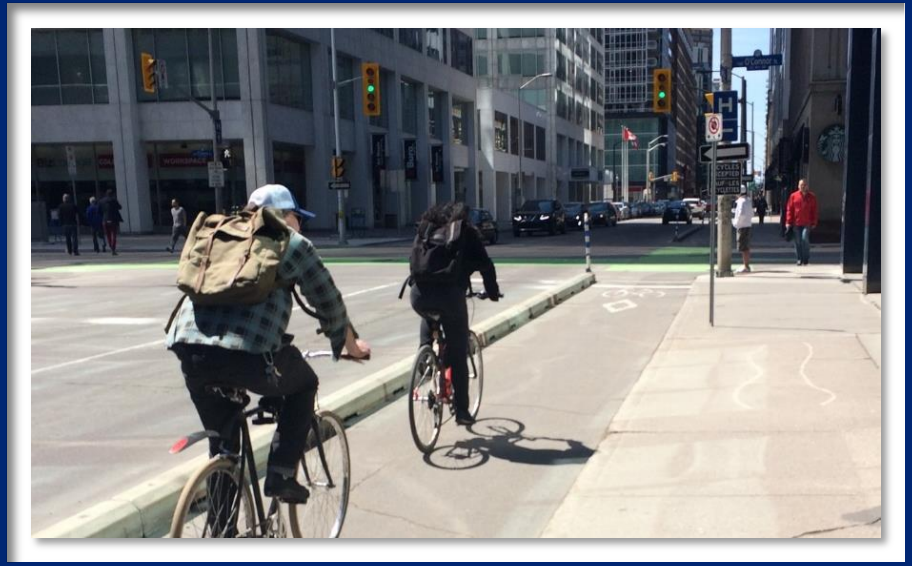
Safety Performance of Bicycle Infrastructure in Canada



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Transportation Association of Canada
Live Webinar Series
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Outline

- Background and need
- Project objectives
- Approach and methodology
- Key findings
- Facility selection flowchart
- Gap analysis
- Conclusions

Background and Need

- Bicycling is a sustainable and energy efficient transport mode - promotes personal and environmental health
- For many years governments across North America have been working to increase bicycling to improve sustainability
- New infrastructure has been implemented without necessarily evaluating its performance
- In Canada there is recognition that a lack of knowledge exists regarding the safety performance of bicycle facilities
- This understanding is important for implementation of new infrastructure

Project Objectives

1. Identify methods to quantify observed and perceived performance of different types of bicycle infrastructure.
2. Identify data requirements to undertake evaluations.
3. Identify principal types of bicycle infrastructure projects that have been undertaken in different contexts in Canada.
4. Document and quantify the outcomes of different types of installations in Canada.
5. Develop a method for considering risks within the decision-making process for facility/treatment selection.

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Approach and Methodology

1. Literature review
2. End user survey of cyclists across Canada
3. Jurisdictional survey
4. Case studies of Canadian and international bicycle facilities
5. Canadian academic community engagement
6. Facility selection flowchart development
7. Gap analysis

Key Findings

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Bicycle Infrastructure Considered - Segments

