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MEMORANDUM

February 6, 2023

To: Transportation Services Division

From: Barbara Gray, General Manager, Transportation Services

Subject: On-Street Bikeway Design Guidelines Chapters 1-3 Adoption

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The purpose of this memorandum is to confirm the adoption of Toronto's On-Street Bikeway Design Guidelines (OSBDG) Chapter 1- Introduction, Chapter 2- Facility Selection, and Chapter 3- Bikeway Design.

In 2016, Transportation Services began the process to develop a City bikeway design guideline. Between 2016 and 2021, Transportation Services engaged with a wide audience to develop the City's OSBDG. A Technical Advisory Committee was formed and included members from Emergency Services Planning, Fire Services, Toronto Transit Commission, Engineering and Construction Services, City Planning, and staff across Transportation Services. Stakeholders were also engaged through public and committee presentations. Stakeholders included non-profits invested in public realm and bikeway projects, various different Accessibility Committees and Public Health advisors.

Since 2016, bikeway design and delivery has evolved. In 2021, the Ministry of Transportation adopted a new Ontario Traffic Manual Book 18 – Cycling Facilities, the first update since 2013. New types of bikeways have been implemented in Toronto and the region including Toronto's first protected intersection, Ontario's first advisory bicycle lanes, etc.

Chapter 1- 3 of the OSBDG is the first step in adopting City bikeway standards. Transportation Services will continue to work toward the adoption of new chapters with a focus on intersection design. Until such adoption, the Ontario Traffic Manual Book 18 and the Transportation Association of Canada Geometric Design Guide for Canadian Roads Chapter 5 - Bicycle Integrated Design should be utilized to make design decisions. Transportation Services has also made progress on adopting a number of construction specifications and standard drawings in order to aid the detail design process. These can be found on the Engineering and Construction Standards for Designing and Constructing City Infrastructure website and new ones will be posted annually in the fall.

The OSBDG Chapter 1-3 should be utilized to inform practitioner's decision making for bikeway facility selection based on the context and conditions of the street and the mid-block design parameters based on current and potential cycling demand. Practitioners will need to continue to utilize professional judgement in applying standard drawings and construction specifications during the detailed design process.

The OSBDG is meant to encourage innovation. Bikeway design in North America continues to rapidly evolve and as such, the OSBDG will require updates and amendments. If a practitioner needs to deviate from the guidance within or implement a new feature, written justification should be provided and approved by the appropriate Division head, Director-level designate, or governing body, as is the case in many other roadway design scenarios.

The adoption of the OSBDG Chapter 1-3 is a step toward fulfilling the City's adopted policies including the Vision Zero Road Safety Plan, the Cycling Network Plan and TransformTO. Together, the City of Toronto can move the needle toward a safer, healthier and more active future where people no matter their age, ability or background will feel safe and comfortable cycling throughout the city.

Attachments:
On-Street Bikeway Design Guidelines Chapter 1-3

CHAPTER CONTENTS

INTRODUCTION

How to Use This Guide

1.1

The City of Toronto bikeways and bikeway design principles have evolved rapidly in the past decade. In 2019, City Council adopted the Cycling Network Plan Update with goals to connect, grow, and renew Toronto's bikeway network. Council also adopted a Vision Zero Road Safety Plan with a goal to reduce traffic fatalities and significant injuries to zero. To meet the goals in these cornerstone plans, this technical guide has been created for City staff and partners to ensure the design and implementation of safe, comfortable, and connected bikeways.

Purpose of the Guide

How streets are designed reflect a city's values. How streets look, feel, and function inform people's mobility choices. As Toronto grows and changes, city streets must have a network of well-designed bikeways to reduce collisions and increase travel by bicycle. The design and installation of **Toronto's bikeways must reflect best practices in engineering design** to ensure that people of all ages and abilities can cycle safely.

This Guide provides technical guidance for the development of an **all ages and abilities cycling network.** It will help the City of Toronto achieve a more consistent approach to designing and delivering on-street bikeways included in the City of Toronto's Cycling Network Plan. This Guide is also meant to be updated over time as the field evolves and new designs are installed and studied.

This Guide is also intended to aid Toronto in reaching it's Council adopted policy, safety, climate and active transportation goals contained within the City's Official Plan, Vision Zero Road Safety Plan, TransformTO and the Cycling Network Plan..

Guide Users

The Guide is **intended for designers, planners, engineers, and other practitioners** who may be involved in the development of bikeways in the City of Toronto. It may also serve as a reference to others who wish to understand the planning and design process or the rationale for design strategies.

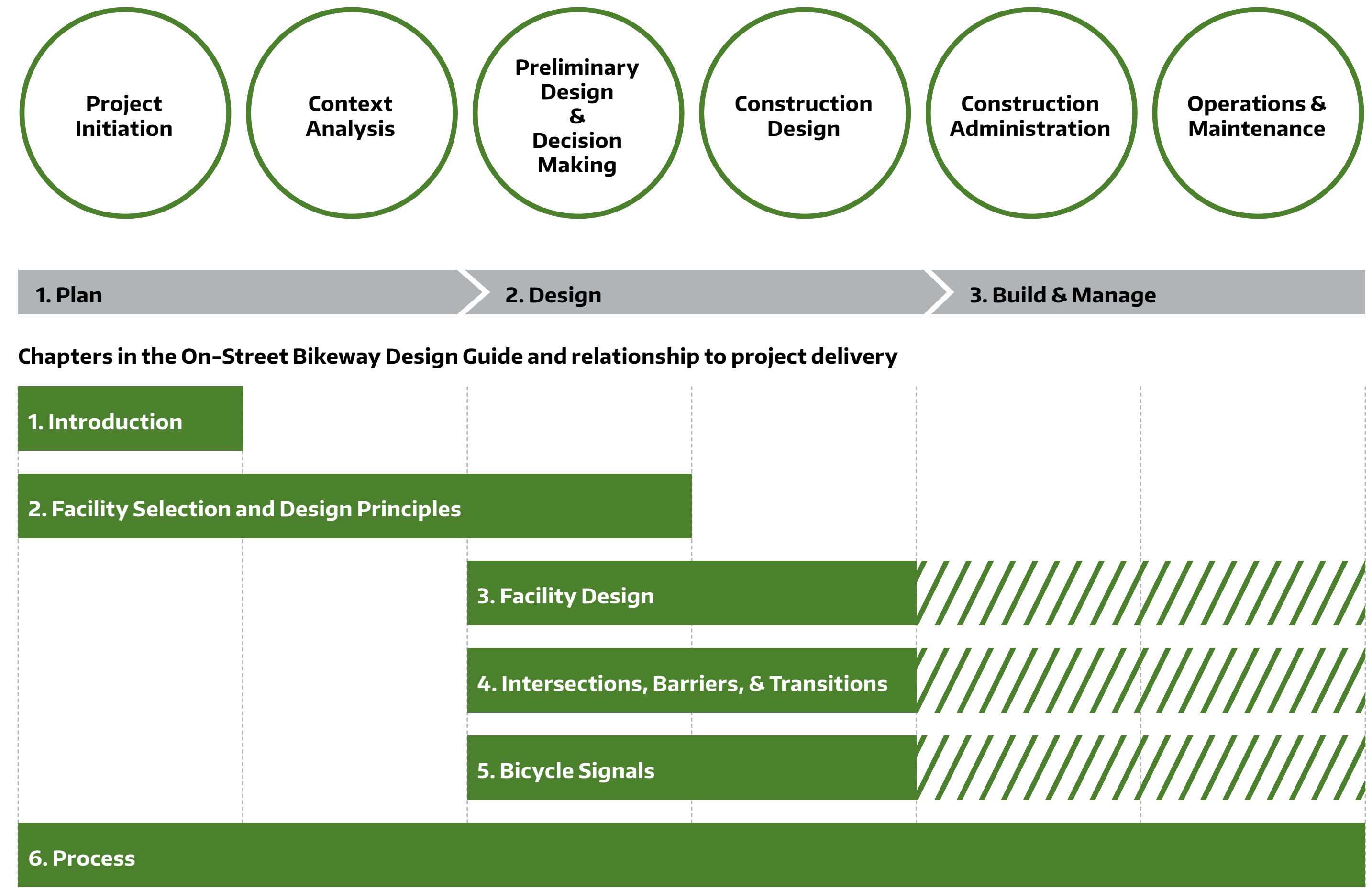


Figure 1.1 The Toronto On-Street Bikeway Design Guide structure outlines the general phases of a bikeway project and the appropriate chapters to consult for each project phase

Structure of the Guide

Chapter 1: Introduction provides an overview of the purpose and use of this guide.

Chapter 2: Facility Selection and Design Principles describes the engineering rationale for cycling facility type selection in relation to the speed, volume and context of the street.

Chapter 3: Facility Design, Chapter 4: Intersections and **Chapter 5: Bicycle Signals** are the main chapters of technical guidance. These chapters provide detailed design guidance on bikeways, intersection treatments including protected intersections, and bicycle signal operations, respectively. Practitioners will find these chapters useful when establishing cross-sections, addressing operational issues, and undertaking preliminary and detailed design.

Chapter 6: Process outlines the planning and design process for bikeway projects. Practitioners may find this chapter useful throughout the planning and design process to ensure that all critical tasks associated with the process are completed at the correct project stage.

Appendices include a glossary of terms, design details shown in Chapters 3 and 4, and a catalogue of cycling-related signage.

What Informed This Guide

1.2

The development of this Guide included a review of existing Toronto guidelines and policies, bikeway guidelines from other jurisdictions, and academic bikeway research. As a practitioner and user of this guide, the list below of City of Toronto guidelines should be consulted and utilized throughout the design process.

Toronto Context

The Guide was developed to complement and build on several other Toronto policies and documents:

- Cycling Network Plan
- Vision Zero Road Safety Plan
- Surface Transit Network Plan
- Complete Streets Guidelines
- Multi-use Trail Design Guidelines
- Accessibility Guidelines
- Lane Width Guidelines
- Curb Radii Design Guidelines
- Traffic Signal Operations Policies & Strategies
- TO360 Wayfinding

Practitioners should consult these documents in conjunction with this Guide when appropriate.

Other Guides

Many of the best practices and much of the design guidance included in this Guide are drawn from other cities and organizations. The following were among the many documents reviewed in developing this Guide:

- Ontario Traffic Manual (OTM) Book 18: Cycling Facilities
- Ontario Traffic Manual (OTM) Book 12A: Bicycle Traffic Signals
- Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (2017)
- National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide (2017), All Ages and Abilities Guide (2018) and Don't Give Up at the Intersection Guide (2019)
- Federal Highway Administration (FHWA) Separated Bike Lane Planning and Design Guide (2015)
- Massachusetts Department of Transportation (MassDOT) Separated Bikeway Planning and Design Guide (2015)
- CROW Design Manual for Bicycle Traffic (2016)

Research

Academic literature reviews were conducted for several topics covered in this Guide, particularly in relation to conflict mitigation strategies.

The design guidance included within integrates lessons learned from the operations of existing bikeways in Toronto.

The project team also developed a series of animated videos to analyze sightlines in relation to various conflict scenarios and intersection crossing designs.

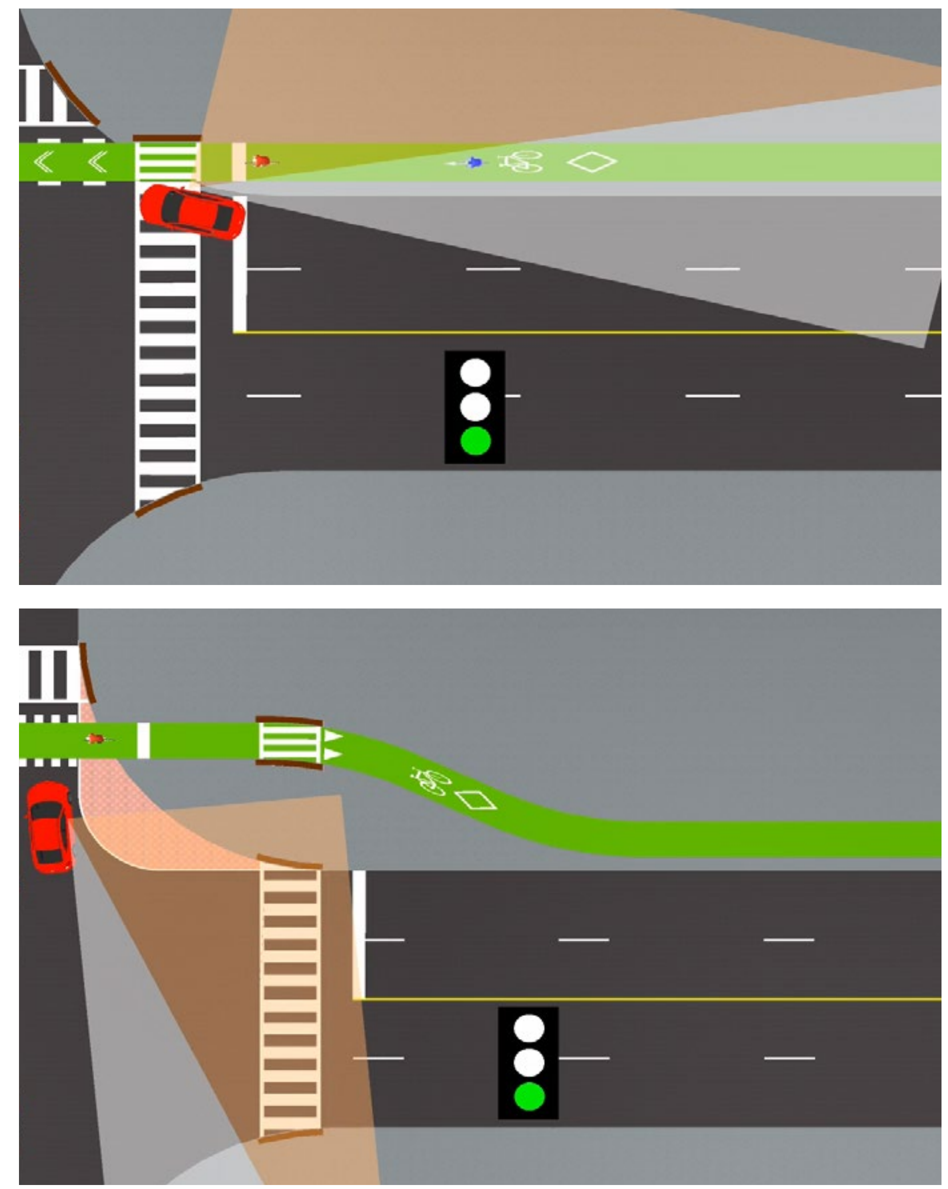


Figure 1.2 Example of the animations used to analyze the sightlines of various intersection designs.

CHAPTER CONTENTS

CHAPTER OVERVIEW

This chapter identifies Toronto's key principles and considerations for designing all ages and abilities bikeways. These design principles should inform planning and engineering decisions when undertaking a new bikeway project, reviewing private development proposals, as well as for planning and infrastructure studies.

The design principles are the foundation of the Facility Selection Process found in Section 2.5. The Facility Selection Process guides users to the most appropriate facility type based on context and current or anticipated motor vehicle use.

FACILITY SELECTION

Design Principles

2.1

This section outlines the key principles that should guide the design of bikeways in Toronto. As the City expands the bikeway network, new bikeways must be designed to reflect these principles and existing bikeways should be improved, where feasible.

Why design better bikeways?

Toronto is investing in its bikeway network to achieve two key measurable outcomes:

- **more people cycling for a variety of trips, and**
- **improved safety and comfort for people cycling.**

Cycling is important to Toronto's future. Well-designed bikeways empower people of all ages and abilities to cycle for any reason or trip. This in turn reduces the number of trips taken by motor vehicles, improves health outcomes, and could make Toronto a more equitable place to live, while reducing environmental impacts.

Yet today, many streets in Toronto discourage riding a bike. The street configurations force people to cycle alongside higher speed and/or higher volume motor vehicle traffic, which is uncomfortable and can be unsafe.

To achieve the two key measurable outcomes, the following design directives must be the foundation of the planning, design and implementation of bikeway projects:

- **Design visible, intuitive and direct bikeways**
- **Prioritize safety of the most vulnerable users**
- **Make cycling a comfortable and social experience**

These design directives are best implemented within a framework that considers all users of the street.

Design visible, intuitive, and direct bikeways

People cycling are not aided by powerful motors or sheltered from the environment. These disadvantages can be mitigated when routes are visible, intuitive and direct.

Visibility: Pavement markings, signage, and physical separation should be easily understood and seen by all roadway users. Attention must be paid to accommodate and integrate the needs of those with accessibility challenges.

Intuitive: Selecting the appropriate bikeway for a corridor ensures that the experience of riding is intuitive to people cycling with all levels of skill and confidence. For example, on streets with higher motor vehicle volumes, people expect more separation from moving vehicles.

Directness: Practitioners should aim to create direct routes for people cycling, even if it means diverting motor vehicles to longer routes. Excessive delay for people cycling should be avoided, especially at intersections.

Prioritize safety of the most vulnerable users

Toronto is aiming to design and install bikeways where people of all ages and abilities are safe riding a bicycle.

This Guide covers a wide variety of subjects related to safety including how to:

- **Identify and mitigate potential conflicts** between road users when designing bikeways,
- **Use pavement markings and signage to identify areas of conflict** and communicate yielding behaviours between people cycling and other road users,
- **Separate high volume conflicting movements** at intersections,
- **Reduce motor vehicle speeds at conflict points,**
- **Maintain accessibility,** and
- **Separate people cycling and walking** particularly in higher volume locations.

Make cycling a comfortable and social experience

A single intersection or block that is uncomfortable to cycle through is enough to dissuade people from riding. It is important to provide comfortable cycling conditions along an entire corridor including all intersections.

A major contributor to stress while cycling is when people must interact with motor vehicles. Thus bikeways must minimize and manage these interactions, which improves both safety and comfort for people cycling and driving.

There are many elements that can be integrated into bikeway design, such as placemaking and green infrastructure. These elements should be considered where feasible.

People traveling by foot and bike often do not travel alone, **nor do they travel at the same speed.** The nature of slower moving road users is more social than driving. Riding together in a group or side by side is referred to as social riding. People of different abilities also travel at varying speeds and require space to safely pass. The width of bikeways and queuing areas at intersections are key factors in providing a comfortable and social space.

Designing for all Ages and Abilities

2.2

In motor vehicle roadway design, practitioners accommodate specific "design vehicles" traveling at certain "design speeds". This approach ensures that all the anticipated users of the street are accommodated, not just a subset of users. This design methodology should also consistently apply to bikeway design to ensure streets are safe and comfortable for all anticipated users, rather than just strong and fearless cyclists. This section describes who should be considered and outlines the implications for bikeway design.

Who are we designing for?

All people who live, work, and travel through Toronto should have the option to travel by bike. From a representative sample of more than 1000 Torontonians, 71 % said that they are interested in riding a bicycle, but have concerns around the safety and comfort of doing so.

In North America, traditional bikeway design was focused on vehicular cyclists. These are strong, fearless, and fast riders who feel comfortable in mixed traffic. Previous design guides focused on the design of narrow painted bike lanes or wide urban shoulders. But extensive research including ridership data in Toronto show that these bikeways do not accommodate people of all ages and abilities.

A "design cyclists" must vary in terms of age, level of experience, physical fitness, gender, etc. Rather than having a single archetype for a "design cyclist", bikeways in Toronto should be designed to meet the needs of **people of all ages, abilities, means, and purposes**.

A range of users should be considered, which may include the following examples:

- A **child** who has some experience riding in the company of an adult,
- An **older adult** riding for everyday trips,
- A **person using an electrically assisted bicycle** (electric assist limited to 20 km/h),
- A **novice** who is learning to cycle for the first time or an occasional rider,
- An individual riding **a loaded cargo bike, tricycle or towing a bicycle trailer**,
- A person who relies on their bicycle as **their main form of transportation** including during winter,
- A **visitor or newcomer** who is not familiar with the layout of the city; and/or is using Bike Share and ,
- A **person with a physical impairment** who operates a non-standard bicycle for utilitarian and recreational trips.

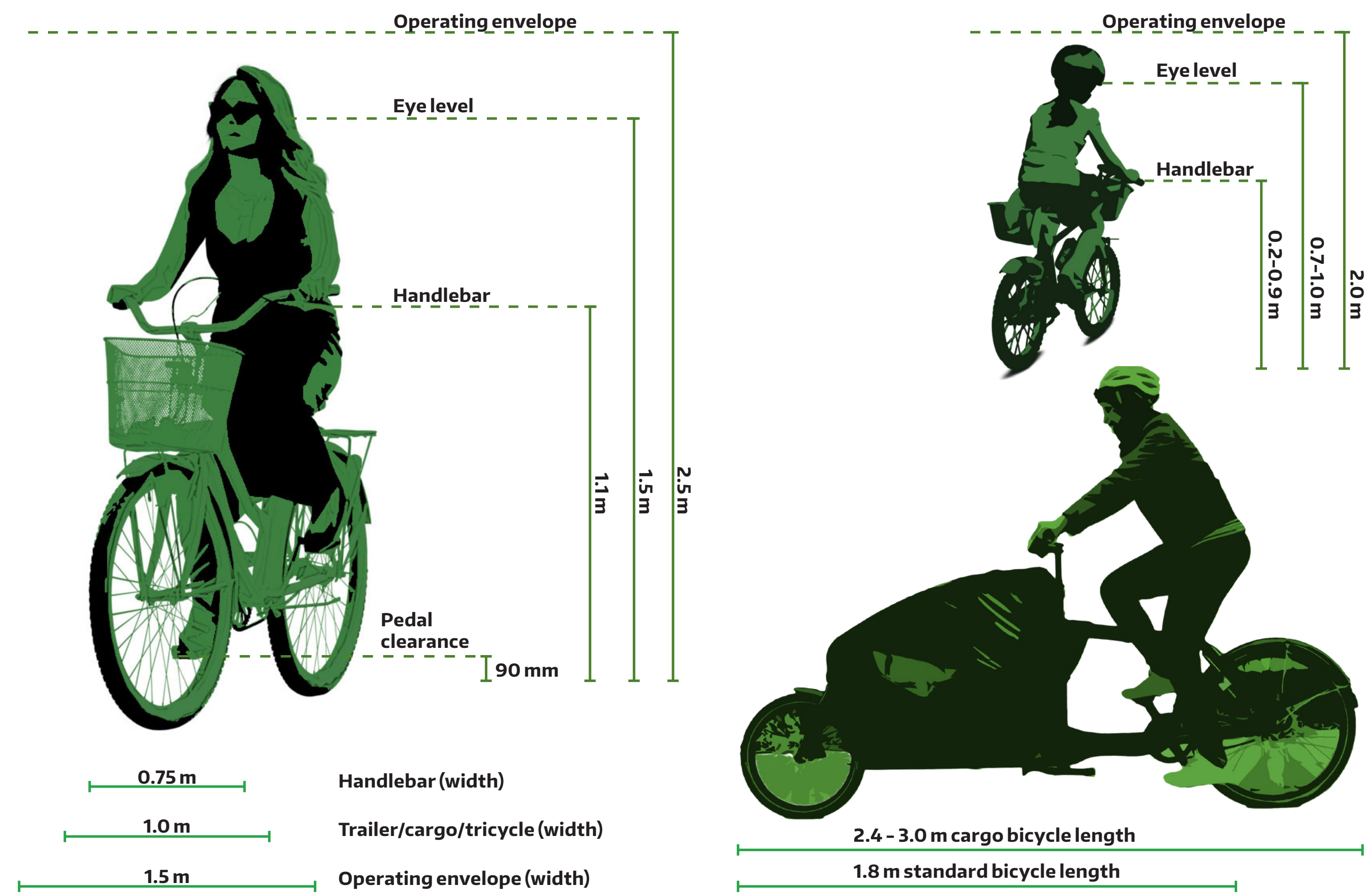


Figure 2.1 Horizontal and vertical operating envelope for an adult and a child (two different 'design cyclists') and the typical length of a cargo bicycle.

