities. Multiple private networks may service the same street.



Overhead electricity and communications cables provide easier access but are vulnerable to tree/ice damage and detract from the streetscape's experience.



Maintenance holes positioned outside the wheel path of vehicles and bicycles in London.



Coordination of pole use to accommodate multiple traffic signal heads and street lighting on a single pole in London.



Before/After LED lighting upgrade shown (King St in London). LEDs are more energy efficient and provide better quality lighting.

- Traffic signal, street lighting, and utility poles should be coordinated to minimize the number of poles in the right-of-way to the greatest extent possible.

Underground Electrical and Communications Utilities

- Advantages of providing electrical and communication utilities underground include less risk of damage from trees or ice, no conflicts with tree branches, and enhanced streetscape aesthetics.
- Challenges of providing electrical and communication utilities underground include the cost of implementation and difficulty in accessing lines for repair.
- Transformer boxes are required above the surface and should be positioned on a concrete pad close to the property line outside of the snow storage area.
- Communications and electrical cables are typically located in the boulevard between the watermain and the gas main and are typically provided on both sides of the street. They should be positioned beneath a soft surface area in the boulevard, though they may be positioned beneath the sidewalk, if necessary.
- Communication and electrical cables should maintain a consistent alignment relative to the edge of the right-of-way to the greatest extent possible.
- The preferred configuration for communication and electric cables is in a duct bank to consolidate the cables, though many existing lines are currently contained in concrete encased conduits and/or direct buried conduits.
- Communication cables must be buried at least 0.6 m below the surface in the boulevard, or 0.8 m below the surface when under the roadway. Electrical cables must be buried at least 0.9 m below the surface in the boulevard or 1.1 m below the surface when under the roadway.
- Cable vaults are underground chambers that provide access to various cable connections and switches. The vaults are large structures that typically provide sufficient space for workers to access. Designers must ensure that the vaults do not impact other utilities or municipal services.

Street Lighting

- Street lighting is essential for accessibility, security, and traffic safety purposes. Lighting standards vary by street classification and should be consistent with the Illuminating Engineering Society Recommended Practice #8 (IES RP-8).
- Light fixtures should be designed to mitigate light pollution and focus light onto the public right-of-way (full cut-off, dark sky compliant).
- LED fixtures are used for all new installations to maximize energy efficiency.
- In Heritage Conservation Districts, special consideration should be given to using street light poles and fixtures that are appropriate for the heritage context.
- The position of luminaires should be coordinated with street trees to minimize light obstruction from the trees. Where a continuous raised centre median exists, street lighting may be provided in the median.
- Typically, both the roadway and the pedestrian realm can be sufficiently illuminated with the same poles and fixtures. However, in areas with high pedestrian volumes, wide rights-of-way, or street trees that may obstruct lighting in the pedestrian realm, pedestrian scale lighting may be considered. These conditions are most likely to exist on Main Streets and Rapid Transit Corridors, and The London Plan accommodates pedestrian-scale lighting for these street classifications.
- Consideration for pedestrian-scale lighting should be balanced with the

City's energy reduction targets, and should typically only be used in localized areas where it provides a clear benefit.

- Underground electrical cables for street lighting should be slightly laterally offset from the line of poles to accommodate a handhole at each pole.

Gas Mains

- Gas mains supply properties with natural gas for heating purposes and are a privately owned utility.
- Gas mains are under constant pressure, and any leak is a safety hazard due to the flammable nature of natural gas.
- Gas mains are typically provided on both sides of the street and are typically positioned 1.2 m from the property line, depending on the design of the boulevard. They should be positioned beneath a soft surface area, though they may be positioned beneath the sidewalk, if necessary. Where possible, gas mains should be positioned away from trees in order to prevent roots from damaging the main and to avoid damaging trees if access to the gas main is required.
- Gas mains should be buried at least 0.8 m below the surface in the boulevard, or 1.0 m below the surface if they are positioned under the roadway.
- Valves and regulator pits (underground chambers) are required at various intervals along the gas main network. A valve is provided on each service connection to an adjacent property.

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Queens Ave.



3

UNDERTAKING COMPLETE STREETS DESIGN

3.1 PROCESS OVERVIEW

Achieving the City's complete streets vision requires a comprehensive process that spans from the initial planning and prioritization stage to project implementation and monitoring. City staff and consultants who are incorporating complete streets elements into capital projects for new construction, reconstruction, or rehabilitation should complete the following five stage process.

Plan: Identify and prioritize candidate complete streets and begin scoping a project.

Conceptualize: Envision what the complete street design could look like, engage the internal and external stakeholders necessary to support the project, and establish design priorities.

Process for Complete Street Planning and Design

	Goal	Tools
ENVIRONMENTAL ASSESSMENTS	1 PLAN	<ul style="list-style-type: none"> • Prioritize projects • Complete Streets Audit Tool • Project Scope Tool
	2 CONCEPTUALIZE	<ul style="list-style-type: none"> • Coordinate between divisions / disciplines and develop the project scope based on the vision from The London Plan and the Complete Streets Design Manual • Project Scope Tool • Chapter 2: Elements of Complete Streets • Chapter 4: Street Design • Chapter 5: Street Design for Intersections • Checklist for Designers and Reviewers • Stakeholder Map – Internal • Complete Streets Audit Tool
	3 DESIGN	<ul style="list-style-type: none"> • Retain consultant, if applicable, and prepare 30%, 60%, 90%, and 100% design drawings • Document rationale for key design decisions • Project Scope Tool • Chapter 2: Elements of Complete Streets • Chapter 4: Street Design • Chapter 5: Street Design for Intersections • Stakeholder Map – External • Street Classification Priorities Tool • Street Element Decision-making Tool
	4 IMPLEMENT	<ul style="list-style-type: none"> • Retain contractor, if applicable, and build design
	5 MONITOR	<ul style="list-style-type: none"> • Monitor to optimize operations and learn for future projects • Chapter 6: Moving Forward with Complete Streets

Process workflow for capital and growth projects

Design: complete the preliminary and detailed design, balancing the trade-offs, priorities, and inputs from stakeholders and project objectives.

Implement: Tender and construct project while communicating with stakeholders.

Monitor: Evaluate the performance of complete streets and integrate lessons learned into future projects.

Street design projects that are led by developers are subject to the City's four-stage File Manager review process for development applications. This process ensures that complete streets design principles are incorporated into new development sites and subdivisions. The File Manager workflow and the five-stage complete streets design process outlined on the opposite page are integrated with each other as indicated by the arrows below.

Workflow for Developer-Led File Manager Projects

	Goal	Tools
1 INITIAL PROPOSAL REPORT AND CONSULTATION	<ul style="list-style-type: none"> Ensure that the developer has incorporated complete streets design criteria in their initial proposal (as reflected in this design manual, The London Plan and the applicable secondary plan) 	<ul style="list-style-type: none"> Chapter 2: Elements of Complete Streets Chapter 4: Street Design for Roadways Chapter 5: Street Design for Intersections Checklist for Designers and Reviewers Street Classification Priorities Tool Street Element Decision-making Tool
2 DRAFT APPROVAL	<ul style="list-style-type: none"> Exceptions to ROW or design guidelines meet or exceed the requirements in The London Plan and this manual Ensure that design criteria and guidelines are reflected in draft plan approval conditions 	<ul style="list-style-type: none"> Checklist for Designers and Reviewers Street Classification Priorities Tool Street Element Decision-making Tool
3 FOCUSED DESIGN STUDIES / CONSOLIDATED DRAWING REVIEW	<ul style="list-style-type: none"> Ensure that guidelines and conditions are reflected in applicable design studies and servicing plans 	<ul style="list-style-type: none"> Chapter 2: Elements of Complete Streets Chapter 4: Street Design for Roadways Chapter 5: Street Design for Intersections Context Analysis Checklist – Part 1 Street Classification Priorities Tool Street Element Decision-making Tool Stakeholder Map – Internal
4 FINAL APPROVAL	<ul style="list-style-type: none"> Approved application advances to construction 	<ul style="list-style-type: none"> Stakeholder Map – Internal

Process workflow for development review process

3.2 PLANNING

Street improvement projects are typically initiated and prioritized in the following three ways:

- **state of good repair**, such as street rehabilitation or resurfacing;
- a desire to **improve performance**, typically with respect to motor vehicle throughput, such as widening a thoroughfare to alleviate congestion; or
- a **new street** being constructed in an area with new development.

These established processes can be refined to take a more complete streets approach. For example, state of good repair projects for streets with cycling facilities should take into account the increased vulnerability of cyclists to road surface deterioration.

In addition to the above approaches the following processes, tools and strategies should also be considered in the identification and prioritization of new projects.

Capital Coordinating Committee (C3) Process

The C3 committee coordinates infrastructure projects across relevant City divisions. Complete streets are an important design consideration in the C3 process, which provides opportunities to deliver multi-modal and streetscape improvements. Asset renewal priorities are a principal output from the C3 process, as are the timelines (construction years) in which infrastructure assets such as streets are rehabilitated or reconstructed. These priorities and timelines are key inputs into the planning stage.

Environmental Assessments

The Municipal Class Environmental Assessment (EA) process is a key tool in the planning and design of municipal infrastructure. This process typically aligns to Stage 2: Conceptualize and to the preliminary part of Stage 3: Design in the complete street design process. Completed road EAs can also help to identify and prioritize investments in complete streets and to inform Stage 1: Planning.

Network Planning and Gap Identification

Network planning and gap identification consists of monitoring network composition and identifying key missing links in pedestrian, cycling, transit and freight networks. Plans, such as the City's Transportation Master Plan and Cycling Master Plan are then developed to implement these connections. Network planning is discussed in detail in chapter 6.

Pilot Projects

Many complete street changes can be implemented, at least on an interim basis, with minimal or no physical construction. This can be done by modifying pavement markings and using planters, flexible bollards and pre-cast curbs to change the configuration of a street. These low cost interventions provide an opportunity to experiment and collect data and are therefore particularly valuable to inform decision-making for major capital investments such as reconstruction projects. Pilot projects should be considered wherever there is a compelling rationale to reallocate street space and viable complete street configuration that fits between the existing curbs.

Secondary, Tertiary, Subdivision, and Site Plans

The CSDM interfaces with the four-stage developer-led File Manager process. Developments are expected to incorporate the design elements of applicable complete street classifications, such as the Neighbourhood Street and Neighbourhood Connector. Once the appropriate street classifications that support the development concept are identified, the corresponding right-of-way width as indicated in The London Plan should be protected, and both The London Plan and the tools in this chapter should be used to determine appropriate street elements to be included within the right-of-way. For the most current development charges rate and guidance, refer to www.london.ca/business/Resources/Development-Financing.

Monitoring

Monitoring involves tracking data that is collected by the City to identify and prioritize candidate corridors. For example, collision data, reviewed through a network screening or warrant analysis, may reveal locations or intersections that have higher risk exposure or disproportionately high collision rates, particularly those involving cyclists, pedestrians, and vulnerable groups such as seniors and children. Baseline data should be reviewed prior to undertaking work, and compared to post-completion performance in the monitoring stage. See section 3.6 and chapter 6 for additional information on monitoring.

Auditing Existing and Proposed Conditions with a Complete Streets Lens

Auditing involves the assessment of specific street segments, based on aspects such as public and stakeholder input or in response to collision analysis, to assess completeness and determine an appropriate project scope to enhance completeness.

Complete Street Audit Tool

The Complete Street Audit Tool evaluates and visualizes the ‘completeness’ of a street in its existing condition. It can also be used to evaluate a proposed design for a street. The tool is integrated with the Street Classification

Priorities Tool, shown in Section 3.4. The Street Classification Priorities Tool indicates the relative priority ranking for each mode / street function based on the street classification. This information is, in turn, based on guidance from The London Plan, and street design best practices. The Complete Streets Audit Tool compares the existing condition with this desired balance of priorities.

The tool is formatted as an interactive Excel file, which allows it to be easily used and adapted by a wide variety of users. Users first select a Street Classification from the drop down (step 1 below) and then rate the current conditions for the eight street element categories such as pedestrian realm or transit service (step 2). The selected street typology automatically loads the priority rankings from the Complete Street Priorities Tool and the graph on the right of the step 3 figure displays the difference between desired and existing conditions. The bar graph visualization shows where existing conditions exceed, match, or fail to meet the priorities for a given street classification.

For the example shown, existing conditions on a sample street are evaluated with the assistance of the priority rankings for the Neighbourhood Collector street classification. The visualization suggests that increased design emphasis should be placed on supports for pedestrians, cyclists, and green infrastructure. The street appears to be balancing transit, on-street parking, and through movement priorities.

STREET CLASSIFICATION | Neighbourhood Collector

- Rapid Transit Boulevard
- Main Street
- Urban Thoroughfare
- Civic Boulevard
- Neighbourhood Collector**
- Neighbourhood Street
- Rural Thoroughfare
- Rural Connector

Priority Level | 5

Current Conditions (user input) | 2

Exceeds (+) / Fails (-) to Meet Priorities

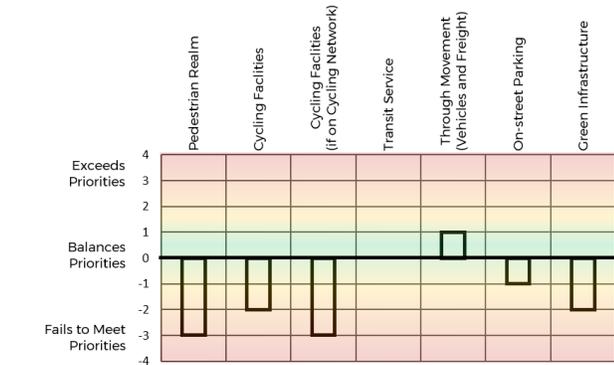
- 5
- 4
- 3
- 2
- 1**

1 Select street classification

2 Rate street elements

STREET CLASSIFICATION | Neighbourhood Collector

	Pedestrian Realm	Cycling Facilities	Cycling Facilities (if on Cycling Network)	Transit Service	Through Movement (Vehicles and Freight)	On-street Parking	Green Infrastructure
Priority Level	5	3	4	3	2	3	4
Current Conditions (user input)	2	1	1	3	3	2	2
Exceeds (+) / Fails (-) to Meet Priorities	-3	-2	-3	0	1	-1	-2



3 Results for Neighbourhood Collector

Defining Conditions and Priorities

The following table serves as a guide for assessing existing conditions when using the Complete Streets Audit Tool. It also helps to describe, at a high level, what

different priority levels typically mean for different street elements. From an operational perspective, the multi-modal level of service (MMLOS) indicators outlined in Chapter 6 can also be used to assess existing conditions and establish goals for future operations.

Street Conditions/Priorities Guideline Tool

Conditions (Existing) or Priorities (Conceptual) Definitions					
	1	2	3	4	5
Pedestrian Realm	<ul style="list-style-type: none"> Dedicated pedestrian facilities are not present or may be provided in the form of a granular or soft shoulder Pedestrian signals provided at all signalized intersections where pedestrians are permitted 	<ul style="list-style-type: none"> Concrete sidewalk approximately 1.5 m wide or a multi-use pathway Even surfaces in good condition Consistent use of basic accessibility features such as tactile walking surface indicators and AODA compliant traffic signals 	<ul style="list-style-type: none"> Concrete sidewalk typically wider than 1.5 m Highly accessible design Pedestrian amenities such as seating and waste receptacles based on user demand Shade trees provided where feasible 	<ul style="list-style-type: none"> Concrete sidewalk typically wider than 1.5 m Highly accessible design Consistent use of pedestrian amenities such as seating and waste receptacles Shade trees, planters and rain garden enhance the pedestrian experience 	<ul style="list-style-type: none"> Concrete sidewalk wider than 2.0 m and able to accommodate peak pedestrian demand Same accessibility, amenity and green infrastructure features as Level 4 Animated pedestrian corridor with active street frontages and public art
Cycling Facilities	<ul style="list-style-type: none"> No cycling facility No designated bicycle parking 	<ul style="list-style-type: none"> Dedicated facilities are provided if sufficient space is readily available Cycling environment is comfortable for commuter cyclists Bicycle parking available where there is observed demand 	<ul style="list-style-type: none"> Dedicated facilities or motor vehicle speed and volume management Cycling environment is comfortable for less experienced cyclists Bicycle parking consistently available 	<ul style="list-style-type: none"> Dedicated or separated facilities and/or speed and volume management Consistently comfortable intersection crossings Bicycle parking consistently available and able to meet peak demand 	<ul style="list-style-type: none"> Same facilities as Level 4 A cycling environment, including intersections that is supportive of all ages and abilities Secure bicycle parking and other end-of-trip facilities (such as repair stations) are present
Transit Service	<ul style="list-style-type: none"> No transit service Stop has no hard surface pad 	<ul style="list-style-type: none"> Local transit service with limited transit priority elements Stop has hard surface pad allowing passenger boarding/alighting from all doors Stop has sign and shelter (based on demand) 	<ul style="list-style-type: none"> Frequent local transit service with some transit priority elements Stops typically have shelters and basic amenities (seating, waste receptacles) 	<ul style="list-style-type: none"> Frequent local service or limited stop express service with significant transit priority elements Stops have the same as amenities as Level 3 as well as real-time information Stops may be enhanced by green infrastructure elements (such as trees and planters) 	<ul style="list-style-type: none"> Rapid transit service with comprehensive priority measures Stops include same amenities and green infrastructure as Level 4 as well as fare payment machines, heated shelters, and a raised curb for level boarding

While a higher LOS (LOS A or B) corresponds to a higher priority ranking (4 or 5), this relationship is not a direct translation of values. There may be many operational reasons, such as induced demand for motor vehicle travel, that could prevent a high priority ranking from achieving a corresponding high LOS.

	1	2	3	4	5
Through Movement (Vehicles and Freight)	<ul style="list-style-type: none"> • Emphasis is on corridor as a "Place" • Priority on pedestrian zone, placemaking, public realm and restricting through movement • Lowest capacity • Regular freight movement not appropriate or possible 	<ul style="list-style-type: none"> • Priority on pedestrian zone, placemaking, public realm while balancing through movement demand • Regular freight movement not desirable 	<ul style="list-style-type: none"> • Balance of priorities between pedestrian zone and through movement of people and freight • Medium to high capacity • Regular freight movement with some restrictions 	<ul style="list-style-type: none"> • Priority on mobility and through movement of people and freight • Medium to high capacity • Regular freight movement in most contexts • Signal coordination to increase capacity 	<ul style="list-style-type: none"> • Emphasis is on corridor as a "Link" • Priority on mobility and through movement of people and freight • Highest capacity • Regular freight movement • Signal coordination to increase capacity
On-Street Parking	<ul style="list-style-type: none"> • On-street parking is not provided 	<ul style="list-style-type: none"> • Some permanent or off-peak parking is provided if there is sufficient space within the ROW and demand cannot be met with off-street supply • Parking is typically available on one side of the street only 	<ul style="list-style-type: none"> • Permanent or off-peak parking is provided • Parking may be on one or both sides of the street 	<ul style="list-style-type: none"> • Permanent or off-peak parking is provided • Parking is typically on both sides of the street • Passenger drop-off, freight loading, and accessible parking zones are provided where there is demand 	<ul style="list-style-type: none"> • Similar parking provision to Level 4 • Parking systems incorporate smartphone payment and dynamic pricing strategies • Consideration given to parking integration that is responsive to new mobility uses such as ridesharing and autonomous vehicles
Green Infrastructure	<ul style="list-style-type: none"> • Street trees and stormwater management practices are not actively provided • Planting arrangement has substandard soil volumes and planting configuration 	<ul style="list-style-type: none"> • Tree canopy at maturity meets coverage guideline in most locations • Design incorporates low impact development (LID) features where possible • Planting configuration and soil volumes conform to DSRM and 'right tree, right place' guidelines 	<ul style="list-style-type: none"> • Tree canopy at maturity meets coverage guideline • Design incorporates low impact development (LID) features where possible • Planting configuration and soil volumes conform to DSRM and 'right tree, right place' guidelines 	<ul style="list-style-type: none"> • Tree canopy at maturity exceeds coverage guideline • Design incorporates low impact development (LID) features • Planting configuration and soil volumes conform to or exceed DSRM and 'right tree, right place' guidelines 	<ul style="list-style-type: none"> • Tree canopy at maturity exceeds coverage guideline • Sustainability, resilience and ecological principles are primary themes of the design • LID incorporated in a comprehensive manner • Planting configuration and soil volumes conform to or exceed DSRM and 'right tree, right place' guidelines

Defining Scope

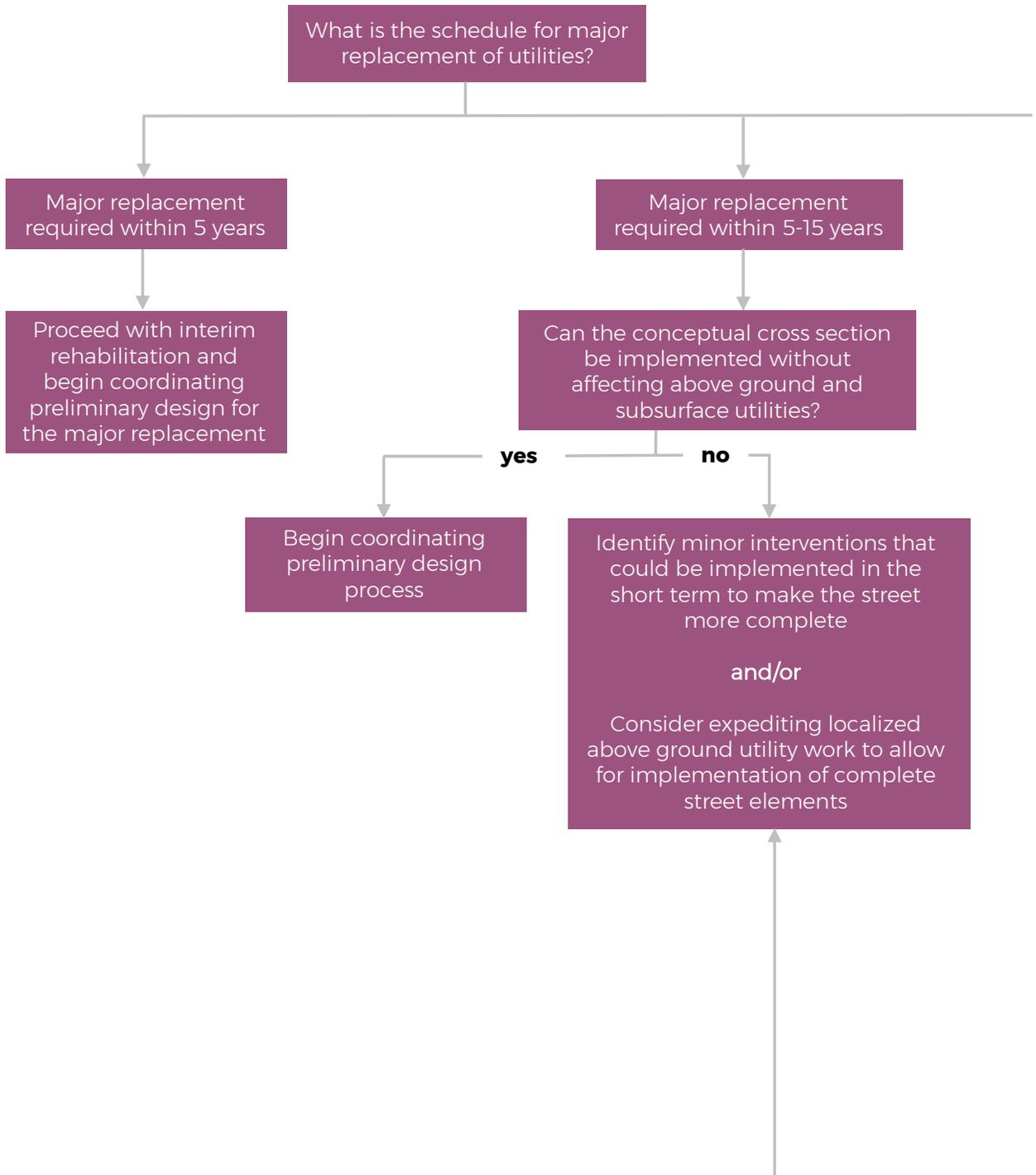
The Project Scope Tool can be used to help identify the most appropriate project scale for a specific corridor. Project scales are consistent with the definitions in the C3 Manual.

The condition of subsurface utilities and the cross section that emerges from the Street Element Decision Making Tool (see Section

3.4) are the most important factors that determine the appropriate project scale and are key parameters in the Project Scope Tool.

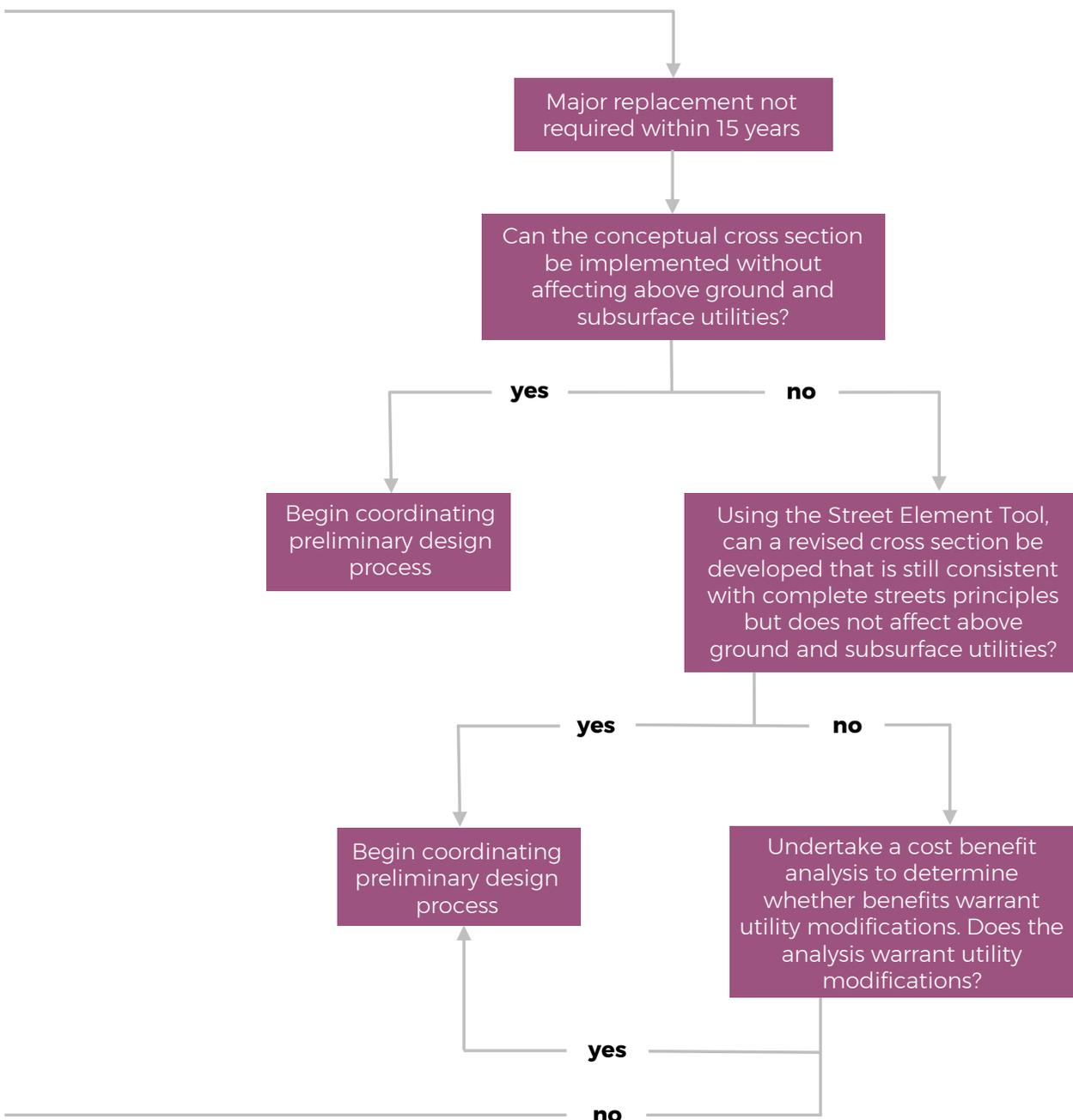
Scoping a project using this tool should begin in the planning stage. However, since the tool requires an understanding of potential utility impacts and a high-level feasibility assessment of a particular

Project Scope Tool



design, the tool should be used iteratively throughout the first two stages of the complete street design process (Plan and Conceptualize).

Within the flow chart below, the term "utilities" encompasses both private utilities and municipal services.



Checklist for Designers and Reviewers

2 | CONCEPTUALIZE

1 Select the corresponding **Chapter 4 cross section**

Review the design elements for the selected cross section and advance to step 2.

2 Select the corresponding **Chapter 5 intersection examples**

Review the design principles that should be incorporated into the corridor design and advance to step 3.

3 Design review of **core design considerations**

Accommodation of the user groups and services below are key design considerations.

If the answer is **no** to any of the questions below, the applicant (if a developer) or project lead (if a City project) should provide a rationale for why a variance is being proposed and how the proposed concept design will be consistent with complete streets principles.