Off-Road Bicycle Pathway

Buffered Bicycle Lane

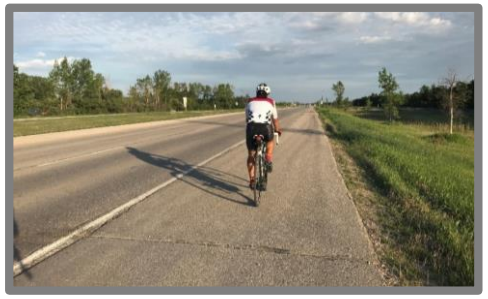
Major Street Shared Lane

Off-Road Multi-Use Pathway

Painted Bicycle Lane

Bicycle Boulevards or Neighbourhood Greenways

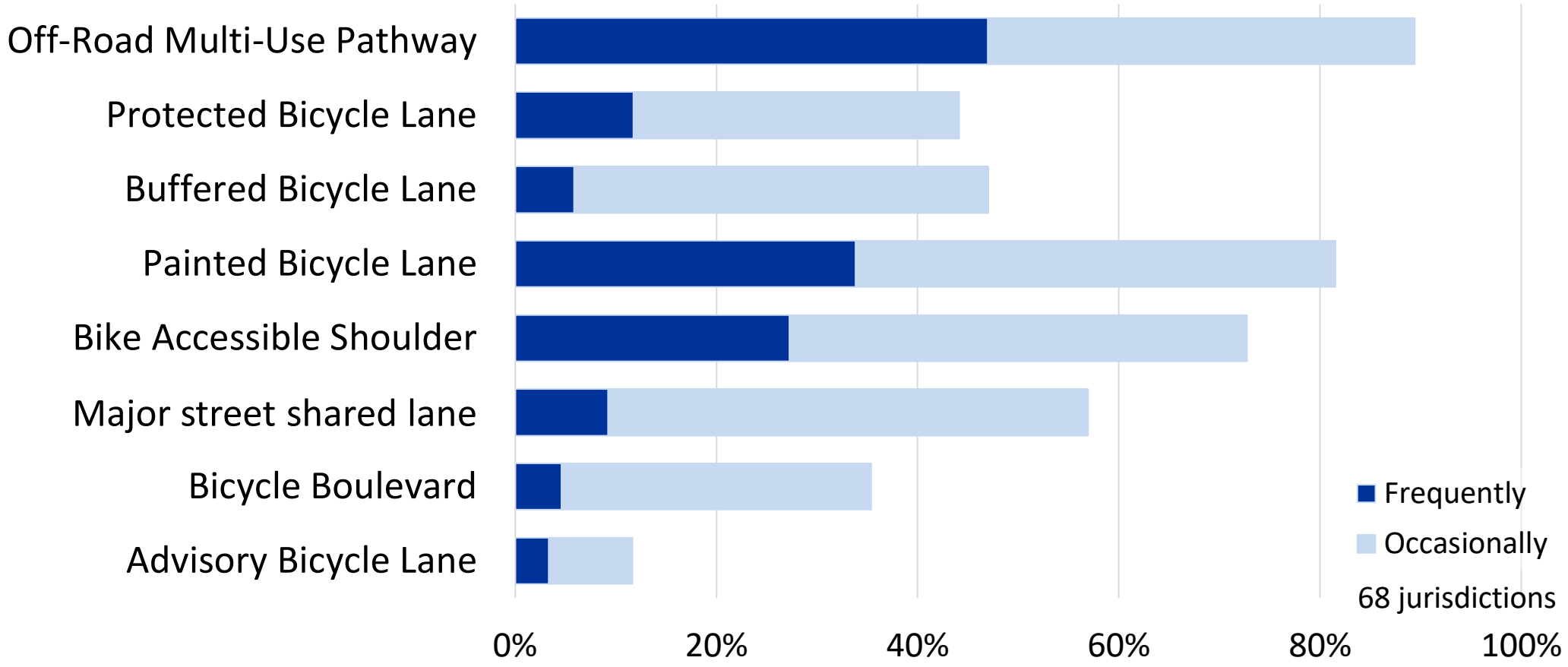
Protected Bicycle Lane or Cycle Tracks



Bicycle Accessible Shoulder

Advisory Bike Lanes

Bicycle Facilities Implemented in Canada



Bicycle Infrastructure Considered - Intersections

Protected Intersection

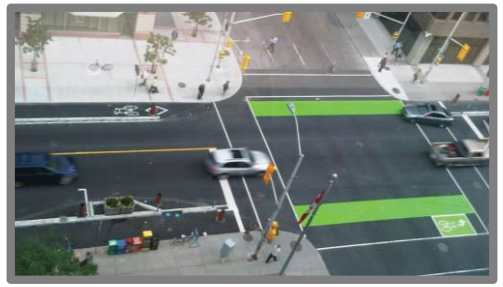
Intersection Crossing Markings

Bend-Out Intersection Approach

Bike Box

Cross-Rides

Protected Signal Phases



Two-Stage Turn Queue Box

Bend-In Intersection Approach

Gates, Fencing and Bollards

Safety Performance Based on Literature

Safety Performance of Bicycle Facilities

Facility Type	Collision Risk	Collision Severity	Perceived Safety

Facility Type	Collision Risk	Collision Severity	Perceived Safety

- ● well-supported positive safety outcome
- ○ general positive safety outcome
- □ general negative safety outcome

Blank cells indicate limited research available

Safety Performance Based on Literature

Safety Performance of Bicycle Facilities

Facility Type	Collision Risk	Collision Severity	Perceived Safety
Off-road bicycle facility	●	○	●
Off-road multi-use path	●	□	●
Protected bicycle lane (one-way)	●	□	●
Protected bicycle lane (two-way)	○	□	●

● well-supported positive safety outcome

○ general positive safety outcome

□ general negative safety outcome

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Protected bicycle lane (two-way)	○	□	●

Facility Type	Collision Risk	Collision Severity	Perceived Safety
Buffered bicycle lane			●
Painted bicycle lane	○	□	○
Major street shared lane	□	□	□
Bicycle boulevard	○	○	

● well-supported positive safety outcome

○ general positive safety outcome

□ general negative safety outcome

Blank cells indicate limited research available

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Safety Performance Based on Literature

Safety Performance of Bicycle Intersection Treatments

Facility Type	Collision Risk	Collision Severity	Perceived Safety
Protected intersection		○	