There are a variety of implications for practitioners to consider, including:

Bicycle considerations

Practitioners must consider a variety of bike types like cargo bicycles ("design vehicles") and their geometric implications such as intersection setbacks and queuing space.

Width considerations

Practitioners must consider passing and social riding when designing bikeways as discussed in the design principles. .

Speed considerations

The speed of the "design cyclist" varies depending on age and ability. On level terrain, a typical speed range is 14 - 25 km/h. The speed at which people travel should be linked to signal design decisions.

Design Domain

2.3

This section describes the concept of design domain and its relevance to bikeways and provides guidance on when lower limit values are appropriate, both along a corridor and at pinch points.

Design domain concept

For any street element, including bikeways, there are a range of geometric values that may be appropriate depending on context. **Many of the geometric values are provided as ranges including lower, default, and upper limit. This range in values is referred to as the design domain**. For some street element only one value is provided because a range of values is inappropriate.

The geometric value decisions most often involve the width of a facility, the width of the separation between the pedestrian zone and motor vehicle lanes and intersection setbacks.

In general, **practitioners should begin the design process with the default** or in cases where high volumes (Table 2.1) of people cycling are anticipated, the upper limit.

The 2017 edition of the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads emphasizes that the assumption that a lower limit value is "safe" is no longer defensible and that unless infeasible, default values should be utilized.

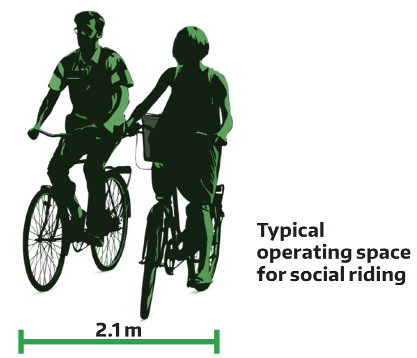


Figure 2.2 A default width of 2.1 m of a cycle track allows for people cycling to ride side by side.

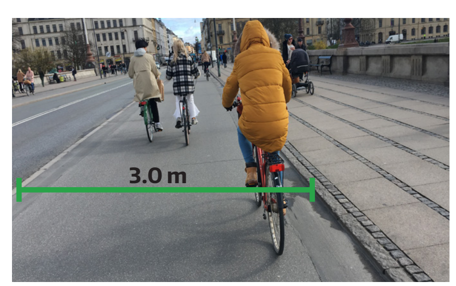


Figure 2.3 ABOVE: Lower limit width of raised cycle track. People cycling cannot ride side by side and stronger riders cannot pass.
Figure 2.4 BELOW: Upper limit width of raised cycle track. Here, riders can be side by side and pass.
While both facilities provide sufficient protection, the second is more comfortable.

Table 2.1 Number of cycling trips per day and per peak hour (volume) and the associated rating. This should be used when considering design domain decisions.

Cycling Volume Rating	Volume	Example Locations in Toronto
High	**>300 cycling trips/peak hour** or **>2000 cycling trips/day**	Adelaide Street Richmond Street Bloor Street
Moderate	**<300 and >50 cycling trips/peak hour** or **<2000 and >400 cycling trips/day**	Davenport Road Woodbine Avenue West Toronto Railpath
Low	**<50 cycling trips/peak hour** or **<400 cycling trips/day**	Rogers Road

Cycling Volume and Limit Values

In motor vehicle planning and design, years of research has informed the design domain and associated decision making. There is clear guidance on traffic volume and lane capacity. But research in North America is still needed to define what constitutes high, moderate and low levels of cycling and when that triggers the use of lower, default and upper limit values.

Count data from existing Toronto bikeways (Table 2.1) provides a starting point for understanding high, medium, and low-volume contexts. Table 2.1 can be used in Toronto as a starting point to understand cycling volume rates.

If the current cycling volume is low, it does not mean that this will remain true in future conditions. For example if a roadway has high speeds and/ or high volumes of motor vehicles and no all ages and abilities bikeway, but is near a transit station and in a dense neighborhood, a new bikeway could greatly increase the cycling volumes.

Practitioners should evaluate if the cycling rate can be expected to rise and consider the following to determine when lower, default, and upper limit values are appropriate:

- the Bikeway Design Principles (Section 2.1),
- the project location and context, and;
- latent demand.

Reasons to use lower limit values

While most new bikeways are expected to be suitable for people of all ages and abilities, there may be instances where it is not feasible to provide this level of comfort due to geometric constraints or the surrounding context, such as a highway interchange.

Decision making for such projects should take into account the primary user group of the bikeway, the potential to implement an all ages and abilities bikeway in the future, and the overall benefit of the planned bikeway.

Constrained right-of-way

Many of Toronto's streets are constrained, with the demand for road space greatly exceeding what is available. Where default limit values are not feasible due to spatial constraints, **a lower value that is still above the lower limit should first be considered.**

Furthermore, in constrained locations, the following variables should be taken into account prior to considering a lower limit dimension:

- Motor vehicle speed and volume,
- Physical separation between the bikeway and motor vehicle lanes,
- Anticipated cycling volume (lower limit dimensions may not be appropriate where moderate or high volumes of people cycling is anticipated),
- Grade of the street, particularly at underpasses,
- Permanence of the design and the ability to adjust the allocation of space in the future,
- The proximity of alternative parallel cycling routes with dedicated, full width bikeways,
- Ability for maintenance equipment (snow removal, sweeping) to operate within the stated lower limit width, and;
- Pavement quality and the likelihood that users may need to veer around uneven surfaces

If after reviewing the preceding reasons and variables it is determined that lower limit values are needed, **justification should be documented with detailed reasoning.**

Pinch points

In some instances, a bikeway with a width that is generally greater than the lower limit width may need to be reduced to the lower limit width for a short distance (100 m or less). This is referred to as a pinch point.

Pinch points may result in greater risk exposure to people cycling if mitigating measures are not implemented. At these locations, the preferred solution is to resolve the spatial constraint and reconstruct the right-of-way in a manner that eliminates or mitigates the pinch point.

Where a pinch point cannot be eliminated the following measures should be considered as part of a strategy to reduce risk exposure:

- Alert and guide road users to the reduced width through signage, pavement markings or traffic signal modifications,
- Reduce motor vehicle travel speed through the posted speed limit or through traffic calming measures,
- Provide adequate sight-lines for all road users at the pinch point and on the approach to it, and;
- Reduce information and decision making load especially for motorists at the pinch point by avoiding clutter and excessive signage.

Figure 2.5 Along the Don Trail, a bridge support creates a pinch point. The multi-use trail has to be narrowed for a short distance. This is an acceptable and unavoidable reason to use a lower limit value.

Facility Type

2.4

Bikeways fall into three categories: physically separated, designated, and shared facilities. Within these categories, there are further variations with respect to the direction of bicycle operation (one-way, two-way and contra-flow). This section outlines each facility type in detail.

Facility type overview

There are a plethora of bikeway types that can be found across the globe. These include:

- **Cycle tracks** including uni- and bi-directional cycle tracks,
- **Multi-use trails,**
- **Buffered and conventional bike lanes,**
- **Advisory bike lanes,**
- **Contra-flow bike lanes,**
- **Neighbourhood greenways,** and;
- **Curbless streets.**

Table 2.2 describes these facility types.

Detailed design guidance for each facility type can be found in Chapter 3.

Facility type categories

The range of facility types above can be separated into three categories

- **Physical separated facilities,**
- **Designated facilities,** and;
- **Shared facilities.**

Table 2.2 Facility type descriptions

Physically Separated Facilities	 Uni-Directional Cycle Track	Uni-directional cycle tracks are physically separated from motor vehicles through the use of various physical separation techniques. They are recommended when there is high motor vehicle volume or speed along with higher rates of parking, loading, pick-up and drop-off activity.
	 Bi-Directional Cycle Track	Bi-directional cycle tracks are physically separated from motor vehicles through the use of various vertical separation techniques on one side of a roadway and carry cycling traffic in two directions. They are recommended only when there are infrequent driveways and intersections or as a short connection between trail segments.
	 Multi-Use Trails	Multi-use trails are off-street facilities that are designed to accommodate people cycling and walking and other non-motorized users. Multi-use trails can be placed adjacent to a roadway or sidewalk, or be completely separated from a street, such as within a park or green corridor. Guidance on the design of multi-use trails can be found in Toronto's Multi-Use Trail Design Guidelines.

Table 2.2 (Continued) Facility Type Descriptions

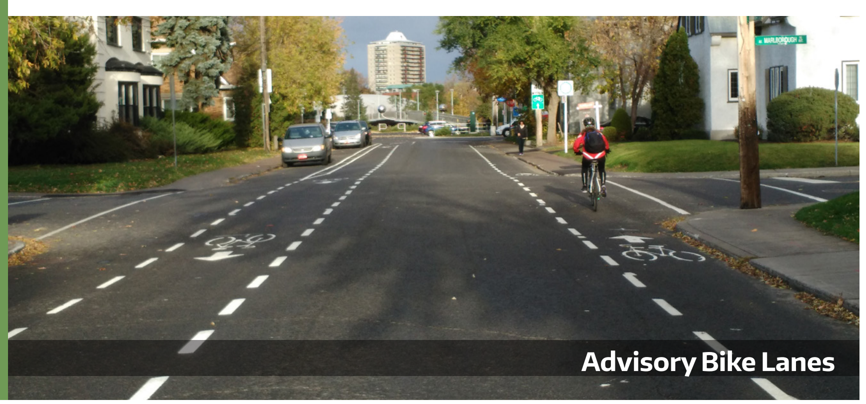
Designated Facilities

Buffered Bike Lanes or Bike Lanes

Buffered bike lanes and bike lanes provide designated space for people cycling through the use of pavement markings and signage. Bike lanes are located adjacent to motor vehicle travel lanes. Buffered bike lanes are bike lanes with a hatched area typically between the motor vehicle lane and sometimes between the parking lane, but no physical separation.

Contra-Flow Bike Lanes

A contra-flow bike lane is a cycling facility on a street with one-way motor vehicle traffic that accommodates people cycling in the opposing direction. It can be located between the motor vehicle travel lane and the curb, between a parking lane and motor vehicle travel lane, or may be separated from motor vehicle traffic by a parking lane.

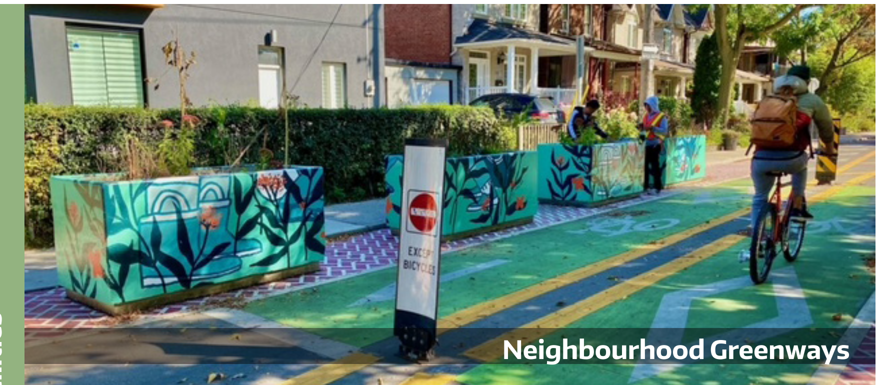


Advisory Bike Lanes

Advisory bike lanes are designated facilities marked with skip lines. A single centre travel lane is located between the advisory lanes and accommodates motor vehicle traffic in both directions. Motor vehicles must yield to people on bikes. Motor vehicles may drive in the advisory lane while an on-coming vehicle is approaching and passing since the centre travel lane is narrower than two motor vehicle lanes.

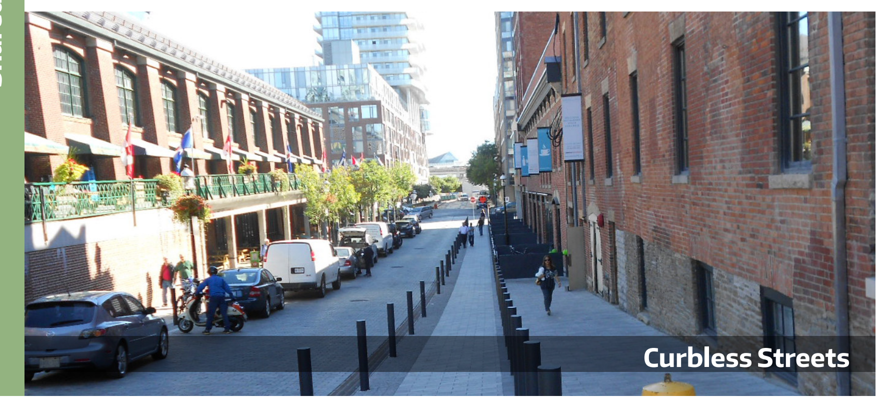
Table 2.2 (Continued) Facility Type Descriptions

Shared Facilities



Neighbourhood Greenways

Neighbourhood Greenways are routes where people cycling are given priority by creating an environment with low motor vehicle volumes and speeds. Cycling priority on neighbourhood greenways should be reinforced by signs, pavement markings, and speed and volume management treatments. Safe and convenient crossings of busy streets also must be installed.



Curbless Streets

Curbless shared streets raise the whole street and sidewalk to one elevation. Utilizing paving materials, bollards, street furniture and landscaping, the public realm blends and a shared, slow street environment is created. These streets put pedestrian activity first. Slow cycling should be accommodated but space for cycling is not designated. This Guide does not provide design guidance on this facility type.

Facility Selection

2.5

This section outlines key principles for selecting an appropriate facility. **Figure 2.6 provides a facility selection decision tree.** Further facility selection guidance specific to direction of bicycle operation, on-street parking, and other street characteristics can be found in Chapter 3.

Facility selection process

The City of Toronto's Facility Selection Matrix (Figure 2.6) provides practitioners with guidance on selecting a facility type to create all ages and abilities bikeways based on suitability criteria. Figure 2.6 should guide initial facility selection, but additional analysis, public consultation, and approvals must follow.

In some cases, a new bikeway may provide less separation than the preferred type in the facility selection process, but could still improve safety. The inability to provide an all ages and abilities facility should not be a reason to avoid implementation.

Suitability Criteria vs. Feasibility

The selection of an appropriate facility for a specific corridor is paramount to creating a comfortable and low-risk cycling environment. Before discussing facility selection criteria, a distinction should be made between criteria that affect the suitability of a facility type (suitability criteria) and factors that affect the feasibility of a facility type (feasibility criteria).

While important, **feasibility should generally be considered secondary to suitability criteria**.

Where the most suitable facility type is not feasible, practitioners need to use their judgment to assess whether an alternate facility type may still be appropriate, perhaps as an interim solution.

If an alternate facility type is judged to be inappropriate, practitioners should reconsider routing, phasing, or major redesign options to achieve a desirable outcome. This is an important step from a liability, public accountability, and general best-practice perspective.

Practitioners must also consider equity. There are under-served areas in Toronto with lower cycling volumes and roadways which require larger changes to road design to achieve an all ages and abilities network. These areas stand to greatly benefit from well-designed bikeways that connect residents with local destinations and transit. Providing a wider range of safe and comfortable travel options should inform the facility selection process and the scale of the project scope for road design changes.

Suitability: Speed and volume

As the Design Principles in Section 2.1 discuss, the creation of comfortable, direct, and safe facilities will help to ensure the desired outcomes.

The **two main suitability criteria** for selecting a facility type for a specific corridor are

- speed of motor vehicle traffic, and;
- volume of motor vehicle traffic including annual average daily traffic volumes (AADT) and peak hour volumes.

Suitability: Anticipated users

While motor vehicle speed and volume are the two guiding suitability criteria, practitioners should consider the community context and anticipated users when selecting an appropriate facility type.

It is particularly important that the design of a facility is consistent with these parameters where children, seniors, or other less experienced riders are anticipated to be recurring users, such as near schools, parks, retirement homes, or in areas with high levels of tourism.

Suitability: Collision history

The collision history of the corridor should inform the selection of bikeway facility type.

Streets with higher volumes of collisions should separate people cycling and driving. Pedestrian and motor vehicle safety improvements should be incorporated into the design of bikeways. Specific attention should be given to mid-block segments and intersections that have a history of collisions that have resulted in fatalities or serious injuries or roadway features that commonly lead to collisions.

Feasibility: Motor vehicle parking

Motor vehicle parking is often impacted when implementing new bikeways. There are several configurations, depending on the width of the street, that can incorporate motor vehicle parking on streets with bikeways.

Avoiding the removal of motor vehicle parking should not be used as the main factor for bikeway selection. Rather, it should be considered after the appropriate facility type is selected based on the suitability criteria above.

Feasibility: Right of Way width, utility and tree conflicts

There will be instances where the appropriate facility type could have impacts on private property or on existing utilities and tree locations. If so, practitioners should consider:

- opportunities to implement road space reallocation projects where feasible, which are often more cost effective than other project types, and;
- opportunities to integrate facilities into the design of road reconstruction projects to achieve economies of scale.

Feasibility: Funding

OTM Book 18 cautions that a lack of funds cannot be used to justify a poorly designed, maintained or constructed facility. If the facility type selected exceeds current budget estimates for the project, practitioners should consider:

- phasing implementation, and;
- identifying the need for additional funding in a future budget year.

Developing cost estimates early in the design process should help manage costs and mitigate funding pressures.

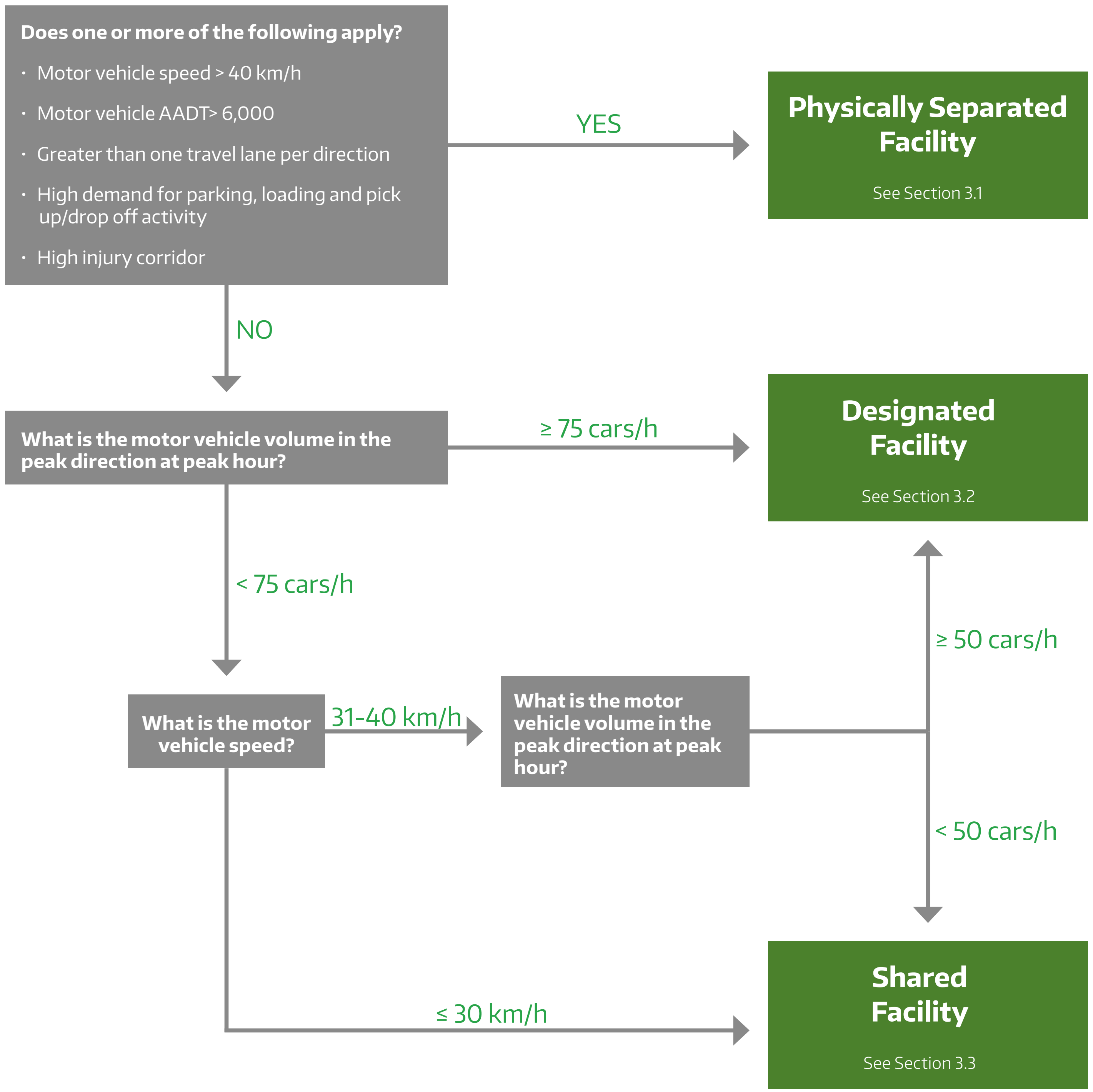


Figure 2.6 City of Toronto Facility Selection Matrix.