If **yes**, advance to the next consideration.

Pedestrian

Are the pedestrian elements contained in the corresponding chapter 4 rendering incorporated into the proposed concept design? Do they have similar size/width, distribution along the corridor, and positioning as the elements in the ch. 4 rendering?

Cycling

Are the cycling facility elements contained in the corresponding chapter 4 rendering incorporated into the proposed concept design? Do they have similar size/width, consistency along the corridor, and positioning as the elements in the ch. 4 rendering?

Transit

Are the transit supportive elements contained in the corresponding chapter 4 rendering incorporated into the proposed concept design? Do they have similar size/width, distribution along the corridor, and positioning as the elements in the ch. 4 rendering?

Motor Vehicle

Are the motor vehicle supportive elements contained in the corresponding chapter 4 rendering incorporated into the proposed concept design? Do they have similar size/width, consistency along the corridor, and positioning as the elements in the ch. 4 rendering?

Green Infrastructure

Are the green infrastructure elements contained in the corresponding chapter 4 rendering incorporated into the proposed concept design? Do they have similar size/width, distribution along the corridor, and positioning as the elements in the ch. 4 rendering? Do they meet applicable guidelines in terms of soil volume and lateral placement?

Utilities and Municipal Services

Are the utility elements contained in the corresponding chapter 4 rendering incorporated into the proposed concept design? Do they have similar depth, configuration and positioning as the elements in the ch. 4 rendering and / or the UCC utility drawing?

Each rationale for any **no** responses to the above questions should be evaluated with a combination of professional judgment and engagement with relevant internal stakeholders to determine if the proposed variance/exception is acceptable. For example, if proposed tree planters have less soil volume than the guideline, a Parks and Forestry representative should be consulted to determine if the variance is acceptable in this case.

4 Review and revise the conceptual cross section based on **land use considerations**

Place Types

Are there specific place type provisions or policies that would affect the design of this corridor?

If **yes**, determine whether any modifications would be appropriate based on provisions for the place type as specified in The London Plan.

Municipal Services

Are there any municipal services that are scheduled for replacement or construction in the corridor?

- If **yes**, update inputs into the Project Scope Tool, and identify opportunities to align project scopes, design parameters, and construction phasing.

Heritage Conservation Districts (HCDs)

Are any segments of the corridor located within a HCD?

- If **yes**, ensure a heritage planner is involved as a stakeholder and determine if any streetscaping or right-of-way-related HCD policies apply.

Community Improvement Plans (CIPs)

Are any segments of the corridor located within a CIP area?

- If **yes**, ensure the appropriate planner is involved as a stakeholder and determine if any streetscaping or right-of-way-related CIP policies apply.

Conservation Authorities

Are any segments of the corridor located within a conservation authority regulated area?

- If **yes**, ensure that a conservation authority representative is engaged as a stakeholder and determine if any relevant watercourse or natural resource area protection policies apply.

Rail Authorities

Do segments of the corridor intersect with railway facilities?

- If **yes**, consult with the applicable railway authority and determine if there are future plans or existing regulations that could influence design considerations.

Future Development

Is development activity anticipated along any segments of the corridor?

- If **yes**, consult with the appropriate land use planner to identify parcels with existing or expected development applications, consult with key land owners, and analyze future needs and travel patterns along the corridor.

First Nations

Are there First Nations communities that could be impacted?

- If **yes**, contact relevant First Nations representatives and engage them as an external stakeholder.

5 Review and revise the conceptual cross section based on relevant network considerations

Cycling Network

Are any segments of the corridor aligned with a designated or proposed cycling network route in the Cycling Master Plan?

- If **yes**, prioritize comfortable cycling facilities and associated amenities such as left turn queue boxes and bicycle parking.

Transit Network

Are any planned or existing rapid transit corridors or conventional transit routes aligned to any segment of the corridor? Whether or not the corridor is part of a current transit route, consider appropriate accommodations for paratransit vehicles and increased ridesharing activity.

- If **yes**, review existing and forecasted routing and ridership, and provide rider amenities and transit priority treatments as appropriate. Ensure roadway geometry accommodates transit vehicles.

Freight Network

Are any segments of the corridor aligned with heavy vehicle routes?

- If **yes**, review roadway geometry parameters to ensure that freight vehicles are appropriately accommodated.

Wildlife Corridors

Do any segments of the corridor abut or intersect with known wildlife corridors?

- If **yes**, review corridor to determine potential wildlife crossing locations.

Operational and Traffic Calming Issues

Are there known issues regarding motorist behaviour or road operations?

- If **yes**, determine if appropriate geometric changes and / or traffic calming measures can be incorporated.

6 Review and revise the conceptual cross section based on relevant user considerations

All streets should be designed to accommodate all users. However, where a specific user group is anticipated to be more prevalent on a corridor, it may be appropriate to enhance the design to support that user group. For example, the City's 1.5 m standard width for sidewalks accommodates individuals with disabilities. If this user group is anticipated to be particularly prevalent, such as near a medical facility, a wider sidewalk should be considered to better meet their needs. The groups below should influence design considerations if they are anticipated to be present in significant proportions along the corridor.

Children (proximity to a school)

- If **yes**, consider providing wider sidewalks, well-designed drop-off areas, and in-boulevard cycling facilities.

Post secondary students (proximity to university/college or student residence)

- If **yes**, consider increasing transit priority, providing wider sidewalks, and providing high capacity cycling facilities in proximity to post-secondary institutions and areas with significant student housing.

Individuals with disabilities and elderly

- If **yes**, provide frequent seating opportunities, wider sidewalks, and well-designed accessible transit drop-off areas near seniors residences, hospitals and related facilities.

Underserved communities

- If **yes**, prioritize safe and comfortable links to common social, employment and civic destinations used by low income and vulnerable communities.

3.3 CONCEPTUALIZING

Once a corridor has been identified for potential improvements, the next step is to imagine what the corridor might look like as a complete street. The starting point should be the corresponding Chapter 4 cross section, followed by the appropriate Chapter 5 intersection configuration. Building on this foundation, land use, transportation network and user considerations should be reviewed and, if necessary, the cross section should be revised accordingly.

The Checklist for Designers and Reviewers is a project management tool that guides stages 2 (Conceptualization) and 3 (Design) of the complete street planning process. It assists the project manager in tracking key steps such as reviewing the corridor context, identifying network constraints and opportunities, and establishing design criteria and parameters.

Collaboration

Rethinking streets with a complete streets lens often requires establishing connections between the various uses of the ROW that may not be as apparent in conventional street design. For example, adding a cycling facility in the boulevard requires consideration of street tree positioning, visibility from the motor

vehicle lane, utility pole positioning, street furniture positioning, separation from the sidewalk, and integration with transit stops. Responsibility for each of these elements frequently lies with different divisions, agencies, and stakeholders. Collaboration between the numerous divisions, agencies, and stakeholders, is critical to maximize the value of investments and ensure project goals are achieved.

At the Conceptualizing Stage, it is important to begin engaging stakeholders to understand priorities, constraints, available resources, and asset conditions. The Stakeholder Map Tool identifies key City divisions and agencies that may be involved in the planning and development of Complete Streets Projects, as well as external groups that provide valuable input into the planning and design process.

Stakeholder Map Tool

Internal

Environmental and Engineering Services

-  Water Engineering
-  Regional Water Supply
-  Wastewater and Drainage Engineering
-  Stormwater Engineering
-  Transportation Planning and Design
-  Roadway Lighting and Traffic Control
-  Rapid Transit Implementation
-  Construction Administration
-  Solid Waste Management
-  Geomatics
-  Sewer Operations
-  Wastewater Treatment Operations
-  Water Operations
-  Transportation and Roadside Operations

Planning Services

-  Urban Design
-  Urban Regeneration
-  Long Range Planning and Research
-  Environmental and Parks Planning
-  Urban Forestry

Development and Compliance Services

-  Development Finance
-  Development Services

Parks and Recreation Services

-  Parks Operations

Finance and Corporate Services

-  Realty Services

Neighbourhood, Children, and Fire Services

-  Neighbourhood, Children, and Fire Services - Administration

External

-  Adjacent Residents and Businesses
-  Upper Thames River Conservation Authority (UTRCA)
-  Lower Thames Valley Conservation Authority
-  Kettle Creek Conservation Authority
-  London Transit Commission (LTC)
-  Rail Authorities
-  Business Improvement Areas (BIAs) / Business Associations
-  First Nations

Education

-  Thames Valley District School Board
-  London District Catholic School Board
-  Viamonde (French Public Board)
-  Providence (French Catholic Board)
-  Western University
-  Fanshawe College

Utilities

-  Bell
-  London Hydro
-  Rogers
-  Start Communications
-  Union Gas
-  London District Energy

Advisory Committees

-  Transportation Advisory Committee
-  Cycling Advisory Committee
-  Diversity, Inclusion, and Anti-Oppression Advisory Committee
-  Trees and Forests Advisory Committee
-  Accessibility Advisory Committee

3.4 DESIGNING

At the design stage, various constraints may require trade-offs to be made in order to develop a design that can feasibly be implemented. This section of the Manual provides guidance on how to adapt the conceptual cross section based on spatial constraints, budgetary constraints, public input, and asset life cycles. The tools in this section are designed to support a transparent and strategic decision-making process that is consistent with complete streets principles.

Design Phases

The design process can be divided into two sub-phases:

- **Preliminary design:** the desired outcomes of this sub-phase include a confirmed project scope, a preferred cross section, 30% design drawings, a preliminary construction cost estimate, intersection concepts, and a documented design rationale.
- **Detailed design:** the desired outcomes of this sub-phase include a tender package with 100% design drawings, specifications, and the final construction cost estimate.

Project Levels

The City C3 process classifies projects into three levels:

- **Rehabilitation:** Generally, no streetscape improvements, but opportunity for changes between existing curbs.
- **Reconstruction:** May include work between curbs and in the boulevards. Significant opportunity for complete street implementation. The Utility Coordination Committee (UCC) should be engaged to determine if utilities are nearing the end of their life cycle and if modification, replacement, or relocation is required.
- **Major Projects:** Large-scale capital projects with specific scope and a minimum 5 year project timeline. These projects provide the most significant opportunity for complete street implementation. Utility relocation, if it is required, should be completed one year prior to construction.

External factors may influence capital priorities and anticipated construction years. As such, the project levels can accommodate a degree of fluidity and

flexibility. For example, a project that was identified as being a rehabilitation project could be elevated to a reconstruction project if the replacement year for a subsurface asset is advanced. Additionally, rehabilitation work could be conducted along the majority of the length of a corridor but a new element such as a parking bay could be implemented in one short segment where it is needed.

Consultation

Consultation is an important part of the design process. In some cases, the public may be engaged as early as the Conceptualizing Stage, to get input on design priorities and better understand usage patterns and local issues. The conclusion of the preliminary design phase is an important consultation opportunity as the design is sufficiently advanced for the public to appreciate what it will look like, but not so far advanced that changes can no longer be made if there is a strong rationale to do so. A final consultation at the conclusion of the detailed design process can help inform the community about what to expect both during construction and once the project is completed.

Coordination between departments is also critical during the design stage. The benefits of coordination include:

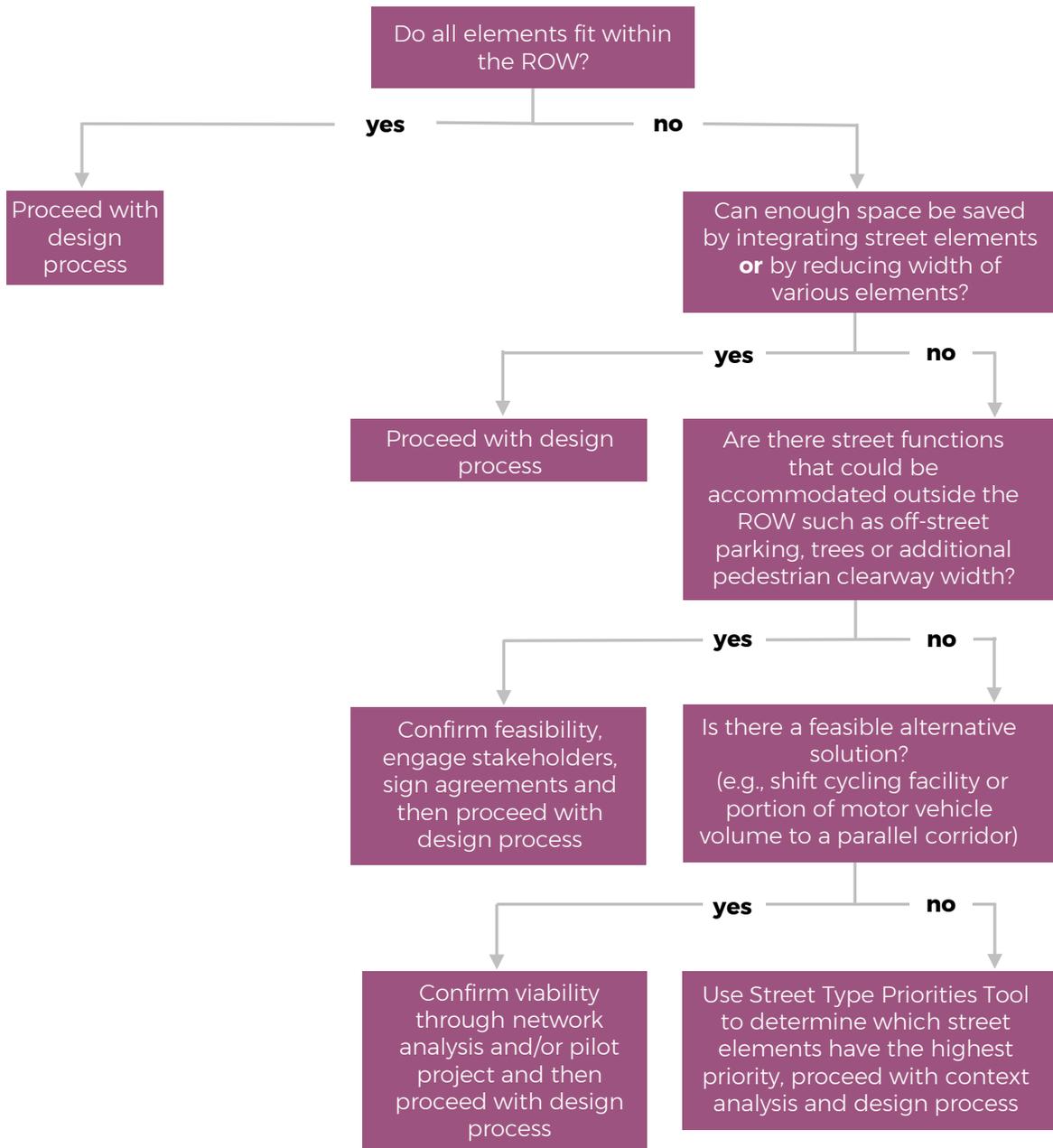
- Identifying and confirming design parameters and project scope
- Addressing emerging issues at the earliest possible stage of design
- Developing solutions for constrained areas or competing priorities with charrettes or workshops

Making Decisions About Street Elements

The purpose of this tool is to determine whether the conceptual cross section could be implemented within the right-of-way (ROW), which on many existing

corridors is narrower than the preferred width outlined in The London Plan. The tool outlines suitable alternatives that should be considered in cases where the ROW is not sufficiently wide.

Street Element Decision Making Tool



Integrated Street Elements

In a constrained environment, it may become necessary to integrate street elements and use the same ROW space to perform multiple functions. Examples are described below.

- **Street tree planters alternating with parking bays:** Street tree planters and parking bays typically have similar widths and could occupy the same zone within the ROW in an alternating pattern. Considerations include demand for on-street parking and loading and the existing and desired tree canopy along the corridor.
- **Integrated cycle track and transit stops:** Transit bus stops adjacent to cycle tracks can be integrated in constrained environments. Pavement markings and tactile plates can be used to indicate boarding and alighting zones for passing cyclists. Signage can be used to notify cyclists that they should stop to allow passengers to board/alight a bus when it is servicing the stop. Considerations include the anticipated volume of transit passengers and the anticipated volumes of cyclists.



Example of an integrated cycle track and transit stop in Toronto.

- **Accommodating mature trees:** Shifting the lateral alignment of design elements such as sidewalks and/or discontinuing the design elements (such as bay parking) in the vicinity of a mature tree can accommodate these other uses without sacrificing the tree. Considerations include the tree's health and expected lifespan and the impact of realigning / discontinuing the other street element (accessibility implications of shifting the sidewalk alignment). If the tree is in poor health, it should be considered for removal and appropriate replacement plantings provided nearby.

Minimum Dimensions

Designers should begin the design process assuming typical widths for street elements, as described in Chapter 2. Prior to considering minimum dimensions (in pinch points or constrained areas), consideration should be given to the following:

- Anticipated user volumes
- Relative priority of each element, given the street classification and overall project objectives
- Operations or maintenance requirements
- Need for physical separation of cyclists and auto modes
- Permanence of facility and ability to modify it in the future

If minimum dimensions are required, consideration should be given to:

- Alert and guide users through signage and pavement markings while avoiding excessive signing
- Ensure appropriate sightlines are maintained
- Prioritize area for ongoing user behaviour monitoring

Street Classification Priorities

In cases where the ROW does not have sufficient width, and the alternatives included in the street element decision making tool have been exhausted, it may not be feasible to include all the desired street elements on a specific corridor. In this case, the Street Classification Priorities Tool provides guidance in determining which elements should be included within the constrained space available. These priorities are grouped by user / function and are based on information contained in The London Plan (where available). The priority levels designated for each user / function are relative, and are compared across each street classification.

While it is critical to define impacts and required changes to utilities, they are typically not an optional component of a street design. There is generally less flexibility in design parameters for subsurface utilities than other street features on the surface. As such, utilities are not included in the Street Classification Priorities Tool.

Street Classification Priorities Tool

	Pedestrian Realm	Cycling Facilities	Cycling Facilities (on Cycling Network)	Transit Service	Through Movement (Vehicles and Freight)	On-Street Parking	Green Infrastructure
Rapid Transit Boulevard	5	2	4	5	4	1	4
Main Street	5	2	5	4	3	3	4
Urban Thoroughfare	3	2	4	4	5	1	3
Civic Boulevard	4	3	5	4	4	2	3
Neighbourhood Connector	5	3	4	3	2	3	4
Neighbourhood Street	5	2	4	1	1	3	4
Rural Thoroughfare	1	1	4	1	5	1	2
Rural Connector	1	1	3	1	3	1	2

Relative Priorities Scale



3.5 IMPLEMENTING

Upon completion of the design stage, implementation may begin through the tender and construction award process.

Tendering for Complete Streets

Some complete streets design elements and construction techniques may be less familiar to some contractors and contract administrators. It is important that the City or developer identify a contractor with appropriate experience and competency to implement all the features in the street design. Design staff/consultants, contract administrators, and contractors should maintain open lines of communication throughout the construction process to ensure that all street elements are constructed appropriately.

Outreach and Education Strategy

New designs for complete streets may incorporate design elements such as cycle tracks, crossings, signage, turn boxes, and lane markings, some of which may be new to Londoners. In order to minimize confusion and optimize operations, a public education strategy should be developed prior to opening a facility with new design features. Such a strategy may include the following:

- **Public education** via outreach events at nearby schools and civic facilities

- **Content on City website** providing guidance on street design features and how they should be used
- **Social media campaign** to encourage resident engagement with complete streets improvements as they are undertaken
- **Police presence** in the opening week to address questions and demonstrate appropriate use of new facility types

During the construction process and Environmental Assessment process, residents should be consulted and informed as per municipal policy and the requirements of the Municipal Class Environmental Assessment process for schedules A+, B, and C.

Maintenance Strategy

A strategy for ongoing maintenance should be prepared and ready to be implemented once the facility opens. Operating cost impacts that may be incurred by the introduction of new facilities should be identified and included in divisional operating budgets.

3.6 MONITORING

As the City leverages the growing interest in multi-modal travel and undertakes improvements to achieve the City's vision for complete streets outlined in Chapter 1, it will be critical to measure success and integrate lessons into future initiatives. Data gathered and lessons learned will assist in evaluating completed complete street project and benefit future projects by informing Stage 1: Planning.

Learning for Future Projects

Thinking of urban streets as complete streets is a relatively recent approach to planning, engineering, and design. Industry-wide, standards of practice are being refined as more streets and urban corridors are constructed or retrofitted. Municipalities are adapting these practices to be appropriate to their local contexts. Learning what worked well and what could be improved for the next project is critical for ongoing success and a valuable tool to inform the City's complete streets program as it matures.

Lessons learned (positive and negative) should be documented and circulated to relevant divisions to ensure that future designs benefit from the experience and knowledge gained.

Areas of learning include:

- **User behaviour and comprehension:** Tracking behavioural patterns for facilities such as cycle tracks, transit stops, and multi-use pathways. These issues may indicate the need for additional public outreach to communicate the desired use of the new facilities. They may also relate to the consistency or condition of a street element that can be addressed with minor design changes, pavement marking changes, or signage.

- **Conflict mitigation:** Document interventions made (pavement marking or design changes) to minimize observed conflicts between user types.
- **Operations and maintenance:** Document any emerging issues associated with complete street implementation and identify strategies to address them. Examples include snow removal, sweeping, and pavement marking durability.
- **Constructibility / implementation cost and asset life cycle:** Total implementation costs and any challenges during the implementation phase should be tracked. Changes undertaken to address the factors listed above will likely have associated costs that should be tracked. This will contribute to a dataset that facilitates a more accurate cost/benefit assessment of each approach undertaken to address emerging issues.

More on Monitoring

Specific metrics to monitor the performance and vitality of complete streets and strategies to collect data are discussed in chapter 6.





4

STREET DESIGN

4.1 STREET TYPOLOGIES

Streets provide both a mobility function and a place function. The mobility function is about moving people whereas the place function is about attracting people, and the relative importance of these two functions varies for each street. Some streets provide a quiet environment where neighbours get to know each other on the sidewalk and kids can play or learn to ride a bike. Other streets are bustling with activity, draw tourists, and offer a broad range of amenities in close proximity. And other streets connect different parts of the City and give priority to the mobility function. While each street is unique, many streets share common features, and a street typology is a useful way of thinking about streets with similar mobility and place functions.

This chapter applies the general guidance contained in Chapter 2 to each specific street classification and illustrates how the various aspects of street design (pedestrian, motorist, green infrastructure, etc.) can fit together. Each section of this chapter is based on the specific street classification vision that is articulated in The London Plan. For each street classification, renderings illustrate the typical right-of-way configurations and accompanying text describes various design options and priorities. The illustrations should not, however, be viewed as definitive designs, since the right-of-way width, place type, bicycle network, transit network and utility configurations are all important contextual factors that affect the preferred design. The renderings are examples of how a street could be designed and serve as a starting point for the design process described in Chapter 3.

London’s street network

The figure on the following page shows a map of London’s street classifications based on The London Plan and also indicates the relative length of each street classification in the City’s network based on centreline kilometres. Provincial highways and expressways are shown on the map but not included in the measurement.

Neighbourhood Streets and Neighbourhood Connector Streets make up the largest proportion of the network, which means that scalable, cost-effective solutions are likely to have the greatest impact on these streets. Major redesigns and investments on specific Neighborhood Streets and Connectors are sometimes appropriate, but typically only benefit those who live on or near the street.

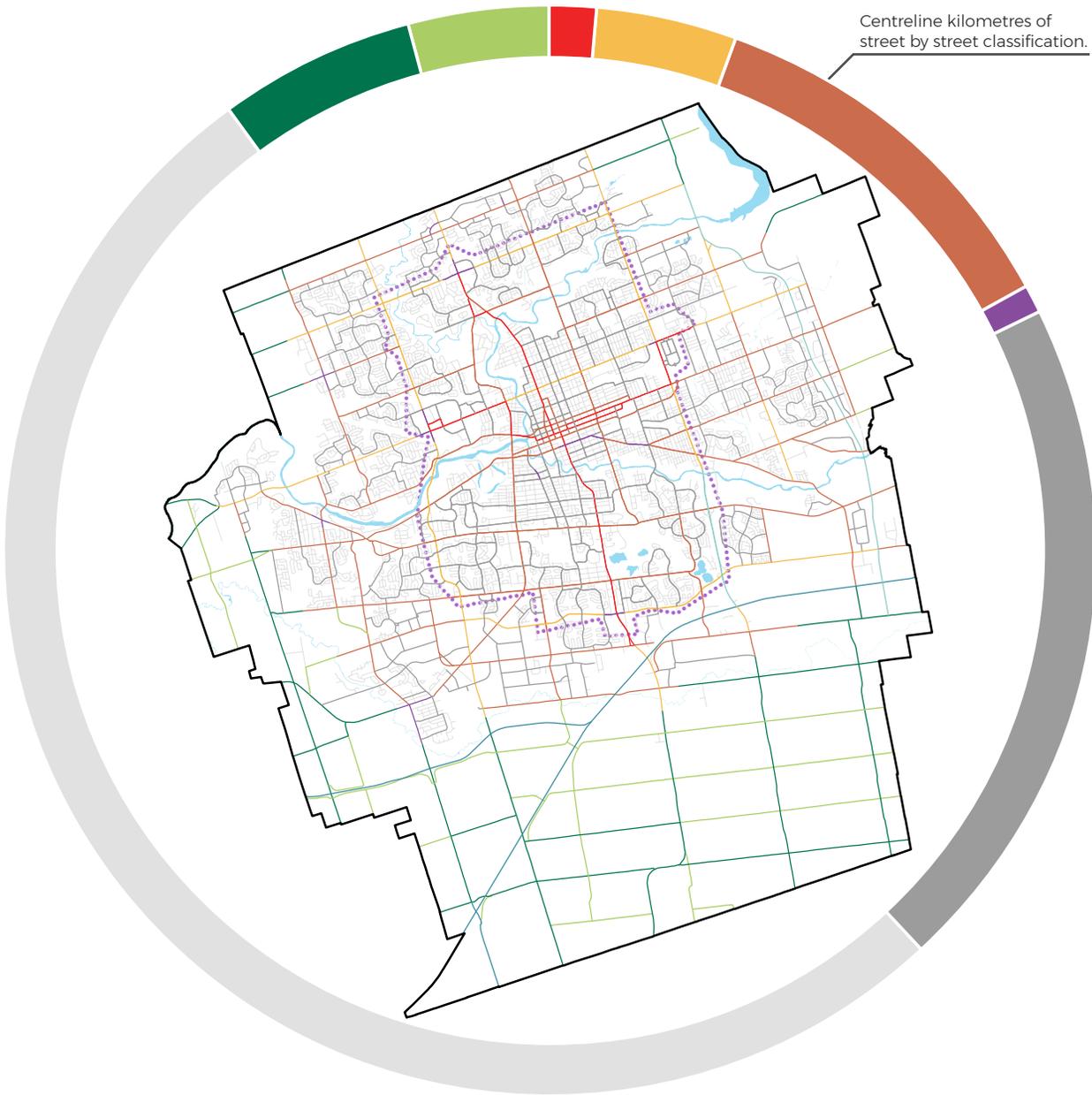
Main Streets, by contrast, make up only a very small proportion of the street network, but are generally used by residents from many nearby neighbourhoods. Developing unique, transformative solutions that allow these corridors to reach their full potential is both more feasible and benefits more people. This also applies to Rapid Transit Boulevards, many of which will be reconfigured through the implementation of rapid transit. The Rapid Transit Boulevard design guidance in this chapter reflects the historic opportunity that London has to design vibrant multi-modal streets for the 21st century.

Urban and Rural Thoroughfares, Civic Boulevards, and Rural Connectors each make up a moderate proportion of the network, and cost-effective small scale enhancements as well as larger transformative redesigns may be equally applicable for these street classifications.

For reference, Table 4.1 categorizes the eight complete street typologies into the more common arterial, primary collector, secondary collector, local, and rural street/road types.

Functional Classification	The London Plan Classification
Arterial	Rapid Transit Boulevard Main Street Urban Thoroughfare Civic Boulevard
Primary/Secondary Collector	Neighbourhood Connector
Local	Neighbourhood Street
Rural Roads	Rural Thoroughfare Rural Connector

Table 4.1: Complete street classification.