Bike box	●		○
Two stage turn Queue box	○		○
Intersection crossing markings	○ □		○

Facility Type	Collision Risk	Collision Severity	Perceived Safety
Cross-ride	○		
Bend-in, bend-out approach			
Protected signal phase	○		
Gate, fencing, and bollards			

● well-supported positive safety outcome

○ general positive safety outcome

□ general negative safety outcome

Blank cells indicate limited research available

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Safety Performance Based on End Users

- General safety perception of facility types (safest to least safe)
  - Separated facilities (off road paths and protected bicycle lanes)
  - Lower classification streets (local streets) with or without facilities
  - Higher volume streets with continuous facilities (separated or not)
  - Higher classification streets with intermittent or no facility
- Bicycle boulevards and buffered bicycle lanes perceived safer than painted bicycle lanes
- Fearless and concerned bicyclists disagree on bi-directional protected lanes
- Major street shared lanes considered least safe of facilities

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Safety Performance Based on End Users

- Protected signal phases are perceived to be the safest followed by protected intersections.
- Fearless cyclists perceive one-way bicycle facilities to be safer than two-way bicycle facilities at intersections.
- Concerned bicyclists perceive the opposite, that two-way bicycle facilities are safer than one-way bicycle facilities at intersections.
- Bend-out approaches are perceived to be safer by concerned bicyclists than fearless and confident bicyclists.
- Bike boxes and two-stage left turn queues are perceived to be equally safe by concerned bicyclists
- Gates perceived as the least safe intersection treatment

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Factors Affecting Observed & Perceived Safety

- Vehicle speed
- Vehicular traffic volume
- Frequency of collisions
- Presence of trucks and buses
- Presence of vehicle parking
- Frequency of approaches
- Bicycle volume
- Others (number of lanes, curb type, roadway width, grade, lighting)