Notes:

1. The Facility Selection Matrix identifies the typical facility type to be considered suitable for people of all ages and abilities. It is always acceptable to provide a facility with a higher level of separation than indicated.

2. The speed and volume thresholds are generally consistent with the NACTO Designing for All Ages & Abilities Guide (December 2017). These speed and volume thresholds are targets, and practitioners should consider the guidance in the Sections 2.1 and 2.2 if these targets are not achievable. AADTs apply to all lanes and all directions of travel on the roadway. The volume of people cycling should be omitted from the AADT.

3. In cases where the default facility type is not feasible and the street characteristics cannot be modified to achieve feasibility, a facility with less separation may still provide benefit. Practitioners should not use an inability to meet the preferred facility type as a reason to not implement a bikeway.

4. Motor vehicle speed should be based on the 95th percentile operating speed. If the 95th percentile is not available, 85th percentile can be considered. If neither is available, posted speed limit may be used as a proxy in instances where operating speed data cannot be gathered, such as on a planned new street or a street that is planned to have significant geometric changes that may affect existing operating speeds.

5. Multi-use trails can be considered for installation when a physically separated facility is needed. More guidance on when to use a multi-use trail vs a cycle track can be found in Chapter 3.

Major City-Wide Cycling Routes

2.6

This section discusses the City of Toronto's Major City-Wide Cycling Routes. These routes will serve as the backbone of Toronto's cycling network forming a grid connecting the city from east to west and north to south. Major City-Wide Cycling Routes should incorporate the highest quality bikeways through road resurfacing, road reconstructions, new developments and standalone projects

The most up to date information on the Cycling Network Plan can be found at toronto.ca/cycling including a map of Major City-Wide Cycling Routes.

Toronto's Cycling Network Plan

The City of Toronto's Cycling Network Plan (adopted in 2019) serves as a comprehensive roadmap and work plan, outlining the investments planned by the City of Toronto in both the near and long term. The Cycling Network Plan's goals are to:

- Connect the gaps in the existing cycling network;
- Grow the cycling network into new parts of the city; and,
- Renew the cycling network routes, where there are opportunities to improve their quality.

The Cycling Network Plan also helps achieve a key cycling policy objective in the City's Official Plan of bringing all Toronto residents within one kilometre (km) of a designated cycling route, as well as the TransformTO goal that 75% of trips under 5 km are taken by transit, walked or cycled by 2030.

The Cycling Network Plan consists of three components: near-term capital implementation program for cycling infrastructure, an overall proposed network; and Toronto's Major City-Wide Cycling Routes.

Major City-Wide Cycling Routes

The Major City-Wide Cycling Routes will serve as the backbone of Toronto's cycling network. These routes will support a connected system across the Greater Toronto Area by linking with other cycling routes in neighbouring municipalities. The routes are significant corridors that cross Toronto.

Major City-Wide Cycling Routes and Facility Selection

Due to the extensive nature of the proposed Major City-Wide Cycling Routes, not all routes will be designed and constructed at once. Every opportunity should be taken to move forward with the design and installation of these routes including bundling with state of good repair work.

When designing a corridor designated as a Major City-Wide Cycling Route, practitioners should strive to implement the highest order facility. Practitioners should avoid compromising the width and level of separation on these routes, even if the cycling volumes are anticipated to be low before more extensive connections can be made.

Figure 2.7 Bloor Street, Danforth Avenue and Kingston Road form an east-west Major City-Wide Cycling Route. In 2021, the existing Bloor Street East bike lanes were widened to 2.1 -2.4 metres and protection was added to align with Ontario's best practices and the City's On-Street Bikeway Guidelines.

Figure 2.8 Along the Finch Hydro Corridor, another Major City-Wide Cycling Route, a new direct and intuitive cycle track and wider sidewalks were built. Careful attention was paid to separate pedestrians and people cycling, as the volumes of both are anticipated to grow overtime.

Private and Transit Developments

2.7

Toronto is experiencing immense growth and investment through new private developments and transit infrastructure. Both provide an opportunity to inform new residents mobility habits. Building safe and comfortable bikeways as part of these projects is an efficient and effective way to improve safety and increase cycling mode share.

Toronto is Growing

Toronto is experiencing unprecedented growth and many areas of the city have a large number of private redevelopments proposed.

Private developments, particularly multi-block developments, and new transit infrastructure provide an opportunity to improve the public realm and cycling connections.

Existing Bikeways and Transit and Private Developments

When a redevelopment is along an existing bikeway, improvements should be considered as part of the development review process including:

- Widening the facility to meet today's standards,
- Upgrading the facility type, for example upgrading a painted bike lane to cycle track or upgrading an on-street cycle track to a raised cycle track,
- Upgrading transit stops to raised integrated platforms or island platforms, and;
- Incorporating intersection improvements including protected intersection features and traffic signal upgrades.

New Bikeways on New Streets

Large private developments and in some cases new transit infrastructure can include the construction of new streets. By default, these new streets must consider the inclusion of new bikeways.

If a roadway is anticipated to have high motor vehicle volume and/or speed as described in Figure 2.6, cycle tracks and/or multi-use trails at sidewalk or intermediate level with barrier curbs and/or raised medians should be used as the default design.

New one-way streets should by default include a contra-flow bike lane to allow for people cycling to travel both ways.

It is also important to consider the design principle of directness. Transit projects and new developments should consider if new 'cut-through' , entrances and routes can be established that make walking and cycling convenient, safe and comfortable.

Grade Separation Projects

Grade separation projects enable safe and efficient transit and freight services. These improvements can also lead to a reduction in traffic conflicts.

Generally, cycling and pedestrian tunnels are preferred over bridges if sight lines through the tunnel are sufficient to see the end of the tunnel before entering.

When designing bikeways along grade separation projects, practitioners should consider :

- Opportunities to raise cycling facilities to elevated sidewalk levels on new or reconstruction of underpasses, in order to physically separate these from traffic and enhance safety and achieve gentler grades with a maximum of 5%, and;
- Opportunities to upgrade and protect space for existing and/or future bikeways on bridge rehab/ retrofit work (including bridge widening) in order not to preclude ability to implement these in the future.

Constraints and Future Proofing

Smaller developments and/or developments along corridors where a lane removal would be required to include linear cycle tracks or bike lanes may not be able to accommodate new bikeways during the site development process.

If so, the frontages should still be reviewed to ensure that the private development does not restrict or eliminate the ability to build future bikeways on the corridor.

CHAPTER CONTENTS

CHAPTER OVERVIEW

In Chapter 2, practitioners learned how to select an appropriate facility type depending on street conditions including motor vehicle speed and volume.

Chapter 3 provides design guidance with respect to width, parking considerations, and types of separation for each facility type.

This Guide does not discuss design speed and associated design elements such as stopping sight distance, all vertical and horizontal alignments, radius and super-elevation. Practitioners should refer to the Transportation Association of Canada Geometric Design Guide for Canadian Roads Chapter 5-Bicycle Integrated Design for these design elements.

BIKEWAY DESIGN

Physically Separated Facilities

3.1

Physically separated bikeways (also known as cycle tracks) create exclusive and separated space for people cycling along or within the roadway. Practitioners must first determine whether a uni-directional or bi-directional cycle track is appropriate. Then practitioners must design two functional elements: separation from motor vehicles and separation from pedestrians.

Overview

The Facility Selection Matrix in Chapter 2 shows that if there are high volumes of motor vehicles and/or high speeds along a street, physical separation is needed. Cycle tracks are also an appropriate facility type along Toronto's Major City-Wide Cycling Routes.

The common elements of cycle tracks are that they create dedicated and physically separated space for people cycling from motor vehicle travel, parking and pedestrian activity. Cycle tracks can operate one way (uni-directional cycle tracks) and two way (bi-directional cycle tracks). Both types of cycle tracks are used throughout North America and internationally. Each cycle track type has different design considerations.

The cycle tracks can be designed to integrate cycling movements at intersections with vehicle movements or to be separated. They can also be designed at street level, an intermediate level or at sidewalk level.

Constraints

Cycle tracks require more width than non-physically separated bikeways, so that people cycling have sufficient operating space. In constrained situations, it may be appropriate to consider a non-physically separated facility even if the Facility Selection Matrix indicates that physical separation should be provided.

While a lesser facility type may fall short of providing an all ages and abilities bikeway, width constraints should not be used as a reason to avoid implementing a bikeway.

Richmond Street

Queens Park Circle

Cycle Track Elements and Configurations

3.1.1

Once it has been determined that a physically separated facility is appropriate, it is then necessary to determine whether a uni-directional or a bi-directional cycle track is desired. On most city streets, uni-directional cycle tracks are preferred, but there are environments where a bi-directional cycle track is desired or even necessary.

Uni and bi-directional cycle track decision criteria

On most city streets, uni-directional cycle tracks are preferred as their operation is more intuitive. Bi-directional cycle tracks are generally less intuitive and can create challenges for people cycling at intersections and transition points to uni-directional cycle tracks.

Bi-directional bicycle operation also increases the number of conflict points and locations that a motorist must check before crossing a bi-directional cycle track.

Thus, uni-directional cycle tracks should be the default configuration for a bikeway that warrants physical separation.

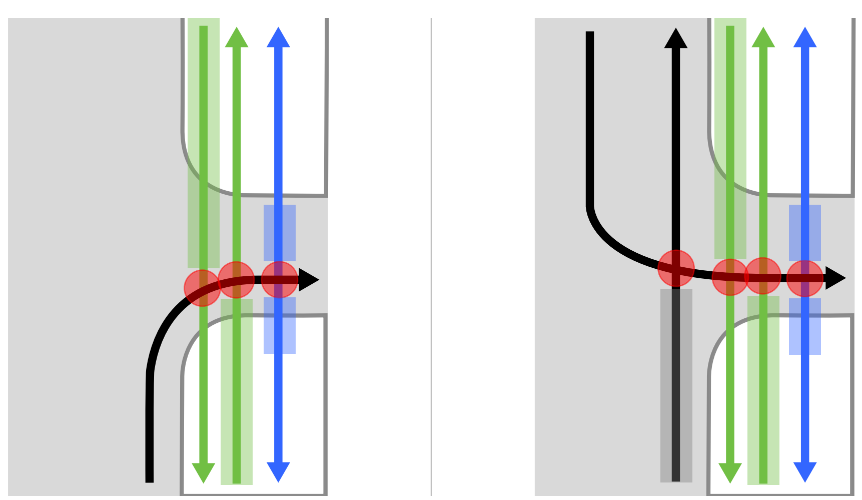


Figure 3.1 Conflict points and streams of traffic that a turning motorist must check for before they proceed across a two-way facility. The conflict points are marked with circles and the approximate areas that a motorist must scan are marked with rectangles. The black lines represent motor vehicle movements, the green lines represent bicycle movements and blue lines represent pedestrian movements.

In some contexts, bi-directional cycle tracks may be a more appropriate choice than uni-directional cycle tracks.

Bi-directional cycle tracks can be considered:

- Along a street that has one-way motor vehicle operation and infrequent driveways / intersections,
- Along a two-way street with minimal turning movement conflicts, such as in locations with infrequent intersections, low volume driveways, and protected turn phases at signalized intersections so that crossing exposure and delay are reduced,
- Through and approaching a crossing of a highway interchange, especially if one side of the street has fewer ramp crossings or greater feasibility of signalized or grade-separated ramp crossings,
- Where a street warrants physical separation but has insufficient space for uni-directional cycle tracks,
- Where a bi-directional cycle track would provide greater opportunity for transit priority measures along the street compared to uni-directional cycle tracks,
- Where it is a key connector route in the network with relatively few destinations on the opposite side of the street,
- Where many trips occur between mid-block destinations along the same side of an arterial with widely spaced controlled crossings, or;
- Where the connector is a multi-use trail.

Cycle track location

Cycle tracks typically are designed between vehicular or parking lanes and the sidewalk. This creates a predictable design for managing user expectations. In rare situations, cycle tracks (both uni and bi-directional) could be placed adjacent to a median. Centre-running cycle track designs may result in intersection design challenges, especially in how people cycling make right and left turns.

As discussed, bi-directional cycle tracks can be desirable in certain environments. A practitioner must determine if a left side or right side location is most appropriate for a bi-directional facility. Considerations include:

- Transit frequency;
- Number of driveways, intersections, highway ramps, or other conflicts on each side;
- Direction of travel for vehicles; and,
- Destination locations.

It may also be appropriate, for example in a suburban context with a wide multi-lane street with destinations on both sides and limited intersection crossings, to install bi-directional cycle tracks on both sides of the street.

Cycle track elements

Cycle tracks are constituted of four elements for design consideration:

1. **Cycle track clearway**: This is the space where a person cycling operates. For design guidance see Section 3.1.2.
2. **Cycle track elevation**: Cycle tracks may be constructed level with the street, sidewalk or at an intermediate elevation. For design guidance see Section 3.1.3.
3. **Motor vehicle separation**: This is the space between the bike lane and motor vehicle traffic. For design guidance see Section 3.1.4.
4. **Pedestrian separation**: This is the space between the bike lane and the sidewalk. Sidewalk level cycle tracks require careful consideration to achieve effective walking and cycling separation. For design guidance see Section 3.1.5.

Design variations

A shared multi-use trail may be considered in areas where two-way cycling makes sense and adjacent pedestrian sidewalk cannot be provided due to space restrictions, and pedestrian volumes are low. For guidance on multi-use trails, refer to the City's Multi-Use Trail Design Guidelines (2015).

Cycle Track Clearway

3.1.2

The cycle track clearway is an important element for design consideration. The clearway should provide a sufficiently wide space to enable comfortable and social cycling. The default widths of cycle track can vary based on existing or anticipated cycling volumes. Where high volumes of cycling are anticipated or where there is more demand for cargo bicycle use, wider cycle tracks should be provided.

Cycle track clearway width

Cycle tracks are all ages and abilities bikeways and can attract thousands of regular riders. The clearway must be able to accommodate all types of users, for example a parent traveling with their child or a person on an adaptive bicycle.

For uni-directional cycle tracks with low to moderate volumes (less than 300 cyclists/peak hour) the default width is 2.1 m width. In constrained situations, 1.5 m is the minimum.

If the lower limit width is utilized in a design, justification should be documented.

In higher volume locations and along the City's adopted City Wide Cycling Corridors (Chapter 2), the recommended default width is 2.4m.

Uni-directional cycle tracks do not have to be the same width on both sides. For example, it may be beneficial on a steep and constrained corridor to have a wider uphill cycle track clearway and a narrower downhill cycle track clearway to enable stronger cyclists to pass on the challenging uphill section, or on downhill sections with sharp horizontal curves it may be beneficial to provide a wider clearway space.

Practitioners should consider that peak cycling volumes may not be aligned to traditional vehicular peak volumes. For example Queen's Quay along Toronto's waterfront has peak cycling volumes on weekends during the mid-day. Cycle tracks should be constructed for the peak volume of cyclists, even if not aligned with peak vehicular volumes.

3.1.2 CYCLE TRACK CLEARWAY

Practitioners should anticipate that on high speed and high volume vehicular corridors without bikeways, that the current cycling volumes do not reflect the potential demand.

In Toronto, after the construction of cycle tracks, cycling volumes have increased by 25%-200%. For example, after installation of University Ave cycle tracks, cycling volumes rose by 138% within three months and after installation of bike lanes on Huntingwood Drive, cycling volumes rose by 25%. Practitioners should estimate the potential for increases in cycling once constructed and consider further increases that may occur with future network expansion in the area.

Bi-directional cycle tracks require wider clearways. In low to moderate volume environments, the recommended default width is 3.5m. In higher volume environments or along a Major City-Wide Cycling Corridor, the recommended default width is 4.0m.

Special care and attention should be paid to any cycle track clearway greater than 3.0 m to ensure people driving do not enter the cycle track.

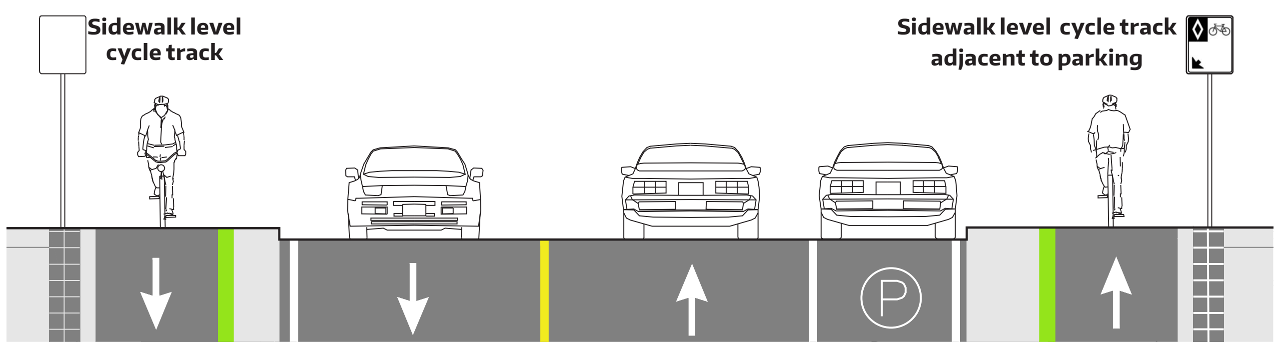


Figure 3.2 Street section of uni-directional cycle track

Table 3.1 Uni-directional cycle track clearway width details

Uni-directional cycle track clearway widths***		
Design Domain	**Moderate to low volume ratings**	**Major City-Wide Cycling Routes and high volume ratings**
Default	2.1 m	2.4 m
Upper Limit	2.6 m	3.0 m**
Lower Limit	1.5 m*	1.8 m

* A cycle track width of 1.5 m must have an additional 0.3 m of clearway from the buffer for a total of 1.8 m of clearway for snow plows

** Additional measures may be required to prevent motorists from mistaking the cycle track for a motor vehicle lane

*** The widths indicated here are for only the bikeway clearway and do not include required buffer space, which is dependent on separation type.

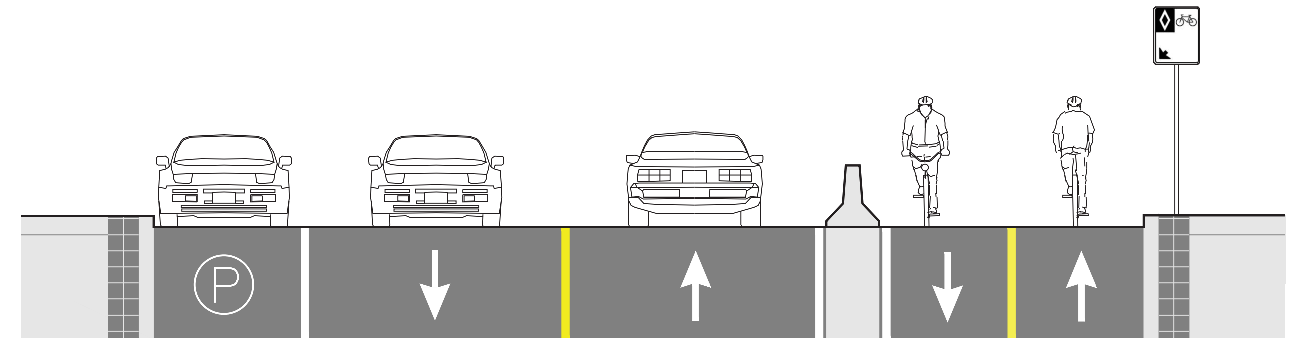


Figure 3.3 Street section of bi-directional cycle track

Table 3.2 Bi-directional cycle track clearway width details

Bi-directional cycle track clearway widths*		
Design Domain	**Moderate to low volume ratings**	**Major City-Wide Cycling Routes and high volume ratings**
Default	3.5 m	4.0 m
Upper Limit	4.5 m	5.0 m
Lower Limit	2.4 m	2.4 m

* The widths indicated here are for only the bikeway clearway and do not include required buffer space, which is dependent on separation type.

Cycle Track Elevation

3.1.3

Cycle tracks may be constructed at street, intermediate or sidewalk level. Street level cycle tracks within existing curbs are faster and less expensive to build and can be used to pilot a project. Sidewalk and intermediate level cycle tracks should be considered when there is a full roadway reconstruction planned or when cycle tracks cannot fit within existing curbs, triggering partial reconstruction. All three elevations have different benefits and drawbacks which a practitioner should consider during the design.

Cycle track elevation

Cycle tracks may be constructed at street, intermediate or sidewalk level.

For road reconstructions and other major infrastructure changes, cycle tracks at sidewalk or intermediate level with barrier curbs and/or a raised medians should be used as the default design. Street level cycle tracks can also be considered with raised medians.

For projects utilizing only pavement markings and other temporary materials, street level cycle tracks should be the default design.

A mix of cycle track elevations can be utilized along a corridor via bicycle ramps including at pedestrian crossings, bus stops, intersections or in constrained locations or to mitigate challenging utility conflicts. It is important that a corridor-wide perspective be considered during the design process. Frequent elevation change is not generally comfortable for people cycling.

While it's important to take a corridor perspective, there are reasons to implement shorter sections of sidewalk or intermediate level cycle tracks.

For example, a new development proposal along a Major City-Wide Cycling Corridor or existing street level bike lane or cycle track should by default upgrade the bikeway to a raised cycle track.