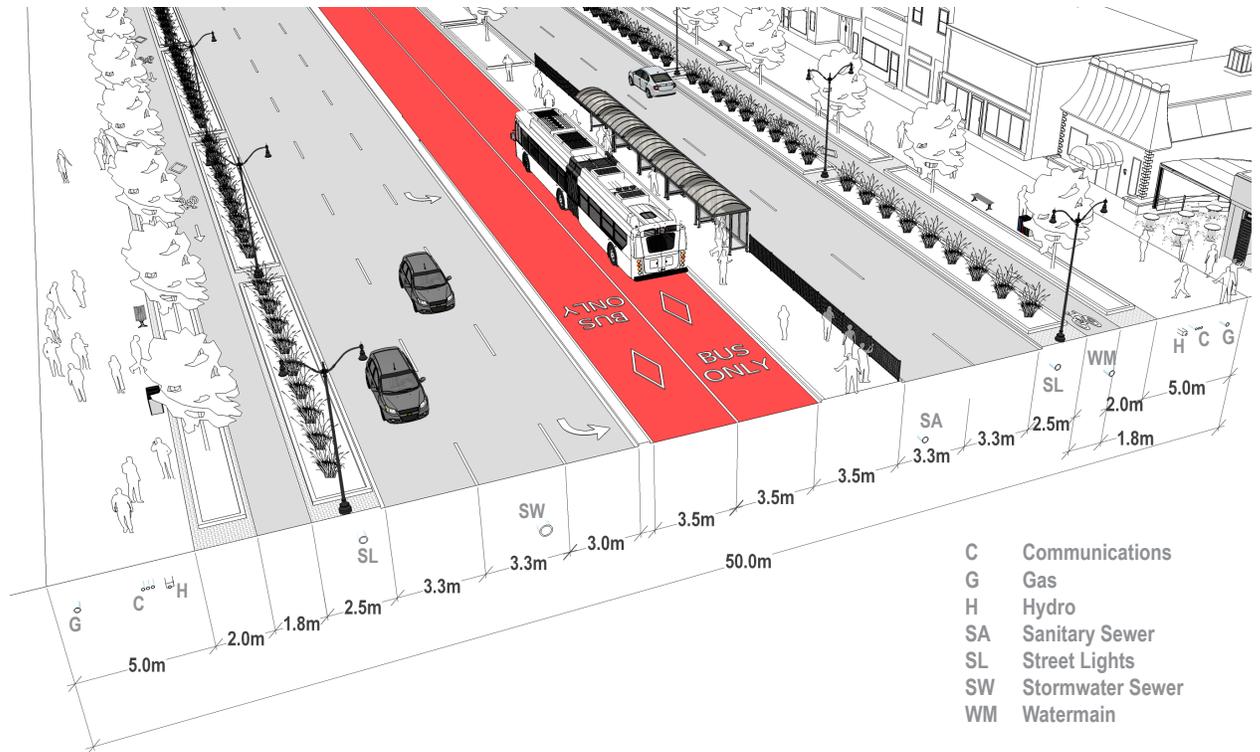


- Provincial Expressway — Urban Thoroughfare [dotted] Primary Transit Area
- Provincial Highway — Neighbourhood Connector
- Rapid Transit Boulevard — Neighbourhood Street
- Civic Boulevard — Rural Thoroughfare
- Main Street — Rural Connector

Map of street classifications in the City of London.

Note: this figure was draft at the time the manual was prepared and is subject to appeal and revision

4.2 RAPID TRANSIT BOULEVARD



Rapid Transit Boulevards are the corridors that be transformed to incorporate London’s planned rapid transit (RT) network. These important transit routes are associated with the Rapid Transit Corridor and Transit Village Place Types detailed in The London Plan. The preferred right-of-way width for these streets is 50 m. These corridors accommodate many different land uses including employment, retail, institutional, recreational and residential. The City’s vision for these corridors includes efficient, high capacity transit service, a vibrant public realm, and moderate to high density mixed-use transit-oriented development.

Pedestrians

- The presence of significant destinations and residential development along these corridors can generate large volumes of walking trips by a broad range of users including mobility device users and children.
- High quality public realm should include seating, waste receptacles, publication boxes, shade trees and where appropriate pedestrian wayfinding, lighting and pedestrian clearway widths between 2.0 and 5.0 m.
- The pedestrian clearway should be set at least 1.5 m back from any adjacent motor vehicle travel lane.
- The boulevard should be constructed of primarily hard surfaces where there is a transit station area, on-street parking, significant pedestrian activity, or active building frontages; otherwise soft surfaces may be considered.

- Enhanced crosswalk treatments should be included where appropriate.
- Transit platforms facilitate two stage crossings at intersections, which makes the crossing more manageable / accessible for slower pedestrians. Due to the large road width of these corridors, consideration should be given to providing signalized intersections or signalized pedestrian crossings at regular intervals and / or where a crossing desire line is observed, in accordance with OTM Book 15. Transit signal priority and appropriate stop spacing can generally ensure the frequency of signals does not negatively affect transit operating speed.

Cyclists

- Cycling facilities may be considered on all Rapid Transit Boulevards, especially those included in the City’s Cycling Master Plan as these corridors provide significant destination access, connectivity to

- downtown and rapid transit access.
- Due to the typical volume and speed of both motor vehicle traffic and transit operations, physically separated and continuous facilities are preferred.
- Where transit operations use the curb lane, cycling facilities should be designed to minimize conflict between buses, boarding passengers, and cyclists.
- Secure, weather sheltered bicycle parking should be considered at or near RT stations.
- To facilitate snow storage the buffer between motor vehicle travel / parking lanes and cycling facilities should be 1.0 m or greater.
- Left turn queue boxes (in-boulevard or on-street) are desirable to provide connectivity for cyclists who are not comfortable cycling in traffic.
- Entrances and intersections should be marked to alert all road users to the intended travel path of cyclists.

Transit

- The provision of frequent and efficient transit service is prioritized above other motor vehicle movements on these streets.
- Centre median, dedicated transit lanes are preferred; where transit operations use the curb lane, boulevard island transit stops are preferred to mitigate cyclist conflicts.
- Where dedicated transit lanes are not possible, queue jump lanes should be considered.
- Transit signal priority should be implemented at all signalized intersections.
- Bus shelters, seating, and real-time schedule displays should be considered at all RT stops.
- Bus bays may be considered in particular circumstances (layover stops, site specific safety considerations, etc.) however the priority should be on minimizing transit delay.

Motorists and Freight

- Emergency and street maintenance vehicles may use dedicated transit lanes.
- Typically 5-8 lane cross sections, including dedicated transit and turn lanes.
- Paid permanent or off-peak parking may be provided, depending on demand, off-street parking supply, and right-of-way width.

- Freight and emergency vehicles are important considerations in determining lane widths and curb radii.
- Desired separation between driveway accesses is 75 m or greater; where centre median transit lanes exist, driveway accesses be right-in / right-out only.
- Preferred design speed: 50-60 km / h.

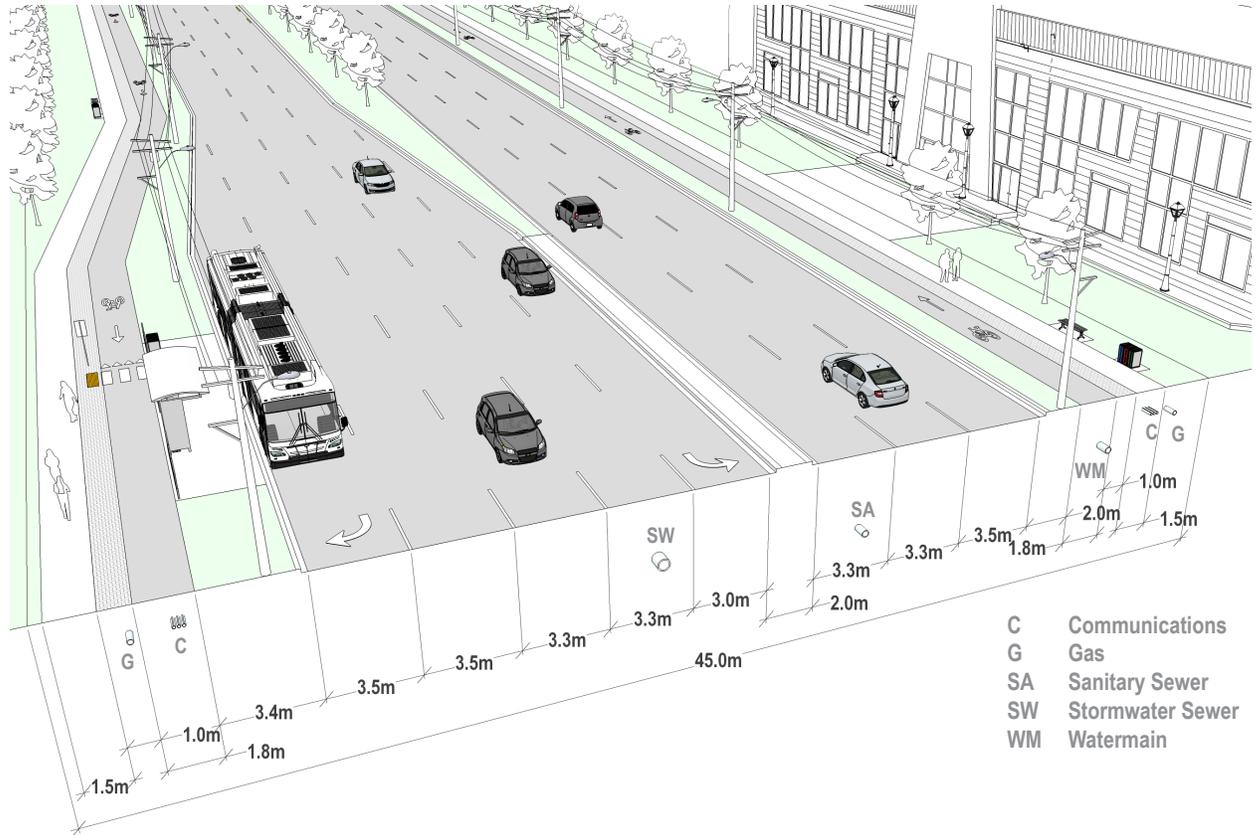
Green Infrastructure

- Boulevards are typically constructed of hard surfaces, but where context permits, soft, planted boulevards may be implemented.
- Street trees are highly desirable and their location should be determined by "The Right Tree, Right Location" selection process. This process matches site conditions with the appropriate tree which can include ensuring the proper amount of soil volume is available to support the eventual mature size of the tree.
- Streets trees may also be placed in grates and planter beds if planting in boulevard green space is impractical or undesirable.
- Planted medians may be implemented where appropriate.

Utilities

- Private utilities should not be located beneath the RT lane and public utilities located beneath the RT lane should be avoided; no utilities should be located beneath RT stop platforms.
- Hydro and communications cables are typically overhead. Hydro, communications, traffic signal and street lighting poles should be coordinated and their preferred positioning is between the sidewalk and the roadway. Cycling facilities may be positioned on either side of the poles.
- The preferred location for gas mains is in the boulevard; consideration should be given to mitigating conflict between a gas main and tree roots.
- Storm sewers and sanitary sewers are all typically located beneath a motor vehicle travel lane.
- Watermains are more likely to require access for maintenance and repair than sewers and should be located beneath the cycling facility, in the boulevard or beneath a parking or curb lane to minimize disruption if access is required.
- Utility maintenance should be performed outside of rapid transit operating hours.

4.3 URBAN THOROUGHFARE



Urban Thoroughfares provide efficient connections between different parts of London. With a preferred right-of-way width of 45 metres, these corridors accommodate a high volume of through traffic and are important corridors for goods movement. They accommodate many different land uses, often on large land parcels, including residential, employment, retail, institutional and recreational. The City’s vision for these corridors includes moderate density development and active street frontages.

Pedestrians

- The variety of destinations along these corridors can generate some pedestrian trips, though the typical distance between destinations limits pedestrian activity.
- Planted medians can facilitate informal pedestrian crossing activity, however signalized pedestrian crossings should be considered where there is evidence indicating a pedestrian crossing desire line (based on land uses, observations, incidents) and no crossing opportunities exist in close proximity, as per OTM Book 15.
- Pedestrian facilities should be set at least 1.5 m back from an adjacent motor vehicle travel lane.
- Sidewalks should be provided on both sides of the street; in less urban areas, multi-use pathways may be an appropriate alternative.
- Where pedestrian volumes are high the

public realm between the curb and the building face should be constructed of primarily hard surfaces.

Cyclists

- Since these corridors connect the rural and central parts of London and sometimes provide access to commercial and institutional destinations, they can generate moderate volumes of cycling traffic. Cycling facilities should be considered on those corridors that are included in the City’s Cycling Master Plan.
- Due to the typical volume and speed of motor vehicle traffic, physically separated and continuous facilities are preferred.
- To facilitate snow storage the buffer between motor vehicle travel / parking lanes and cycling facilities should be 1.0 m or greater.
- One-way cycle tracks are generally

preferred, though two-way cycle tracks should be considered where crossing opportunities are infrequent and may lead to cyclists using a facility to travel in the contraflow direction. If two-way bicycle operation is accommodated, appropriate signal strategies, pavement markings, and signage should be used at all intersections and driveways.

- Entrances and intersections should be marked with elephant feet, bicycle (and if applicable pedestrian) stencils and optional green pavement markings to alert all road users to the intended travel path of cyclists.

Transit

- The design of transit stops and provision of amenities such as shelters, benches, waste receptacles, etc. should be based on stop usage (boardings / alightings).
- Boulevard island stops are preferred where cycling facilities are provided in the boulevard; in more constrained environments, integrated cycle track platform stops may be appropriate.
- While bus bays are typically not preferred (see Section 2.3 for exceptions) the high travel speeds on these corridors should be considered, especially for far-side stops where motorists may not anticipate a stopped vehicle in a motor vehicle travel lane. Consideration should also be given to the expected delay for transit users (if any), and the total person-hour delay for traffic and transit users should be compared for in-lane and bus bay stop configurations.

Motorists and Freight

- A four, five or six lane cross section is typical, in addition to turn lanes.
- Off-peak parking may be provided on-street in more urban environments, though it is more frequently provided off-street (preferably behind development).
- Freight and emergency vehicles are important considerations in determining lane widths, curb radii and the suitability of raised medians.
- Desired separation between driveway accesses is 150 m or greater.
- Preferred design speed: 60 - 70 km / h.

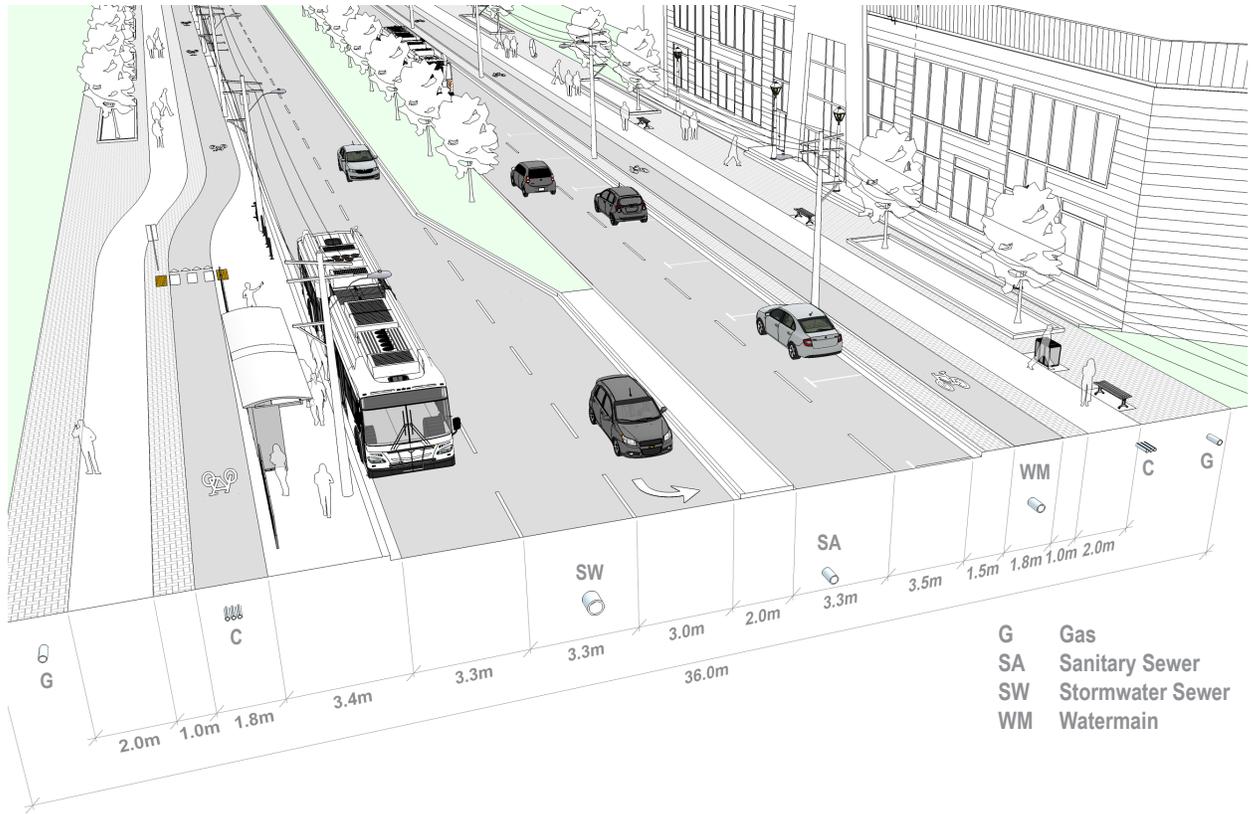
Green Infrastructure

- The boulevard is typically constructed of soft surfaces except where on-street parking is provided and parking utilization is high, in which case the boulevard between the motor vehicle parking lane and the sidewalk should be constructed with a hard surface.
- Street trees are highly desirable and their location should be determined by "The Right Tree, Right Location" selection process. This process matches site conditions with the appropriate tree which can include ensuring the proper amount of soil volume is available to support the eventual mature size of the tree.
- Planted centre medians may be appropriate if they do not have an undue negative impact on emergency services' response times or demand for left turns into / from private property.
- Planters can be integrated into gateway features at strategic entrance points to the City along these corridors.

Utilities

- Hydro and communications cables are typically overhead. In constrained locations, the preferred positioning for utility poles, signal poles and light standards is between the cycling facility / multi-use trail / sidewalk and the roadway where snow is typically stored.
- Wherever possible, hydro, communications, traffic signals and street lighting should be coordinated to use the same poles.
- The preferred location for gas mains is in the boulevard, beneath a soft surface area; consideration should be given to mitigating conflict between a gas main and tree roots.
- Storm sewers and sanitary sewers are typically located beneath a motor vehicle travel lane.
- Watermains are more likely to require access for maintenance and repair than sewers and should be located beneath the cycling facility, the boulevard, the curb or the motor vehicle parking lane to minimize disruption if access is required.

4.4 CIVIC BOULEVARD



Civic Boulevards provide multi-modal connections between different neighbourhoods across the City including downtown. With a preferred right-of-way width of 36 m, these corridors provide for multi-modal travel, with a priority on pedestrian, cyclist and transit movements, while moving medium to high volumes of vehicular traffic and provide access to many prominent destinations. Land uses fronting onto Civic Boulevards include residential, employment, retail, institutional and recreational. The City’s vision for these corridors includes transit-supportive development with moderate density development and active street frontages.

Pedestrians

- The density and variety of destinations along these corridors can generate significant volumes of walking trips by a broad range of users including mobility device users. Children are also likely to be part of the user group for these corridors.
- Pedestrian crossovers or pedestrian refuge islands should be considered where the gap between signalized intersections exceeds 400 m, or when justified by pedestrian desire lines, connectivity considerations, or pedestrian and vehicular volume, as per OTM Book 15.
- A high quality public realm is a priority and should include seating, waste receptacles, publication boxes, shade trees and where appropriate pedestrian wayfinding and clearway widths

exceeding the 1.5 m minimum standard.

- The pedestrian clearway should be set at least 1.5 m back from any adjacent motor vehicle travel lane.

Cyclists

- Density and variety of destinations as well as the connectivity provided by these streets can generate significant volumes of bicycle traffic. Cycling facilities should be considered on all corridors, especially those included in the City’s Cycling Master Plan.
- Due to the typical volume and speed of motor vehicle traffic, physically separated and continuous facilities are preferred.
- The preferred width of the buffer zone between a cycling facility and the adjacent motor vehicle travel or parking

lane is 1.0 m to accommodate snow storage, however narrower buffers are possible depending on snow clearing procedures.

- Due to the presence of frequent driveway accesses and potential conflict zones between motorized vehicles and cyclists, unidirectional cycling facilities on both sides of the street are recommended.
- Left turn queue boxes (in-boulevard or on-street) are desirable to provide connectivity for cyclists who are not comfortable cycling in traffic.
- Entrances and intersections should be marked to alert all road users to the intended travel path of cyclists.

Transit

- The provision of frequent and efficient transit service is prioritized on Civic Boulevards. Queue jump lanes, transit signal priority and bus shelters should be considered at all intersection / stop locations.
- The design of transit stops and provision of amenities such as shelters, benches, waste receptacles, etc. should be based on stop usage (boardings / alightings).
- Cycling facilities may be integrated into the stop with pavement markings and signage indicating that cyclists must yield to pedestrians when bus doors are open. At stops with significant peak period boardings and alightings, and where there is sufficient space, an island transit stop should be considered to mitigate pedestrian-cyclist conflict.
- Bus bays are typically not preferred (see Section 2.3 for exceptions). Where there is a desire to include bus bays, consideration should be given to the expected delay for transit users (if any), and the total person-hour delay for traffic and transit users should be compared for in-lane and bus bay stop configurations.

Motorists and Freight

- A 3-5 lane cross section is typical. Depending on access requirements, either a planted median or two-way left turn lane may be appropriate.
- On-street parking is permitted and may be off-peak only or permanent.
- Freight and emergency vehicles are important considerations in determining lane widths, curb radii and the suitability of raised medians.
- Desired separation between driveway accesses is 75 m or greater.
- Planted medians can be included to enhance aesthetics, facilitate pedestrian crossings and separate oncoming vehicular traffic, though frequent breaks may be required to accommodate left turn vehicle access and left turn vehicle storage.
- Preferred design speed: 60 km / h.

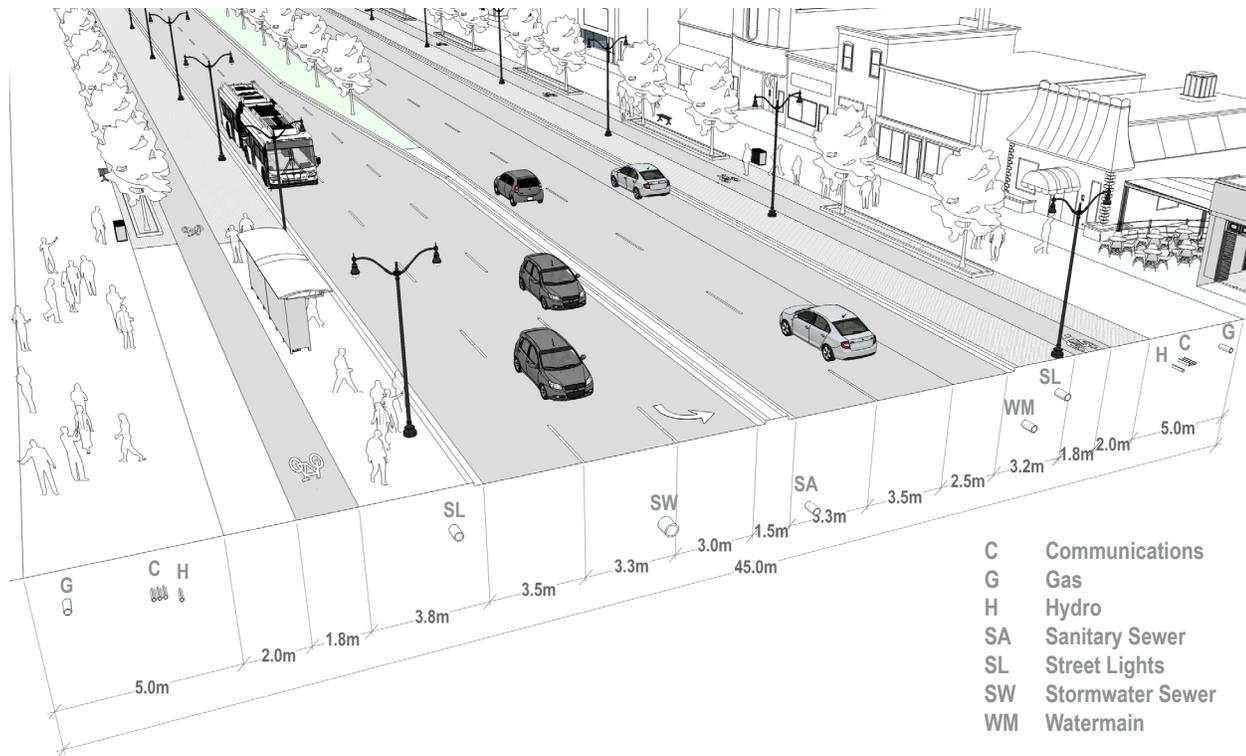
Green Infrastructure

- Where active street frontages, significant volumes of pedestrian activity or on-street parking exist, the boulevard should be constructed of predominantly or entirely hard surfaces.
- Street trees are highly desirable and their location should be determined by "The Right Tree, Right Location" selection process. This process matches site conditions with the appropriate tree which can include ensuring the proper amount of soil volume is available to support the eventual mature size of the tree.
- Streets trees may also be placed in grates and planter beds if planting in boulevard green space is impractical or undesirable.
- Planted centre medians may be appropriate if they do not have an undue negative impact on emergency services' response times or demand for left turns into / from private property.
- Planters can be integrated into gateway features at strategic entrance points to the City along these corridors.

Utilities

- Hydro and communications cables are typically overhead. The preferred positioning for utility poles, signal poles and light standards is between the sidewalk and the roadway where snow is typically stored. Cycling facilities may be positioned on either side of the poles.
- Wherever possible, hydro, communications, traffic signals and street lighting should be coordinated to use the same poles.
- The preferred location for gas mains is in the boulevard, beneath a soft surface area (if one exists); consideration should be given to mitigating conflict between a gas main and tree roots.
- Storm sewers and sanitary sewers are typically located beneath a motor vehicle travel lane.
- Watermains are more likely to require access for maintenance and repair than sewers and should be located beneath the cycling facility, in the boulevard or beneath a parking or curb lane to minimize disruption if access is required.

4.5 MAIN STREET



Main Streets are neighbourhood hubs with vibrant commercial activity. These cherished and historic business areas are also associated with the Main Street Place Type, which is described in detail in The London Plan. Main Streets are often part of a corridor that is designated as a Civic Boulevard or Urban Thoroughfare at other locations. The preferred right-of-way width for Main Streets is 45 m, however established or historic Main Streets may have a narrower width. The City's vision for these corridors is to preserve their heritage character while allowing for new development that complements the existing built form and enhances the attractiveness of the corridor. A high quality pedestrian realm, active street frontages, and multi-modal travel options are high priorities for these areas.

Pedestrians

- A variety of destinations and the presence of residential land use can generate significant volumes of walking trips by a broad range of users including children and mobility device users.
- Signalized pedestrian crossings, pedestrian crossovers or pedestrian refuge islands should be considered where the gap between signalized intersections exceeds 400 m, or when justified by pedestrian desire lines, connectivity considerations, or pedestrian and vehicular volume, as per OTM Book 15.
- A very high quality public realm should support the attractiveness and heritage character of these areas, with the provision of a wide pedestrian clearway (2.0 - 5.0 m), seating, waste receptacles, publication boxes, public art, and shade trees.

- Pedestrian-scale lighting is essential to Main Streets but should be balanced against the City's energy efficiency targets (see Section 2.6: Street Lighting for further information).
- Pedestrian wayfinding and sidewalk cafés may be appropriate.
- Raised or planted medians may be added to provide median pedestrian refuge points.
- Enhanced crosswalk treatments should be included where appropriate.

Cyclists

- The vibrant commercial environment typically found along Main Streets can generate significant volumes of cyclists. Cycling facilities should be considered on all Main Streets, especially those included in the City's Cycling Master Plan.

- Where Main Streets transition to other street classifications, cycling facilities should extend beyond the segment that is designated as a Main Street to provide connectivity. While unidirectional facilities are preferred, continuity with connecting facilities should also be considered in selecting the preferred facility type.
- Left turn queue boxes (in-boulevard or on-street) are desirable to provide connectivity for cyclists who are not comfortable cycling in traffic.
- Entrances and intersections should be marked to alert all road users to the intended travel path of cyclists.

Transit

- The provision of frequent and efficient transit service is prioritized on these streets.
- Queue jump lanes, transit signal priority and bus shelters should be considered at all intersection / stop locations.
- At stops with significant peak period boardings and alightings, and where there is sufficient space, an island transit stop should be considered to mitigate pedestrian-cyclist conflict.
- Bus bays are typically not preferred (see Section 2.3 for exceptions). Where there is a desire to include bus bays, consideration should be given to the expected delay for transit users (if any), and the total person-hour delay for traffic and transit users should be compared for in-lane and bus bay stop configurations.

Motorists and Freight

- Typically three, four or five lane cross sections, including a two-way left turn lane or raised median.
- On-street parking in a dedicated lay-by is preferred as it can increase sidewalk activity, reduce motor vehicle speeds, and reduce the need for surface parking lots outside the ROW. Off-peak parking in a motor vehicle travel lane may also be appropriate if peak hour parking demand is low or there is insufficient space for a lay-by.
- Freight and emergency vehicles are important considerations in determining lane widths, curb radii and the suitability

of raised medians.

- Desired separation between driveway accesses is 50 m or greater.
- Preferred design speed: 50 km / h.
- Curb extensions may be included where appropriate.