Facility Selection Flowchart

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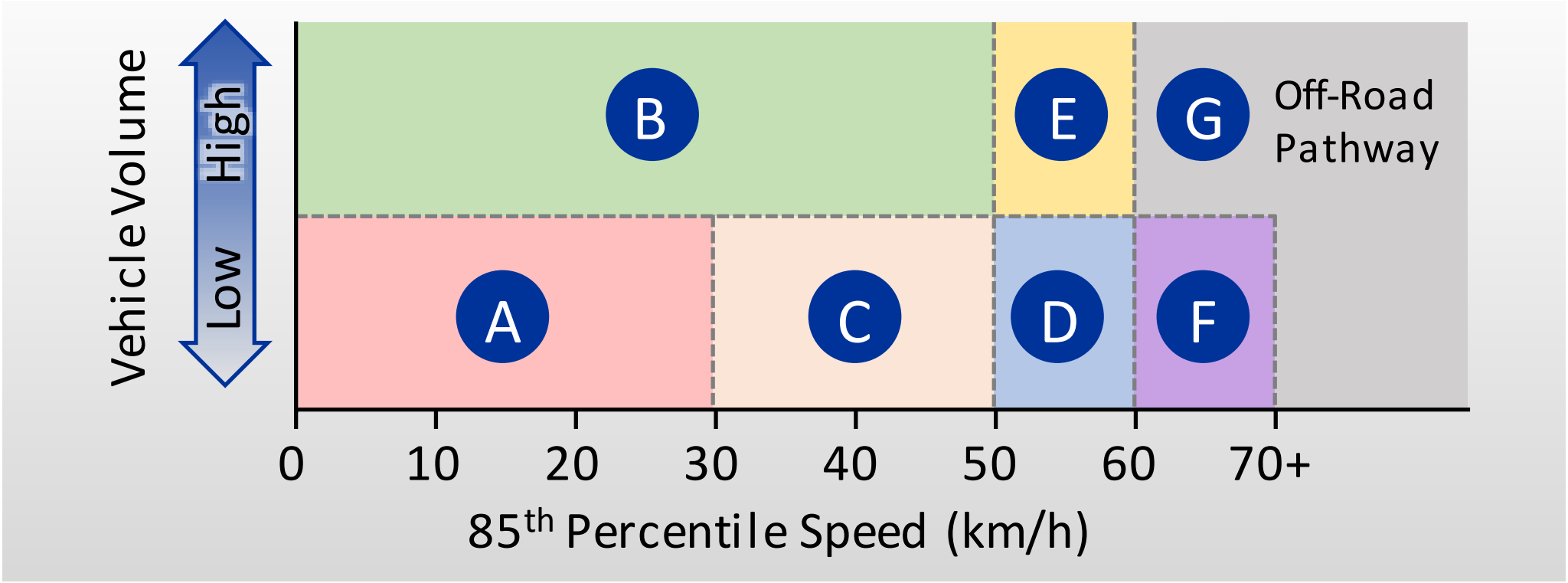
Speed-Volume Envelope



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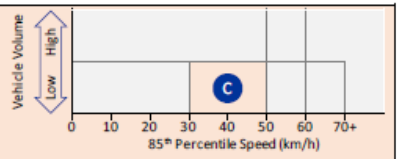
Facility Selection Flowchart Application

DOMAIN TEMPLATE C

Relatively low vehicular speed and low traffic volume



This domain generally comprises local and collector streets where the 85th percentile speed is above 30 km/h but less than or equal to 50 km/h, and the vehicular volume is low.

BICYCLE FACILITY SELECTION FACTORS

COMPATIBLE INTERSECTION TREATMENTS

SPECIAL CONSIDERATIONS

- Description of Domain
- Bicycle facility selection factors
- Compatible intersection treatments
- Special considerations