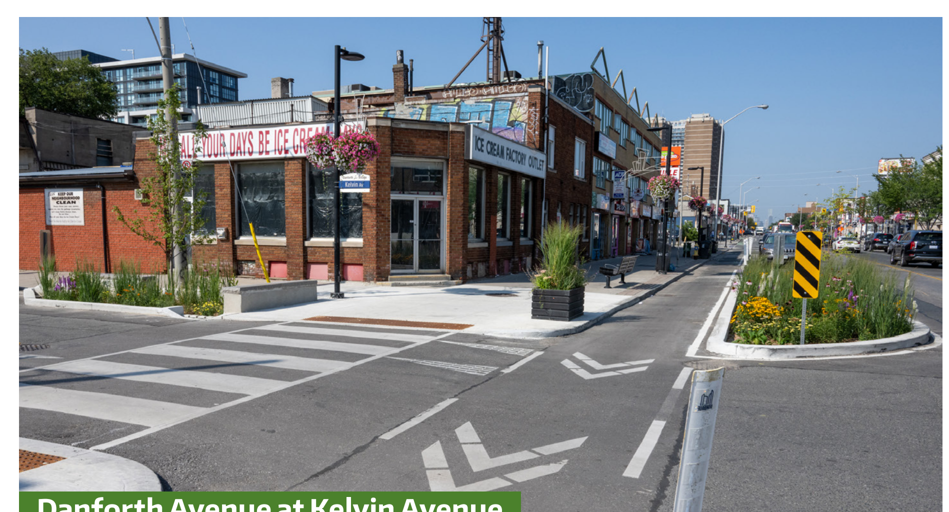
Also intersection reconfiguration projects should review existing or future planned bikeways and incorporate the default standard facility, even if the linear facility is not yet planned or is at street level.


Cummer Avenue

Sidewalk level cycle tracks ensure greater separation between people driving/parking and those cycling. They are best used when a larger buffer/furniture zone can be provided between people cycling and pedestrians. They can also be used where there are lower volumes of people cycling and pedestrians.


Bloor Street

Intermediate level cycle tracks should be considered during roadway reconstruction. The curb between the bikeway and sidewalk makes it easier for people with low to no vision to navigate. Drainage, width and the speed of the roadway are important considerations. If setbacks of 2m or greater cannot be achieved between a travel lane and the cycle track on roadways with operating speeds of at least 60 km/h, intermediate level cycle tracks may not be an appropriate design. The shorter curb is not a deterrent from fast moving traffic.


Danforth Avenue at Kelvin Avenue

Street level cycle tracks are typically easier to implement. Existing roadway space can be re-purposed and drainage, signal poles and utilities are less impacted. Features like concrete parking bulb outs, planting areas, and curbs, can be explored in the design to ensure robust separation between people driving, cycling and walking.

3.1.3 CYCLE TRACK ELEVATION

Sidewalk level

Sidewalk level cycle tracks are effective at deterring motor vehicle encroachment. They also enable passengers in vehicles to board to the buffer zone at sidewalk elevation and maneuver to the sidewalk without any grade changes. This helps improve accessibility.

The main consideration when designing sidewalk level cycle tracks should be mitigation of cycling/ walking conflicts.

A planting and street furniture zone between the cycle track and pedestrian clearway is the most effective strategy for separating people walking and cycling.

Pedestrian-related street furniture such as waste receptacles, publication boxes, pedestrian wayfinding and seating should be positioned between the cycle track and the sidewalk.

Where there is insufficient space for a planting / street furniture zone, **a minimum 0.6 m wide textured and visually contrasting band of unit pavers should be provided between the cycle track and the pedestrian clearway.**

Intermediate level

On pedestrian-oriented streets with constrained rights of way, intermediate or street level cycle tracks are generally preferred to mitigate these conflicts. But when there is sufficient width, sidewalk level cycle tracks can be the default since intermediate cycle tracks with a roadway curb less than 150 mm tall do not deter motor vehicle encroachment as well.

Intermediate level cycle track configurations may or may not include a raised median between the roadway and the cycle track. Including a raised median helps deter motor vehicle encroachment by increasing the height of Curb A (Figure 3.4) and decreases the risk of people cycling unintentionally entering the roadway.

If a raised median is included, the cycle track should have a minimum 1.6 m clear width to accommodate snow clearing and sweeping equipment.

The grade change between the cycle track and the sidewalk must have a minimum 50 mm elevation difference to help people with low to no vision avoid entering the cycle track.

Street level

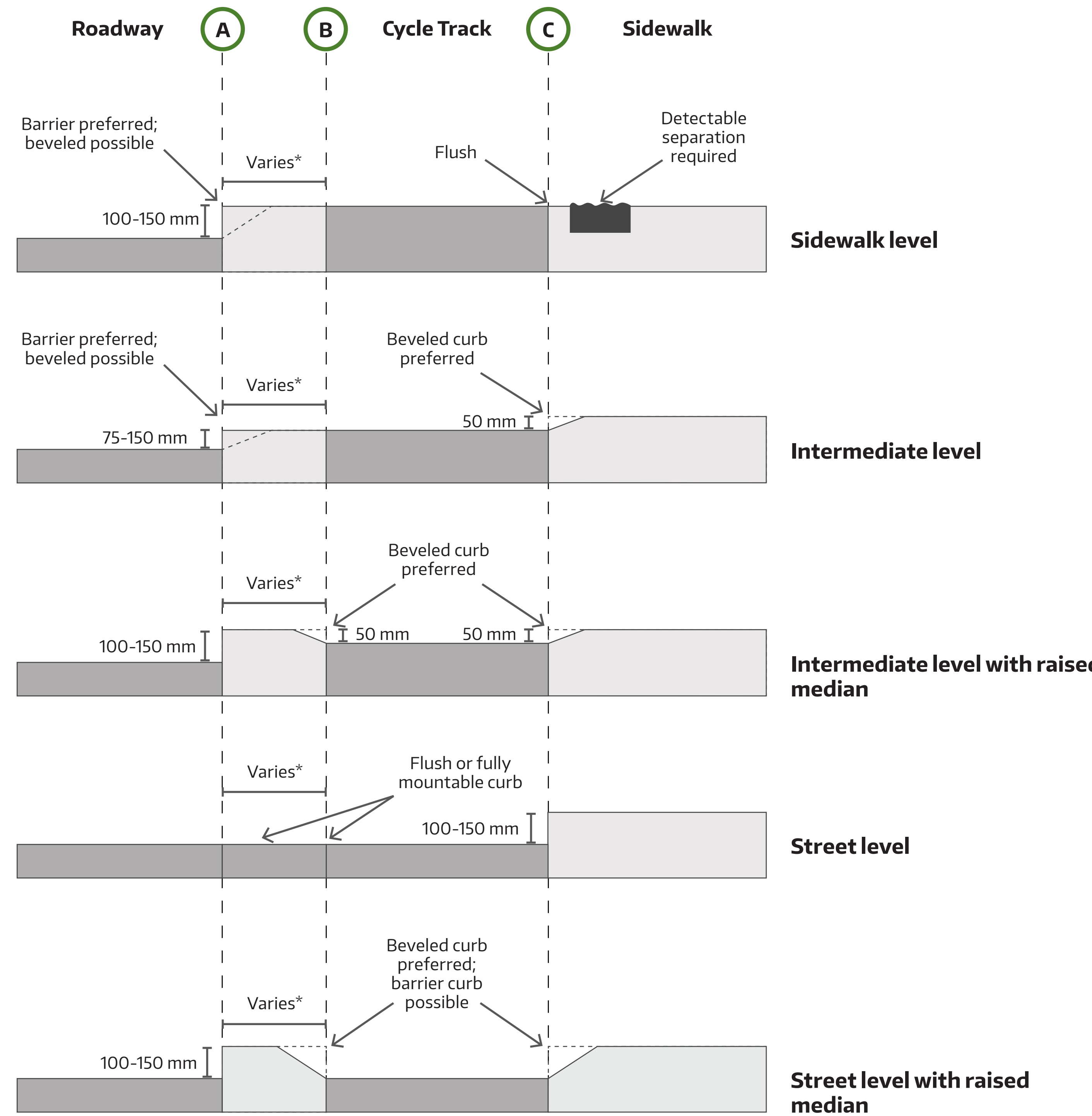
When looking to make faster and less expensive bikeway improvements, street level cycle tracks are the most feasible to implement.

This configuration may or may not include a raised median or other form of separation between the roadway and the cycle track.

If a raised median is included, the cycle track should have a minimum 1.6 m clear width to accommodate snow clearing and sweeping equipment.

If a street level cycle track is installed, without a raised median, the separation type is important consideration adjacent to parking.

Without a raised median, motorists do not have a curb to guide them as they park. If a raised median is provided, pedestrians moving between the parking lane and sidewalk must cross multiple curbs. Accessible loading and parking should be implemented when implementing new street-level cycle tracks.



* Buffer widths vary based on separation and curb type.

Figure 3.4 Curb locations and heights

Turning movements

For all cycle track types, turning movements for people cycling should be accommodated at intersections through protected intersection treatments or two-stage bicycle left turn boxes because people cycling cannot maneuver between the travel lane and the cycle track. Turning movements for people cycling should be considered for all intersections, but with focus on providing the most comfortable turning facilities at intersecting existing or planned future bikeways.

Curb types

The types of curbs adjacent to the cycle track clearway is also an important topic when discussing shy distances and pedal strikes.

There are three main types of curbs: barrier curbs, beveled curbs and fully mountable curbs.

Cycle tracks may include curbs at locations A, B, and / or C as shown on Figure 3.4 depending on the cycle track level and whether a raised median is included.

Barrier curbs typically provide 100 - 150 mm of elevation change at location A and 50 mm of elevation change at locations B and C. They are preferred at location A especially where there is parking, as the barrier curb helps to guide motorists as they park and deter encroachment into the cycle track.

The preferred **beveled curb** has a 50-150 mm of elevation change and is 200 mm wide (not including a gutter). They are well suited for curbs at location B and C, as they reduce the risk of a cyclist's pedals striking the curb. Other beveled curbs with different slopes can also be considered to mitigate pedal strikes in constrained conditions.

Beveled curbs provide a moderate level of encroachment deterrence if they are used in location A. Most people cycling can comfortably traverse a beveled curb at a low speed. However, traversing them at a high speed can cause discomfort or risk of losing control, and they should not be used within the bike clearway.

Beveled curbs are readily cane detectable, can be traversed by most mobility devices, and are considered to be less of a trip hazard than barrier curbs.

Fully mountable curbs typically provide 0 - 30 mm of elevation change. Where they are used, they are typically positioned at location A and / or B. There are drawbacks to fully mountable curbs. For example, it is easy for people driving to enter the cycle track, so these curb types should not be a default design choice.

Locations where motorists may be required to enter the cycle track in order to allow an emergency vehicle to pass, fully mountable or beveled curbs may be an appropriate choice. **For example, if the roadway is too narrow to maintain the 6.0 m clearway for emergency vehicles.**

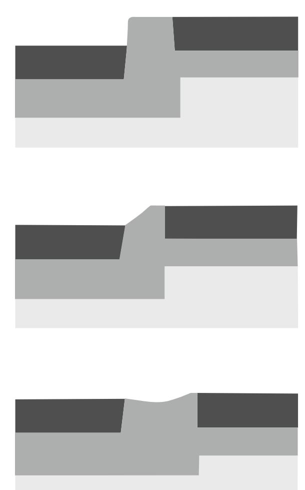


Figure 3.5 Curb types between cycle tracks and roadway or sidewalk.

Cross Slopes and Drainage

Providing proper drainage as part of cycle track design enhances the safety and comfort of all users by reducing water ponding and the accumulation of debris. Where ever possible, green infrastructure should be considered, particularly in suburban and unconstrained conditions.

Practitioners should keep in mind that the **preferred cross slope for a cycle track is 2.0% - 4.0%**, though slopes between 0.35% and 8.0% can be considered on a case by case basis. If the area is utilized for accessible boarding/parking, the cross slope should not exceed 4%.

Where green infrastructure is not possible, three categories of drainage are possible: drainage toward the sidewalk curb, drainage toward the roadway curb or dual catch basin drainage (Figure 3.6)

Drainage toward the sidewalk curb will mostly likely be the main design with street level cycle tracks. Gaps in the barrier between the travel lane and cycling operating space must be provided. If a street level cycle track is being constructed with a full reconstruction or major roadwork, side inlet catch basin should be the preferred design to eliminate catch basin grates in the cycle track, which can be slippery and can create an uneven riding surface.

Drainage toward the roadway curb (referred to as reverse drainage) can be implemented with sidewalk, intermediate or street elevation cycle tracks. This configuration is typically feasible when the cycle track is being constructed in a boulevard area. A cycle track with this drainage configuration can also be implemented on an existing roadway, however this may result in minimal elevation change

Drainage with dual catch basins can be implemented with sidewalk, intermediate or street elevation cycle tracks, where needed.

A **dual catch basin** is the most effective configuration for drainage in winter conditions, since snow melt from both the sidewalk and roadway can drain without flowing across the cycle track.

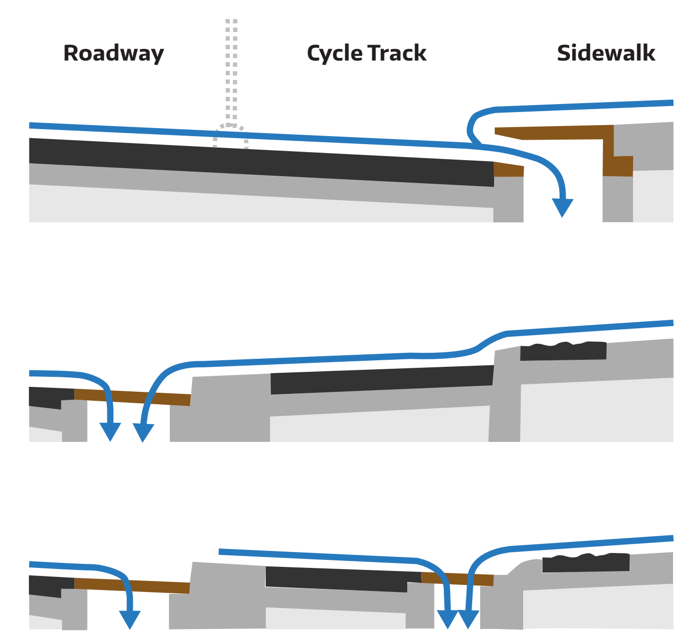


Figure 3.6 Drainage options for cycle tracks.

If the elevation change between the cycle track and the sidewalk is less than 100 mm, a side inlet catch basin may not be feasible. A narrow 300 mm wide catch basin could be used in this context so that the grate is not aligned with the bicycle wheel path.

For sidewalk elevation cycle tracks with dual drainage, a trench drain may be required between the cycle track and the sidewalk in key locations.

Figure 3.7 A narrow catch basin adjacent to a bi-directional cycle track.

Types of Bicycle/Motor Vehicle Separation

3.1.4

A range of types of vertical separation may be used to separate people cycling and people driving. The type of separation should be selected based on the characteristics of the street, such as motor vehicle speed, presence of on-street parking, and available road or right-of-way space.

Flex Bollards and Modular Curb

Flex posts are vertical posts mounted to the roadway surface at regular interval. Modular curbs are short curb (typically approx. 150 mm high) made typically of concrete and anchored into the roadway, with bollards mounted on top to aid in visibility.

Poured Concrete Curb/Median

Poured concrete curbs/medians are linear segments of poured concrete that is raised above the level of the roadway (typically at curb height). If space allows, planted medians and/or integrated green gutters are possible.

Planter Boxes

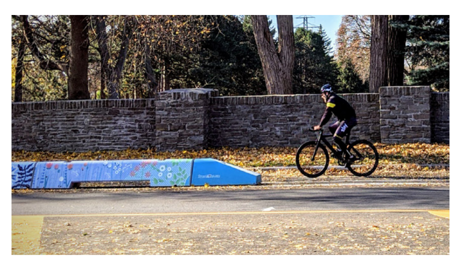
The City of Toronto utilizes self-watering planters that are placed on top of the roadway, on top of a median, or inside of a median. They are typically 0.6 m high without vegetation and must include a reflective materials on the all sides.

Planted Median

A linear area of grass separating the roadway from cycling facility. Where the road is constructed with an urban cross section, the grass median is behind the barrier curb along the edge of the road.

Semi-Rigid Guard Rail

A steel beam guard rail that is designed to redirect errant vehicles into the roadway with a moderate amount of deflection. Guard rails are implemented as a continuous type of separation with infrequent gaps. Type M30 design assumed.



Concrete Barrier

A precast or cast-in-place rigid barrier that is designed to redirect errant vehicles into the roadway with little or no deflection. Concrete barriers are implemented as a continuous type of separation with infrequent gaps. Low height (450 mm) or standard height (825 mm) barriers may be used, depending on context.

Design considerations

Motor vehicle speed is one of the primary street characteristics affecting the choice of separation. At lower speeds, vertical separation primarily serves as a method of delineating the cycle track from the rest of the roadway and discouraging encroachment by motorists. As speeds increase, it becomes more important for the separation to protect people cycling (as well as people walking along an adjacent sidewalk) from errant motor vehicles.

Table 3.3 provides details on the appropriate types of separation for use based on motor vehicle speed. In some contexts, a separation type may be "not preferred but permitted". Another separation type should be selected if possible, with these used as a last resort if it is the only way of achieving separation.

Table 3.3 provides minimum buffer widths for different separation types based on motor vehicle speed. Greater widths should be provided where feasible, to increase comfort for people cycling. The table footnotes indicate situations where a lesser buffer width is permissible if it is the only way of achieving separation.

On the approach to driveways or intersections, the effect of separation width and height on sight-lines should be considered. The buffer may need to widen or narrow to provide appropriate visibility, but must not be decreased below the minimum width for the type of separation used.

Taller forms of separation such as planters or guard rails may need to transition to a shorter form of separation approaching driveways and intersections.

Where there is a greater chance of motor vehicles encroaching on the bikeway, such as on retail corridors with high levels of curbside activity, more robust forms of separation are preferred.

The available space within the right-of-way may affect which types of separation are feasible. Minimum buffer widths for each type of separation are provided in Table 3.3.

At locations where accessible parking is provided or frequent Wheel-Trans boarding occurs, the separation needs to allow curbside access for Wheel-Trans vehicles and/or access from the roadway to the sidewalk for mobility device users. Where the bikeway is at street level, a gap should be provided in the separation to allow this access. In some cases, raising the bikeway with a permanent or modular platform can provide step-free access between a parked motor vehicle and the sidewalk.

On narrow and congested arterial streets, it may be necessary to provide space between separators to allow motorists to pull over and provide a path for emergency vehicles. An appropriate separation technique and clear width should be determined in consultation with all emergency service providers.

3.1.4 TYPES OF BICYCLE / MOTOR VEHICLE SEPARATION

Table 3.3 Bicycle/ motor vehicle separation types and minimum buffer widths

Separator Type			Flexible Bollards	Modular Curbs	Planter Boxes	Poured Concrete Curb/ Median	Planted Median	Semi-Rigid Guard Rail	Concrete Barrier
Minimum Buffer Width[1]	**Low Speed**	**Operating: < 50 km/h Posted: 30 or 40 km/h**	0.3 m, max spacing of 6m	0.3 m, max spacing of 6m	0.9 m	0.3 m	1.0 m	1.2 m with curbside placement[2] 3.0 m if installed 1.8 m from curb face[3]	0.7 m, 450 mm low height barrier[4]
	Medium Speed	**Operating: >50 km/h through <60km/h Posted: 50 km/h (1 lane/direction)**	0.5 m, max spacing of 6m	0.3 m, continuous	0.9 m	0.3 m	1.0 m	1.2 m with curbside placement[2] 3.0 m if installed 1.8 m from curb face[3]	0.7 m, 450 mm low height barrier[4]
	High Speed	**Operating: > 60 –80 km/h Posted: 50 km/h (2+ lanes/direction), >60 km/h**	Not acceptable	Not preferred, but permitted in a standalone retrofit project	Not acceptable	Combination with semi-rigid guard rail preferred (buffer width based on guard rail); not preferred but permitted without a guard rail at minimum width of 0.4 m	1.0 m combined with curbside semi-rigid guard rail (1.5 m with op. speed >70 km/h)[2] 1.5 m combined with raised concrete planter 3.0 m combined with setback semi-rigid guard rail (op. speed ≤70 km/h)[3] 5.0-6.5 m without guard rail[5]	1.2 m with curbside placement (1.5 m with op. speed >70 km/h)[2] 3.0 m if installed 1.8 m from curb face (op. speed ≤70 km/h)[3]	1.0 m, 825 mm low height barrier[4]
Compatibility with Bikeway Elevation		**Street Level**	Yes	Yes	Yes	Yes	Rural cross section only	Yes	Yes
		Intermediate Level	Yes	No	Yes	Yes (may be asphalt if flush with cycle track and cycle track width is unable to accommodate side-by-side cycling)	Yes	Yes	Yes for standard height barrier only if it serves as the roadway curb No for low height barrier
		Sidewalk Level	Yes	No	Yes	Yes (may be asphalt if flush with cycle track and cycle track width is unable to accommodate side-by-side cycling)	Yes	Yes	Yes for standard height barrier only if it serves as the roadway curb No for low height barrier
Suitable Next to Parking Lanes			Yes (min. buffer width 0.6m, default buffer width 1.0m)	Yes (min. buffer width 0.6m, default buffer width 1.0m)	No	Yes (min. buffer width 0.6m, default buffer width 1.0m)	Yes	No	No
Suitable Along Bidirectional Facility			No, unless adjacent to parking lane	Yes, if generally continuous	Yes, if combined with other suitable separators	Yes	Yes	Yes	Yes
Durability			Low	Medium	Medium	High	High	High	High

NOTES

1 When existing operating speed data is available and operating speeds are not anticipated to significantly change with bikeway implementation, this should be used to determine buffer width and separator type. Operating speed should be based on 95th-percentile speed. Otherwise, the posted speed can be used.

2 Buffer width assumes approx. 0.1 m setback of guard rail face from face of curb (maximum 125 mm), 0.1 m rail thickness, 0.3 m offset block, approx. 0.2 m post width, 0.1 m rail thickness (no offset block), and an additional 0.4 m working width (zone of deflection in case of collision). This provides 1.0 m working width in case of 70 km/h collision (TL-2 crash test). An additional 0.3 m width should be provided where 95th-percentile speeds exceed 70 km/h to meet 1.3 m working width for a 100 km/h collision (TL-3 crash test). A lesser buffer width is not preferred since the guard rail may deflect into the bikeway and cause injury to the person cycling, but is acceptable in constrained conditions as some protection is still provided. In this situation, a minimum 0.2 m clear from the face of guard rail to edge of cycle track must be maintained.

3 When not installed immediately behind the curb, Type M30 guard rail can be installed a minimum of 1.8 m from curb face. This placement is tested to 70 km/h (TL-2 crash test). If the guard rail is installed more than 1.8 m from curb face, an additional 1.2 m of buffer width should be provided to accommodate the guard rail.