Green Infrastructure

- The boulevard is typically constructed of hard surfaces.
- Street trees are highly desirable and their location should be determined by "The Right Tree, Right Location" selection process. This process matches site conditions with the appropriate tree which can include ensuring the proper amount of soil volume is available to support the eventual mature size of the tree.
- Street trees may also be placed in grates and planter beds if planting in boulevard green space is impractical or undesirable.
- Planted centre medians may be appropriate if they do not have an undue negative impact on emergency services' response times or demand for left turns into / from private property.
- Planters can be integrated into gateway features at strategic entrance points to the City along these corridors.

Utilities

- The preferred configuration for hydro and communications cables is underground to provide an enhanced streetscape.
- Heritage appropriate light standards that include pedestrian lighting should be considered.
- The preferred location for gas mains is in the boulevard, beneath a soft surface area; consideration should be given to mitigating conflict between a gas main and tree roots.
- Storm sewers and sanitary sewers are typically located beneath a motor vehicle travel lane.
- Watermains are more likely to require access for maintenance and repair than sewers and should be located beneath the cycling facility, in the boulevard or beneath a curb or parking lane to minimize disruption if access is required.

4.6 NEIGHBOURHOOD CONNECTOR

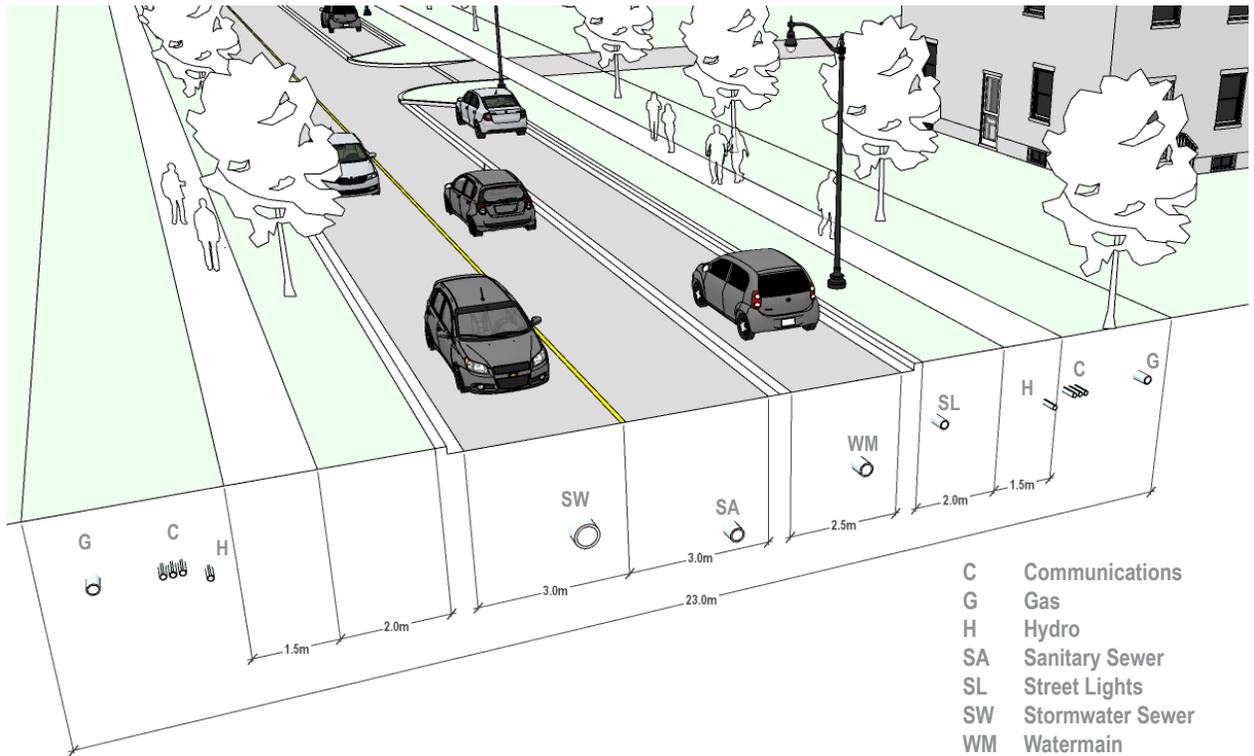
Neighbourhood Connectors are the second most common street classification in the City (by length) and link residential areas to the network of higher order streets. The preferred right-of-way width for these streets is 23 m. These corridors primarily accommodate residential land use, though commercial and retail land uses can also be accommodated in proximity to major intersections. Place types associated with Neighbourhood Connectors in The London Plan include Neighbourhood, Shopping Area, and Industrial. The City's vision for these corridors includes a high quality pedestrian realm, strong multi-modal connectivity, and managed motor vehicle speeds and volumes that support a high quality of life in residential neighbourhoods.

Pedestrians

- Connectivity to key neighbourhood destinations can generate large volumes of pedestrian trips by a broad range of users including children and mobility device users.
- High quality public realm should include waste receptacles, publication boxes, and shade trees.
- Pedestrian clearway widths exceeding the 1.5 m minimum standard may be appropriate where there is a high volume of pedestrian traffic (near schools for example), a high proportion of pedestrians who use mobility devices (near seniors residences for example), or where the sidewalk is immediately adjacent to a raised cycle track, as in Example B.
- The pedestrian clearway should be set at least 1.0 m back from any adjacent motor vehicle travel lane.

Cyclists

- The Cycling Master Plan indicates when a cycling facility is required on a new or an existing Neighbourhood Connector. Due to their high degree of connectivity through residential neighbourhoods, these streets can generate significant volumes of cycling trips. Bike lanes or cycle tracks are typically appropriate facility types.
- A bike lane positioned between a motor vehicle travel lane and a motor vehicle parking lane, as shown in Example B, is typically more appropriate on streets with lower traffic volumes. This design may be more feasible than a raised cycle track in a street rehabilitation context and it also facilitates maintenance which is integrated with regular street maintenance. Some cyclists may feel less comfortable with this configuration due to the potential for conflict with motor vehicles in the motor vehicle travel lane, motor vehicles entering / exiting the motor vehicle parking lane and motorists opening their doors. This design also results in a wide roadway and, where warranted, traffic calming measures may be considered to manage motor vehicle speeds.
- Where a cycling facility is provided and parking is not permitted on one side of the street, some form of physical separation, such as flexible bollards, should be considered in order to avoid creating the perception of an excessively wide roadway.
- Where spatial constraints create a challenge for the implementation of cycling facilities, the following strategies may be considered: (a) assess parking demand and consider shifting on-street parking to other nearby streets; (b) implement a limited number of parking bays in the boulevard where tree impacts can be mitigated; (c) consider opportunities for a "couplet" design where a dedicated cycling facility is provided in one direction only, and travel in the opposite direction is provided on a nearby parallel street.
- An urban shoulder may be included in a resurfacing project context to accommodate cyclists and very low volumes of parked vehicles. Since this design is less comfortable for cyclists, it should only be considered when no other alternative (bike lanes, advisory lanes, couplet, neighbourhood greenway) is feasible.
- If snow is intended to be stored in a buffer zone adjacent to a cycling facility, the preferred width of the buffer is



Example A - Neighbourhood Connector with a permanent parking bay.

1.0 m, though this may not always be achievable on Neighbourhood Connector streets.

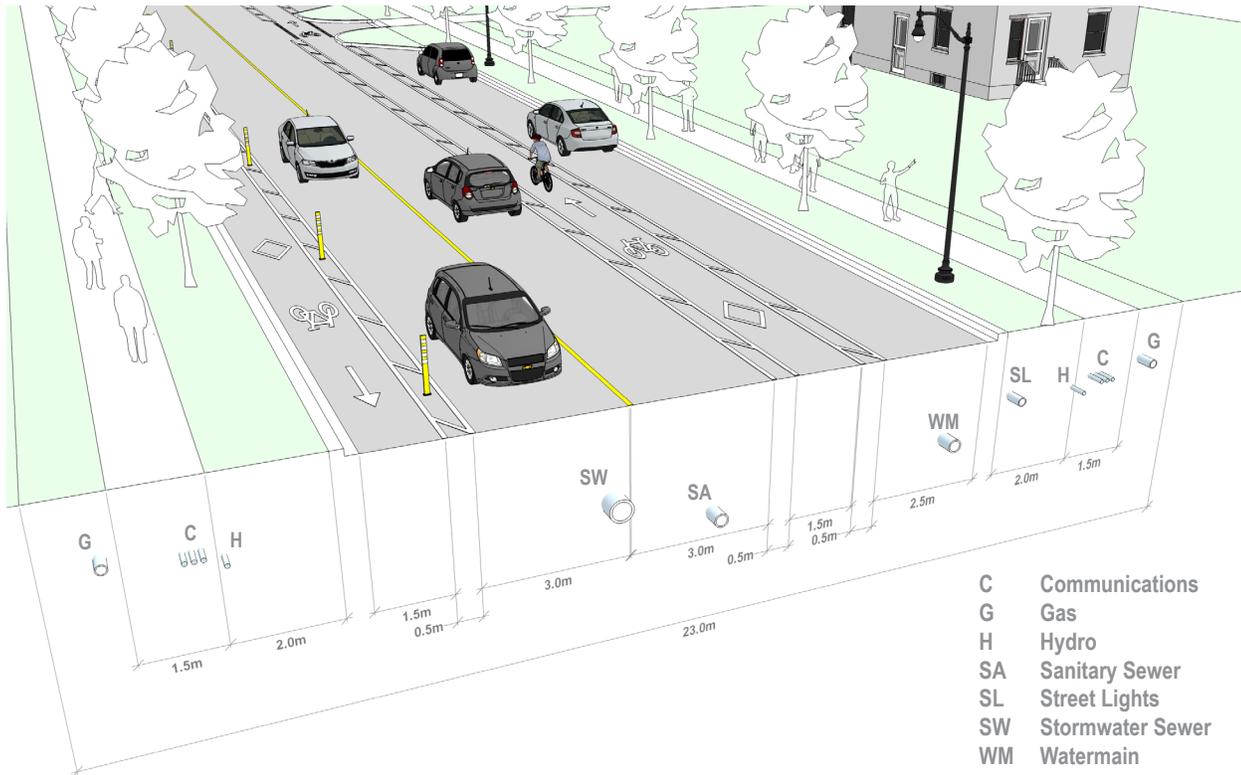
- Where Neighbourhood Connectors with cycling facilities intersect streets with more than one motor vehicle travel lane in each direction, a signalized intersection is preferred. If this is not warranted, other crossing strategies should be explored such as a PXO and / or refuge island or a two-way cycle track in the boulevard of the major street that connects to a signalized intersection.

Transit

- Many Neighbourhood Connectors are well-suited for local transit service. Transit priority measures should be considered at specific locations if recurring delays are observed.
- The design of transit stops and provision of amenities such as shelters, benches, waste receptacles, etc. should be based on stop usage (boardings / alightings).
- Where transit vehicles must pull into parallel cycling facilities, integrated cycle track stops are preferred, however, shared space stops may also be appropriate.

Motorists and Freight

- A two lane cross section is typical.
- The connectivity of Neighbourhood Connectors may attract through traffic, which is undesirable due to the residential context of these streets. Traffic calming measures such as speed cushions, raised intersections or crossings, neighbourhood traffic circles and centre island medians should be considered where observed travel speeds significantly exceed the posted speed limit.
- On-street parking is often provided though utilization in most areas is typically low. Various strategies can be considered to integrate parking with cycling facilities (see Cycling). Where no cycling facility exists, parking may also serve a traffic calming function, especially if it is permitted on both sides of the street or alternates from one side of the street to the other. Lay-by parking can reduce the width of the road platform and also provide a traffic calming effect.
- The needs of freight and emergency vehicles should be considered, but also balanced against the benefits of



Example B - Neighbourhood Connector with the cycling facility between the motor vehicle travel lane and the motor vehicle parking lane.

managing motor vehicle speeds and volumes in residential areas.

- Motor vehicle travel lanes may be reduced to 3.0 m, unless the street is part of a transit route.
- A barrier curb should always be provided between the roadway and the boulevard in order to mitigate the risk of a motor vehicle entering the boulevard. This is particularly important near schools and parks.
- Desired separation between driveway accesses is 30 m or greater where possible.
- Preferred design speed: 40 - 60 km / h.

Green Infrastructure

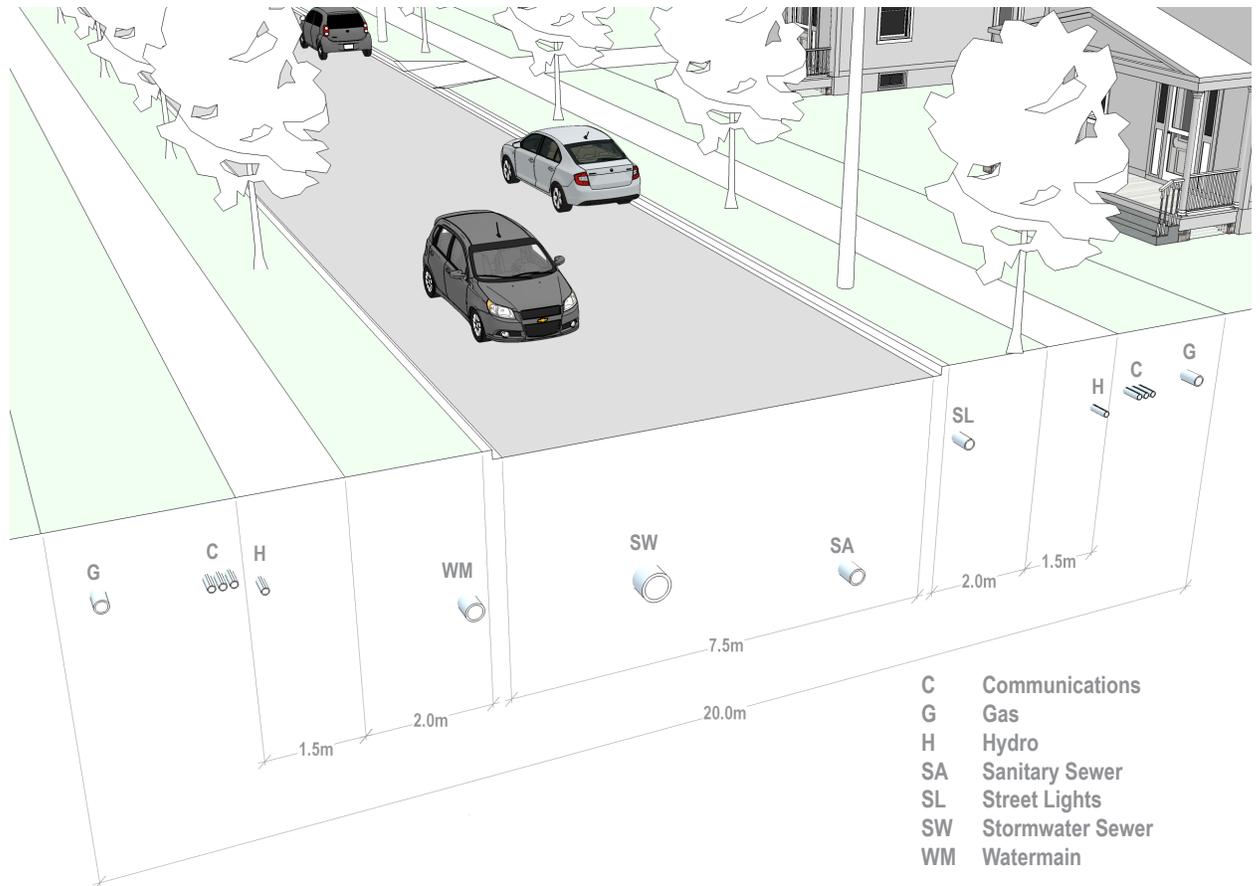
- Aside from the sidewalk and any cycling facilities, boulevards should have a predominantly soft surface. An exception to this would be adjacent to a motor vehicle parking lane with high turnover and utilization.
- Many Neighbourhood Connectors have mature trees in the boulevard, and rehabilitation and reconstruction projects

should seek to minimize tree impacts wherever possible.

Utilities

- For new developments, hydro and communication cables should be located underground.
- Wherever possible, above ground traffic signals and street lighting should be coordinated to use the same poles.
- The preferred location for gas mains is in the boulevard, beneath a soft surface area; consideration should be given to mitigating conflict between a gas main and tree roots.
- Storm sewers and sanitary sewers are typically located beneath a motor vehicle travel lane.
- Watermains are more likely to require access for maintenance and repair than sewers and should be located in the boulevard, beneath the cycling facility or beneath a permanent motor vehicle parking lane to minimize disruption if access is required.

4.7 NEIGHBOURHOOD STREET



Neighbourhood Streets are where most Londoners, including many families, live; enhancing livability, sense of community, ability to age-in-place, and safety for children are important considerations for these streets. The preferred right-of-way width for these streets is 20 m. These corridors accommodate residential land use and are strongly associated with the Neighbourhood Place type detailed in The London Plan. The City's vision for these corridors includes narrow motor vehicle travel lanes and low volumes of traffic, vibrant community life, and street design that supports active transportation and transit connections to essential local amenities.

Pedestrians

- The presence of residents, families, and proximity to essential local amenities can generate large volumes of walking trips by a broad range of users including children and mobility device users.
- Shade trees enhance the public realm and amenities such as waste receptacles, benches and newspaper boxes are typically provided at corners with higher-order streets.
- A 1.5 m pedestrian clearway width is acceptable, though a wider clearway may be desirable in areas with higher density / pedestrian activity.
- The pedestrian clearway should be set at least 1.0 m back from any adjacent motor vehicle travel lane and a barrier curb should be provided. The boulevard should be constructed of soft surfaces, unless there is significant use of on-street parking.
- Where these streets are more curvilinear (cul-de-sacs, crescents, etc.) active transportation connections between streets should be provided to improve pedestrian access to adjacent schools, grocery stores, parks, and other essential destinations.
- Wayfinding for active transportation connections should be provided, such as pedestrian exemptions for No Exit signs.
- Planters, curb extensions in permanent motor vehicle parking lanes, and

other improvements to the pedestrian realm should be considered to provide attractive community gathering points and traffic calming effects; traffic calming measures are often appropriate, especially in school zones.

- New cul-de-sacs and crescents are discouraged in order to enhance connectivity and route options for pedestrians.

Cyclists

- The presence of residents and connectivity to local amenities can generate significant volumes of cyclists.
- Due to the low volume and speed of motor vehicle traffic, neighbourhood greenways are often appropriate, particularly for residential streets that provide connectivity through neighbourhoods.
- On one-way streets, contraflow bike lanes can be considered to improve the connectivity of the cycling network.

Transit

- Transit is generally not provided on Neighbourhood Streets due to their limited connectivity and width. Neighbourhood Streets should be designed to maximize pedestrian access to nearby transit stops.

Motorists and Freight

- Typically two lane or occasionally one-way, single lane cross sections, which may widen at intersections in some cases.
- Travel speeds may be managed with speed cushions, refuge islands or on-street parking that alternates from one side of the street to the other.
- On-street parking is typically provided and may also serve a traffic calming function, especially if it is permitted on both sides of the street or alternates from one side of the street to the other. Lay-by parking can reduce the width of the road platform and also provide a traffic calming effect.
- Where driveways are spaced so closely that on-street parking becomes impractical, it should be prohibited.

- Pavement width may be narrowed to 6.5 m on Neighbourhood Streets servicing fewer than 45 units and that have low parking utilization.
- The needs of freight and emergency vehicles should be considered, but managing motor vehicle speeds and volumes in residential areas is typically prioritized.
- Cul-de-sacs are discouraged and should only be implemented when other options are not available; cul-de-sac lengths should not exceed 215 m.
- Preferred design speed: 40-50 km / h.

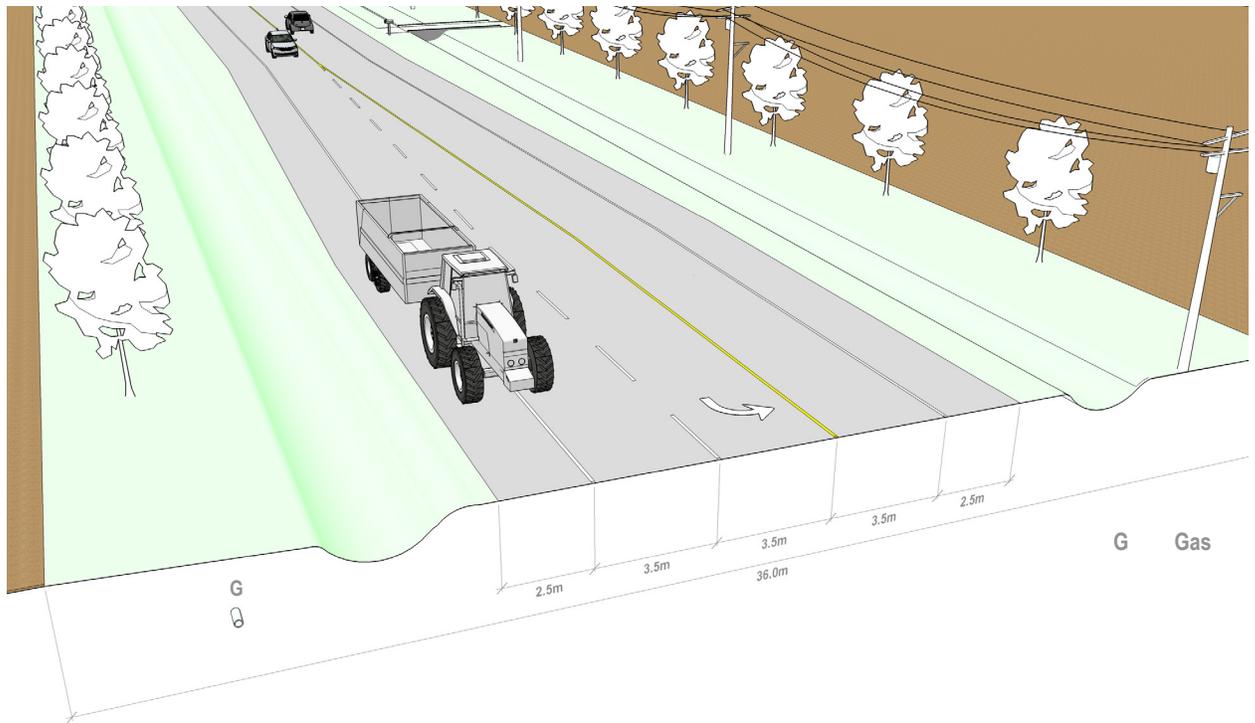
Green Infrastructure

- Street trees are highly desirable and may be positioned on either side of the sidewalk, though positioning them between the sidewalk and the property line may provide better growing conditions and mitigate potential utility conflicts.
- Curb extensions or other lane narrowing infrastructure may include planted soft surfaces and LIDs to enhance aesthetics and the stormwater management system.

Utilities

- The preferred positioning for utility poles, signal poles and light standards is between the sidewalk and the roadway where snow is typically stored
- For new developments, hydro and communication cables should be located underground.
- The preferred location for gas mains is in the boulevard, beneath a soft surface area; consideration should be given to mitigating conflict between a gas main and tree roots.
- Storm sewers and sanitary sewers are typically located beneath a motor vehicle travel lane.
- Watermains are more likely to require access for maintenance and repair than sewers and should be located in the boulevard to minimize disruption if access is required.

4.8 RURAL THOROUGHFARE



Rural Thoroughfares provide the primary routes for through movement within the Farmland and Rural Neighbourhood Place Types detailed in The London Plan. Though some Londoners live on these streets, distances between destinations are typically much longer than in urban areas and the degree of street related activity is much less, making some of these streets more conducive to higher speed travel. The agricultural focus in these areas requires road design to accommodate trucks and large, slow moving farm equipment. The preferred right-of-way width for these roads is 36 m. The City's vision for these corridors is to preserve agriculture lands and limit further residential development in these areas.

Pedestrians

- Low population densities, the typical distance between destinations, and high vehicle speeds limit pedestrian activity. However, recreational pedestrian activity may occur on the gravel shoulder along these corridors.
- Within the Rural Neighbourhood Place Type, posted speed limits should be reduced and pedestrian crossing signs should warn drivers of increased pedestrian activity in these residential clusters; school bus warning signs should also be considered where appropriate.
- Where rural neighbourhood areas have land uses other than residential that may generate short trips, sidewalks should be considered.

Cyclists

- Low population densities, the typical distance between destinations, and high vehicle speeds limit cycling trips, however, these low traffic, scenic corridors may be popular routes for recreational sport and touring cyclists.
- A 2.5 m fully paved shoulder is recommended on streets that have a significant residential population, that are known cycling touring routes, that are identified in the Cycling Master Plan, or that have crests or horizontal curves that limit sightlines.
- Cycling wayfinding amenities should be considered to attract cycling tourism to the City of London.

- Within and around the Rural Neighbourhood Place Type, buffered paved shoulders should be considered to provide a more comfortable environment for families cycling in these areas.

Transit

- These streets are typically not served by transit.

Motorists and Freight

- Typically two lane cross sections with 3.5 m motor vehicle travel lanes; turn lanes are often appropriate at intersections.
- Centre line and edge line markings should be provided.
- Where a 2.5 m fully paved shoulder is not implemented, a 2.5 m shoulder with 1.0 m paved and 1.5 m granular surface should be provided in order to accommodate wide farm equipment. Shoulder widths should exceed 2.5 m in areas with poor sightlines.
- Where road-side parking demand is observed, a 2.5 m or wider soft shoulder should be provided.
- Freight, emergency vehicles, and farm equipment are important considerations in determining lane widths and curb radii.
- Rumble strips may be considered where the roadway curves. A minimum 2.0 m paved shoulder must be provided and the rumble strips should be immediately adjacent to the edgeline markings. In order to accommodate cyclists, breaks in the rumble strips should be provided at approximately 10 - 15 m intervals to allow cyclists to maneuver around debris or parked vehicles.
- Preferred design speed: 60 - 80 km / h.

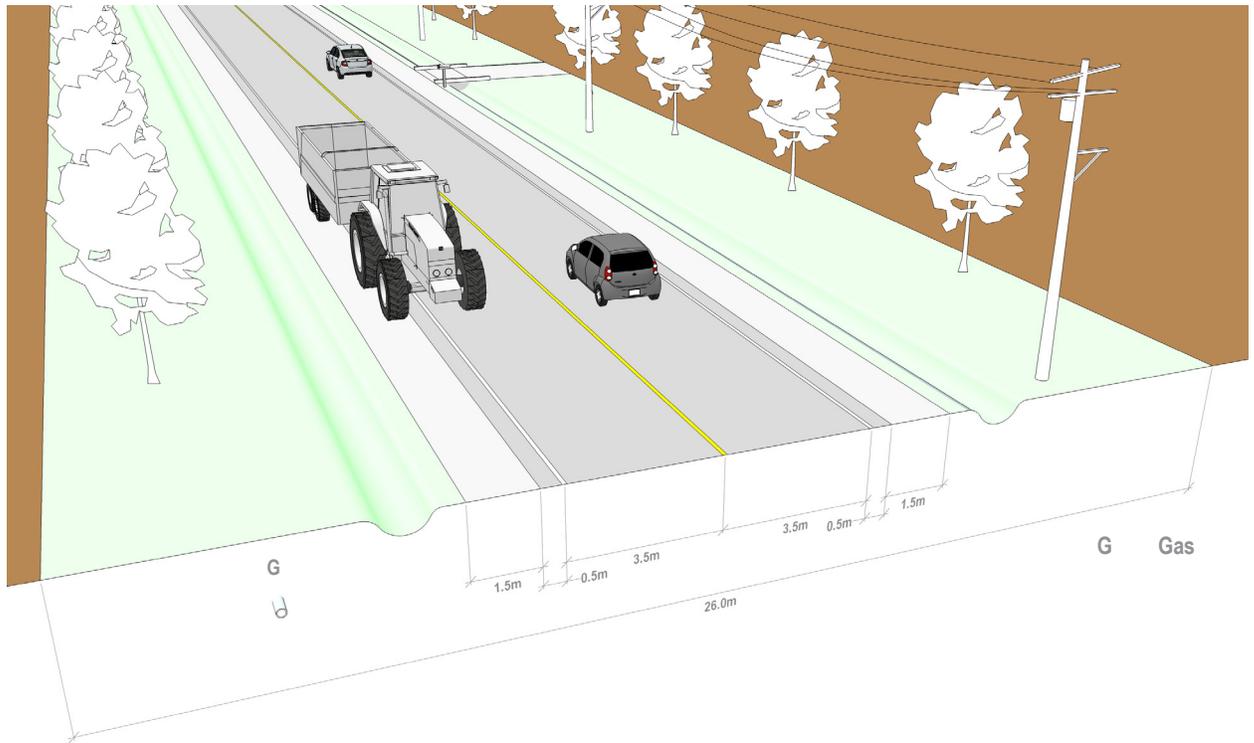
Green Infrastructure

- Where drainage flow volumes permit, roadside swales may include specific planted species and design features to temporarily hold and filter run-off from adjacent fields and the roadway.
- Trees are generally desirable, where there is sufficient space in the right-of-way in order to mitigate erosion, act as windbreaks, and enhance biodiversity; at City of London gateway locations, a double row of trees if preferred.