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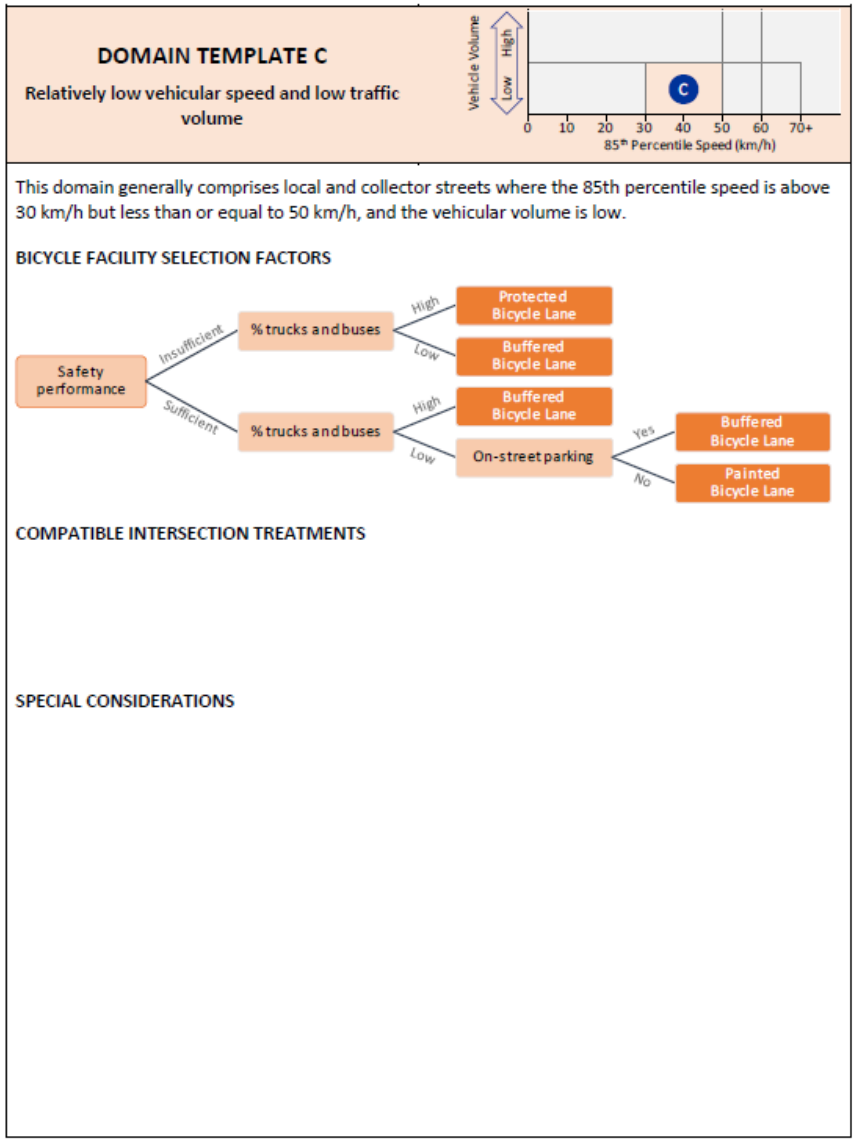
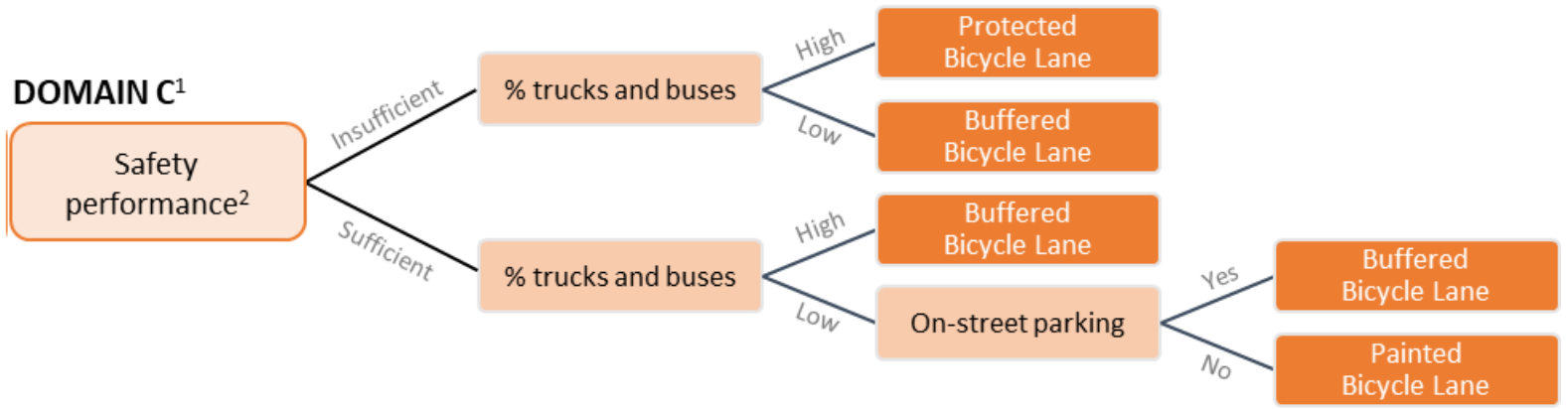
Facility Selection Flowchart Application