4 Buffer width assumes width of separator plus clear zone on bicycle side: 0.2 m for low height barrier, 0.5 m (at handlebar height) for standard height barrier. The buffer for a low height barrier may be narrowed to 0.6 m when the adjacent bikeway is above minimum width. Barrier wall is assumed to be placed on edge of adjacent vehicle lane. Additional buffer width is required if snow storage space or clear zone is desired on the vehicle side of the barrier.

5 Based on MTO clear zone values in flat conditions, which is 5.0 m for roads with design speed ≤60 km/h and 6.5 m for roads with design speed of 70-80 km/h. Vegetated buffers of a narrower width may be used without a guard rail, but the bikeway would be within the clear zone of the road, with users at an increased risk of being struck by a vehicle that leaves the roadway.

Types of Bicycle/Pedestrian Separation

3.1.5

This section describes a range of types of separation for mitigating cycling and walking conflicts and increasing accessibility. Many of these types of separation can be combined to achieve multiple design objectives.

Design considerations

Pedestrians can include utilitarian walkers, recreational walkers, joggers, dog walkers, children, seniors, tourists, individuals with vision or hearing impairments, and mobility device users. The needs of each user group should be considered in the design of pedestrian / bicycle separation and mixing zones.

Pedestrian considerations should be informed by the Accessibility for Ontarians with Disabilities Act (AODA) Built Environment Standard and the City of Toronto Accessibility Design Guidelines.

The provision of sufficiently wide and well delineated pedestrian clearways and bikeways is essential to mitigate conflicts between pedestrians and cyclists.

While it is important to reduce conflicts, there is limited danger in the interaction between people cycling and pedestrians. People cycling and pedestrians, particularly in low volume situations, can safely interact. The largest danger to both vulnerable road users is high speed motor vehicle traffic.

Shared pedestrian / cyclist facilities may be appropriate on corridors with low volumes of both pedestrians and cyclists. The thresholds within TAC Geometric Design Guide Section 5.3.1.4 can be used as a guide.

Every effort should be made, however, to provide dedicated facilities where significant volumes of pedestrians or cyclists are anticipated. Pinch points where dedicated facilities transition to shared facilities around a specific barrier should be avoided to the greatest extent possible.

Types of separation

Beveled curbs and barrier curbs provide effective separation of pedestrians and cyclists and are readily cane detectable. Beveled curbs allow pedestrians using mobility devices to traverse the curb, whereas barrier curbs require curb cuts.

Street furniture, street trees, planting strips, raised or modular planters, bicycle parking and **bike share docking stations** should be used to separate pedestrians and cyclists wherever space is available (unless the volume of pedestrians is very low). A 0.5 m lateral clear distance is preferred between these features and the bikeway, especially where the facility is approaching the lower limit width.

Where a barrier curb, beveled curb or planting strip cannot be provided, a 600 mm band of **visually contrasting and cane detectable unit pavers** should be used to separate the pedestrian clearway from an adjacent sidewalk level cycle track. The pavers should be separated from the bikeway with a 0.2 m flush concrete curb. If space is insufficient, an angle bracket may be used instead of the curb to retain the pavers.

Bikeways should be constructed with asphalt and pedestrian facilities should be constructed with concrete in order to communicate the desired use of the space. Multi-use pathways are typically constructed of asphalt.

Pedestrian / cyclist mixing zones at intersection corners should generally be avoided, but are permissible where the mid-block facilities are multi-use. If installed, they should be constructed of concrete and include either shark's teeth or a stop bar at the end of the multi-use pathway.

Signage can be used to inform pedestrians and cyclists of separated or shared facilities.

Railings may be considered where pedestrian encroachment is highly probable or used to guide the path of pedestrians away from areas where the risk of a collision is high (i.e. around blind corners or floating island transit stops).

Shy Distance

Objects along cycle tracks, whether at sidewalk or at an intermediate height, can lead to handlebar or pedal strikes. Thus people cycling tend to shy away from these types vertical obstructions to avoid potential contact. Vertical obstructions include signs, bicycle parking rings, transit shelters for example.

All objects taller than 0.2 m, such as a sign post or parking meter, should have a minimum offset of 0.2 m of the cycle track clearway.

Where there is no curb, such as a sidewalk level cycle track, or where there are linear vertical elements, such as retaining walls or railings, there should be a minimum 0.5 m offset from the edge of the cycle track clearway and the vertical object.

Figure 3.8 A band of visually contrasting, cane detectable unit pavers adjacent to a sidewalk elevation cycle track.

Figure 3.9 A sidewalk elevation cycle track separated by a planting strip.

Figure 3.10 A railing separates pedestrians and cyclists at a high volume transit stop on Queens Quay.

Example streets: Urban Uni-directional Cycle Tracks

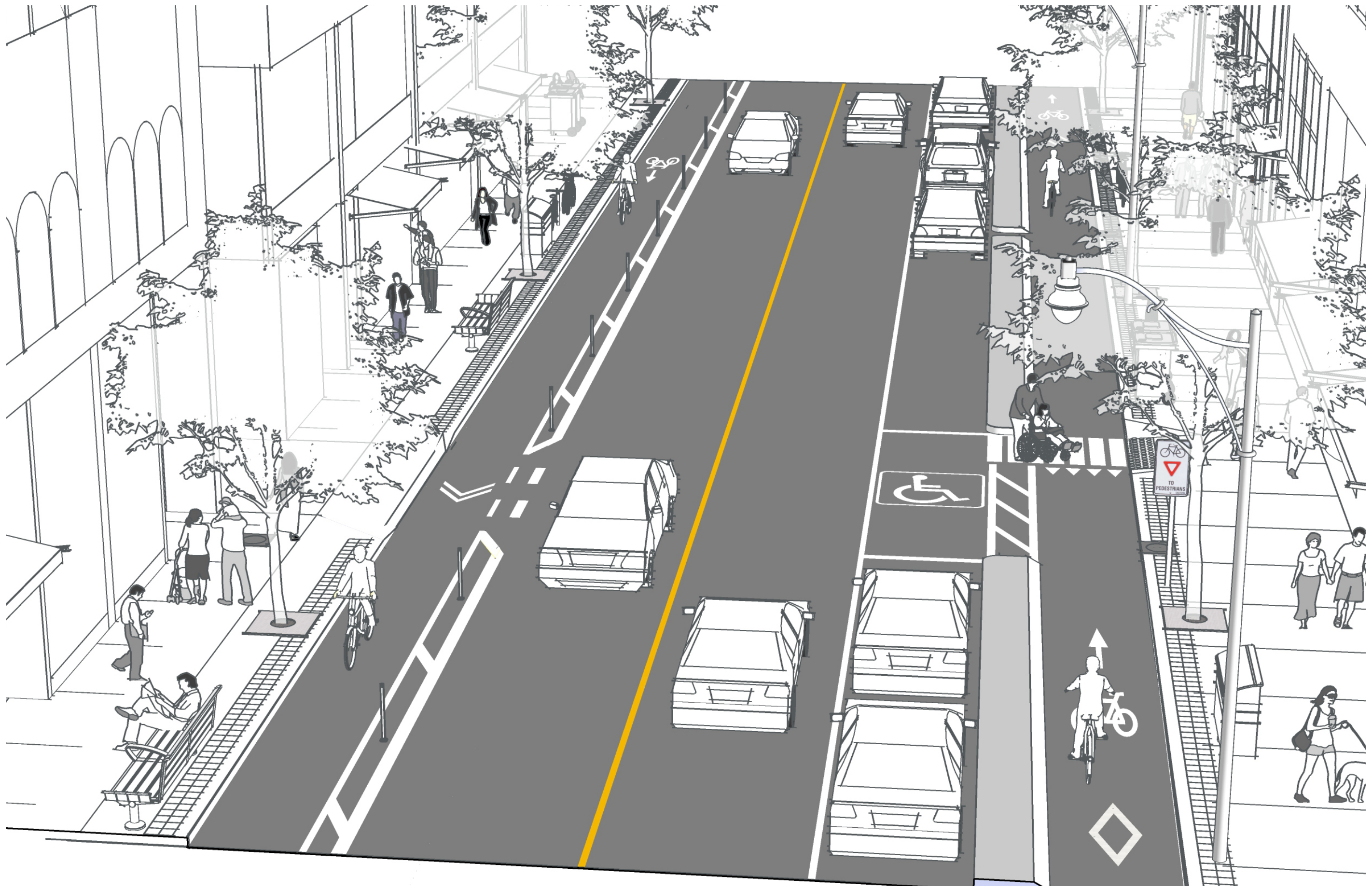


Figure 3.11 Uni-directional cycle tracks on an urban, low-speed street.

Figure 3.12 Flex bollards used as a separation technique adjacent to parking for a pilot project.

Figure 3.13 A sidewalk elevation cycle track with a concrete buffer adjacent to parking.

Figure 3.14 Landscaped medians can enhance aesthetics and create a transition where parking is introduced or discontinued.

Example streets: Suburban Uni-directional Cycle Tracks

Figure 3.15 Uni-directional cycle tracks on a suburban, high-speed street.

Figure 3.16 Woodbine Avenue cycle tracks, separated from the roadway by flexible bollards.

Example streets: Urban Bi-directional Cycle Tracks

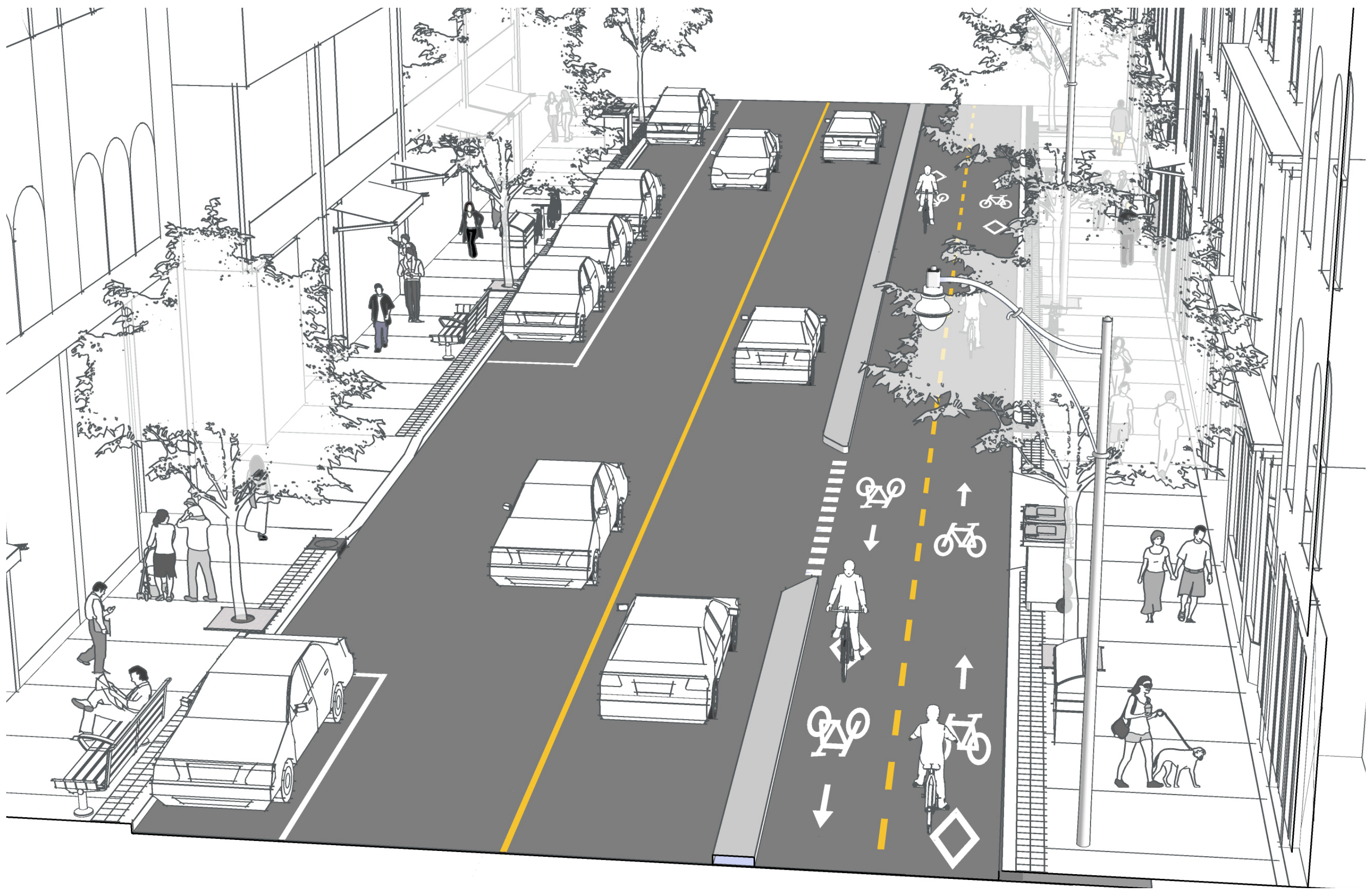


Figure 3.17 Bi-directional cycle tracks on an urban street.

Figure 3.18 A poured barrier curb and flex bollards separation treatment.

Figure 3.19 Signal and crossride treatment for uni-directional to bi-directional transition.

Figure 3.20 A precast barrier curb and flex bollards separation treatment.

Example streets: Suburban Bi-directional Cycle Tracks

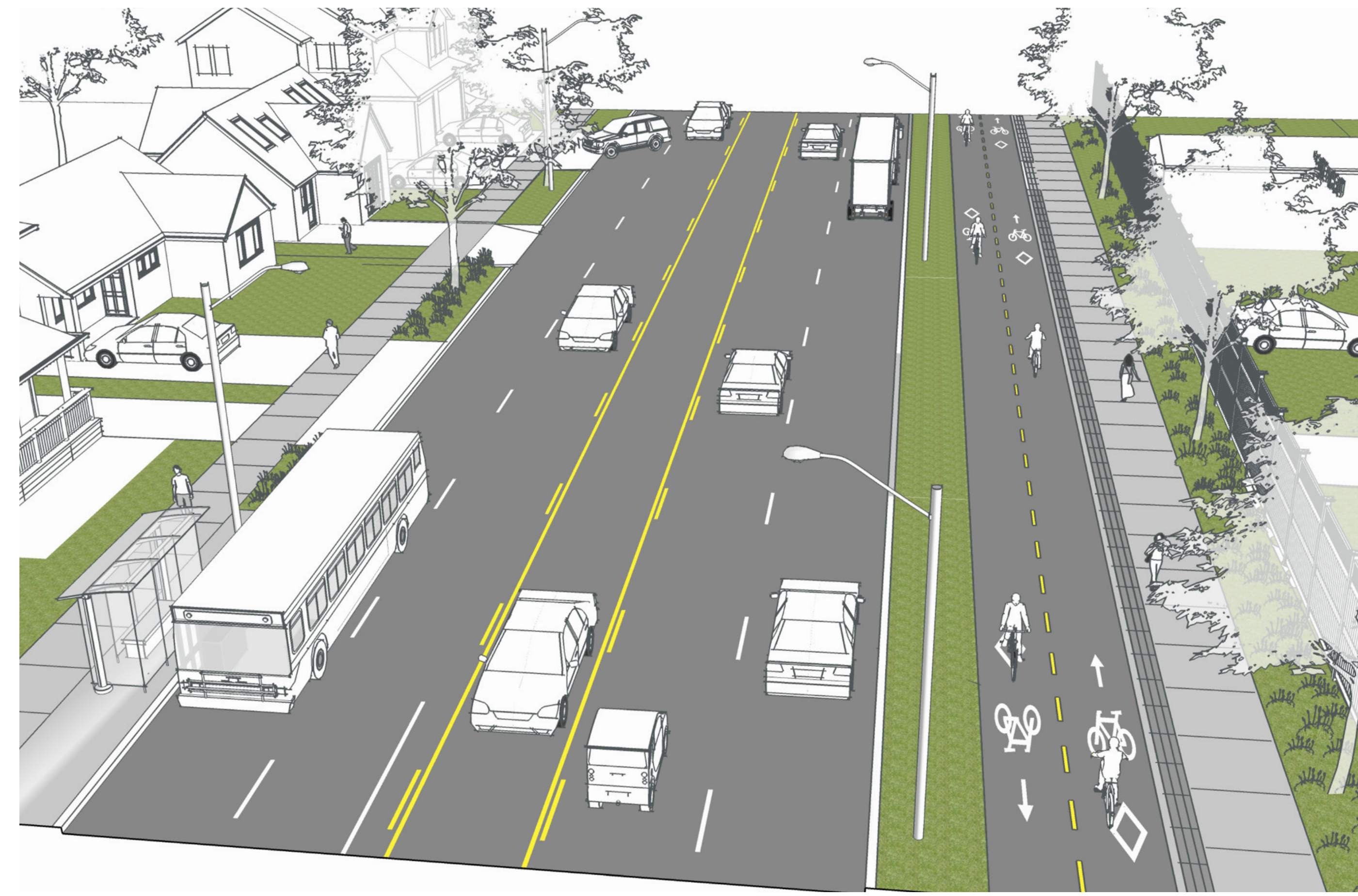


Figure 3.21 Bi-directional cycle track on a suburban street.

Figure 3.22 A multi-use path separated with a guard rail.

Figure 3.23 A multi-use path adjacent to a sidewalk with tactile unit paver as separation.

Curbside Activity

3.1.6

The effective management of curbside activity is critical to the success of a cycle track since cycle tracks often eliminate direct motor vehicle access to the sidewalk. Curbside management is about coordinating how the space between the sidewalk and the roadway is used.

Context

Activities that should be considered in curbside management include cycling, boarding and alighting from transit, Wheel-Trans, taxi, private transportation companies or personal vehicles, freight deliveries, motor vehicle parking, bicycle parking, bike share docking, fire hydrant access, waste collection, snow storage and animation activities such as parklets.

As cycling, e-commerce deliveries, and travel with private transportation companies continue to grow, demand for curb space is also expected to increase.

The management of curbside activity should be considered early in the planning and design process so that all possible design solutions can be considered.

Curbside management strategy

The City's Curbside Management Strategy (CMS) provides the policy basis from which to consider and coordinate the bicycle facility planning and design processes in concert with curbside management needs.

The CMS offers strategies and tools necessary to effectively manage curbside space. It is designed to help balance and resolve competing demands for space, particularly in constrained urban corridors.

The CMS' principles should be used to guide future operational recommendations around issues that commonly impact curbside space allocation.

These principles are underpinned by eight policy themes. Policies are intended to ensure that the high-level, strategic aims of the plan can be used to inform future operational recommendations.

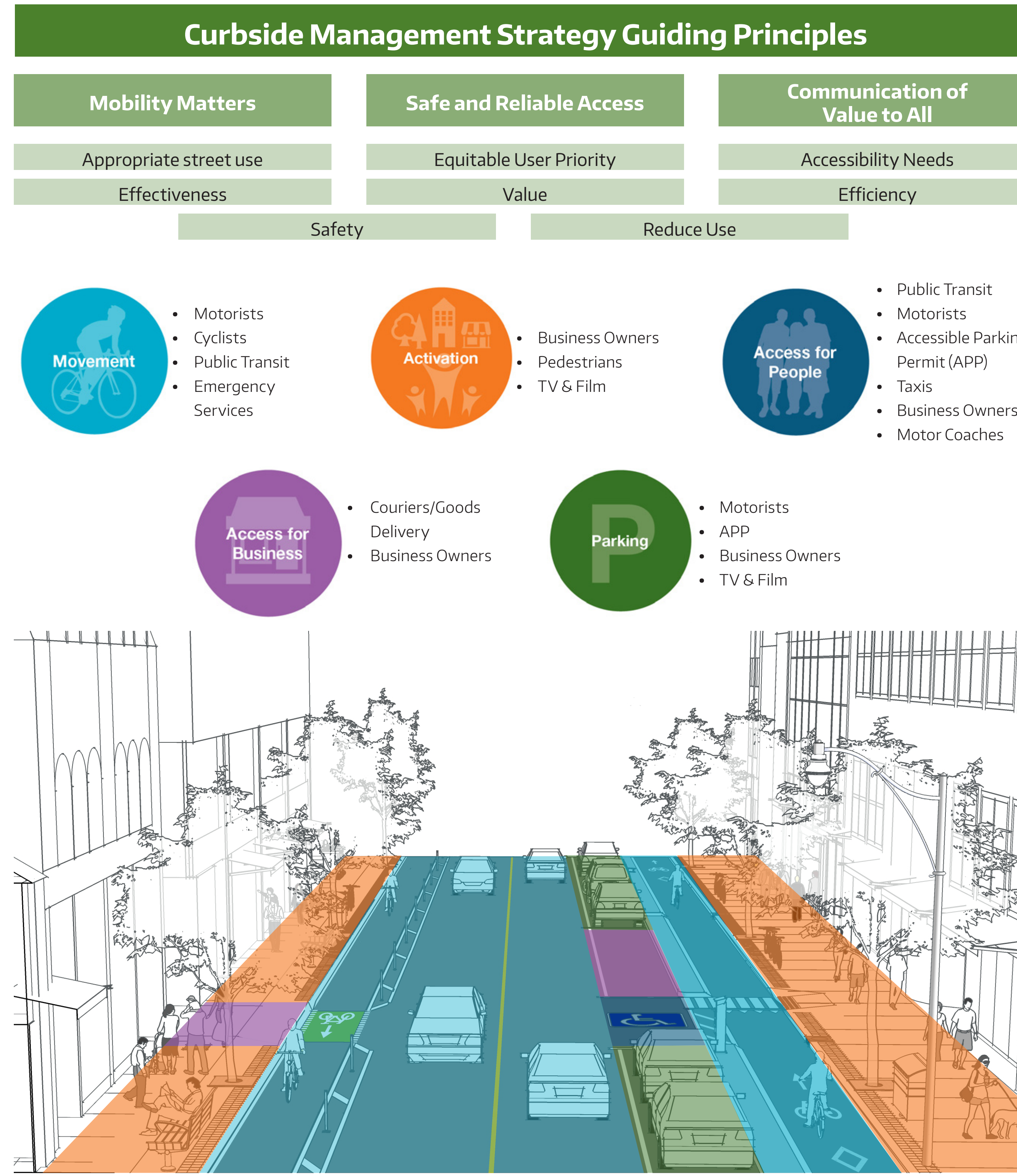


Figure 3.24 Curbside management profiles on a street with a cycle track. The principles and policies of CMS are described above.