Utilities

- Hydro and communications cables are overhead. Utility poles and mailboxes should be positioned to ensure clearance for oversized farm equipment.
- Wherever possible, hydro, communications, traffic signals and street lighting should be coordinated to use the same poles.
- Watermains and sanitary sewers are typically not provided; where they are provided, watermains should be located in the boulevard to minimize disruption if access is required, while sanitary sewers should be located beneath a motor vehicle travel lane.
- Gas mains should be located between the swale and the property line.

4.9 RURAL CONNECTOR



Rural Connectors predominantly accommodate local traffic and farm equipment and are strongly associated with the Farmland and Rural Neighbourhood Place Types detailed in The London Plan. Though some Londoners live on these streets, distances between destinations are typically much longer than in urban areas and the degree of street related activity is much less, making some of these streets more conducive to higher speed travel. The agricultural focus in these areas requires road design to accommodate trucks and large, slow moving farm equipment. The preferred right-of-way width for these roads is 26 m. The City's vision for these corridors is to preserve agriculture lands and limit further residential development in these areas.

Pedestrians

- Low population densities, the typical distance between destinations, and high vehicle speeds limit pedestrian activity. However, recreational pedestrian activity may occur on the gravel shoulder along these corridors.
- Within the Rural Neighbourhood Place Type, posted speed limits should be reduced and pedestrian crossing signs should warn drivers of increased pedestrian activity in these residential clusters; school bus warning signs should also be considered where appropriate.

- Where rural neighbourhood areas have land uses other than residential that may generate short trips, sidewalks should be considered.

Cyclists

- Low population densities, the typical distance between destinations, and high vehicle speeds limit cycling trips, however, these low traffic, scenic corridors may be popular routes for recreational sport and touring cyclists.

- A 2.0 m fully paved shoulder is recommended on roads that have a significant residential population, that are known cycling touring routes, that are identified in the Cycling Master Plan, or that have crests or horizontal curves that limit sightlines.
- If a paved shoulder exists on a nearby, parallel route, a soft shoulder may be considered instead of a paved shoulder.
- Cycling wayfinding amenities should be considered to attract cycling tourism to the City of London.
- Within and around the Rural Neighbourhood Place Type, buffered paved shoulders should be considered to provide a more comfortable environment for families cycling in these areas.

Transit

- These streets are typically not served by transit.

Motorists and Freight

- Typically two lane cross sections with 3.5 m motor vehicle travel lanes; turn lanes may be considered where justified by turning volumes.
- Centre line and edge line markings should be provided.
- Where a 2.0 fully paved shoulder is not implemented, a 2.0 m shoulder with 0.5 m paved and 1.5 m granular surface should be provided in order to accommodate wide farm equipment. Shoulder widths should exceed 2.0 m in areas with poor sightlines.
- Where road-side parking demand is observed, a 2.5 m or wider soft or paved shoulder should be provided.
- Freight, emergency vehicles, and farm equipment are important considerations in determining lane widths, and curb radii.
- Preferred design speed: 50 - 60 km / h.

Green Infrastructure

- Where drainage flow volumes permit, roadside swales may include specific planted species and design features to temporarily hold and filter run-off from adjacent fields and the roadway.
- Trees are generally desirable, where there is sufficient space in the right-of-way in order to mitigate erosion, act as windbreaks, and enhance biodiversity.

Utilities

- Hydro and communications cables are typically overhead. Utility poles and mailboxes should be positioned to ensure clearance for oversized farm equipment.
- Wherever possible, hydro, communications, traffic signals and street lighting should be coordinated to use the same poles.
- Watermains and sanitary sewers are typically not provided; where they are provided, watermains should be located in the boulevard to minimize disruption if access is required, while sanitary sewers should be located beneath a motor vehicle travel lane.
- Gas mains should be located between the swale and the property line.





5

STREET DESIGN FOR INTERSECTIONS

5.1 INTERSECTION DESIGN PRINCIPLES

Intersections connect streets and allow users to navigate through the street network. They can serve as hubs, gateways, and transfer points and allow adjacent land uses to benefit from connectivity to multiple corridors. Due to the overlapping paths of the various movements and modes, intersections also have greater potential for conflict than mid-block locations. With eight different street classifications in the City of London, and many more contextual factors that affect intersection design, each individual intersection is unique. The example intersections illustrated in the subsequent sections of this chapter are intended to show how the principles below can be applied, rather than serving as definitive designs.

Prioritize vulnerable users

Pedestrians and cyclists are more vulnerable than transit users and motorists because they are not protected within a vehicle. Since intersections have a high potential for conflict, protecting vulnerable road users is a particularly important focus of intersection design. Many of the principles described below support this overarching principle, which can be manifested through both intersection design and intersection operation. OTM Books 15: Pedestrian Crossing Treatments and 18: Cycling Facilities provide helpful guidance for applying this principle.

Reduce motor vehicle speeds through the intersection

Motor vehicle speed has a strong correlation to the severity of collisions, with slower vehicle speeds leading to less severe outcomes. In addition, motorists are faced with higher levels of information and decision loading at intersections relative to typical mid-block locations. By reducing motor vehicle speeds, motorists are given more time to check mirrors and blind spots or take evasive action. Strategies include:

- Consider reducing turn radii and avoid right turn channels
- Avoid unnecessarily large lane widths
- Implement raised intersections or crossings

Maximize the visibility of all users

Visibility between users, especially visibility of vulnerable users who are much less conspicuous than vehicles, is essential to mitigate collisions. Strategies include:

- Avoid positioning any street furniture or other visual obstructions at intersection corners or on the approaches to the intersection
- Use advance stop bars, bicycle boxes, and leading pedestrian and / or cyclist signal intervals to improve the visibility of pedestrians and cyclists for right turning motorists

Guide users to create predictable movements and positioning

A clear understanding of the appropriate path of travel and yielding behaviour is essential for collision mitigation.

- Use pavement markings such as zebra stripes for pedestrians and elephant feet with a green surface treatment for cyclists at conflict points. These markings should indicate the desired path of travel and alert motorists where they should anticipate other road users to be traveling
- Align intersection approaches to avoid offset or skewed intersections wherever possible



A **raised intersection** in London helps to reduce travel speed through the intersection.



Green pavement markings serve to highlight conflict areas and alert motorists to anticipate cyclists.



Abundant **pedestrian queuing space and clear sightlines** at a recently reconstructed intersection in London

Design for accessibility

Intersections can be difficult for individuals with disabilities to navigate. Individuals with visual impairments may struggle to determine the alignment of crossings as well as traffic control indications. For individuals using mobility devices, it may be a challenge to cross in the allotted time or to traverse transitions between surface types. Strategies include:

- Use tactile walking surface indicators, audible signals, and pedestrian countdown timers
- Align pedestrian crossings with the pedestrian clearway to the extent possible. This strategy must be balanced against the desire to provide a shorter crossing or a refuge island. Where the crossing cannot be aligned with the mid-block pedestrian clearway, provide a transition to the crossing alignment on the intersection approach if space is available.

Provide abundant pedestrian space, especially on corners with mixing zones

At signalized intersections, sufficient corner space should be provided for pedestrians to queue at a crossing during the red / “don’t walk” indication without impeding the flow of pedestrians in the cross direction. Providing a larger hard surface area on intersection corners also facilitates snow storage. Sidewalk level cycling facilities with low volumes of cyclists may transition to a mixing zone at a corner. Strategies include:

- Connect pedestrian clearways at corners of large intersections with a triangular hard surface area to mitigate conflicts and accommodate pedestrian desire lines
- Include bicycle stop bars and “cyclists yield to pedestrian” or “stop here on red” signs where sidewalk level cycling facilities transition to a pedestrian-cyclist mixing zone

Maximize connectivity and comfort for cyclists

Large intersections can be major barriers for cyclists who are uncomfortable being exposed to the volume and speed of traffic at these intersections. Strategies include:

- Signalizing intersections, particularly where Neighbourhood Connector streets that have cycling facilities intersect streets with a total of four or more lanes (an OTM signal warrant should be undertaken and considered in the decision-making process)
- Provide two stage left turn queue boxes, either in the boulevard or on-street, depending on context
- Include the bicycle crossing in the design of any refuge islands

Minimize transit delay

Transit vehicles often experience increased delay at intersections relative to other motor vehicles. This is typically caused by traditional signal coordination, which does not take stops for passenger boarding into account. Since long travel times are a major deterrent for potential transit riders, every effort should be made to minimize transit delay. Strategies include:

- Provide transit signal priority, typically in combination with far-side stops
- Implement far-side stops where right turn queues are observed to delay transit operations at near-side stops (See NACTO Transit Street Design Guide: Stop Placement and Configuration for more details on near-side and far-side stops)
- Provide queue jump lanes (see also Section 2.3: Lanes)



A **"Cyclists stop here on red signal" sign** alerts cyclists to queue on the approach to the mixing zone



A **pedestrian crossover (PXO) with rapid flashing rectangular beacons** prioritizes vulnerable road users at this one-way stop controlled intersection in London.



A **dedicated bus left turn lane** minimizes transit delay in London.

Accommodate large vehicles appropriately

Large vehicles including trucks, buses and emergency vehicles require wider lanes and larger curb radii. Unfortunately, wide lanes and large curb radii can also induce undesirably high speeds for motorists in smaller vehicles. Strategies include:

- Establish both a “design vehicle” and a “control vehicle” to determine an appropriate curb radius where large vehicle turning movements are infrequent (see Section 2.4). The design vehicle should be able to complete a right turn with relative ease whereas the control vehicle still needs to be able to complete a turn, but may take advantage of space in adjacent motor vehicle travel lanes to do so. If an exception from the City’s standard curb radii is permitted, poles and other fixed objects should still be positioned in accordance with the standard radius.

Coordinate intersection design with intersection operation

Complete intersections require attention to, and coordination of, both intersection design and operation. Many intersection design features depend on how the intersection will be operated. For example, protected turn signal phases (an operational measure), which separate conflicting movements in time, require dedicated turn lanes (a design measure). Strategies for the operation of complete intersections include:

- Identify and anticipate potential future operational strategies during intersection design
- Review signal timing and adjust to promote the desired travel speed

Manage access points to mitigate conflicts

Intersections have high volumes of turning vehicles which can make it difficult for motorists entering or exiting a driveway to predict when a suitable gap in traffic appears. This is particularly challenging for left turning exit and entrance movements. Key considerations for managing access points in proximity to intersections include travel speed and the number of motor vehicle travel lanes. Further information can be found in the City’s Access Management Guidelines and Section 2.4 of this Manual. Strategies include:

- Restrict accesses within 150 m of signalized intersections and within 75 metres of stop controlled intersections on high volume, high speed streets, to the extent possible
- Restrict left in and left out movements based on the criteria in the City’s Access Management Guidelines
- Provide clear sightlines around accesses, particularly on high-speed streets and corridors with cycling facilities in the boulevard

5.2 RAPID TRANSIT BOULEVARD INTERSECTING A MAIN STREET

This intersection highlights several of the features that are unique to the Rapid Transit Boulevard street classification with its centre running bus rapid transit design. Beyond these specific design features, it is also representative of large intersections in a dense urban environment with significant pedestrian and cyclist volumes.

Pedestrians

- On the Rapid Transit Boulevard intersection approach, the pedestrian clearway widens as the planter boxes and trees are discontinued, providing for greater ease of pedestrian movement and queuing.
- Due to the potential for a high volume of both cyclists and pedestrians, a pedestrian - cyclist mixing zone is not used, and the raised cycle track continues uninterrupted between the roadway and the mid-block cross section. Pedestrian crossings of the cycle track are marked with zebra stripes, sharks teeth and tactile walking surface indicators.
- Where there is sufficient space for pedestrians to queue between the cycle track and the roadway, an extra set of tactile walking surface indicators is provided.
- The end of the transit platform also serves as a pedestrian refuge island, which makes crossing the seven lane cross section more comfortable for pedestrians.
- The curved alignment of the cycle track on the Main Street intersection approaches helps to guide pedestrians to the pedestrian crossing of the Rapid Transit Boulevard, which is set back from the intersection to accommodate the refuge island.
- The pedestrian crossing of the Rapid Transit Boulevard is extra wide to accommodate high volumes of pedestrians. The wider zebra stripes also increase the visibility of the crossing.

Cyclists

- Cycle tracks bend outward away from the street on the Main Street to take advantage of the pedestrian refuge island. There are minimal physical obstructions on the intersection approach which creates clear sightlines between cyclists and motorists.
- On the Rapid Transit Boulevard, the cycle tracks bend toward the roadway slightly on the approach to the intersection to maximize visibility.
- The use of green and the presence of elephant feet markings in the crossride helps to increase the visibility of the bicycle crossing.

Transit

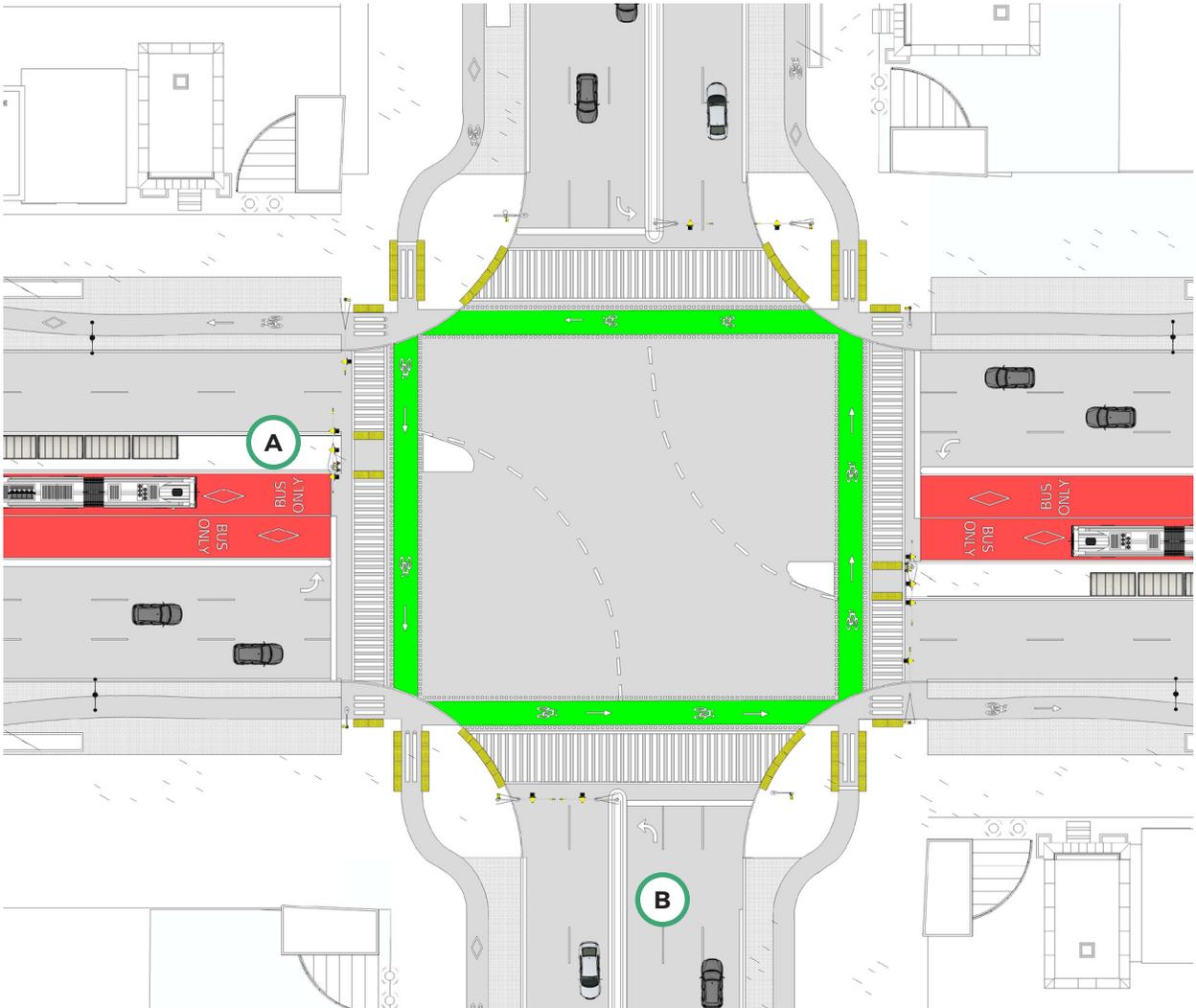
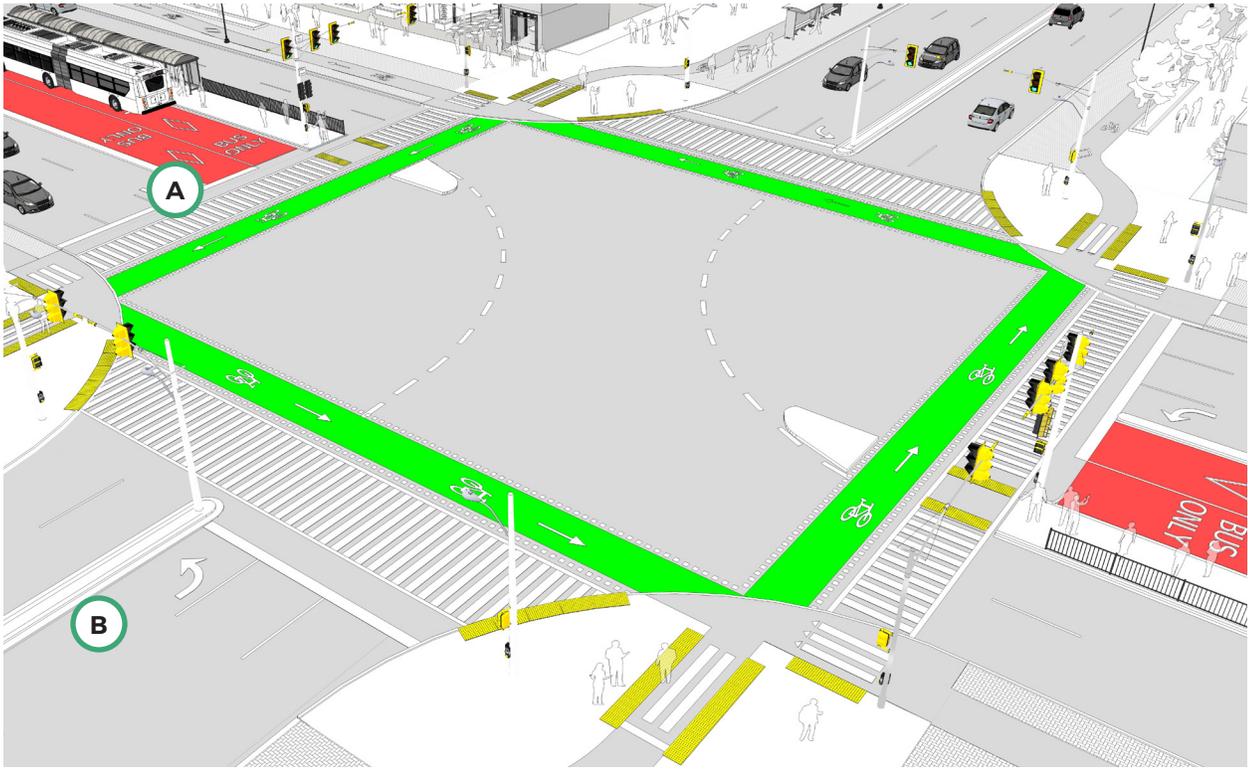
- Transit platforms should accommodate at least two vehicles to reduce transit delays.
- Centre median design requires dedicated transit signals which typically use the same phasing as the parallel motor vehicle through movement.

Motor Vehicles

- Left turn guidelines are used for two of the left turn movements to guide motorists through the large intersection and avoid median collisions.

A Rapid Transit Boulevard

B Main Street



5.3 URBAN THOROUGHFARE INTERSECTING A CIVIC BOULEVARD (SIGNALIZED)

This intersection is an example of a large suburban signalized intersection with high volumes of motor vehicle traffic and more moderate volumes of pedestrians and cyclists and moderately frequent transit service.

Pedestrians

- The alignment of the pedestrian and bicycle crossings across the eight lane Urban Thoroughfare are pushed back from the intersection to accommodate pedestrian refuge islands.
- The pedestrian-cyclist mixing zone connects the two sidewalks on each corner with a diagonal line accommodating the pedestrian desire line between the sidewalks.

Cyclists

- A pedestrian-cyclist mixing zone is used on the corners as the volume of pedestrians and cyclists is typically low in this context. The mixing zone also provides ample space for pedestrian and cyclist queuing including queuing for bicycle left turns. A "Cyclists Yield to Pedestrians" sign should be included on all cycling approaches.
- The cycling facility is included in the refuge island for the Urban Thoroughfare crossings.

- Green pavement markings increase the visibility of the bicycle crossings.
- The cycling facility transitions first to a mixing zone and then to a separated crossride through the intersection.

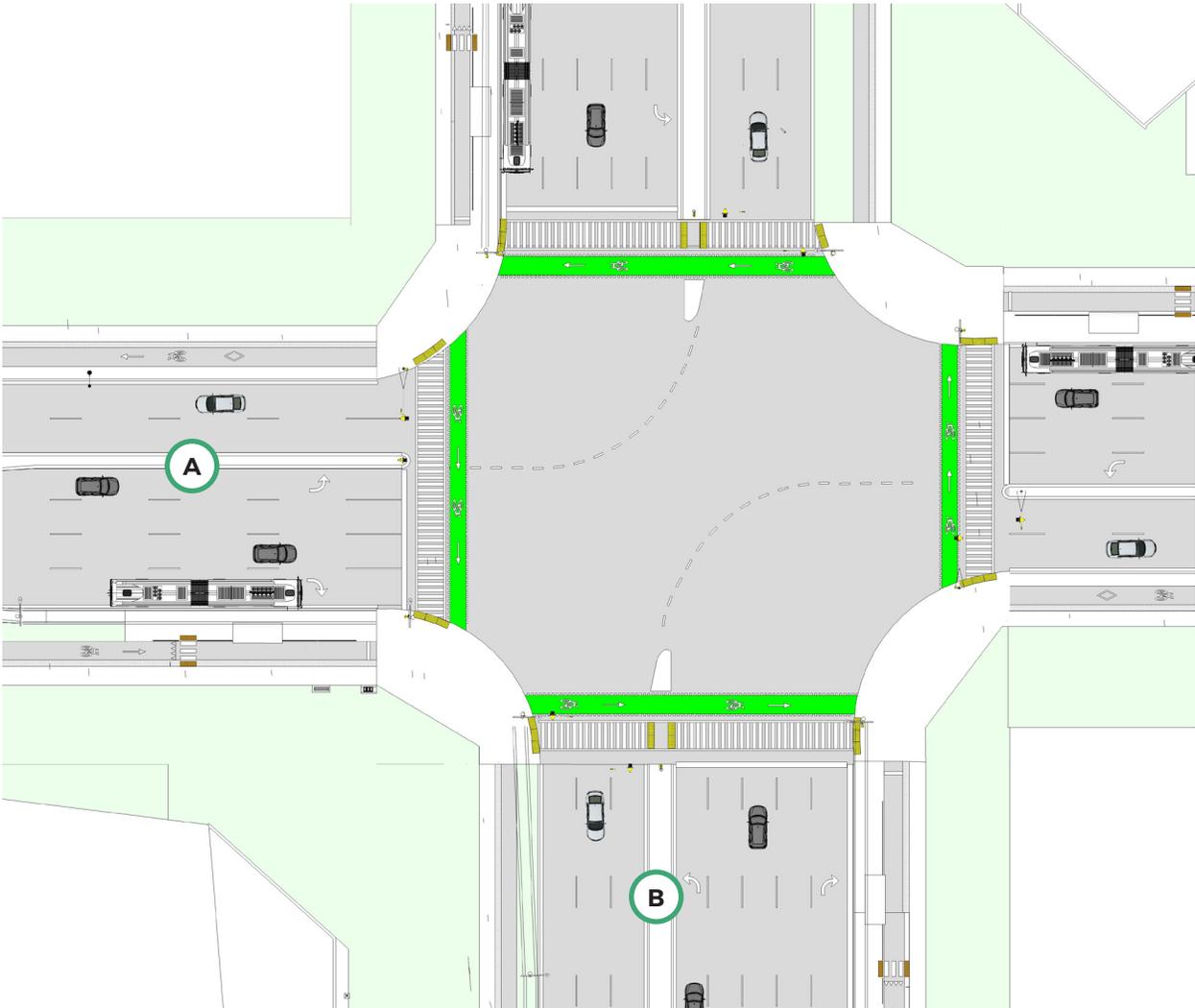
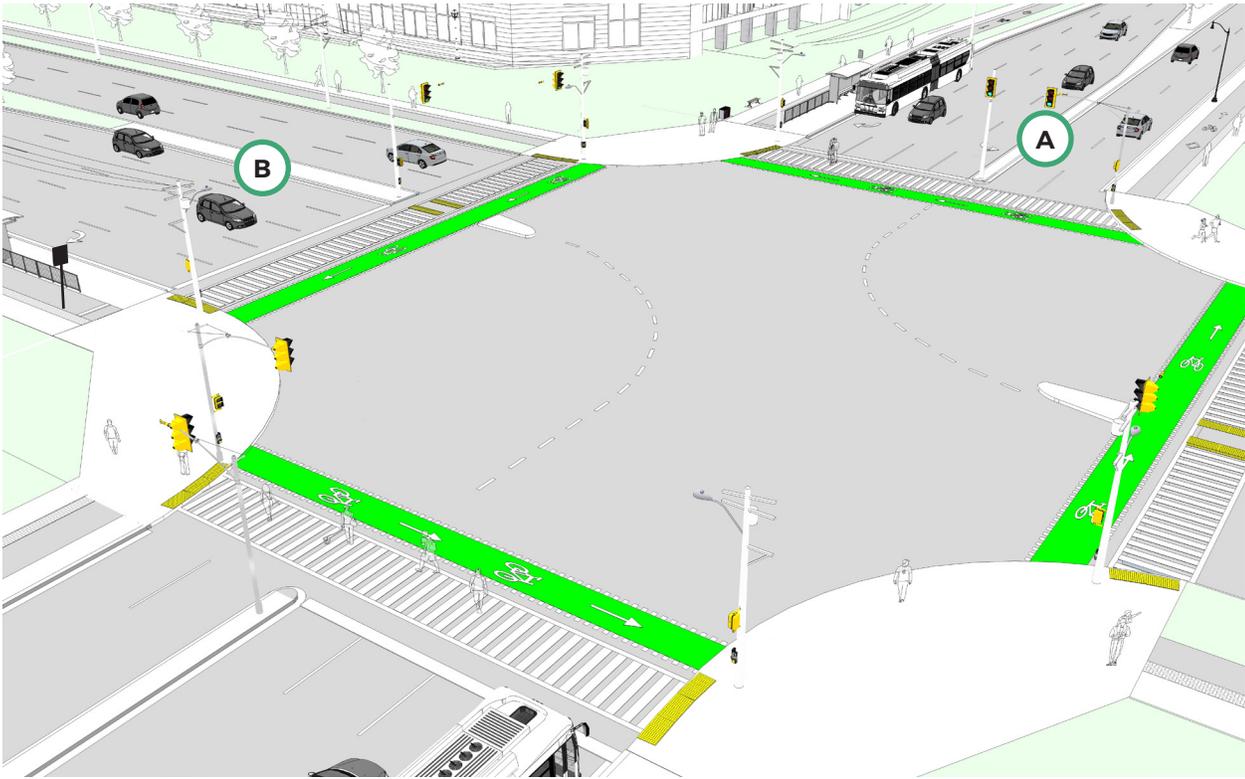
Transit

- Right turn lanes act as bus bays for near side transit stops. The large size of the intersection gives buses the opportunity to accelerate slightly before merging back into traffic.

Motor Vehicles

- Left turn guide lines are provided two of the left turn movements.
- Since all of the pedestrian and cyclist crossings are positioned several metres away from the intersection, a significant portion of the curb radius can be constructed as a barrier curb to provide better separation between motor vehicles and active transportation users.





5.4 URBAN THOROUGHFARE INTERSECTING A CIVIC BOULEVARD (ROUNDBOUT)

Roundabout intersections have many unique design features and operational considerations. Traditionally, accessibility has been a significant challenge at roundabout intersections, especially large ones. This example of a large, suburban roundabout includes several features to improve accessibility and mitigate conflicts, based on guidance from Ontario Traffic Manual (OTM) Book 15: Pedestrian Crossing Treatments and research from the 2011 NCHRP Report 674: Crossing Solutions at Roundabouts and Channelized Turn Lanes. In addition to these design best practices, public education may be helpful when new roundabout intersections are being implemented.

Pedestrians

- A Level 2 Type B (per OTM Book 15) pedestrian crossing is used which includes push button activated rapid flashing rectangular beacons, roadside and cantilevered pedestrian crossing signs, a raised crossing, zebra stripes and sharks teeth.
- A splitter island is used on all legs which allows pedestrians to cross in two stages.
- Pedestrian connections between the legs of the intersection have a straight alignment, accommodating the pedestrian desire line.