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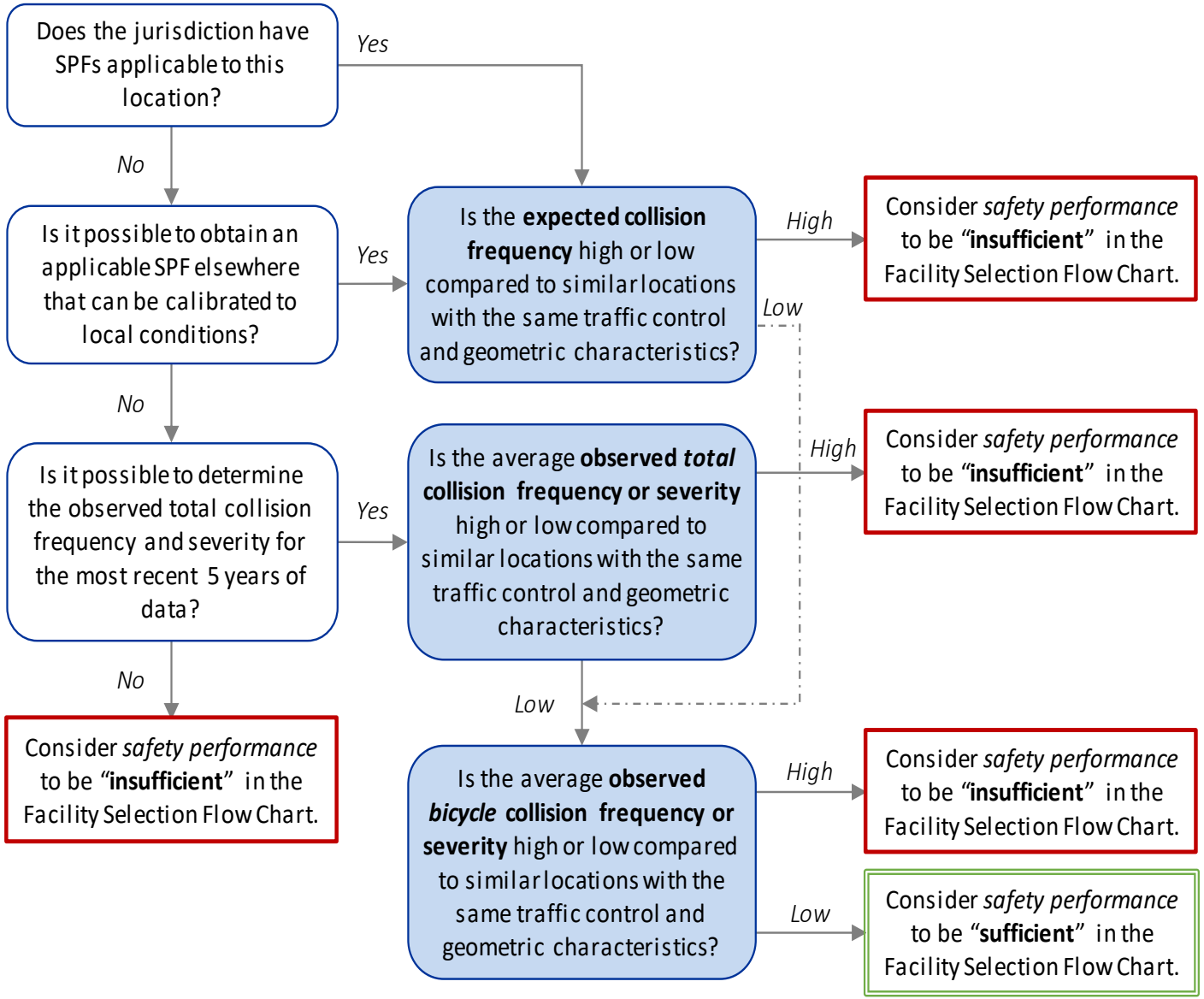
Safety Performance Evaluation Tool