3.1.6 CURBSIDE ACTIVITY

Parking and loading

Since cycle tracks are physically separated, motor vehicle parking is located between the motor vehicle travel lane and the cycle track.

Various forms of separation between the cycle track and the parking lane are possible.

The default cycle track design for road reconstructions and private developments is sidewalk level or intermediate level cycle tracks. These types of cycle tracks help to alleviate issues with accessible and commercial parking and loading needs. These bikeways help guide parking motorists, reduce tripping hazards, and reduce maintenance costs.

Laybys should have a sufficient length, width, and taper length to accommodate the design vehicle (car, van, Wheel-Trans vehicle, etc.). Laybys should be provided in areas where frequent on-street pick-up and drop-off occurs for taxis, Wheel-Trans, community buses, or Private Transportation Companies (PTC). While dimensions vary based on demand and design vehicle, typical dimensions include a 15 m storage length with 10 m tapers.

Cycling facility width can be reduced to 1.2 m (although not desired) to accommodate a layby provided that buffer of 1.0 m is provided and there are no vertical obstructions immediately adjacent to the cycle track to ensure adequate width for sweeping and snow clearance..

Where implementing laybys is not feasible, the opportunity to provide formal accessible parking on side streets close to the intersection should be explored.

Accessible parking and loading is key to the successful design of a new cycle track. Wheel-Trans data and consultation with the accessibility community should be conducted to prioritize locations. Practitioners should utilize laybys, raised accessible platforms and marked crossings, where possible.

Between the loading/accessible parking zone and the cycling facility there should be a minimum 1.5 m access aisle for the length of the zone. An access aisle provides a designated path for pedestrians through the bike lane to the loading / accessible parking zone. Aisles should be free of obstructions such as bollards or planters.

A dedicated pedestrian crossing of the cycle track should be provided at the rear of the **loading zone** or near the centre of the **accessible parking zone** and should be marked with zebra stripes, shark's teeth, a curb cut with a tactile walking surface indicator and a "cyclists yield to pedestrians" sign (Rb-73 OTM); the width of the cycling facility can be reduced to a minimum of 1.2 m for this section if necessary.

Snow clearing and garbage collection

For sweeping and snow clearing purposes, the clear width between curb faces or other vertical obstructions must be at least 1.6 m. A buffer zone of 1.0 m is preferred for roadway snow storage though <1.0 m is permitted and >1.0 m may be appropriate on multi-lane roads.

The type of separation can also affect snow storage capability (e.g. plows may not be able to push snow over concrete barrier walls).

The choice of separation technique can affect the feasibility of snow removal, if the buffer is not sufficiently wide to store the snow. The winter maintenance staff should review designs of bikeways should be reviewed that deviate from standards.

On corridors where there is existing windrow clearing, the same level of service is required after the installation of new bikeways.

Where curbside waste collection is provided, the separation must be designed to facilitate bins being moved from the boulevard to the collection truck. Continuous curbs, medians, or barriers may negatively impact waste collection operations. Gaps in these barriers can be provided to allow bins to be wheeled across the buffer. Another option along raised cycle tracks is for a concrete median at bikeway level and at least 1.5 m wide, where bins can be parked.

Commercial loading zones can be used to accommodate waste collection by restricting loading activities during waste collection times. If there is demand for an accessible parking/boarding space in close proximity, opportunities should be explored to position the accessible space upstream of the commercial loading zone to facilitate greater access for commercial vehicles when the accessible space is not in use.

Curbside Dining

Curb lane and sidewalk cafés provide outdoor expanded outdoor dining areas for licensed eating and drinking establishments.

It is generally preferred for curb lane cafés to remain adjacent to the sidewalk. If a parking protected cycle track is present and is built from movable materials, the cycle track can be bent around the cafés. The cycle track entrance taper should be between 12m and 16m. The cycle track exit taper should be between 10m and 16m. These taper lengths provide a guideline, but site conditions should be reviewed. In some cases longer tapers will be required or a shorter taper could be appropriate. No taper should be less than 8m.

If a parking protected cycle track is present and is built from permanent materials (raised or interim height), the café applications can be reviewed for different configurations including installation in an existing parking lane (where serving staff and patrons would cross the cycle track) or in the cycle track, if a temporary adjacent cycle track can be installed.

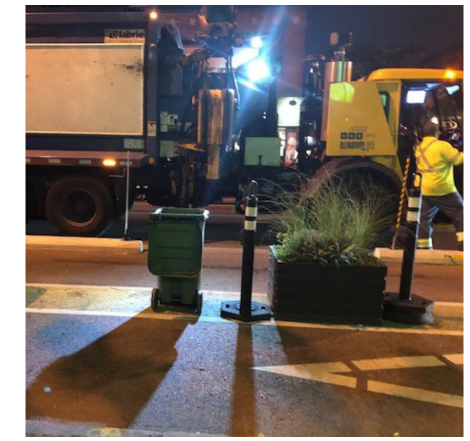


Figure 3.25 Space is left in the buffer of the Danforth cycle tracks to facilitate bins being moved from the boulevard to the collection truck

Figure 3.26 A cycle track with snow stored on both sides of the facility.

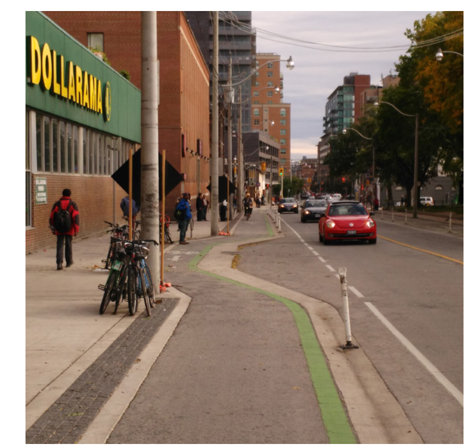


Figure 3.27 A layby for taxi and Wheel-Trans boarding.

Figure 3.28 A cycle track bends around a temporary curb lane café.

When designing a new bikeway, practitioners should review up to date café regulations and permits. Every effort should be made to investigate potential for curb lane cafés, but some may not be possible or must be removed. Generally, connected and safe bikeways should take precedence over private cafés.

Even without the presence of bikeways, curb lane cafés must take in consideration cycling safety. No café items should be closer than 1.2m from the traveled path of traffic or 1.5m on streetcar routes to provide space for people cycling and prevent contact with motor vehicles.

Designated Facilities

3.2

Designated facilities include conventional, buffered and contra-flow bike lanes, and advisory bike lanes. These bikeways use pavement markings and signage to designate space for people cycling. Designated facilities do not provide any physical separation and should only be considered when motor vehicle volume and speed are lower than thresholds discussed in Chapter 2.

Overview

The Facility Selection Matrix in Chapter 2 shows that if there is moderate volumes of motor vehicles and/or moderate speeds along a street, designated facilities can be considered.

There are three types of designated facilities: **bike lanes (buffered or conventional) and contra-flow bike lanes, and advisory bike lanes.** Each facility has different design considerations and function.

Once a designated facility type is selected, practitioners should proceed to the corresponding sections to learn about the fundamental design elements including width, pavement markings and physical separation techniques.

Designated facility decision criteria

Conventional and buffered bike lanes are appropriate when the street meet the Chapter 2 speed and volume thresholds. They are not substitutes for cycle tracks. Where space permits, buffered bike lanes are preferred. If there is high turnover parking in the area, cycle tracks should be considered to reduce conflicts.

Contra-flow bike lanes are appropriate on streets where motor vehicles can operate in one direction. Contra-flow bike lanes allow people cycling to travel in both directions. People cycling have to share one lane with cars in one direction and have designated space in the other.

Contra-flow bicycle lanes facilitate greater connectivity and opportunities for crossing/signalization at arterials in comparison with a couplet bike lane configuration on separate one-way streets. Contra-flow lanes can be protected if speeds or volume necessitate it and there is roadway space.

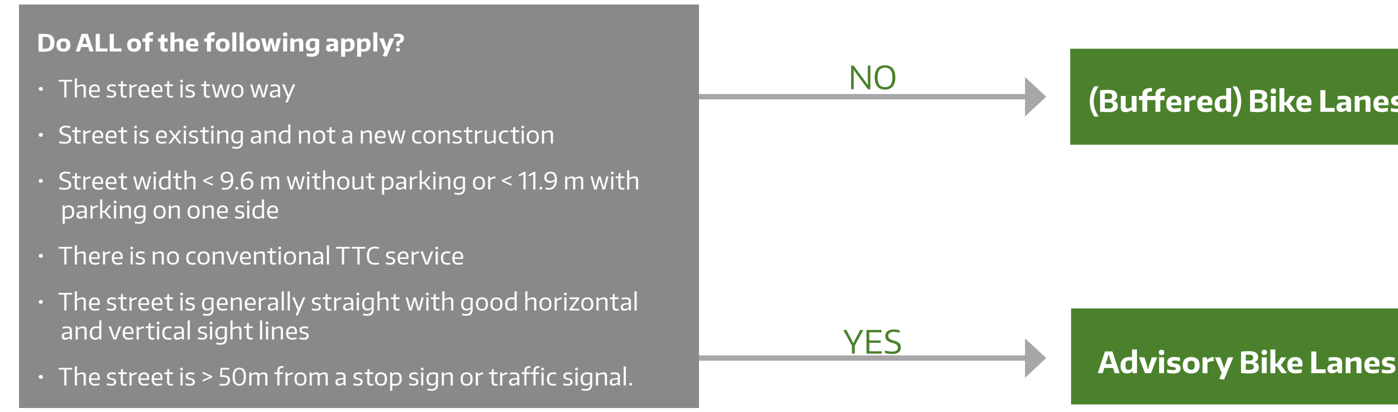


Figure 3.29 Conventional or buffered bike lanes and advisory lane facility decision matrix

Advisory bike lanes mark the space for cycling with skip lines. The cross section allows for only one centre lane, where people driving would enter the advisory bike lane when passing another vehicle and would yield to people cycling.

They are well suited for two-way streets with or without parking, an AADT between 1,000 and 4,000, a posted speed limit of 40 km/h or less, a low volume of heavy vehicle traffic (<10 per hour), and not used by the TTC.

Advisory lanes are also only well suited for streets without any significant vertical or horizontal curves, as clear sight-lines are required.

Figure 3.29 should guide practitioners on how to determine if an advisory bike lane or a conventional bike lane can be used. If all the criteria of an advisory bike lane are met, they could be used when a roadway is too narrow to accommodate conventional bike lanes.

Bike Lanes and Cycle Tracks

Streets with both on-street parking and bikeways can be configured in two ways: a buffered bicycle lane adjacent to curbside parking or a cycle track with parking adjacent to the travel lane.

The advantages of cycle tracks with parking adjacent to the travel lane include greatly increased separation from motor vehicles, reduced / eliminated conflict with parking motorists, reduced risk of dooring as drivers do not alight directly into the bikeway and the cycle track acts as buffer for pedestrians. Thus generally, cycle tracks are preferred.

Buffered bicycle lanes with curbside parking can be considered when:

- There is comparatively low motor vehicle traffic speeds and volumes,
- There is comparatively low parking turnover (e.g. residential areas); and
- Sufficient road space to provide a buffer zone on both the parking edge and travel lane edge of the bike lane.

Conventional & Buffered Bike Lanes

3.2.1

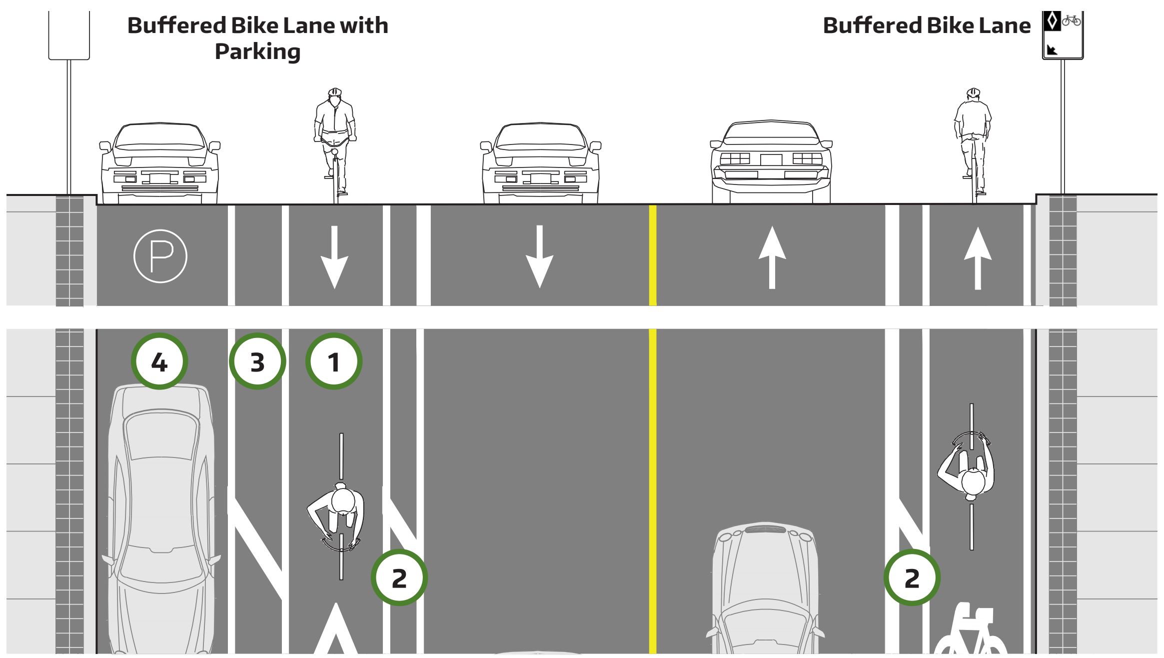


Figure 3.30 Plan view and street section of buffered bicycle lanes

Table 3.4 Conventional and Buffered bicycle lane design domain width details

Design Domain	1 Bike Lane Width	2 Motor Vehicle Buffer****	3 Parking Buffer	4 Parking Width
Default Limit	1.6 m	0.5 m	0.7 m	2.2 m
Upper Limit	1.8 m*	1.0 m	0.8 m	2.5 m
Lower Limit	1.5 m**	0	0.5 m***	2.0m

* A bike lane of greater than 1.8 m may be considered: however additional measures may be required to prevent motorists from mistaking the bike lane for a travel lane

** If a 1.5 m wide bike lane must be temporarily discontinued, a 1.2 m edge line, which would not be signed or by-lawed as a bicycle lane, can be considered for short distances (See Sections 2.3 and 3.4). Edge lines should not be used to create a paved shoulder of less than 1.2 m.

*** A parking buffer may be reduced to 0.3 m in constrained environments to provide sufficient width for the bicycle lane, but only for a short length as to not increase the chance of dooring incidents.

**** The Motor Vehicle Buffer is preferred if there is sufficient space, but not required. The parking buffer is required to accommodate curbside parking and a bike lane.

General cross section

Bike lanes are designed with up to four separate spaces for consideration:

1. **Bike Lane**: This is the space where a person cycling operates. This space is positioned either between the motor vehicle buffer and either the curb or parking buffer.
2. **Motor Vehicle Buffer**: This is the space between the bike lane and motor vehicle traffic lane.
3. **Parking Buffer**: This is the space between the bike lane and curbside parking.
4. **Parking Width**: This is the space for parked vehicles along the curbside.

Please refer to the Table 3.4 for design domain widths for each space. For motor vehicle lane widths, practitioners should refer to the City of Toronto's Lane Width Guidelines.

Bike lane design

Bike lanes are considered travel lanes specific to people cycling and are defined by white pavement marking line(s).

Similar to cycle tracks, the width of the bike lane should be sufficient for people traveling of all ages and abilities. Social side by side riding and passing should be accommodated, which is why the default limit width is 1.8 m.

If there is sufficient space, a motor vehicle buffer between the bike lane and travel lane is preferred. The buffer between bike lane and motor vehicle lane is particularly important in the vicinity of roadway curves or where the lane alignment shifts and the swept path of larger vehicles could cross into the buffer or bike lane space.

The parking buffer is required between a parking lane and the bike lane. If there is not space to accommodate both a parking lane and a parking buffer, parking removal should be considered to avoid dooring incidents.

The Transportation Association of Canada's Geometric Design Guide Chapter 5 allows for a lower limit width of 1.2 m for unbuffered bike lanes. In Toronto, a space of 1.2 m can be utilized if absolutely necessary, but that space should not be by-lawed or signed as a bike lane and design exception justification should be provided.

Edge lines

Edge lines are not bikeways and should not be viewed as substitutes to bike lanes. If bike lanes are being included as part of project where curbs cannot be moved and a short segment is too narrow to accommodate even the lower limit width, edge lines could be considered.

Practitioners should be careful when including edge lines to ensure that larger vehicles do not encroach into the edge line space along curves or approaching intersections. More information on edge lines can be found in Section 3.4.

Example streets: Buffered Bike Lanes

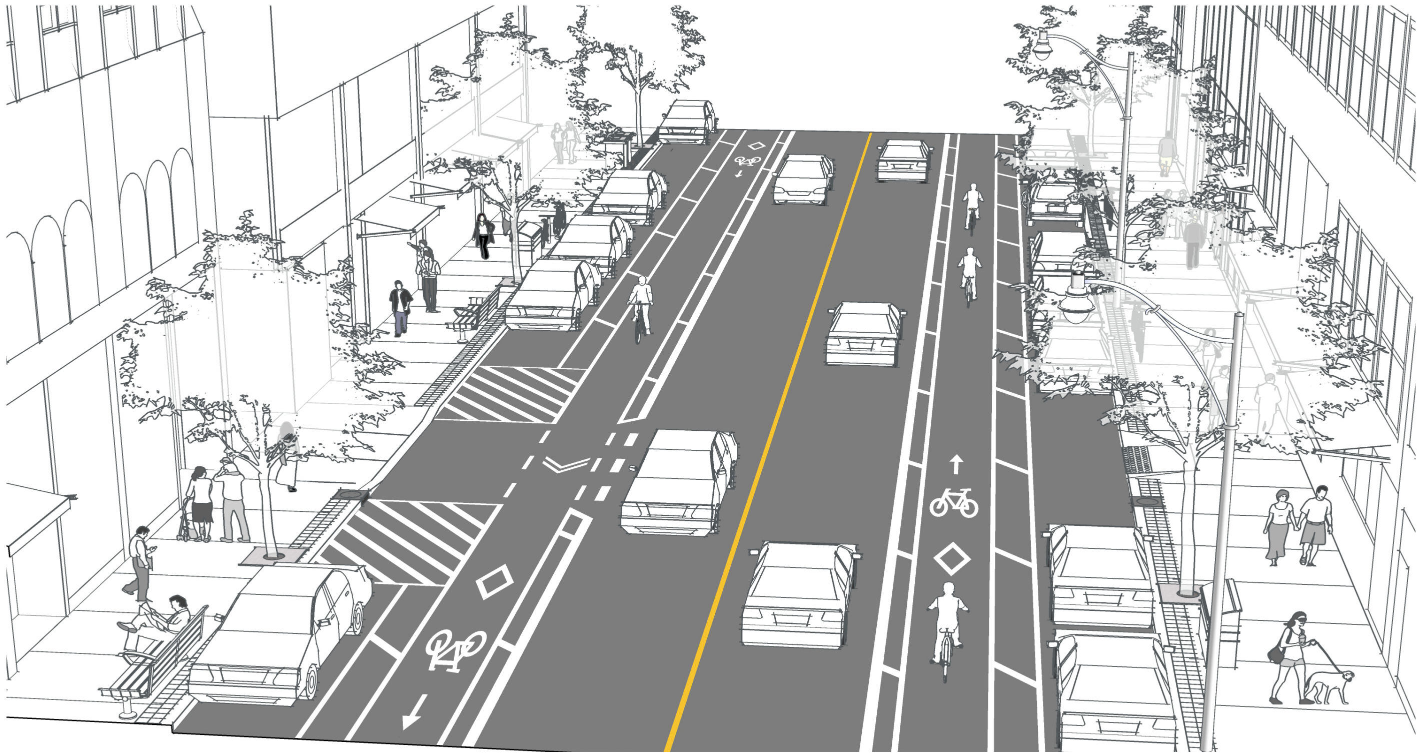


Figure 3.31 Buffered bike lanes with parking on both sides of the street.

Figure 3.32 A buffered bike lane.

Example streets: Conventional Bike Lanes

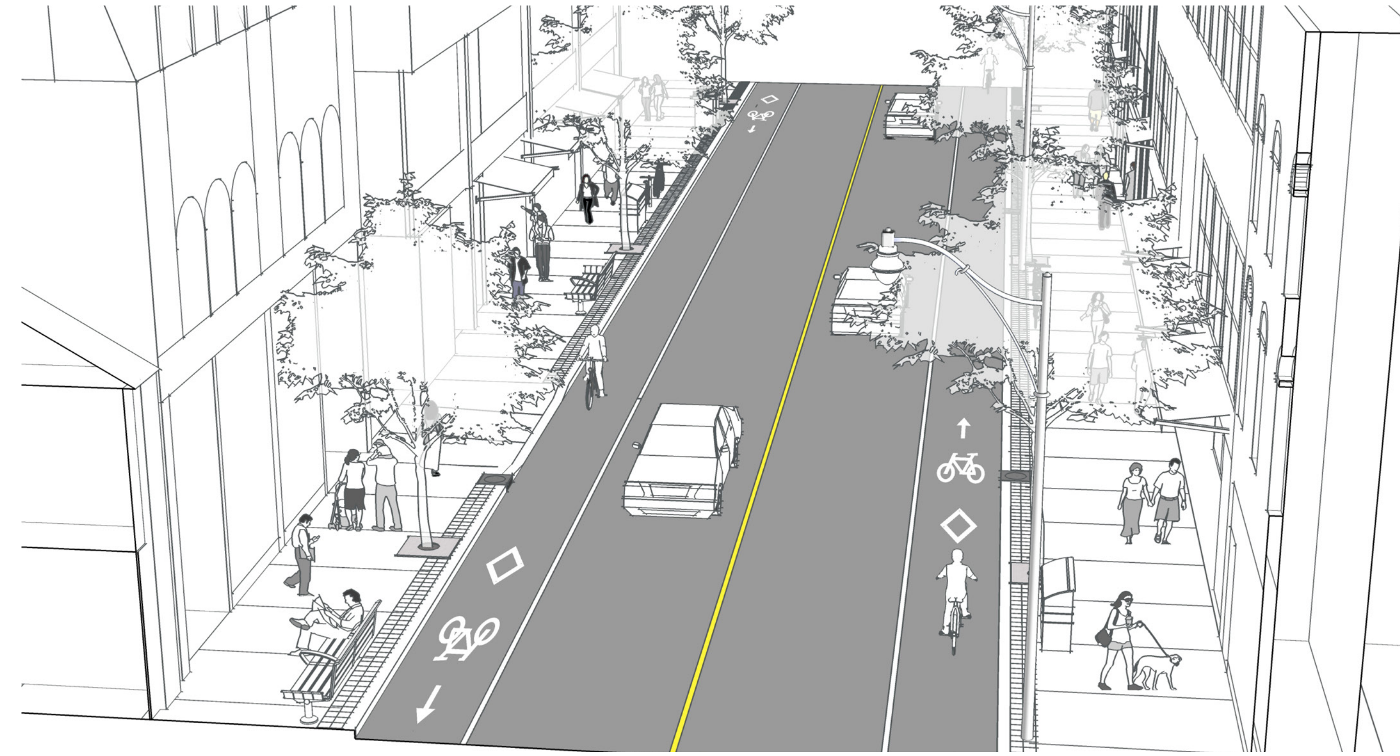


Figure 3.33 Conventional bike lanes without parking.