Cyclists

- Since there are two entry lanes and two circulating lanes, cyclists should be discouraged from entering the roundabout. All of the connecting cycling facilities in this example are in the boulevard, so there is no need for ramps to or from street level.
- Sharks teeth and a "Cyclists Yield to Pedestrians" sign should be included at all pedestrian crossings of the cycling facility.
- Cyclists cross the roundabout as pedestrians and activate the PXO through a pushbutton. "Cyclists Dismount" signs are required at all crossings. A short connecting link between the PXO and the cycle track requires cyclists to make a 90 degree turn, reinforcing the need for cyclists to reduce their speed, stop and dismount. This link also improves the predictability of pedestrian and cyclists movements for motorists, as only pedestrians and cyclists who are crossing the roadway traverse the connecting link.

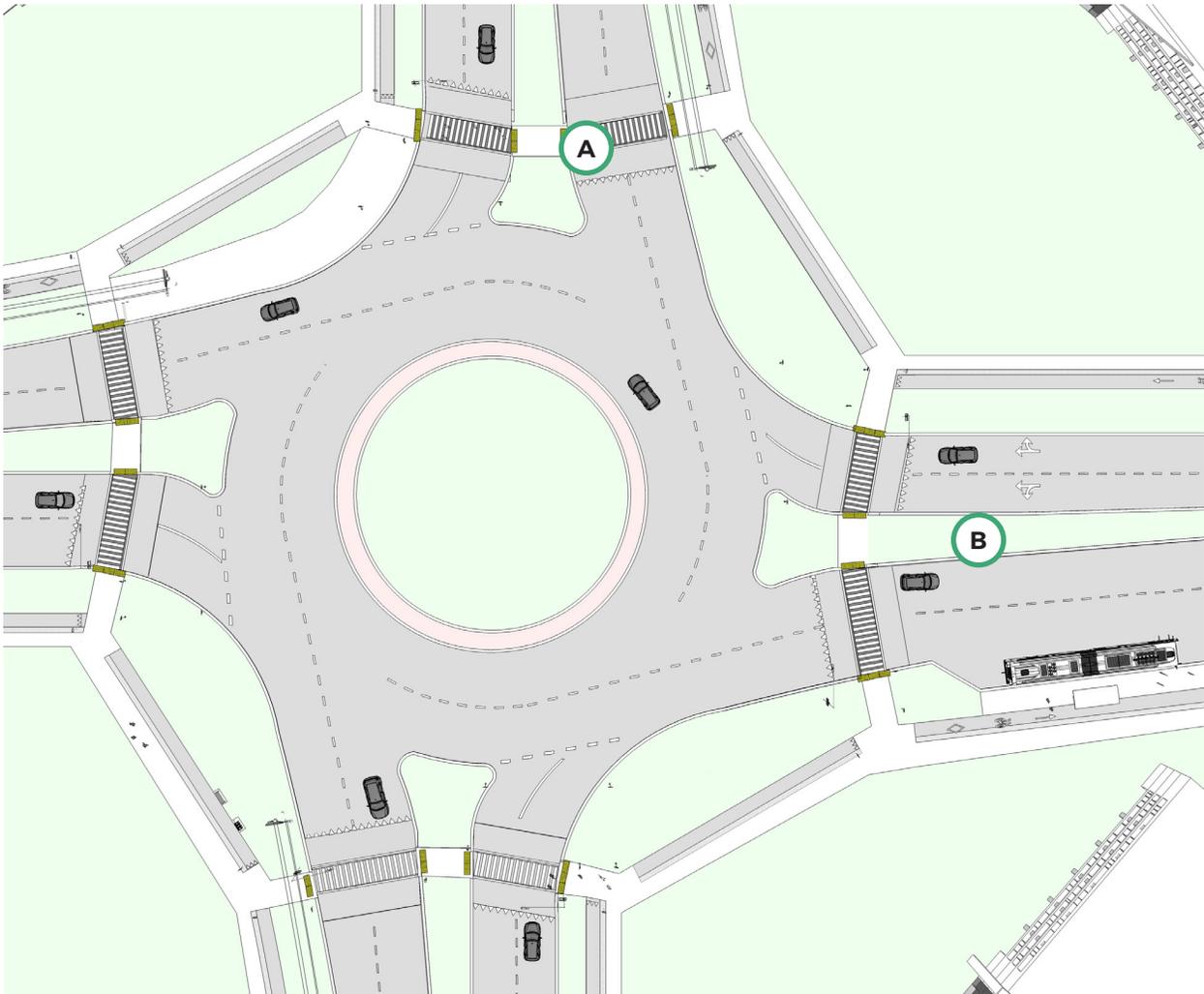
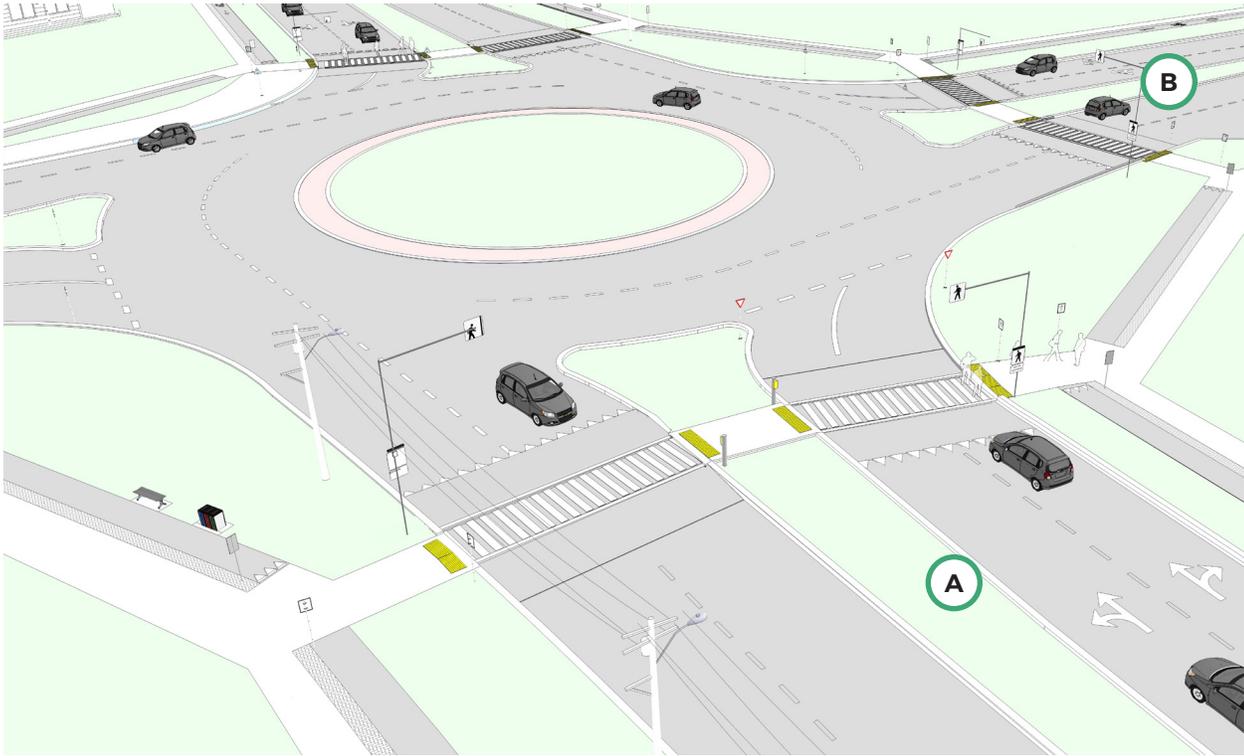
Transit

- Transit stops should be positioned on the far side of the roundabout, beyond the pedestrian crossing in order to maintain clear sightlines between pedestrians at the crossing and approaching motorists (in a near side stop, a stopped bus would obstruct this sightline).
- Motorists would typically not expect a vehicle to stop in the lane on the far side of the roundabout, downstream of pedestrian crossing. Therefore, transit stops should include a bus bay to avoid rear end collisions with the bus.

Motor Vehicles

- The geometric design of the roundabout creates a greater angle of deflection for the entry lanes than for the exit lanes. This encourages motorists to reduce their speed as they enter the roundabout and provides motorists with a better sightline to the exit lane pedestrian crossing.
- A truck apron in the centre island deters motorists in smaller vehicles from traveling through the roundabout at an excessive speed, while still accommodating large vehicles
- Sightlines between the motor vehicle travel lanes and the pedestrian and cycling facilities are clear on the roundabout approach and through the roundabout.





5.5 URBAN THOROUGHFARE INTERSECTING A NEIGHBOURHOOD CONNECTOR

This intersection is an example of a large, high capacity corridor intersecting a lower capacity street at a traffic signal. While Neighbourhood Connectors may have less capacity, they can play an important role in the City's cycling network, and the accommodation of cyclists across large intersections such as this one is an important factor in determining cyclists' comfort level.

Pedestrians

- The alignment of the pedestrian crossings across the Urban Thoroughfare are pushed back from the intersection to accommodate the pedestrian refuge islands. While these islands allow slower pedestrians to cross the intersection in two stages, sufficient walk time should be provided for most pedestrians to be able to cross the full intersection in a single signal phase.
- The pedestrian cyclist mixing zones connect the two sidewalks on each corner with a diagonal line accommodating the pedestrian desire line between the sidewalks.

Cyclists

- A pedestrian-cyclist mixing zone is used on the corners to accommodate cyclists on the Urban Thoroughfare, as the volume of pedestrians and cyclists is typically low in this context. A "Cyclists Yield to Pedestrians" sign should be included on all cycling approaches.
- In-boulevard left turn queue boxes are provided on all corners. Due to the size of the intersection and volume of motor vehicle traffic, on-street queue boxes are not desirable and cyclists should not be encouraged to make direct left turns. The use of an in-boulevard queue box also communicates to cyclists turning left from the on-street cycling facility that there is space available in the boulevard for them to queue. The shape of the queue box varies to accommodate bicycle and pedestrian movements around the queue box.

- On the Neighbourhood Connector, the stop bar for motorists is positioned approximately 1.0 m further from the intersection than the cyclist stop bar, to improve the visibility of cyclists at the intersection.
- Physical separation (bollards) is maintained on the on-street cycling facility up to the point where the motor vehicle turning radius begins / ends.
- Green pavement markings increase the visibility of the bicycle crossings.

Transit

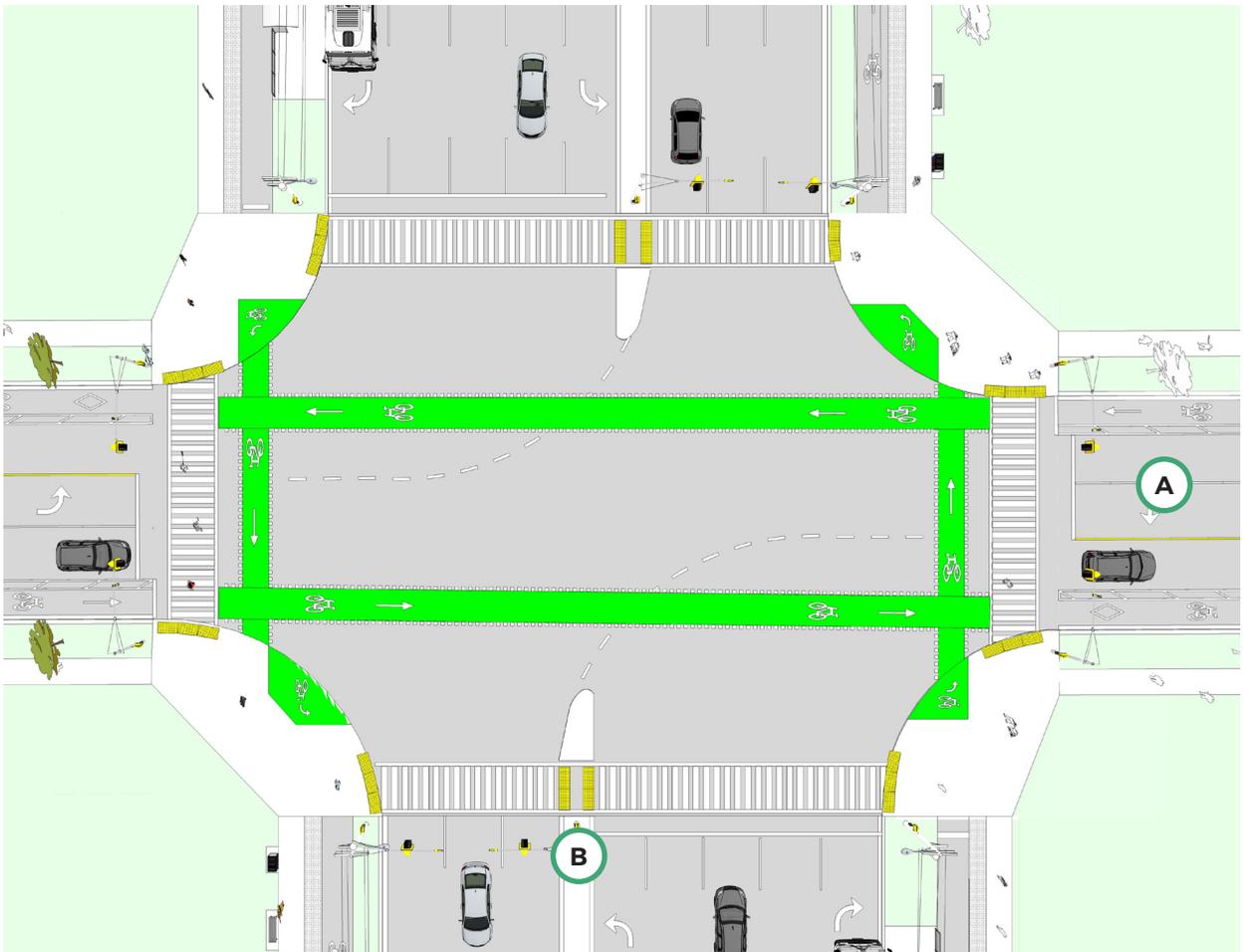
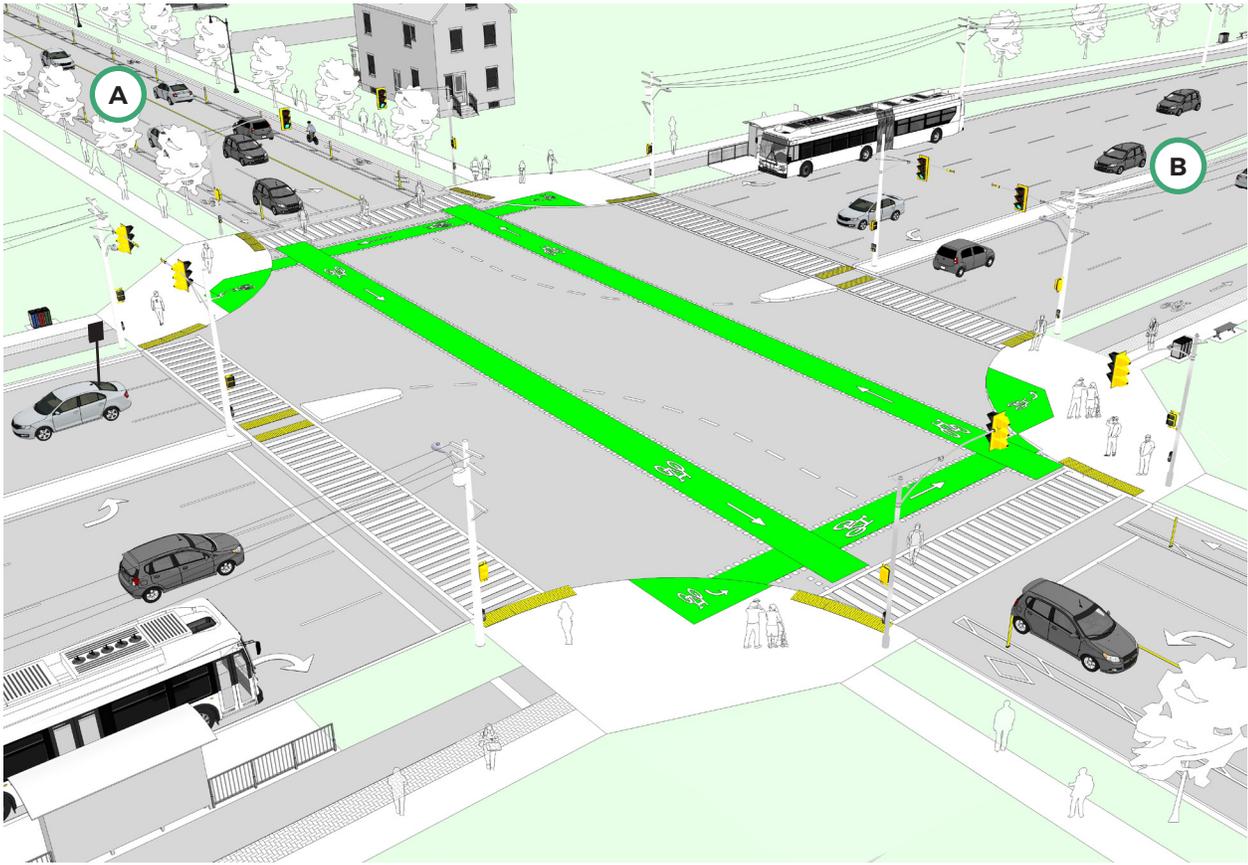
- Right turn lanes act as bus bays for near side transit stops. Since right turn volumes onto a Neighbourhood Connector are often relatively low, the right turn lane may function as a queue jump lane if the Urban Thoroughfare operates with significant congestion and the turn lane is of sufficient length.

Motor Vehicles

- Left turn guide lines are provided for the left turn movements onto the Urban Thoroughfare. Since there is no dividing median on the Neighbourhood Connector, left turn guidelines onto this street are optional.

A Neighbourhood Connector

B Urban Thoroughfare



5.6 CIVIC BOULEVARD INTERSECTING A NEIGHBOURHOOD STREET

This intersection is an example of a two-way stop controlled intersection in a more urban context. The Neighbourhood Street has neither a formal cycling facility nor transit service.

Pedestrians

- Pedestrian amenities such as benches, which are typically not provided on Neighbourhood Streets, should be considered in proximity to these intersections.
- At two-way stop controlled intersections, pedestrian crossings of the uncontrolled street are typically not provided. If warranted, an optional pedestrian crossover may be provided at these locations, as per OTM Book 15.

Cyclists

- Since there is no pedestrian facility crossing the cycle track at the intersection, the cycle track is maintained up to the crossing and no mixing zone is required.
- In the example shown, the cycle track bends toward the roadway to maximize the visibility of cyclists to motorists turning onto the Neighbourhood Street.
- An alternate design can also be considered, where the cycle track bends away from the roadway. This option can be combined with a raised bicycle and pedestrian crossing. In this alternative, however, the stop bar is positioned much further from the intersection, which may reduce motorist compliance with the stopping location.

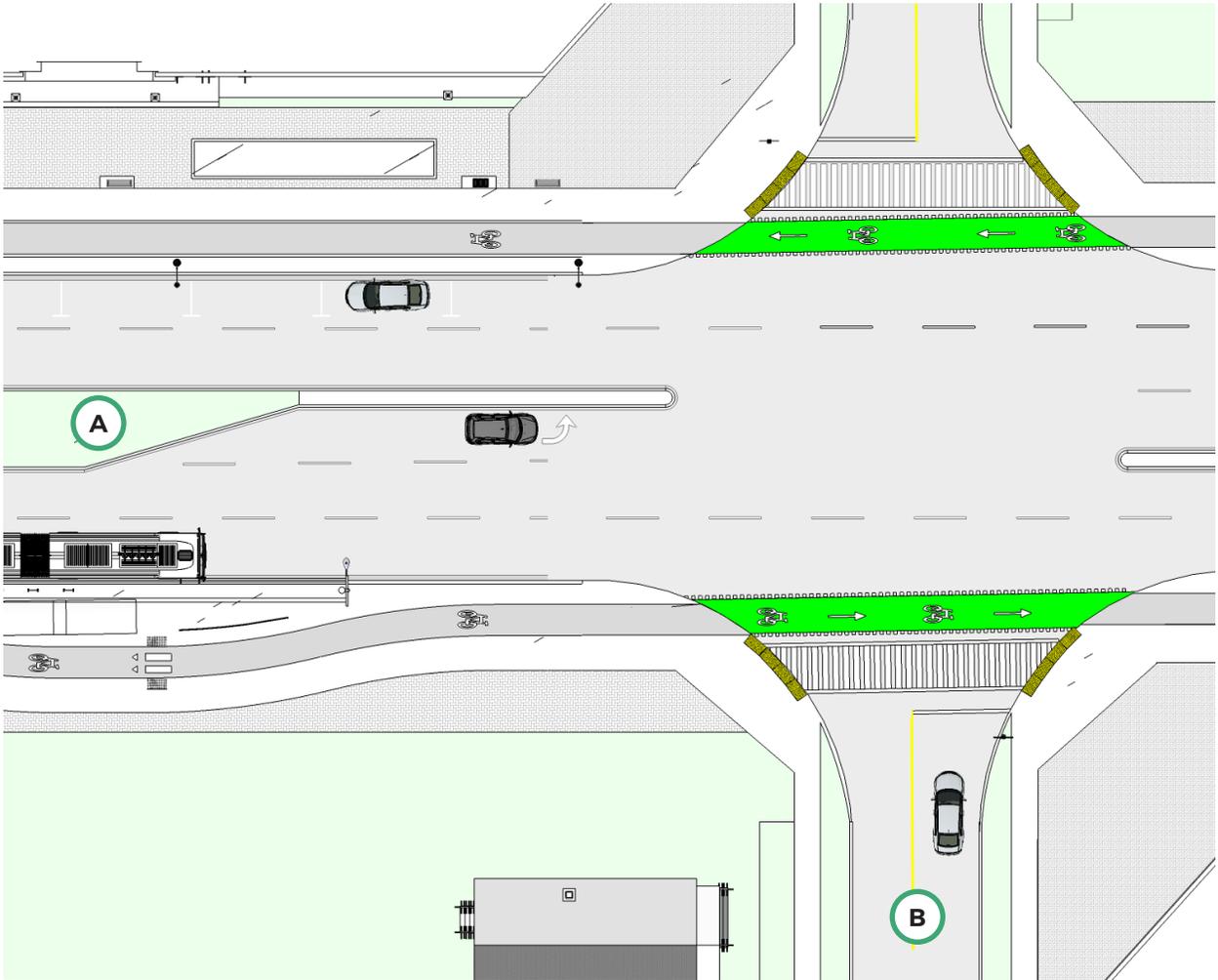
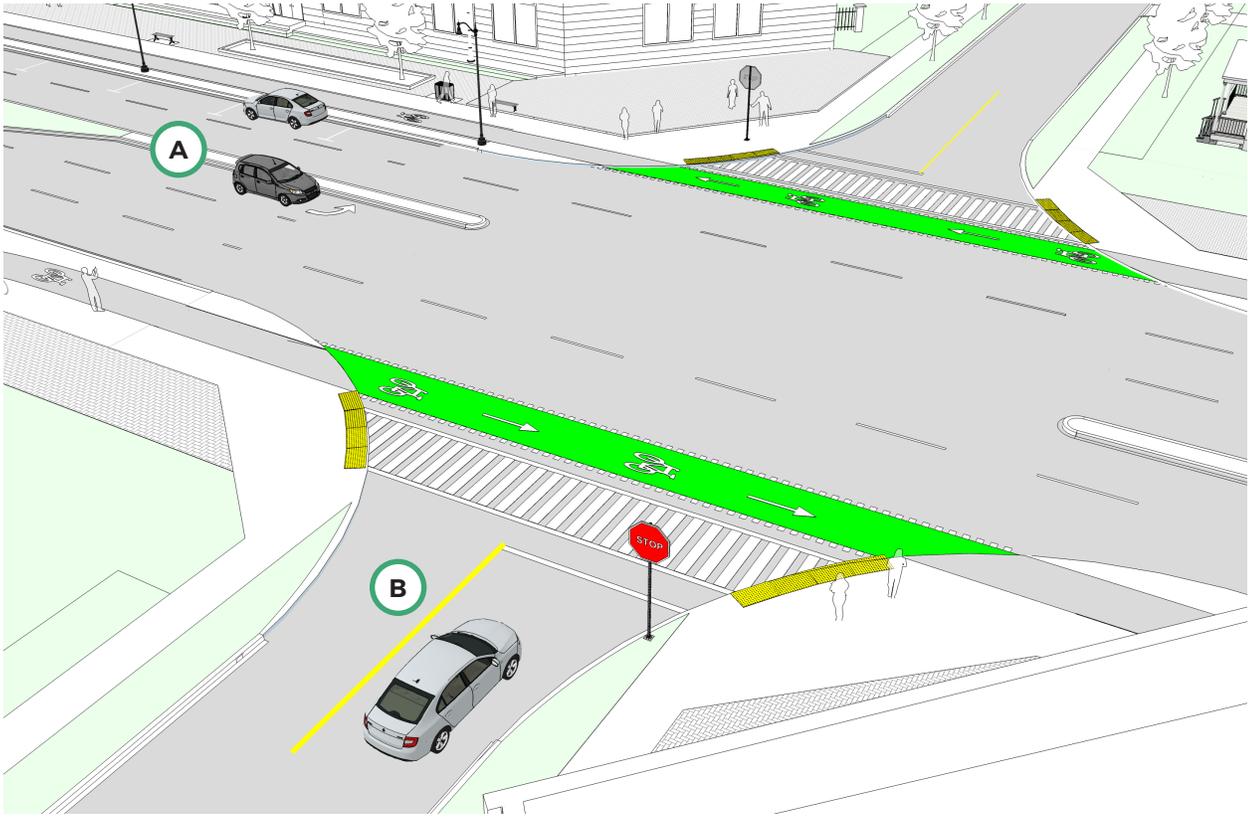
Transit

- Since there is no pedestrian crossing of the Civic Boulevard, all transit passengers must cross the cycle track at the transit stop.
- Buses stop in the motor vehicle travel lane and do not need to merge when pulling away from the stop increasing the efficiency of transit operations.

Motor Vehicles

- Clear sightlines are provided on all corners, as motorists turning onto the Civic Boulevard should be able to watch for gaps in motor vehicle, cyclist and pedestrian traffic from the stop bar position, without encroaching onto the crosswalk or crossside.
- Even though Neighbourhood Streets frequently have no centreline, a short centreline is provided on the approach to the intersection, along with a stop bar.







6

**MOVING FORWARD
WITH COMPLETE
STREETS**

6.1 PRINCIPLES OF PERFORMANCE MEASUREMENT

Methods used to measure complete streets should be relevant to the fundamental design principles of complete streets outlined in Chapter 1. These include safety, accessibility, sustainability, connectivity, vitality, and support for multi-modal travel. Analysis that is undertaken should be relevant to specific projects, consistent across projects (to facilitate cross-project evaluation), and directly inform planning and design.

Develop a baseline

Performance data should be gathered and metrics prepared prior to undertaking a complete streets project. This will facilitate comparisons between pre- and post-implementation performance and help determine how the design affects usage patterns after the new design is implemented.

Analyze usage patterns in context

Complete streets metrics should distinguish between observed demand based on existing conditions, and latent demand that is currently unmet by an existing design. Implementing a new design can lead to new usage patterns. For example, measuring existing cycling demand on a high motor vehicle volume street with limited cycling infrastructure does not accurately capture the cycling demand that could exist if better facilities were available. Similarly, expanding a roadway to alleviate congestion may induce more motor vehicle travel, contributing to further congestion. The conceptualization of potential street designs should consider how they could affect usage patterns.

Latent or unmet demand is generally difficult to estimate and survey tools may be required to provide a gauge of how many potential users would use a facility if it better met the needs of more user types. Public surveys are often used to gauge interest in a complete street design, the degree of latent demand, and the usage of an existing facility. Responses to public surveys should be segmented based on user behaviour and/or demographic characteristics to contextualize findings and develop a representative assessment of preferences and behaviours.

Finally, complete streets improvements typically take time to affect usage patterns. Behaviours do not change immediately after opening day, and it is important to undertake on-going analysis in 6 or 12-month intervals.

Developing a feasible monitoring strategy

While important, ongoing monitoring takes resources and time. This means it is important that the City identify metrics that are feasible to collect, and the cost of data collection is integrated into operating or project budgets as appropriate. Wherever possible, the City should use existing data sources from its own divisions and partner agencies. The metrics should be used as consistently as possible for all comparable projects.

Communicate findings and integrate data analysis into project decision-making

Metrics used should be easy to understand and communicate to the public and stakeholders. The results of ongoing monitoring and the associated lessons learned should be incorporated into Stage 1: Planning of the complete streets design process. By integrating performance results from previous projects into subsequent projects, decision-making about project prioritization and street design can be better supported.

6.2 METRICS

Mobility (Multi-modal Level of Service)

Traditional transportation metrics such as intersection level of service (LOS) have a narrow focus on specific users and functions. These metrics are valuable but should not be used in isolation. Streets are only complete if they support multiple users and functions. Therefore, LOS assessment methods have been developed for pedestrian, transit, and cycling, and integrated into a multi-modal level of service (MMLOS) methodology.