Figure 3.34 A conventional bike lane with parking.

Figure 3.35 A conventional bike lane without parking.

Advisory Bike Lanes

3.2.2

Advisory bike lanes are a designated facility marked with skip lines. A single centre travel lane is located between the advisory lanes and accommodates motor vehicle traffic in both directions. Motor vehicles may drive in the advisory lane while an on-coming vehicle is approaching and passing since the centre travel lane is narrower than two motor vehicle lanes. These bikeways can be attractive alternatives to conventional bike lanes when road widths are constrained and traffic speeds and volumes are low.

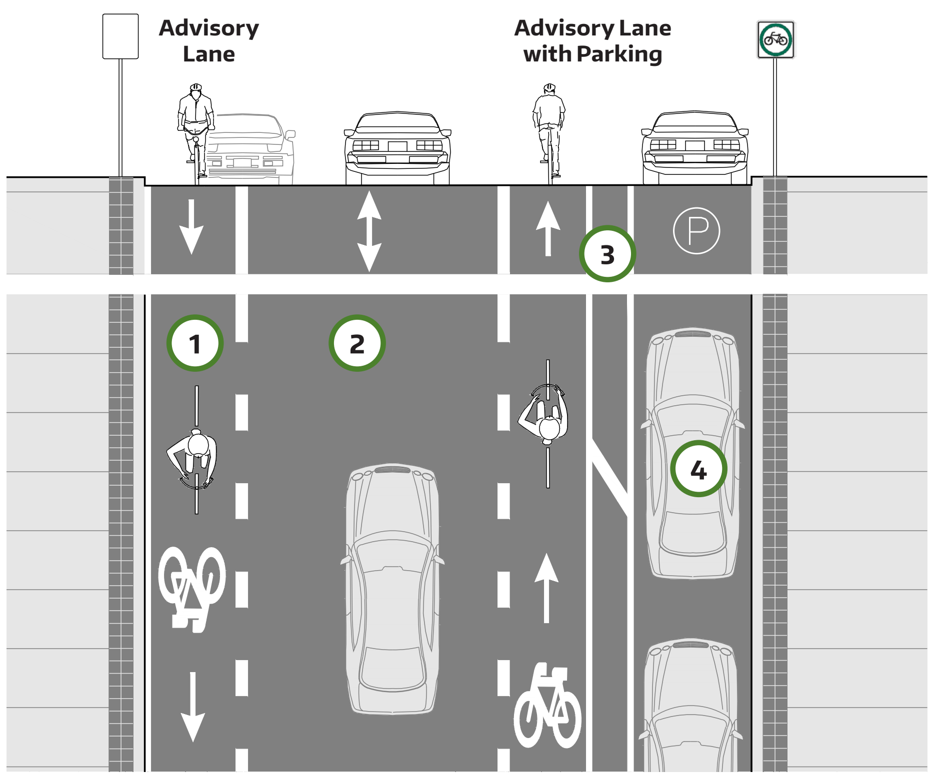


Figure 3.36 Plan view and street section of advisory bicycle lanes with and without parking.

Table 3.5 Advisory bike lane design domain width details

Design Domain	1 Bike Lane Width	2 Motor Vehicle Lane	3 Parking Buffer	4 Parking Width
Default Limit	1.8 m	4.8 m*	1.0 m	2.2 m
Upper Limit	2.0 m	5.7 m	1.2 m	2.5 m
Lower Limit	1.5 m	3.0 m	0.7 m	2.0m

* Guidance from the Netherlands suggests that centre motor vehicle traffic lanes between 3.8 and 4.8 m should be avoided where advisory bike lanes are implemented; further research and consideration should be done before implementing a centre lane width within this range in Toronto.

General cross section

Advisory bike lanes are constituted by up to four separate spaces for design consideration:

1. **Bike Lane**: This is the space where a person cycling operates. In advisory bike lanes, the bike lane is dashed and vehicles while passing other vehicles can enter, but must yield to people cycling.
2. **Motor Vehicle Lane**: This is the space where motor vehicles would travel. In advisory bike lane streets, the motor vehicle lane is only wide enough to accommodate one car.
3. **Parking Buffer**: This is the space between the bike lane and curbside parking.
4. **Parking Width**: This is the space for parked vehicles along the curbside.

Please refer to the Table 3.5 for design domain widths for each space.

Design considerations

At intersections with stop or signal control, the centre travel lane should transition to two conventional travel lanes with a centreline for at least 15 m from the stop bar. On-street parking should be discontinued, and if sufficient space is available, advisory bicycle lanes can transition to conventional or buffered bicycle lanes.

For streets without on-street parking, advisory bicycle lanes may need to be discontinued and transition to sharrows on the intersection approach.

Pavement markings

100 mm skip (1m : 1m) white lines should be included between the centre travel lane and the advisory lanes.

If parking is provided, a hatched buffer zone with 100 mm white lines and hatch 600mm markings spaced at 6.0 m should be used.

A bicycle stencil and directional arrow should be placed in the centre of the advisory lanes and be repeated every 100 m and at the far side of all intersections. The diamond symbol should not be used.

Low volume residential driveways do not require a specific treatment. Commercial and higher volume driveways should be marked with a bicycle stencil and directional arrow in the advisory lane.

Signage

Includes a bicycle route sign Rb-169 spaced every 200 m and after all intersections.

The City may explore more detailed informational signage if or when this design is implemented.

Example streets: Advisory Bicycle Lanes

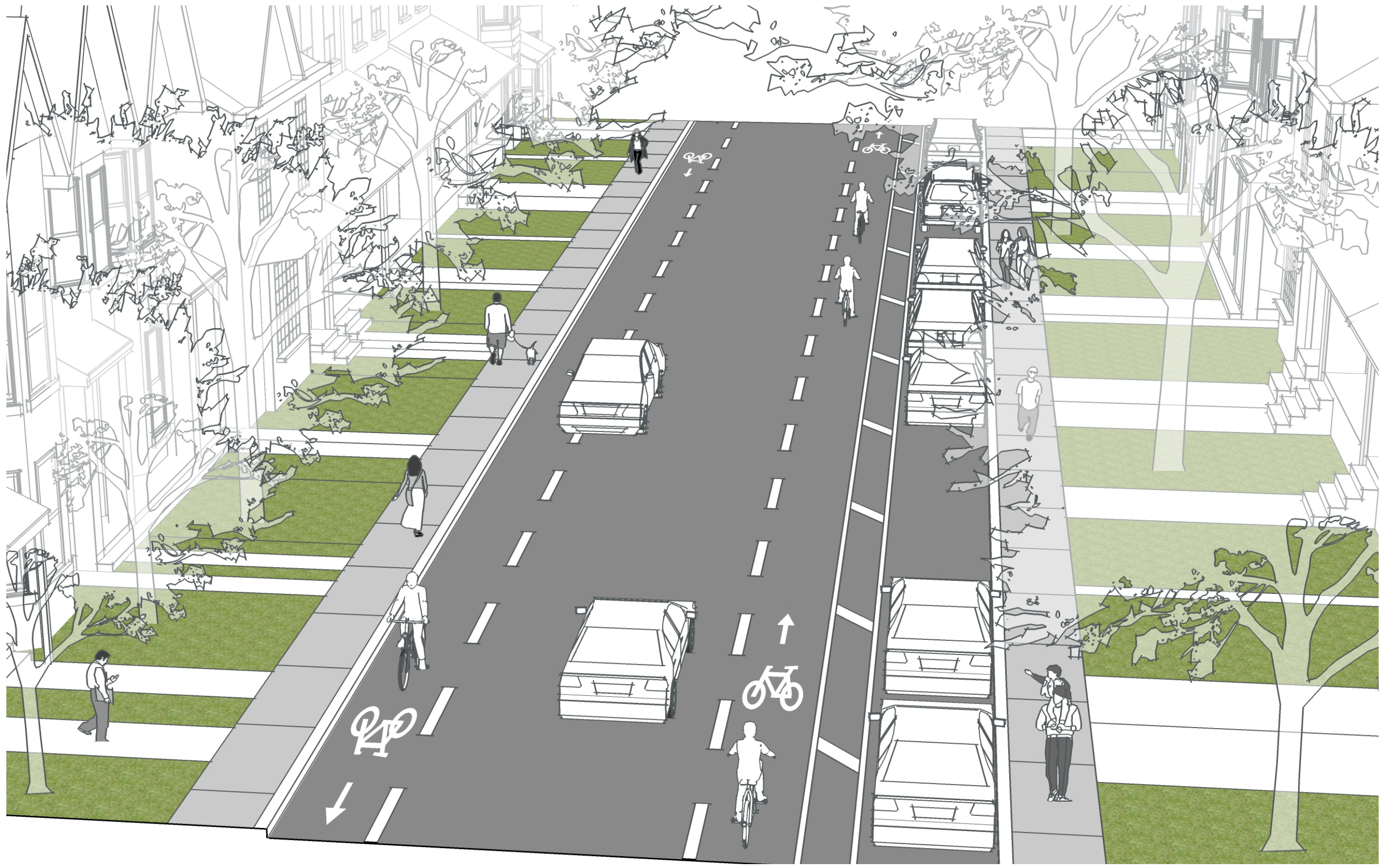


Figure 3.37 Advisory bike lanes with parking on one side.

Figure 3.38 Example of advisory bike lanes in Ottawa.

Figure 3.39 Advisory bike lanes with parking on one side in Ottawa.

Contra-flow Bike Lanes

3.2.3

A contra-flow bike lane is a cycling facility on a street with one-way motor vehicle traffic that accommodates people cycling traveling in the opposing direction. It can be located between the motor vehicle travel lane and the curb, between a parking lane and motor vehicle travel lane, or may be separated from motor vehicle traffic by a parking lane or physical separation. Contra-flow bike lanes are typically located at street level, but could be raised and follow the same guidance in Section 3.1.4.

Option A: Contra-flow bike lane or cycle track

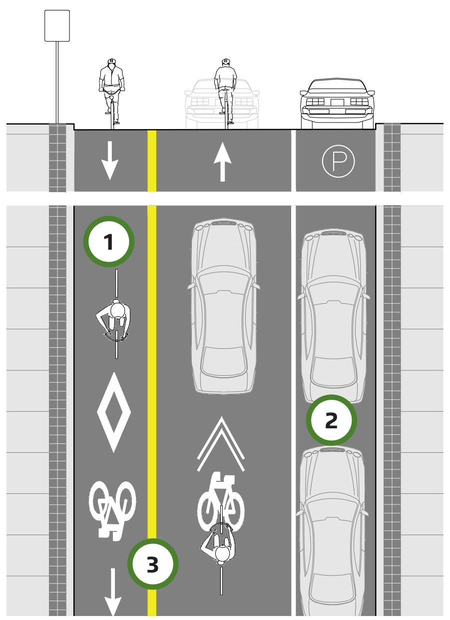


Figure 3.40 Plan view and street section of conventional contra-flow bicycle lanes.

Option B: Contra-flow cycle track protected by parking

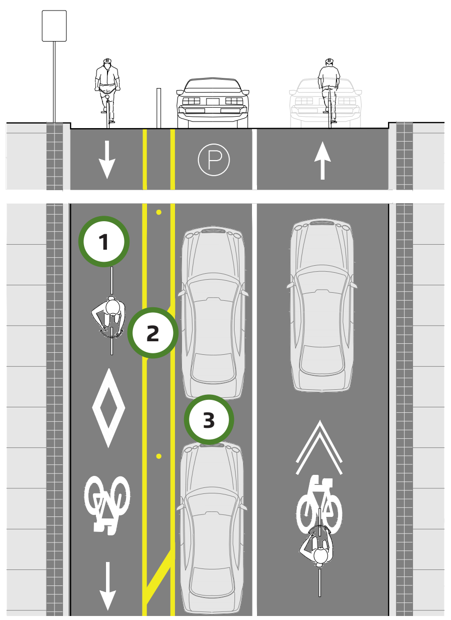


Figure 3.41 Plan view and street section of buffered contra-flow bicycle lanes.

Option C: Contra-flow bike lane adjacent to curbside parking

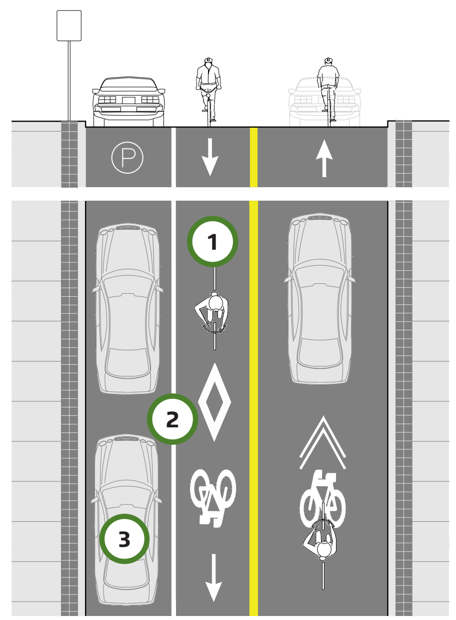


Figure 3.42 Plan view and street section of a contra-flow lane adjacent to curbside parking.

Table 3.6 Design domain width details of conventional contra-flow bicycle lanes.

Design Domain	Bike Lane Width (1)	Parking Lane Width (2)
Default Limit	**2.0 m**	2.2 m
Upper Limit	**2.3 m**	2.5 m
Lower Limit	**1.8 m**	2.0 m

(3) Separation widths and types of physical separation will vary based on if it a bike lane or cycle track. (See **Section 3.1.4** & **3.2.1**)

Table 3.7 Design domain width details of buffered contra-flow bicycle lanes.

Design Domain	Bike Lane Width (1)	Parking Buffer (2)	Parking Lane Width (3)
Default Limit	**2.0 m**	1.0 m	2.2 m
Upper Limit	**2.5 m**	1.2 m	2.5 m
Lower Limit	**1.5 m**	0.6 m	2.0 m

Table 3.8 Design domain width details of contra-flow lane adjacent to curbside parking.

Design Domain	Bike Lane Width (1)	Parking Buffer (2)	Parking Lane Width (3)
Default Limit	**2.2 m**	0.7 m	2.2 m
Upper Limit	**2.3 m**	0.8 m	2.5 m
Lower Limit	**1.8 m***	0 m	2.0 m

*The lower limit of the bike lane width cannot be utilized in conjunction with the lower parking buffer. The absolute lower limit of Option C is 2.0 m for the bike lane width and 2.0 m for parking lane width with no parking buffer. If the width of the bikeway and parking is wider than the lower limit, it is advisable to provide a parking buffer.

General cross sections

Three configurations of contra-flow bicycle lanes are possible: Option A: contra-flow lane between a travel lane and the curb, Option B: contra-flow lane between the parking lane and a curb or Option C: contra-flow lane between a parking lane and travel lane.

All options should be considered with the techniques in the Neighbourhood Greenway Section 3.3. While traveling in the opposite direction of travel provides designated space, those cycling in the same direction of motor vehicles must share the lane. Sharing the lane is only comfortable when there is less than 75 cars/peak hour. If the shared lane is above this threshold, contra-flow lanes should be designed with other elements like traffic diverters.

Option A is generally preferred to avoid conflicts between parking motorists and people cycling. Option A can also include a buffer, particularly if the roadway has higher volume and speeds, following the width guidance in Figure 3.30.

Option B should be considered if there are higher volumes of parking turnover and if there is sufficient space.

Option C is the least favourable option and is only appropriate where significant space restrictions are present.

Other considerations

Option A or **Option B** can be designed with physical separation and are preferred on streets with multiple motor vehicle lanes or higher motor vehicle speeds/volumes.

When designing the space for people cycling with the flow of motor vehicle traffic, practitioners should consider sharrows, bike lanes, or cycle tracks depending on the facility selection guidance in **Section 2.4**.

Contra-flow bike lanes in Toronto are mostly in operation on local one-way streets. There are many reports of people standing and stopping in the lanes illegally. Option B, adding physical separation or raising Option A to a interim or sidewalk height would help to elevate parking and loading issues.

Contra-flow bike lanes can also be pared with bicycle lanes in the same direction of motor vehicle travel. This is particularly important when motor vehicle volumes exceed the shared lane thresholds in Table 3.9.

Pavement markings

Contra-flow lane line and buffer markings must always be yellow.

A 100 mm solid white line should be used to delineate the parking lane.

Parking and standing should be restricted for a minimum of 10.0 m upstream in the motor vehicle direction of travel at low-volume driveways and 15.0 m for higher volume driveways.

Signage

Reserved bicycle lane signs (RB-91 OTM) should be spaced every 200 m and after all intersections.

Bicycles Excepted tabs (Rb-17t OTM) must be attached on to One-way Street and Do Not Enter signs.

Example streets: contra-flow bicycle lanes (Option A)

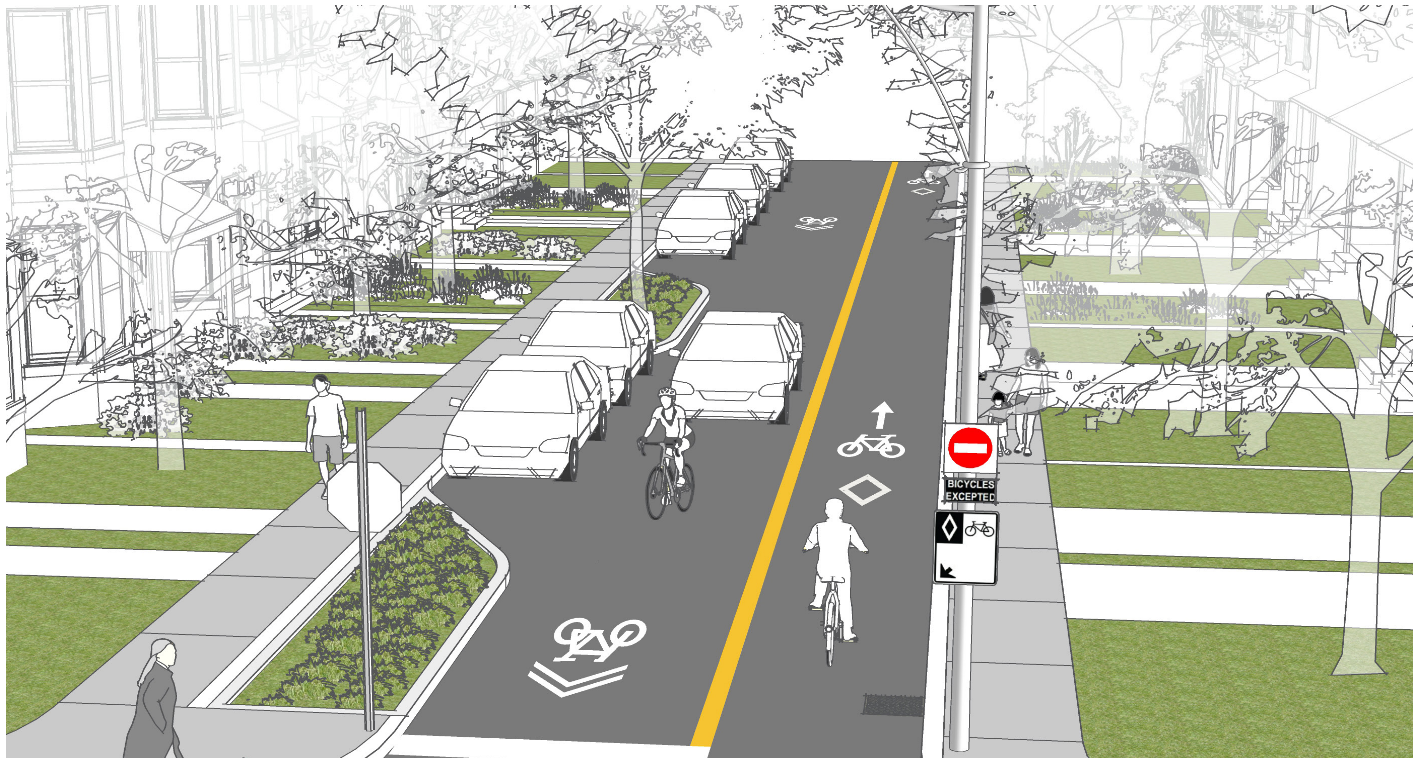


Figure 3.44 A contra-flow bicycle lane positioned between a travel lane and the curb.

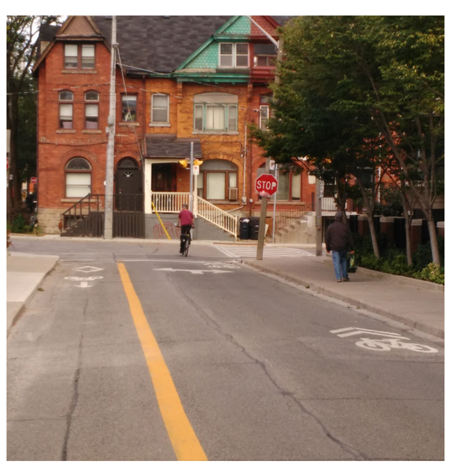


Figure 3.45 A contra-flow bicycle lane with no parking and a wide travel lane with sharrows positioned to the side. (Option A)

Figure 3.43 A contra-flow cycle track with flex bollard and planter separation (Option B).

Example streets: contra-flow bicycle lanes (Option B)

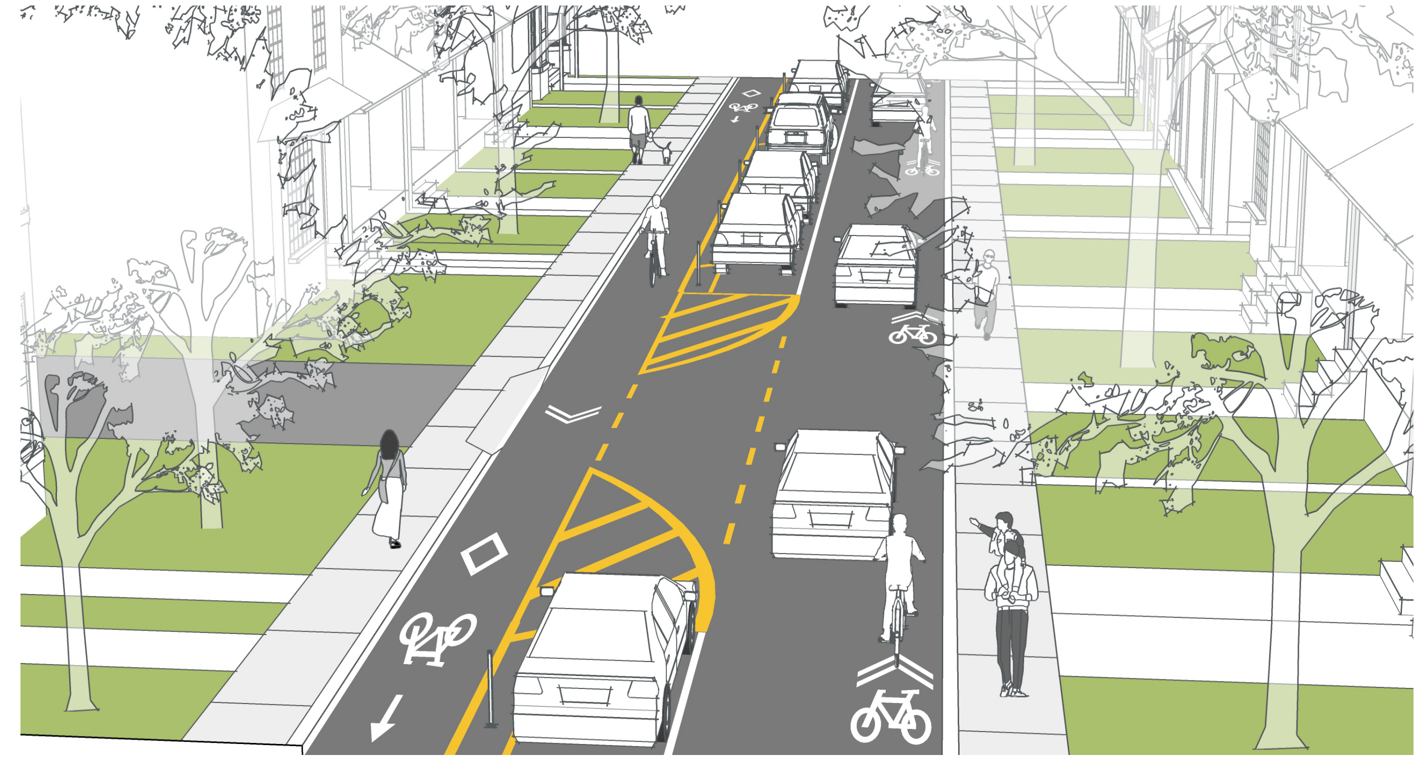


Figure 3.46 A contra-flow bicycle lane positioned between the curb and parking.

Figure 3.47 A contra-flow bicycle lane along side a parking lane and a wide travel lane with sharrows positioned to the side. This is the least preferred configuration due to parking and cycling conflicts, but can be utilized. (Option C)

Figure 3.48 A contra-flow bicycle lane along with additional traffic calming.

Curbside Activity and Bike Lanes

3.2.4

Curbside activity for bike lanes is generally more flexible than for cycle tracks as there is no physical separation restricting access to the curb. While snow clearing operations, waste collection, taxi boarding, Wheel-Trans boarding, and responding emergency vehicles may make use of bike lanes, parking, stopping and commercial loading are restricted in the bike lane.

Pedestrian, freight and parking

1. Wheel Trans and taxi vehicles may stop in the bike lane for passenger boarding/alighting and anyone picking up/dropping off a person with a disability.

Commercial loading, stopping and parking in a bike lane are restricted. Cycle tracks should be the default option if there is demand or will be demand for parking and loading, otherwise there will be significant issues with illegal parking and loading.

If bike lanes are utilized along a commercial corridor, parking lanes, loading zones or laybys should be considered, where no feasible loading or parking alternative exists.

Consideration should also be given to the proximity of side streets that do not have cycling facilities that can accommodate this activity.

Municipal services

2. Snow should be stored above the curb. Snow clearing of bike lanes can be integrated with regular roadway snow clearing. This also applies to contra-flow bike lanes though operators should be alerted to the presence of a contra-flow bike lane to ensure windows are not created in the contra-flow direction.

3. Waste collection trucks are permitted to operate in conventional or buffered bike lanes. People cycling should pass a waste collection truck on the left.

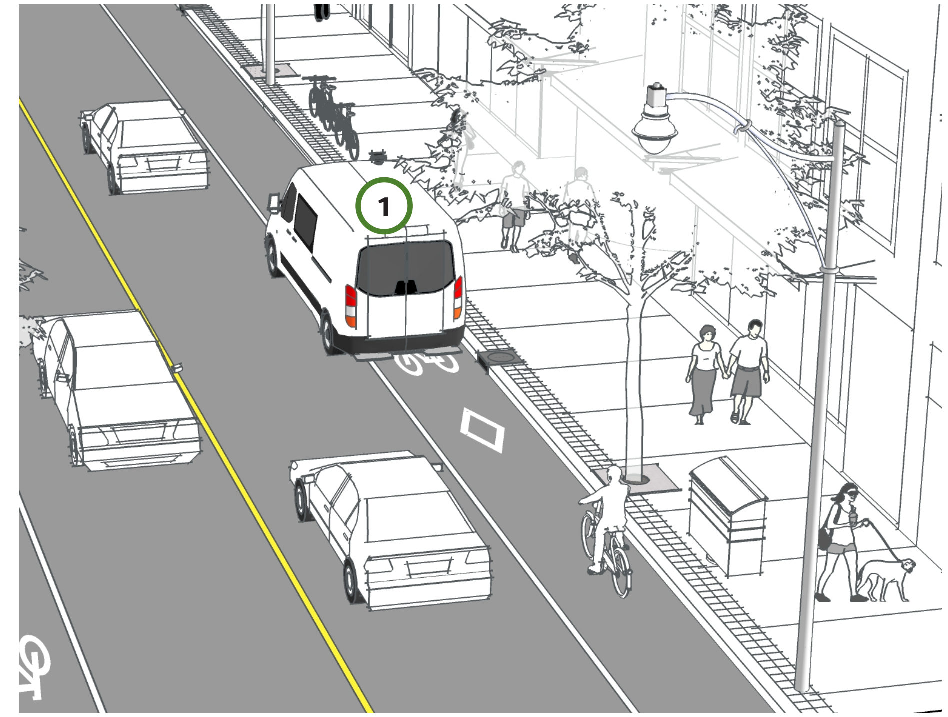


Figure 3.49 An accessible taxi stopped in a bicycle lane to allow a passenger to board/alight

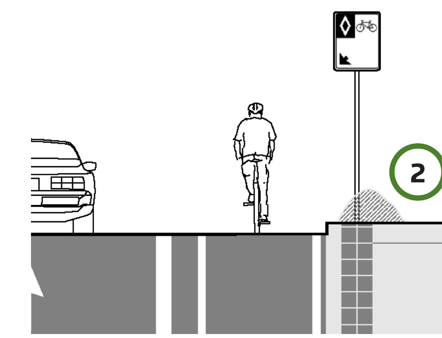


Figure 3.52 Snow stored above the curb

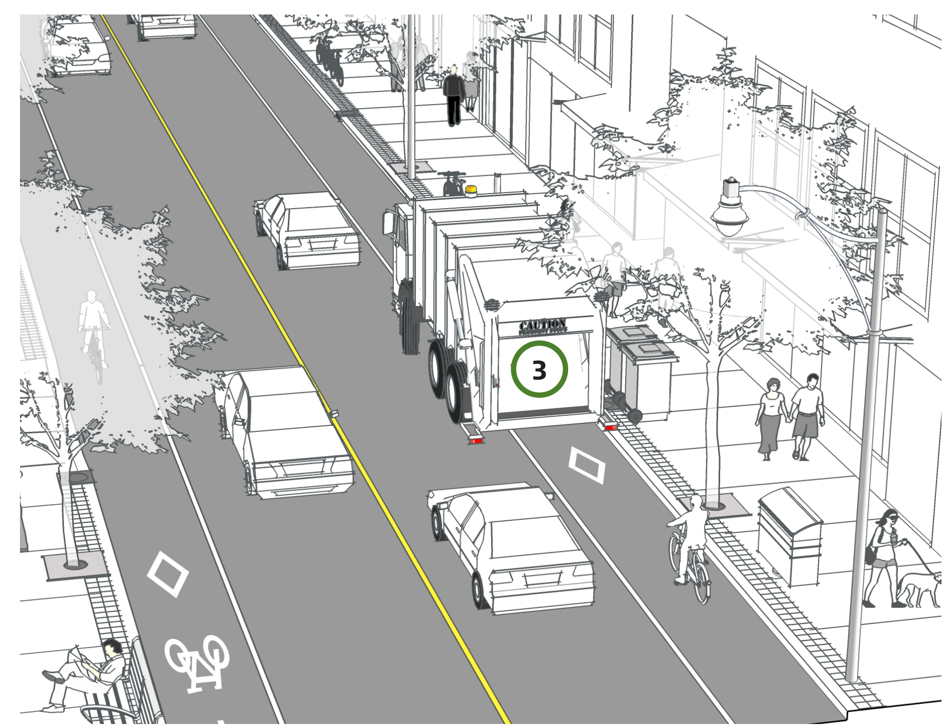


Figure 3.50 A waste collection truck operating in the bike lane.

Figure 3.51 Automated collection arm.

Shared Street Facilities

3.3

Shared streets also known as neighbourhood greenways, are low-traffic streets where people cycling and driving share space. They are designed to prioritize bicycle travel and attract people cycling of all ages and abilities. Motor vehicle speeds and volumes are managed mostly through design and regulatory measures. I

Design considerations

The two main design considerations for neighbourhood greenways are: **speed management and volume management.**

Neighbourhood greenways do not work when people cycling have to share space with fast moving or a high number of motor vehicles. Shared lane markings on arterial roads were once an acceptable design, but research shows that they have no impact on creating a safe environment for people cycling.

It is no longer sufficient to expect people to cycle on shared roadways without carefully managing the speed and volume of motor vehicles to reduce the chance of conflict or collisions that could result in injury or a fatality.

There are two main measures to reduce motor vehicle volume and speed: design and regularly measures.

Design measures are physical changes that are intended to reduce motor vehicle volume and speed and increase cycling and pedestrian volumes. These may include traffic diverters, curb extensions, on-street parking or the implementation of bikeways.

Regulatory measures are by-laws pertaining to travel restrictions and changes to traffic flow. These are indicated by signage and traffic signals.

Speed management

Designing an effective shared street requires that a speed study be implemented. The 95th percentile speeds should be 30 km/h or lower.

The main regulatory measure to control speed is to change the posted signed speed limit. On a Neighbourhood Greenway, the posted speed should be maximum 30 km/h.

There are many design measures for speed management to consider including:

- Chicanes, curb extensions and speed humps;
- Narrowing a roadway or providing on-street parking on alternating sides of the street; and,
- Traffic circles.

For more design options for speed management, the City of Toronto's Traffic Calming Guide should be consulted.

Volume management

High motor vehicle traffic volumes decrease comfort for people cycling and may lead to more conflicts. Volume management should be pursued on existing and planned shared streets that have motor vehicle volumes above the City's target maximum. (See Table 3.9)

A combination of regulatory and design measures may be most effective at lowering motor vehicle volume and increasing pedestrian and cycling volumes.

Volume can be managed through regulatory measures such as:

- Hourly or permanent through restrictions, turn prohibitions, and one-way streets.
- Turn prohibitions and through restrictions. They could be considered by themselves only if minor volume management is needed, as they may require enforcement to be effective.

Motor Vehicle Volume Design Domain	Peak Hour, Peak Direction	AADT, each direction
Target Maximum	50	750
Upper Limit (for short segments, e.g. 100m)	75	1500

Table 3.9 Vehicle volume thresholds for shared streets.

- Directional closures should be considered to reduce motor vehicle volume while maintaining connectivity for people cycling.

Design measures can help to lower the motor vehicle cut-through volumes on a street and aid in reducing reliance on motor vehicles for short trips. When deploying design measures, adjacent streets and laneway impacts should be monitored.

Examples of design measures include:

- Diagonal diverters, full block diverters and median diverters along major intersections;
- Forced turns at intersections, channelized right-in/right-out islands; and,

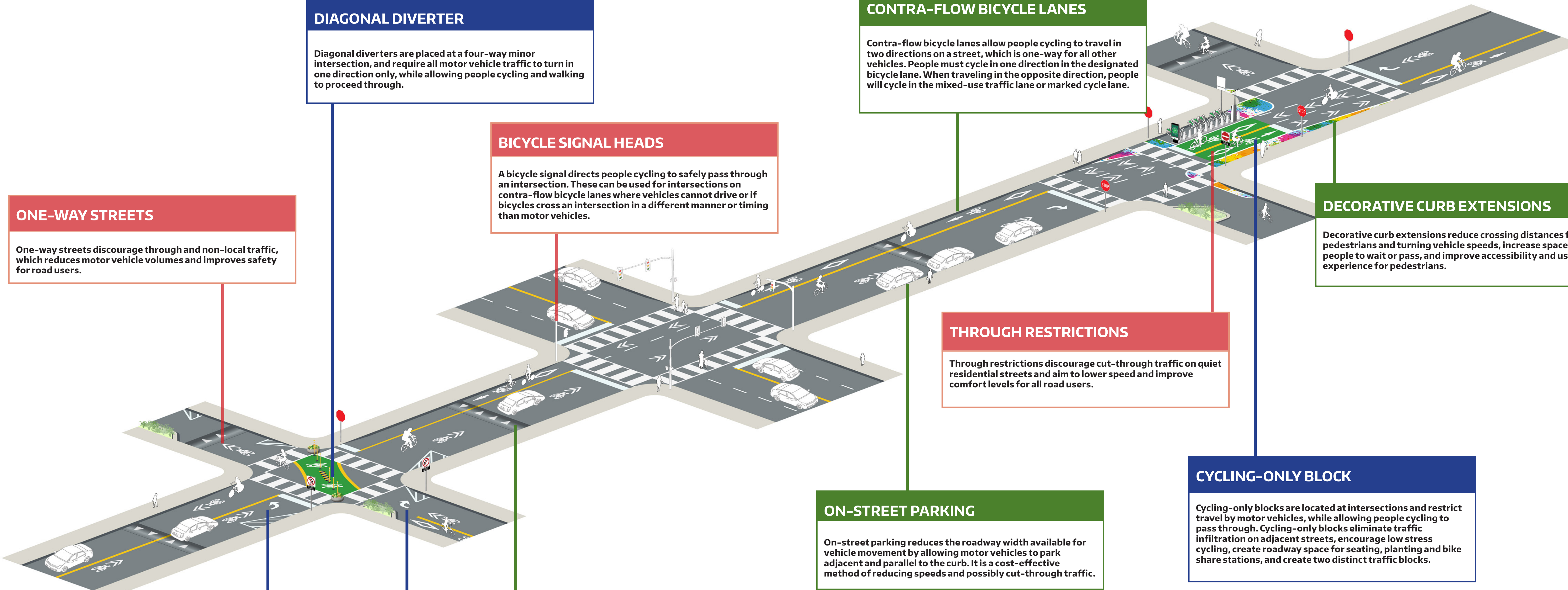
Other considerations

Neighbourhood Greenways are often on one-way motor vehicle streets and are regularly coupled with contra-flow bike lanes.

Route should be planned in order to provide comfortable crossings across arterial streets, and connect to the rest of the cycling network. See Chapter 4 for more information on intersection design.

Bicycle wayfinding, using signs and pavement markings, is critical to make shared streets visible and intuitive. Further guidance can be found in the City's Cycling Wayfinding Guidelines.

Features of Neighbourhood Greenways



DIAGONAL DIVERTER

Diagonal diverters are placed at a four-way minor intersection, and require all motor vehicle traffic to turn in one direction only, while allowing people cycling and walking to proceed through.

BICYCLE SIGNAL HEADS

A bicycle signal directs people cycling to safely pass through an intersection. These can be used for intersections on contra-flow bicycle lanes where vehicles cannot drive or if bicycles cross an intersection in a different manner or timing than motor vehicles.

ONE-WAY STREETS

One-way streets discourage through and non-local traffic, which reduces motor vehicle volumes and improves safety for road users.

CONTRA-FLOW BICYCLE LANES

Contra-flow bicycle lanes allow people cycling to travel in two directions on a street, which is one-way for all other vehicles. People must cycle in one direction in the designated bicycle lane. When traveling in the opposite direction, people will cycle in the mixed-use traffic lane or marked cycle lane.

DECORATIVE CURB EXTENSIONS

Decorative curb extensions reduce crossing distances for pedestrians and turning vehicle speeds, increase space for people to wait or pass, and improve accessibility and user experience for pedestrians.

THROUGH RESTRICTIONS

Through restrictions discourage cut-through traffic on quiet residential streets and aim to lower speed and improve comfort levels for all road users.

CYCLING-ONLY BLOCK

Cycling-only blocks are located at intersections and restrict travel by motor vehicles, while allowing people cycling to pass through. Cycling-only blocks eliminate traffic infiltration on adjacent streets, encourage low stress cycling, create roadway space for seating, planting and bike share stations, and create two distinct traffic blocks.

ON-STREET PARKING

On-street parking reduces the roadway width available for vehicle movement by allowing motor vehicles to park adjacent and parallel to the curb. It is a cost-effective method of reducing speeds and possibly cut-through traffic.

FORCED TURNS AT INTERSECTIONS

Forced turns at intersections orient motor vehicles in the desired direction or directions, thus reducing traffic volumes and creating safer spaces for vulnerable road users.

SPEED HUMPS

Speed humps are raised sections of the roadway designed to discourage motor vehicle drivers from traveling at excessive speeds. Studies have indicated that speeds drop by approximately 15km/h between speed humps and about 20km/h at the hump itself.

Legend

- Design Measure (Volume Management)
- Design Measure (Speed Management)
- Regulatory Measure (Volume Management)

Figure 3.53 A rendering of a cross-section of a neighbourhood greenway features several regulatory and design measures.

Cycling-friendly Streets

3.4

All streets should be designed and maintained to be bicycle-friendly, even if they do not have a formal cycling facility. Additionally, some streets that do not have formal cycling facilities may be signed as bicycle routes for wayfinding purposes.

Application

These principles apply to all City streets where cyclists are legally permitted to ride.

Bicycle friendly roadway improvements should be prioritized based on bicycle volume (if data is available), reported incidents and proximity to alternate cycling routes.

Design considerations

Improving bicycle friendliness on all streets reduces cyclists' risk for trips where the existing cycling network does not offer a direct route between their origin and destination.

The impact of turn and entrance restrictions should be considered for bicycle traffic and where these restrictions are for traffic calming purposes or to enhance traffic flow, consideration should be given to exempting bicycles by adding a "bicycles excepted" tab (Rb-17t OTM).

The condition of pavement at the edge of the roadway affects cyclists' comfort and safety and areas with significant deterioration should be repaired promptly. The quality of pavement should be monitored during road patrols and from 311 reports and repaired promptly.

Road patrols should pay particular attention to the condition of pavement at the edge of the roadway, as this is where deterioration is most prevalent and the area where cyclists are most likely to travel.

Longitudinal cracks are particularly problematic for cyclists due to the narrow profile of a bicycle tire.

The restoration of utility cuts should be completed with no longitudinal edges between existing pavement and restored pavement located within 1.5 m of the curb.

Where a utility cut is located within 1.5 m of the curb, the restoration should include a resurfacing of the entire area within 1.5 m of the curb to prevent any longitudinal discontinuities in the area where cyclists typically travel.

Catch basins should have herring bone grates or other grate patterns with diagonal or square drainage slots.

Side inlet catch basins as shown in are preferred for roadway reconstruction projects.

Street cleaning should be undertaken on all streets in early spring after the last snow melt and performed routinely on collector and arterial roadway curb lanes.

A reduction in the curb radii should be considered for all roadway reconstruction projects based on Toronto's Curb Radii Guidelines to reduce the speed at which motor vehicles make a turn.

Where the roadway width exceeds the minimum requirements in Toronto's Lane Width Guidelines and designated cycling facilities are not provided, additional width should be allocated to the curb lane to provide greater space between cyclists and overtaking motorists; wider curb lane widths are particularly important on bridges and through underpasses and tunnels.

Edge lines and urban shoulders can reduce motor vehicle speed, but are not considered a bikeway. However, if the urban shoulder is less than 1.2 m wide, it can be perceived as a bike lane without providing sufficient space for a bicycle to operate and consequently have a negative impact on the cycling environment. Edge lines should therefore not be marked unless the resulting shoulder is at least 1.2 m wide.

Urban shoulders shall never include reserved bicycle lane signs, or diamond/bicycle stencil pavement markings, as they are not designated bikeways.

Adequate lighting is critical to ensure cyclist visibility through underpasses and in tunnels. Lighting intensity should be variable, with greater intensity during daylight and reduced intensity at night. Sufficient lighting should be installed along routes in general, particularly at intersections.

Figure 3.54 A left turn restriction with a "bicycles excepted" tab (Rb-17t).

Figure 3.55 A catch basin with herring bone grates.

Figure 3.56 A side inlet catch basin

Figure 3.57 Lighting provided in an underpass to improve cyclist visibility in an conventional bicycle lane located in an underpass.