The MMLOS evaluates not only the design of a facility but how people are using the facility. A useful advantage of performing a MMLOS analysis is that in addition to the modal LOS score, performance metrics that contribute to the LOS score calculations may be used to identify trouble spots and potential improvements. For example, pedestrian queuing area at the corner of an intersection is a required input for the pedestrian LOS for intersections. The additional metrics are also useful in comparing concept designs and comparing proposed and existing conditions.

The four modes assessed by the MMLOS methodology for street facilities are pedestrian, cyclist, transit, and auto LOS. Each mode is assigned a score from 1.50 to 5.50, and a corresponding grade from A to F. For motor vehicles, LOS A indicates a primarily free flow operating condition for that mode, and F is characterized by very low speeds, congestion, and queuing. The LOS grades for pedestrian, cyclist, and transit are based on user perceptions of travel time and comfort and on the time the non-auto user spends in each segment. For example, if a pedestrian experiences significant delay while waiting for a crossing phase at an intersection, this impacts the pedestrian LOS.

Inputs

LOS calculations require inputs of data that can be derived from as-built drawings, surveys, and field observations for existing conditions and design drawings for proposed conditions. Data are also required from numerous sources such as traffic

movement counts; signal cycle timings; and pedestrian, cyclist, and transit vehicle/passenger volumes.

Analysis Scales

The Highway Capacity Manual (HCM) provides methodologies for determining LOS per mode based on three scales of analysis: intersection, segment, and facility. The section below summarizes the input requirements for each modal LOS, as well as some of the calculations that are needed to complete the LOS that are also useful on their own as a performance metric.

Intersection

Intersections that are signalized, stop controlled, or have a roundabout may be evaluated.

- **Pedestrian LOS** inputs include flow rates and corner waiting area. These are useful for evaluating pedestrian comfort and space at intersections, as well as calculating crossing distance and delay.
- **Cycling LOS** inputs include cyclist flow rates, on-street parking utilization, signal cycle timing, and cycling facility dimensions. The primary calculation is delay for cyclists.
- **Transit LOS** is addressed at the segment scale.
- **Motor Vehicle LOS** inputs include volume, percentage of right-turn-on-red, percentage of heavy vehicles, transit bus activity, signal cycling timings, platooning rates, and grades. The primary calculations are volume-to-capacity ratio, travel speed, and delay.

Segment

Segments include both the link between intersections (of the types noted above) and the intersections themselves. Segment analysis is useful to assess the linear experience of a block length between intersections and to measure the characteristics of the pedestrian realm.

- **Pedestrian LOS** inputs include mid-block flow rates, distance to nearest signalized crosswalk, sidewalk presence and width, and buffer between the curb and the pedestrian realm. These are useful for evaluating pedestrian comfort and space at midblock locations, as well as calculating crossing distance and delay.

- **Cycling LOS** inputs include adjacent vehicle flow rate, on-street parking utilization, pavement condition, and cycling facility or curb lane dimensions. The primary calculations are travel speed and delay for cyclists.
- **Transit LOS** inputs include stop dwell time, service reliability, passenger load factors, signal cycle timings, physical characteristics of transit stops and waiting areas, and re-entry delay. The primary calculations are transit running time and speed, delay to transit vehicles, and the transit wait-ride score.
- **Motor Vehicle LOS** inputs include flow rates, upstream intersection characteristics, speed limit, access point volumes and characteristics. The primary calculations include running time and speed, through delay, delay due to turning vehicles, and spatial stop rate.

Facility

Analysis at the facility scale evaluates a contiguous length of one or more segments and intersections in corridor wherein the segments share common attributes such as land use context, average daily traffic volume, and through-lane capacity. If these attributes change substantially at a location (for example, when crossing a major arterial street), a separate analysis should be undertaken as this is a separate “facility”.

For all modes, the segment and intersection LOS methodologies reviewed above are used as appropriate.

- **Pedestrian LOS** calculations are pedestrian space and travel speed.
- **Cycling LOS** calculation is travel speed.
- **Transit LOS** calculation is travel speed.
- **Motor Vehicle LOS** calculations are base free-flow speed, travel speed, and spatial stop rate.

The MMLOS process is documented in detail in chapters 16 to 23 of the HCM 6th Edition. Additional guidance on applying the MMLOS evaluation, and in what

circumstances the three analysis levels should be used, can be found in NCHRP Report 825: Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual.

Some important considerations when undertaking MMLOS review

- The HCM 6th edition does not provide a combined LOS for all modes of a facility. The travel characteristics and user expectations vary considerably between modes, and as such, an integrated MMLOS for a facility would not provide a useful metric.
- LOS calculations for each mode affect each other such that the provision of a higher LOS for one mode is typically associated with the trade-off of a lower LOS for another mode. For example, providing more space for a bicycle lane while maintaining auto capacity, may require a lower pedestrian LOS (reduction in sidewalk width) as there is a finite amount of width in the right-of-way.
- If freight movement is a high priority identified for the corridor being analyzed, the assessment methods in NCHRP Report 31: Incorporating Truck Analysis into the Highway Capacity Manual or the City of Ottawa Multi-Modal Level of Service (MMLOS) Guidelines should be used.
- It is typically not feasible to achieve an LOS of A for each mode along a corridor due to restrictions on right-of-way space and available resources. Rather, the MMLOS assessment allows decision makers and designers to compare the performance of modes against each other based on the design objectives of the complete street project. The Complete Street Priorities and the Street Condition/Priorities Guideline tools in Chapter 3 are useful resources in determining how the LOS for each mode should compare against the design objectives for the complete street project.

Connectivity (Spatial Analysis)

Detailed land use data, transportation network data, and geographic information systems (GIS) can also be used to visualize and analyze the ability for Londoners and vulnerable road users to access essential amenities using complete streets. For example, locations of grocery stores, schools, civic centres, and parks can be used to develop complete street connectivity metrics within a chosen catchment area. Locations that may have less access to sustainable mode choices can also be identified.

Methods to assess connectivity include:

- Ratio of direct distance vs. on-the-ground distance between a community or facility and any associated destination points
- Network completeness (% of all streets with sidewalk coverage, % of population within 1 km of cycling route network)

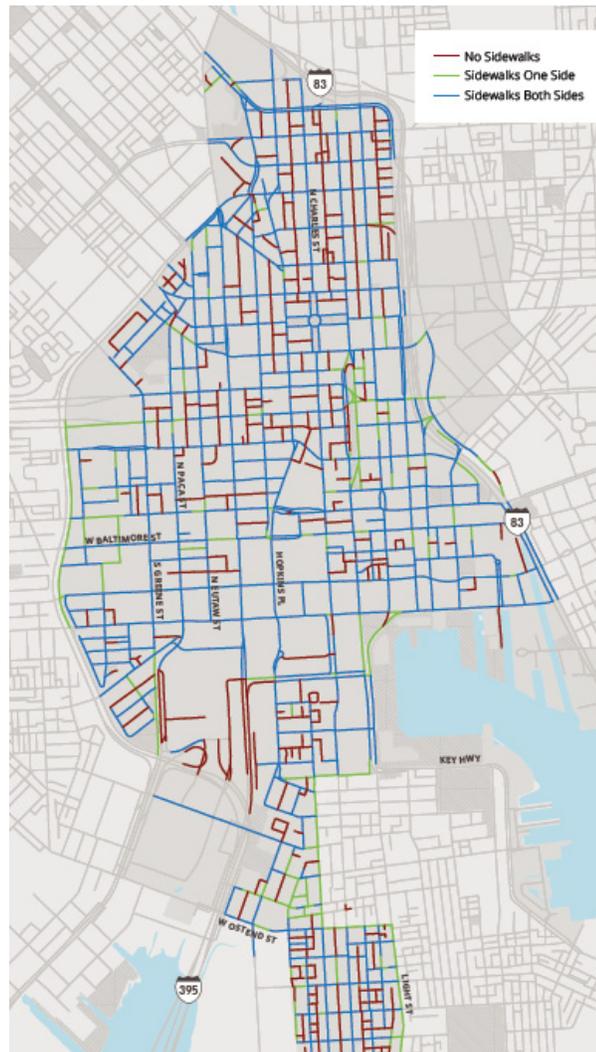
Vitality

Together with public parks and squares, streets are the primary public space in a city. They are the connective tissue of London. The fifth guiding principle of complete streets is to create places in and near London's streets where Londoners want to spend time. While qualitative in essence, vitality can be measured and tracked with quantitative approaches. It is expressed through activity and quality of the public realm, as well as retail activity.

Public Life

Tools and techniques to measure public life have been used by public realm experts such as William H. Whyte and Jan Gehl. *How to Study Public Life* (by Jan Gehl and Birgitte Svarre) is an excellent resource for metrics. Some of the measures are recorded through manual observation, while others are automated using sensors and videography. Potential techniques include:

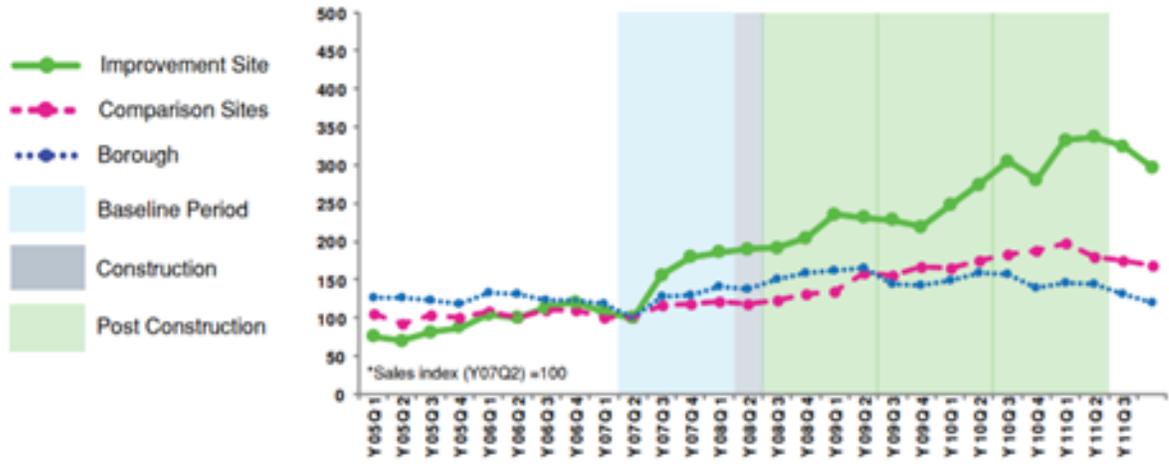
- Maintaining a “corridor diary” whereby the data collected for a study corridor can be reviewed in one place and compared over time. The diary should be



Baltimore, MD, pedestrian network completeness mapping analysis.

hosted on a project website.

- Tracking the number of public events that take place per year.
- Conducting pedestrian cordon counts at key locations along the corridor.
- Noting pedestrian queues and spillover at intersections while pedestrians are waiting for a crossing phase.
- Noting pedestrian desire lines where there are no sidewalks.
- “Tracing” pedestrian paths to determine typical flows.
- Noting areas where people tend to congregate, and the approximate volumes and duration.
- On-street parking demand and turnover.
- Bicycle parking demand.



NYC DOT Combined Sales: Improvement Sites vs. Comparison Sites - Vanderbilt Avenue

Retail Sales

Sales data may be collected via electronic payment vendors and can be used to compare changes on streets where improvements are made with sales activity on control streets that have a similar character. A retail sales monitoring approach was used by New York Department of Transportation in their Measuring the Streets analysis as well as by the City of Toronto for the Bloor Street Bike Lanes pilot program. Due to limitations on how a Canadian municipality such as London can use sales data, aggregated point-of-sale (POS) electronic sales volumes in partnership with POS payment vendors can be used in lieu of local sales tax rolls.

Safety

Motorist, cyclist, and pedestrian collision and near miss data can be used to identify priority locations for improvements and to inform the design of these improvements. It is important to collect volume data for all modes in order to reflect proportional collision rates rather than absolute collision counts.

Methods to monitor safety include:

- Network screening assessment to identify killed or seriously injured (KSI) collision hot spots.
- Corridor review of priority areas identified in the network screen using collision data and video detection and vector analysis of identified locations to review user paths and identify near-miss frequency.
- Engineering assessment of identified locations. Concentrations of a certain

types of collision or injury/fatality are detailed review.

- Maintain partnerships with key community organizations and agencies. Examples include active and safe routes to school programs, walking school buses, and police traffic safety programs.

Accessibility

Beyond the requirements of the Accessibility for Ontarians with Disabilities Act, and its associated regulations, universal accessibility is critical to enable the greatest number of Londoners and visitors to London to benefit from civic life and the design of streets. Methods to monitor accessibility include:

- Tracking accessible and non-accessible corner ramps, curb cuts, transit stops, and other public facilities such as stairs and grade changes.
- The number and percentage of fully accessible intersections and transit stops along the study corridor.

Sustainability

Climate change, air quality, the increasing frequency of extreme weather events, the increased risk of flooding, and the public health impacts of auto-dependency will pose a challenge for the City regarding designing and operating the complete streets of the future. Methods of monitoring sustainability and resilience include:

- Tracking incidents of weather-related flooding in corridors identified for complete street design, or where a complete street project has been completed.

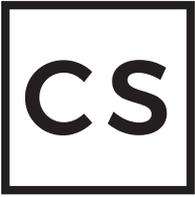
- Number of LID features, or storm water retention capacity of LID features along study corridors.
- Non-auto mode share along a study corridor using estimates derived from pedestrian cordon counts, cyclist cordon counts, turning movement counts (TMC) and average annual daily traffic (AADT) measurements, observed pick-up/drop-off activity, and transit ridership data.
- Tree canopy coverage.
- Greenhouse gas (GHG) emissions (this exercise, for practical purposes, should be City-wide and at a strategic level, rather than a corridor level analysis).

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APPENDICES



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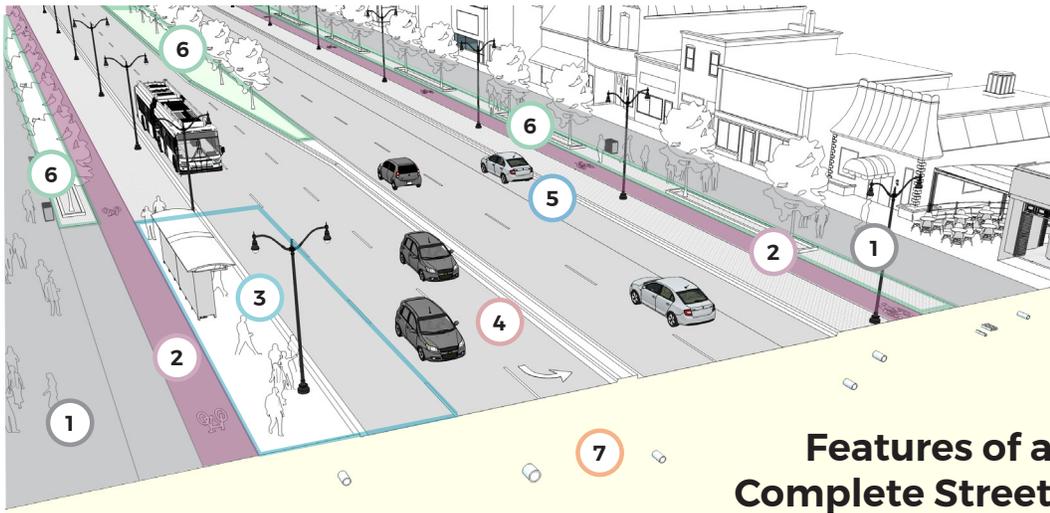
COMPLETE STREETS FOR LONDON

A Citizen's Guide

What are Complete Streets?

Streets are complete when they are designed to support many different forms of mobility.

They provide an environment where all street users, particularly the most vulnerable, find getting around safe, attractive, comfortable, and efficient. This means that regardless of age, ability, or confidence level, London's streets and public realm should be accessible and appropriate for the needs of all users. They should also support the vitality of public life and business activity. Depending on the corridor in question, different user groups will receive priority to ensure that the street functions efficiently. Complete streets also provide a positive physical environment that supports the form of development that is anticipated along the street.



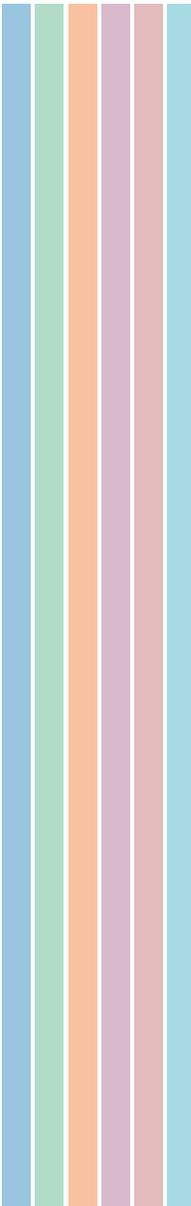
Features of a Complete Street

- 1 Walking**
Greater sidewalk width where higher volumes of pedestrians are expected, higher quality design elements in the public realm, lighting and universal accessibility features to ensure ease of use
- 2 Cycling**
Consideration of on street cycling facilities and increased cyclist priority if on the cycling network
- 3 Transit**
Comfort and amenities for waiting passengers as well as design elements to speed up transit service
- 4 Through Movement (Vehicles and Freight)**
Ensure efficient through-movement of vehicles while balancing priorities such as building a sense of place and support for all street users
- 5 Parking**
Provision of adequate on-street parking where appropriate
- 6 Green Infrastructure**
Design features that promote environmental sustainability
- 7 Utilities**
Accommodation of utilities above and below ground



London
CANADA





Why Complete Streets?

Change is coming to London's streets.

The City of London is preparing for a new era of rapid transit and city-building, and is encouraging the design and development of streets that more effectively meet the needs of a wide variety of users. Street trees, protecting wildlife corridors, and green design features help the City address urban sustainability and climate change. Cycling and walking are key components of this strategy, and the City is building infrastructure including sidewalks, bike lanes, and cycle tracks to encourage walking, cycling, and other forms of active transportation. Improving health and activity levels, reducing traffic congestion, and supporting the character of London's neighbourhoods are key objectives of the complete streets program.

Complete streets support movement

Complete streets support movement by emphasizing moving people, rather than vehicles. The degree to which a mode is emphasized on each street is defined in the London Plan, the City's Official Plan. In all cases, a complete street integrates multiple modes of travel, depending on their priority.

Complete streets support safety

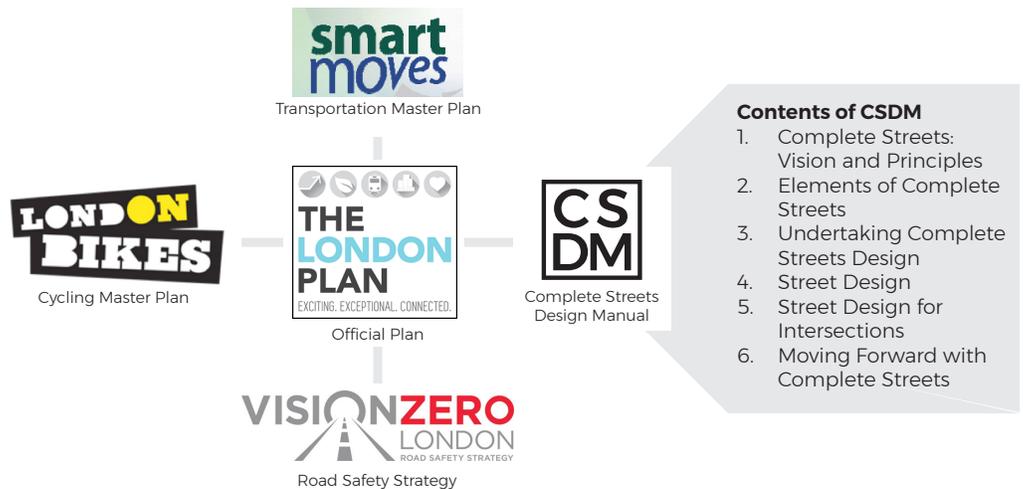
Complete streets share a similar approach to Vision Zero, an international safety movement that states that no loss of life is an acceptable outcome of getting around a city. Research has shown that after complete streets design features are incorporated onto an existing street, the volume and severity of collisions is reduced. By supporting all modes of travel, particularly those most vulnerable, everyone is safer.

Complete streets support placemaking

Complete streets projects have been shown to result in increased pedestrian and retail sales activity. They contribute to making certain streets and corridors unique, providing them with an identity that attracts people. A street that attracts people will have a vibrant and engaging public realm.

London's Complete Streets Toolkit

These City plans work together to enable the City of London to advance complete street projects. The Complete Streets Design Manual is the key resource that guides staff, consultants, and decision makers.



How can you get involved?

Public Consultations for Environmental Assessments, Master Plans, and Infrastructure Plans

Visit www.london.ca or call 519 661 CITY (2489)

Your Ward Councillor

Visit www.london.ca/city-hall/city-council/ or call 519 661 CITY (2489)

GLOSSARY

The definitions in this glossary are taken or adapted from the following documents: London Plan (2016), Ministry of Transportation Freight Supportive Guidelines (2016), Ontario Traffic Manual: Book 18 Cycling Facilities (2013), and the Ministry of Transportation Transit Supportive Guidelines (2012). Terms that are not defined in any of these documents have been defined by the authors of this manual.

Accessibility for Ontarians with Disabilities Act (AODA): Provincial legislation and associated regulations that set targets and provide standards for making the built environment accessible to all Ontarians.

Active Building Frontages: Land uses such as retail, storefronts, cafes and restaurants, which keep the area active with pedestrian activity at street level and maintain visual interest.

Active Mobility Network: Sidewalks, crosswalks, cycling lanes, designated streets, and multi-use pathways that accommodate active transportation.

Active Transportation: Human-powered travel, including but not limited to walking, cycling, inline skating, skateboarding, and travel with the use of mobility aids for those who need them. Transit ridership is often seen as a form of active mobility because every transit trip begins and ends with a walk.

Bicycle Box: Pavement markings typically found on streets with bike lanes which allow cyclists to queue at a traffic ahead of motor vehicles.

Bicycle Corral: A bicycle parking structure positioned in a motor vehicle parking lane.

Bicycle Facility: A general term used to denote facilities designed for use by cyclists. Some examples of cycling facilities are: paved shoulders, bicycle lanes, cycle tracks, and multi-use pathways.

Bicycle Lane: A portion of a roadway which has been designated by pavement markings and signage for the exclusive use of cyclists.

Bicycle Signal Head: A traffic signal head specific to cyclists. The circular lenses with a red, amber, and green bicycle outline on a black background differentiate the bicycle signal head from the conventional signal head used by motorized vehicles.

Bidirectional Travel: Moving or operating in opposite directions. Cycle tracks and multi-use pathways may all be designed for two-way travel by cyclists if space and site conditions allow for it.

Bioswale: Landscape design elements intended to collect surface runoff water and concentrate, filter, or remove debris and pollution.

Boulevard: The space between the curb and the edge of the right-of-way on an urban street.

Boulevard Island Stop: A transit stop where passengers board from/alight to a platform that is positioned between a motor vehicle lane and a cycling facility.

Buffer: A spatial or physical separation.

Built Form: Includes all the elements that make up the physical shape of the city. These include neighbourhoods, streets, streetscapes, public spaces, landscapes and buildings.

Bus Bay Stop: A bus stop where the bus pulls out of a lane of live traffic into a designated area, allowing traffic to overtake the bus while it is serving the stop.

Bus Rapid Transit (BRT): Buses on grade-separated roadways or dedicated lanes to transport passengers without interference from other traffic. Such systems usually include dedicated bus lanes, signal priority at intersections, off-bus fare collection to speed up boarding, level boarding (low-floor buses or high-level platforms) to enhance accessibility and enclosed stations.

Cable Vault: Underground chambers that provide access to various cable connections and switches. The vaults are large structures that typically provide sufficient space for workers to access.

Catch Basin: A chamber that receives stormwater, traps sediment and channels stormwater into the storm sewer via a pipe called a catch basin lead.

Centre Median Platform Stop: A transit stop positioned between a dedicated transit lane and a motor vehicle lane.

Channelized Right Turn: A segment of roadway that connects two intersecting streets and allows vehicles to make a right turn without traversing a full intersection.

City building: An activity, plan, design, investment, public work or development that sets the future shape, character and form of the city.

Clearway: The continuous portion of a right-of-way that is intended for through movement by pedestrians, bicycles, or vehicles.

Collision: An incident resulting in property damage, personal injury, or death. It involves the loss of control or the striking of one or more vehicles with another vehicle, a person, an animal, or an inanimate object.

Communication and Electric Cable: Utility cables that provide telephone, internet, cable, and electrical services to properties.

Complete Community: A community that meet people's needs for daily living throughout an entire lifetime by providing convenient access to an appropriate mix of jobs, local services, a full range of housing, and community infrastructure including affordable housing, schools, recreation and open space for their residents. Convenient access to public transportation and options for safe, non-motorized travel is also provided.

Complete Street: Streets that are planned to balance the needs of all road users, including trucks and service vehicles, pedestrians, cyclists, transit, and motorists. Complete streets provide physical environments that make all forms of mobility safe, attractive, comfortable, and efficient. Complete streets also provide a positive physical environment that supports the form of development that is planned for, or exists, adjacent to the street. In some cases, complete streets may also incorporate corridors for wildlife movement.

Concrete Median or Concrete Short

Wall Barrier: A pre-formed barrier that is designed to separate directions of travel or user types. Typically made of concrete but can be plastic for temporary usage during construction.

Contraflow Bike Lane: Allows only bicycles or priority vehicles (such as a transit bus) to travel in the opposite direction along a one-way street. Note that this term can also apply to bi-directional lanes reserved for peak-hour, peak-direction travel.

Corridor: A linear route that provides for the movement of people and goods using a variety of transportation modes, including walking, cycling, transit and private vehicles. Corridors designated for transit-supportive intensification are typically associated with more intense density, activity and mix of uses, located along major transit routes (Guideline 1.1.3 in the Transit-Supportive Guidelines). For the purposes of this manual, corridor typically refers to the length of street facility being studied for complete street design.

Crossride: A part of the roadway specifically intended as a crossing for cyclists. This is indicated by signs, pavement markings, and a traffic signal if the crossing is signalized. Cyclists do not need to dismount to use this crossing.

Crosswalk: A part of the roadway specifically intended as a crossing for pedestrians. This is indicated by signs, pavement markings and a traffic signal if the crossing is signalized.

Curb: A vertical or sloping construction element along the edge of a pavement or shoulder forming part of a gutter. It strengthens and protects the edge of the pavement, and clearly defines the edge to vehicle operators. The surface of the curb facing the general direction of the pavement is called the "face".

Curb Extension: a location where the boulevard extends into the roadway, typically into a permanent motor vehicle parking lane.

Curb Radius/Radii: The size and curve of an intersection corner. A wide curb radius typically results in high-speed turning by motorists. Reducing the turning radius reduces turning speeds, shortens the crossing distance for pedestrians and improves sight distance between pedestrians and motorists. Nearby land uses and types of road users should be considered when designing an intersection so that curb radii are sized appropriately. Where there is a parking and/or bike lane, curb radii can be tighter, because vehicles have more room to make the turn.

Cycle Track: A one-way or two-way cycling facility that physically separates cyclists from motorists through the use of curbs, bollards, planters, or other separation devices.

Cyclist: A person who operates a muscle-powered or motor assisted bicycle, tricycle, or unicycle.

Dedicated Transit Lanes: Traffic lanes designated for bus use only, that are marked and signed differently from adjacent lanes but are not physically separated from them.

Departure Leg: The part of an intersection used by traffic leaving the intersection.

Design Speed: A speed selected for purposes of design and correlation of the geometric features of a street. It is a measure of the quality of design offered by the street.

Desire Line: A route or connection between two locations where active transportation demand is observed, but no formal facilities are provided.

Directional Diverter: A median barrier positioned diagonally across and intersection. Diverters prevent motor vehicles from making a through movement and discourage traffic infiltration. They are typically designed to allow cyclists and pedestrians to continue through.

Directional Sharrows: A bicycle pavement marking that instructs cyclists to make a turn and also communicates the desired alignment of cyclists in the roadway.

Door Zone: The space on either side of a motor vehicle parking lane aligned with the open door of a parked vehicle. It is typically approximately 1.0 m on either side of a motor vehicle parking lane. Cyclists should avoid riding in the door zone.

Elephant Feet: Square pavement markings (typically 200 mm x 200 mm) that delineate a crossride.

Far Side Stop: A transit stop along a roadway that is located directly after an intersection.

Flex Bollard: A post anchored into the roadway that temporarily bends when it is impacted. Flex bollards are frequently used to separate motorists and cyclists.

Free-flow Speed: The expected speed of vehicles in a link. Calculated by beginning with the posted speed and making adjustments for lane width, lateral clearance, median type, and access points.

Green Infrastructure: Natural and human-made elements that provide ecological and hydrological functions and processes. Green infrastructure can include components such as natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, and green roofs.

Hard Surface: A firm surface that is typically designed to accommodate pedestrians, cyclists, or motor vehicles, and constructed of concrete, asphalt, or unit pavers.

High Occupancy Vehicle (HOV) Lane: Special lanes typically reserved for vehicles carrying at least two people as well as transit vehicles. They are often denoted by signs and a recognizable symbol (a diamond symbol is used on Ontario highways) painted on the pavement. Ontario's provincial HOV lanes are located in the median lane and are separated from the general traffic lanes by a painted buffer. Vehicles carrying at least two people may enter and exit the HOV lane only at clearly designated points. On municipal streets,

HOV lanes are generally located in the curb lanes. HOV lanes can be designated on a full-time basis, or may be limited to peak travel periods of the day. Bicycles may also be permitted on municipal HOV lanes in some instances.

Horizontal Deflection: A traffic calming measure that prevents motorists from travelling in a straight line, intended to reduce travel speeds and/or motor vehicle volumes.

In-Boulevard/On-Street Left Turn Queue Box: A designated space in the boulevard or on the street at an intersection that is marked with green pavement markings and allows cyclists to queue while awaiting a green signal indication to complete a two-stage left turn.

Infrastructure: Physical structures, facilities, and corridors that form the foundation for development. Infrastructure includes sewage and water systems, septage treatment systems, stormwater management systems, waste management systems, electricity generation facilities, electricity transmission and distribution systems, communications/telecommunications, transit and transportation corridors and facilities, oil and gas pipelines and associated facilities. (PPS 2014). Infrastructure also includes community infrastructure such as parks, libraries, community centres, police facilities, and fire facilities.

Integrated Cycle Track Platform Stop: A transit stop where the cycle track also serves as the transit platform where passengers board and alight. When no transit vehicle is present, passengers wait behind the cycle track, and cyclists are not required to stop. When passengers are boarding or alighting from a transit vehicle, cyclists must stop and wait behind the stop.

Intersection Approach: The part of an intersection leg used by traffic approaching the intersection.

Intersection Control: The mechanism that indicates to road users who has the right-of-way at any time to traverse an intersection. Forms of intersection control include traffic signal, roundabout, four-way stop, two-way stop, and yield control.

Ladder Pavement Marking: Pedestrian crossing markings that resemble a ladder.

LED: Light emitting diode. A high efficiency type of street lighting.

Level of Service: A standard measurement used by transportation officials which reflects the relative ease of traffic flow on a scale of A to F, with free-flow being rated LOS A and congested conditions rated as LOS F.

Light Standards: A pole with a street light mounted on it that illuminates the right-of-way.

Low Impact Development (LID): Design strategies that increase infiltration of rainwater runoff to minimize the overland flow volumes, recharge groundwater systems, and improve the water quality before it reaches a stormwater management facility or open watercourse.

Maintenance Hole: A surface access point on the street or boulevard that connects to underground utility for repair, inspection, and other maintenance operations. Typically covered by a circular metal plate.

Median Island: A zone or physical island constructed in the centre of a roadway to separate opposing directions of traffic. In the context of traffic calming, it may be used to reduce the overall width of the motor vehicle travel lanes.

Midblock: The segment of the roadway between two intersections.

Mini-Roundabout: A small-scale roundabout used on a Neighbourhood Street or Neighbourhood Connector to slow motor vehicle traffic and allow bicycles to cross through an intersection without coming to a complete stop.

Mixing Zone: An area along a roadway where motorists and cyclists share the same road space.

Mobility: The movement of people and goods through the city going from one location to another in a safe, accessible, convenient and affordable manner. Mobility, conventionally referred to as transportation, can be classified into five main types: walking, cycling, transit, movement with mobility devices, and motorized vehicle movement.

Motorist: A person who operates a motor vehicle on a highway.

Motor Vehicle: Includes automobiles, motorcycles, trucks, buses, motor-assisted bicycles (mopeds), and any other vehicle propelled or driven other than with muscular power.

Multi-Modal Mobility Network: A mobility network that supports all forms of mobility in a way that is attractive, comfortable, cost-effective, safe, efficient, and convenient for its users.

Multi-Use Pathway (MUP): A dedicated pathway for mixed active transportation, such as cycling, walking and inline skating. MUP networks ideally link key areas of the community and connect neighbourhoods, town centres, parks and schools.

On-Street Parking: The use of the roadway surface or the adjacent shoulder for vehicle parking.

One-Way Travel: See Unidirectional Travel.

Pavement Marking: Painted or durable lines or symbols applied on any paved bikeway or roadway surface for guiding vehicular, cyclist, and pedestrian traffic.

Pedestrian: All people on foot or moving at walking speed, including those who use mobility aids (such as wheelchairs and scooters), those with strollers and buggies, and people with limited mobility. A person pushing a bicycle or a motorized or non-motorized wheelchair is also considered a pedestrian. It does not include any person who is in or upon a vehicle, motorized or otherwise propelled.

Pedestrian Crossover (PXO): A pedestrian crossing facility that includes pavement markings and signage and may include rapid flashing rectangular beacons. Motorists must yield to pedestrians, but pedestrians are also required to check for conflicting traffic prior to crossing.

Pedestrian-Oriented: The degree to which the built environment has been designed to support and appeal to pedestrians. This often stands in contrast to buildings, sites, streets and streetscapes that are built primarily for the convenience of motorists. Factors affecting pedestrian-orientation may include such things as providing a sense of enclosure through the presence of a street wall; no front yard parking; street connectivity and convenient pedestrian linkages from common origins and destinations; amenities for pedestrians such as benches, weather protection, shade structures or trees, and pedestrian-scaled lighting; widened sidewalks and direct walkway connections to buildings; variety of building types; a high frequency of entrances and transparency through windows and doors; the absence of blank walls; high quality landscaping; tree planting to create attractive treescapes; and environments that are safe and comfortable for pedestrians by virtue of such things as sidewalk maintenance, quality lighting and casual surveillance of the street by building inhabitants.

Pedestrian-Scale Lighting: Specific light fixtures that are designed to illuminate the pedestrian realm.

Placemaking: An approach to the planning, design, and management of public spaces. Placemaking emphasizes the community's vision for public spaces with regard to improving equity, public health, and community identity.

Posted Speed: The maximum vehicular speed permitted on a roadway or highway. It is displayed on a regulatory sign.

Pre-Cast Concrete Curb: A concrete curb that is fabricated off-site and mounted onto the roadway, typically as a form of separation between motorists and cyclists.

Primary Transit Area: Centrally located area that will accommodate residential intensification, and improvements to transit and active transportation facilities. The goal is for 75% of all intensification to occur within the Primary Transit Area.

Public Realm: All those areas within the city that the public has unrestricted physical access to including such areas as streets (including the paved portion, sidewalks, and boulevards), seating areas, transit stations, parks, squares, plazas, forecourts, community facilities, publicly accessible natural areas, and public rights-of-way and easements established for public access.

Publication Boxes: Boxes placed along a pedestrian clearway for dispensing printed media.

Queue Jump Lane: Short roadway lanes provided on the approaches to signalized intersections which allow buses or cyclists to by-pass queued traffic and enter the intersection before other traffic when the signal turns green.

Rain Garden: A depressed, sodded, or landscaped area that collects stormwater runoff from impervious surfaces in urban environments.

Raised Intersection: An intersection that has ramps on all approaches which encourages motorists to reduce speed when they traverse the intersection.

Refuge Island: An island provided on a street for the safety of pedestrians. It can be either a median island on a wide street where the width may not permit pedestrians to cross the street on a single pedestrian signal indication, or as a loading island for transit such as streetcars or LRT.

Resilience: Also referred to as urban climate resilience. The ability of an urban system to absorb stresses and maintain function when external pressures are imposed upon it by climate change. Also, the ability of an urban system to adapt, reorganize, and evolve into more desirable configurations that improve sustainability.

Right-of-Way (ROW): Land that is reserved, usually through legal designation, for transportation and/or utility purposes, such as for a trail, hydro corridor, rail line, street, or highway. A right-of-way is often reserved for the maintenance or expansion of existing services. A permit or legal permission is generally required for any work or encroachment on a right-of-way.

Right-turn-on-red Ratio: The proportion of vehicles turning right to the vehicles making a through movement.

Road Diet: An approach to reducing the number of through lanes on a street, often by changing the lane format from 4 through lanes to 2 through lanes and a centre left-turn lane. The remaining space may be used for other purposes such as bike lanes.

Roadway: The part of the road that is improved, designed, or ordinarily used for the passage of vehicular traffic.

Roundabout: A raised circular island located in the centre of an intersection, which requires vehicles to travel through the intersection in a counterclockwise direction around the island.

Saturation Flow Rate: The stable maximum rate of vehicles in a group of lanes through an intersection.

Shared Space Stop: A transit stop where buses enter the bicycle lane to service a stop.

Sharrow: The term for shared roadway lane markings or shared lane arrows. A sharrow consists of two white chevron markings and a bicycle stencil. Sharrows are intended to guide cyclists as to where they should ride within a travel lane shared by both motorists and cyclists. Sharrows are an optional treatment and are context-specific.

Shoulder: Areas of gravel or hard surface placed adjacent to through or auxiliary lanes. They are intended for emergency stopping and travel by emergency vehicles. They also provide structural support for the pavement.

Sidewalk: A travelled way intended exclusively for pedestrian use, following an alignment generally parallel to that of the adjacent roadway.

Sign: A traffic control device mounted on a fixed or portable support which conveys a specific message by means of symbols or words, and is officially erected for the purpose of regulating, warning or guiding traffic.

Signalized Intersection: An intersection where traffic approaching from all directions is regulated by a traffic control signal.

Signed Bike Route with Paved Shoulder: A form of bicycle facility on a street with a rural cross section. A paved shoulder is a portion of a roadway which is contiguous with the travelled way. It provides accommodation for stopped and emergency vehicles, pedestrians and cyclists as well as for lateral support of the pavement structure. A paved shoulder on a designated bike route may include a buffer zone to provide greater separation between motorists and cyclists.

Skip Line: A lane line that has regularly spaced gaps between the line markings, conveying that users may cross the lane line when it is safe to do so.

Streetscape: The combination of visual and structural elements including such things as the street right-of-way, the design and placement of buildings, street trees, landscape elements, street furniture, lighting, and signage. Streetscapes can be divided into different types, depending on land use type/intensity, primary user groups and built form character. Streetscaping is the application of various elements found within the streetscape to support the unique character and function of an area.

Sustainable: An action that meets the needs of the present without compromising the ability of future generations to meet their own needs. It is a holistic approach to planning to achieve a balance between the social and economic needs of the community, and environmental conservation.

Tactile Walking Surface Indicator (TWSI): A metal or polymer plate that is integrated into the sidewalk and includes miniature raised domes that are cane detectable for visually impaired pedestrians. TWSIs warn pedestrians that they are about to leave a dedicated pedestrian clearway.

Traffic Volume: The number of vehicles that pass a given point during a specified amount of time such as an hour, day or year.

Transit: The public transit systems, including specialized transit, operated by or on behalf of municipal, regional or provincial governments, or transit authorities and includes all transit modes such as buses, streetcars, light rail and commuter rail lines. In this document, the term transit may also include transportation vehicles such as vans, ferries or taxis used to supplement transit service.

Transit Signal Priority (TSP): Gives transit vehicles priority at traffic signals by adjusting signal duration to minimize the transit vehicle delay. Signal priority may be manually activated by the driver with a switch, or automatically through the use of an Automatic Vehicle Location system.

Transportation System: A system consisting of facilities, corridors, and rights-of-way for the movement of people and goods, and associated transportation facilities including transit stops and stations, sidewalks, cycle lanes, bus lanes, high occupancy vehicle lanes, rail facilities, parking facilities, park-and-ride lots, service centres, rest stops, vehicle inspection stations, intermodal facilities, harbours, airports, marine facilities, ferries, canals, and associated facilities such as storage and maintenance.

Truck Apron: A design feature implemented at intersection corners and channelized right turns to establish separate curb radii for small and large vehicles and discourage small vehicles from making right turns with excessive speed.

Two-Way Travel: See Bidirectional Travel.

Urban Heat Island Effect: The phenomenon whereby urban areas experience higher ambient temperatures than surrounding areas due to the prevalence of low-reflectivity dark surfaces such as asphalt.

Unidirectional Travel: Moving or operating in one direction. Most bicycle facilities are designed for one-way travel by cyclists.

Unit Pavers: Bricks that are designed to create a smooth surface for motor vehicles to travel on. They may also be used in other areas, such as the furnishing zone.

Vehicle: A wheeled vehicle is any device which is capable of moving itself and a person, or of being moved, from place to place. This includes a bicycle.

Volume/Capacity (v/c) Ratio: A ratio of the measured volume of vehicles and the capacity of the facility they are travelling in. A v/c ratio less than 0.85 generally indicates that adequate capacity is available and vehicles are not expected to experience significant queues and delays.

Wayfinding Signs: Signs that contain information such as street names or destinations to help people find their way.

Yield: To cede the right-of-way.

PROVINCIAL POLICY SUPPORT FOR COMPLETE STREETS

Provincial Policy Statement (2014)

The Provincial Policy Statement (PPS) provides policy directions for land use and development regulation within the province of Ontario. It provides policy support for appropriate and context-sensitive urban and rural development, environmental and resource protection, and social equity in planning matters. An overarching vision for Ontario's land use planning system, articulated in the PPS is that the "long-term prosperity and social well-being of Ontarians depend on maintaining strong communities, a clean, healthy environment and a strong economy."

Relevance to the Complete Streets Design Manual

The PPS provides direction for the development of policies that reflect provincial objectives. It promotes land use patterns that support increase use of active transit and public transit, including changing the allotment of street space to accommodate for a wider variety of users. The PPS outlines the following policies that support the development of complete streets:

- Promotion for the design of "healthy, active" communities that support active transportation, existing and planned transit services (1.1.3.2; 1.5.1), as well as reduce lengths and numbers of vehicle trips (1.6.7.4)
- Enhancement of connectivity within and among systems and modes (1.6.7.3)
- Integration of transportation and land use considerations at all stages in the planning process (1.6.7.5)
- Long-term corridor planning, and mitigation of their negative impacts (e.g. pollution, noise) (1.6.8)
- The prohibition of development in transportation corridors that could "preclude or negatively affect the use of the corridor for the purpose(s) for which it was identified" (1.6.8.3)

Ministry of Transportation Cycling Strategy (2013)

This strategy acknowledges the importance of developing cycling facilities to help reduce greenhouse gas (GHG) emissions, ease gridlock, improve the economy, increase tourism, and increase the overall health and quality of life of Ontarians. Key elements of the Province's vision include:

- Develop a safe cycling network that connects the province;
- Continue to reduce collision and injury rates; and
- Empower everyone from occasional cyclists to daily commuters to feel safe when they get on a bicycle in Ontario.

The strategy is intended as a guide to make sure this vision is achieved.

Relevance to the Complete Streets Design Manual

The Cycling Strategy outlines a 20-year vision for cycling in the province, with proposed cycling infrastructure, educational components, and legislation. This strategy, along with other provincial documents, aims to promote and strategically develop sustainable transportation infrastructure province-wide. The strategy provides policy and program support for increasing the extent and connectivity of London's active transportation infrastructure in the context of complete streets. It aims to create "healthy, active and prosperous communities" by collaborating with municipalities to implement active transportation plans when applicable (p. 6).

Other mentions of complete streets in the Cycling Strategy that are relevant to the London Design Manual include:

- "Complete Streets are roads and adjacent public spaces that are designed for people of all ages, abilities and modes of travel. That is, Complete Streets are designed for all road users. Within Complete Streets, safe and comfortable access for all pedestrians, cyclists, transit users is not an afterthought, but an integral planning feature. Planning and designing Complete Streets also

includes the consideration of the built form along roads – both the type/mix of users and design of buildings – as well as the relationship between built form and public spaces. For cycling, this could include various forms of bike lanes, traffic calming elements, parking facilities and a pleasant environment with trees, etc.” (p. 15)

- “[Complete Streets] is not a cookie-cutter approach to street design. Different streets require different balances of transportation infrastructure, responding to current and future needs of road users of all ages and abilities. It involves integrating a wide range of transportation options and traffic management tools to support quality of life, economic, and environmental sustainability.” (p. 16)
- “Increasingly, municipalities have been incorporating policies and approaches to implement the concepts of healthy, active communities and Complete Streets into their official plans. In addition, more municipalities are developing transportation and/or cycling master plans as part of their guiding policy framework and to lay out implementation strategies.” (p. 17)

Accessibility for Ontarians with Disabilities Act (2005)

The Accessibility for Ontarians with Disabilities Act (AODA) is a provincially-legislated document that calls on the business community, public sector, not-for-profit sector and people with disabilities or their representatives to develop, implement and enforce mandatory standards. This policy is a first of its kind in Canada to apply to both the private and public sectors. These accessibility standards are the rules that local governments, agencies and businesses in Ontario must follow to identify, remove and prevent barriers to accessibility.

Relevance to the Complete Streets Design Manual

The Integrated Accessibility Standards (2012) component of the AODA is relevant for the planning, design and construction of transportation facilities. This policy document provides direction on the appropriate and inclusive design and location of these facilities. It is a key reference document that has informed the contents of the Complete Streets Design Manual and its design specifications.

MUNICIPAL POLICY SUPPORT FOR COMPLETE STREETS

The London Plan (Official Plan, 2016 Consolidation)

The London Plan establishes a set of policies and land use designations that are meant to guide physical development and manage community change in London over a 20-year period. The intent of the Official Plan is to build upon the City's status as a fast-growing community with a changing economic and demographic profile. London aims to move more aggressively towards becoming a sustainable social, environmental and economic structure that caters to the needs and desires of its residents now and in the future.

Relevance to the Complete Streets Design Manual

The Official Plan acts as a guiding document for the development of the City's future transportation network and its supportive policies and guidelines. Policies that provide explicit support for complete streets include:

211-220 (Street Network)

- 211: The City's street network will be designed to ensure high-quality pedestrian environments, maximized convenience for mobility, access to focal points, and to support the planned vision for the place type;
- 213: Street patterns will be easy and safe to navigate by walking and cycling and will be supportive of transit services;
- 216: Street networks, block orientation, lot sizes, and building orientation should be designed to take advantage of passive solar energy while ensuring that active mobility and other design criteria of this chapter are satisfied;
- 217: Neighbourhood street networks and block sizes will be designed to ensure connectivity and support active mobility including cycling, walking, blading, boarding and transit. Infrastructure and amenities to support these modes of mobility will be incorporated; and
- 218: "To support connectivity, blocks within a neighbourhood should be of a size and configuration that supports connections to transit and other

neighbourhood amenities within a typical ten minute walk."

221-229 (Streetscapes)

- 221-223: These policies mandate that streetscape design adhere to the classification features outlined in The London Plan and reflect neighbourhood-specific modal priorities, and that a coordinated approach to planning and design for all modes, landscaping, and public-space improvements be taken.
- 224: "The paved portion of streets within neighbourhoods should be as narrow as possible, while meeting required design standards, to calm traffic and emphasize the priority of the pedestrian environment. Street rights-of-way should be of adequate size to accommodate all services within an efficient space and allow sufficient room for street tree planting and the long-term growth of mature trees."
- 225-229: These policies outline specific requirements related to low-impact development, traffic calming, on-street-parking, safety, and rear-lotting for streets in London.

370-378 (Streets)

- 370-372: These policies outline the 10 classifications of streets and the intended character, goals and functions to be used for the planning and design of public rights-of-way. These explanations are followed by specific design features of these classifications, and a design cross-section of various "zones" in a public right-of-way.
- 373-374: These sections identify street classifications and outline the process by which privately-initiated amendments to street classifications will be addressed, outlining explicit decision-making criteria, including considerations such as impact on the street hierarchy; impact on intensity of development; availability of supporting infrastructure; impact on traffic volumes/mobility/ accessibility; impact on planned street function.
- 378: This section establishes the need to prepare the Complete Streets Design Manual, including design parameters for

the public realm and cross-sections for each classification type.

Some of The London Plan policies may be under appeal. Check www.london.ca/business/Planning-Development/Official-Plan for the most current list of policies under appeal.

London ON Bikes (Cycling Master Plan 2016)

This report provides a comprehensive update to the City's 2007 Cycling Master Plan. It outlines and addresses four key objectives:

- To establish a cycling vision, review background information and best practices and identify route alternatives;
- To develop a comprehensive on- and off-street cycling network that is continuous and connected throughout the City;
- To identify a proposed implementation timeline for the network and to establish supportive programs and initiatives [including short-, medium-, and long-term projects]; and
- To consolidate the results from Phase One through Three and develop a plan for design and implementation.

Relevance to the Complete Streets Design Manual

Complete streets is identified as a key policy area within the Cycling Master Plan (p. 31-32). Section 2.1 outlines key considerations, London's local context (including the mandate to create a Complete Streets Design Manual), and offers recommendations, along with principles and intended outcomes of adopting complete streets-oriented policies. The primary recommendation is for complete streets to continually be integrated into transportation planning and design in the City of London.

Strategic Plan for the City of London, 2015-2019 (2015)

The Strategic Plan outlines City Council's "Vision, Mission, Values, Strategic Areas of Focus and the specific strategies that define how Council and Administration respond to the needs and aspirations of Londoners."

The strategic areas of focus identified include:

- Strengthening our community;
- Building a sustainable city;
- Growing our economy; and
- Leading in public service.

Relevance to the Complete Streets Design Manual

As part of the Strategic Plan for the City of London, specific policies (p. 11-13) support and enhance mobility throughout the City, and indirectly support the development of complete streets:

- The City will continue to make pedestrian and cycling routes safer year-round for school aged children by implementing a School Crossing Guard Program, Active and Safe Routes to School and Winter Maintenance Strategy;
- In efforts to build a more sustainable city, the City of London will manage and upgrade transportation infrastructure, such as cycling facilities; and
- These facilities will include safe mobility between cyclists, pedestrians, transit users and drivers through the provision of complete streets, connected pathways, and enhanced transit services.

Our Move Forward: London's Downtown Plan (2015)

London's Downtown Plan outlines a plan to revitalize the City's downtown. Specifically, the Plan includes a planning framework and outlines strategic directions, identifies "transformational projects" for the downtown, describes many policy and fiscal tools for downtown improvement, and outlines an implementation strategy for downtown improvement.

Relevance to the Complete Streets Design Manual

Relevant sections from the Downtown Plan that support the development of complete streets and active modes of transportation include (p. 24):

- Opportunities to enhance the existing pedestrian network and experience, both by adding new connections and improving the condition of the existing

network;

- Opportunities for recreational and commuter cyclists, connecting to the Thames Valley Parkway and over 150 kilometres of pathways across the city;
- The Bicycle Master Plan guides route selection and bicycle parking within the city and promotes cyclist safety and wayfinding; and
- A new plan for cycling routes in the downtown will be established through the preparation of the Mobility Plan in 2015.

Design Specifications and Requirements Manual – Transportation

This manual provides specific guidelines for the design of all types of transportation infrastructure in London.

Relevance to the Complete Streets Design Manual

This manual includes detailed specifications for designing elements located in public rights-of-way. All four sections (Roads Design, Intersections, Traffic Calming, and Street Lighting) of the manual are relevant to the Complete Streets Design Manual, and have been considered in the development of the cross-sections for each type of classification identified in the Official Plan.

Road Safety Strategy, 2014-2019 (2014)

The Road Safety Strategy outlines a five-year plan for reducing injuries and fatalities in London, in collaboration with the Middlesex London Health Unit, Middlesex County, and other partners. The Strategy identifies six target areas for new programs and actions, including:

- Intersections;
- Distracted and aggressive driving;
- Young drivers;
- Cyclists; and
- Red light running.

The goal of the Strategy is to reduce collisions resulting in fatality or injury by

10% by 2019.

Relevance to the Complete Streets Design Manual

The Strategy's vision ("A path to a safer road environment for all transportation users in London") and mission ("To save lives and reduce serious injuries to all transportation users through leadership, innovation, coordination, and program support in partnership with other public and private organizations") both resonate with the emphasis of the Complete Streets Design Manual on safety, coordination among City departments and other stakeholders. Countermeasures to enhance safety in each of the target areas have been incorporated into the Manual, particularly those related to intersections.

London Moves 2030: Transportation Master Plan (2013)

London's Transportation Master Plan (TMP) provides strategic direction for the development of all modes of transportation in the City. The TMP is described as "a long-term transportation strategy for the City that will help guide the City's transportation and land use decisions through to 2030 and beyond. The TMP is focused on improving mobility for residents of the City by providing viable choices through all modes of travel" (p. ES -1).

Relevance to the Complete Streets Design Manual

London's TMP provides transportation-specific policy directions that has been taken into account in the development of the Complete Streets Design Manual. The vision for the future of London as a pedestrian- and cyclist-friendly community with safe, convenient, and efficient route and facility connections is included in the TMP. Components of the TMP particularly relevant to complete streets include:

- [T]he city will improve local transit services connecting with pedestrian and cycle infrastructure (ES-14);
- Other initiatives include expanding the Active and Safe Routes to School (ASRTS) program to a city-wide scale, working with school boards to develop secondary

school programs, and accelerating the implementation of on-street cycling routes and secure bicycle parking facilities (ES-15);

- Specific initiatives include completing gaps in the sidewalk network;
- Providing a more continuous and extensive network of on-street bike routes;
- Providing secure bike parking facilities at all key public destinations and employment concentrations (ES-17); and
- To increase usage of bike lanes, the routes need a greater degree of recognition and thus they should be named, well maintained in all seasons, very well marked on the pavement, and well signed (ES-18).
- Smart Move 3 – Greater Investment in Cycling and Walking Infrastructure (p. 1-25): A key initiative within this focus area of the TMP involves planning for and investment in complete streets.
- Smart Move 5 – More Strategic Program of Road Network Improvements (p. 1-26): “Despite the greater emphasis of this TMP on transit, active transportation, TDM, and parking, more road improvements will still be required. The City’s approach to defining the need for road network improvements has become more strategic (and selective) than in past TMP efforts. First, the more strategic approach reflects a reduced modal share for the automobile by 2030, consistent with the expectation that transit and active transportation modal shares will increase significantly from current levels. Second, roadway improvement needs have been based on a corridor level analysis, as opposed to a link by link analysis. This means, for example, that where two adjacent roadway links both show capacity efficiencies, only one improvement may be necessary to resolve the corridor deficiency. Additionally, this approach recognizes that some road widenings will be required to support the proposed BRT, with new lanes being dedicated for exclusive transit use. This is in keeping with the “complete streets” philosophy and the new focus on people (rather than vehicles) movement.”
- Moving Towards Complete Streets (p.

3-47-3-48): “[Complete streets involve] more fairly apportioned road rights-of-way to all users (including pedestrians and cyclists) so as to maximize the person-carrying capability of the roadway (people movement rather than vehicle movement). A “complete street” is sometimes also referred to as a livable corridor, which:

- Hosts one or more transit routes;
- Has market demand to attract supportive levels of mixed-use development;
- Has land available for different types of development;
- Is pedestrian and cyclist friendly, with easy walking and cycling paths and facilities; and
- Exhibits potential for an attractive public gathering place, such as open green space.

This concept should be the accepted policy approach to pursuing all roadway improvements within the City.”

- Initiate Corridor Land Use Planning Studies (p. 4-18): “The land use planning studies should include a review of opportunities to incorporate ‘complete streets’ planning principles into the corridors and nodes to begin the transformation process and set the framework for more detailed planning studies, road / transit Class EAs, or individual development site plans.”

Bicycles on Sidewalks (Civic Works Committee Report 2012)

This report from the City’s Civic Works Committee investigated the use of bicycles on City sidewalks, in recognition of a growing trend in London and the need to accommodate the needs of cyclists with a wide range of experience and confidence on local streets.

Relevance to the Complete Streets Design Manual

The report recommends (p. 3) that the Streets By-Law (S-F) be changed to allow children under the age of 14 to ride their small bikes on City sidewalks. This

policy recommendation relates to the inclusiveness of complete streets. The focus on this age is due to the typical transition from elementary to high school which can be associated to a transition into riding on the street. Furthermore, youth around this age do not commonly carry identification, which enforcing age restrictions more difficult.

The proposed new by-law:

- Does not limit the use of Electric Personal Assistive Mobility Devices;
- Allows only children riding small bicycles on the sidewalk;
- Encourages young people to cycle as a part of an active lifestyle;
- Does not allow any power-assisted bicycles (i.e. e-bike) on sidewalks; and
- Requires young cyclists to yield the right-of-way to pedestrians on sidewalks.

The Streets By-Law was updated with the proposed changes.

London's Rapid Transit Initiative (Ongoing)

London's Rapid Transit System is “a bold and important initiative for transportation for London. It focuses on rapid transit as part – along with cars, bikes, and pedestrians – of the transportation system that will help our city grow and prosper.” London's Rapid Transit initiative involves the identification of transit projects for London in the context of an environmental assessment process designed to encourage public participation and attract development and other forms of investment.

Relevance to the Complete Streets Design Manual

The London BRT System includes a number of aspects relevant to the development of complete streets in the city. The London BRT System includes a 24-km system of Bus Rapid Transit (BRT). The inclusion of dedicated transit lanes for BRT relate closely to the cross-sections that were developed for the following classifications of roadways:

- Rapid transit boulevards; and
- Urban thoroughfares/civic boulevards



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