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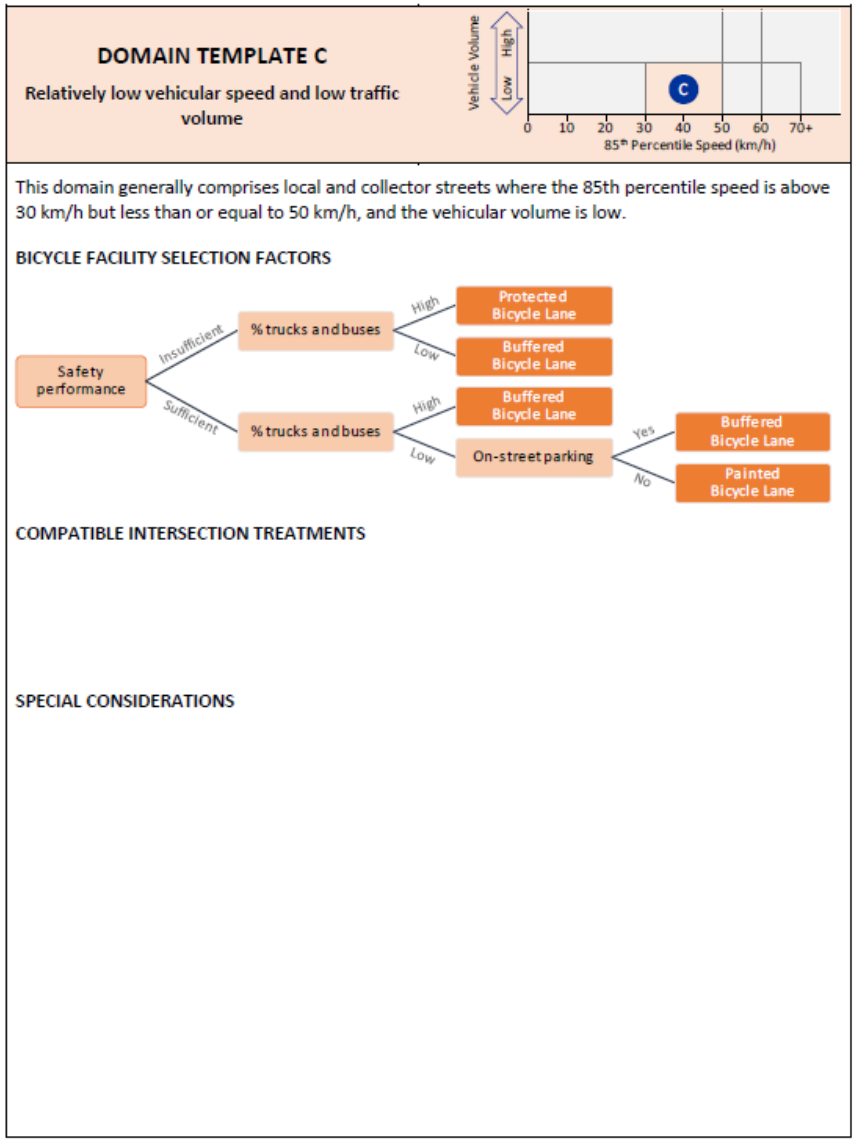

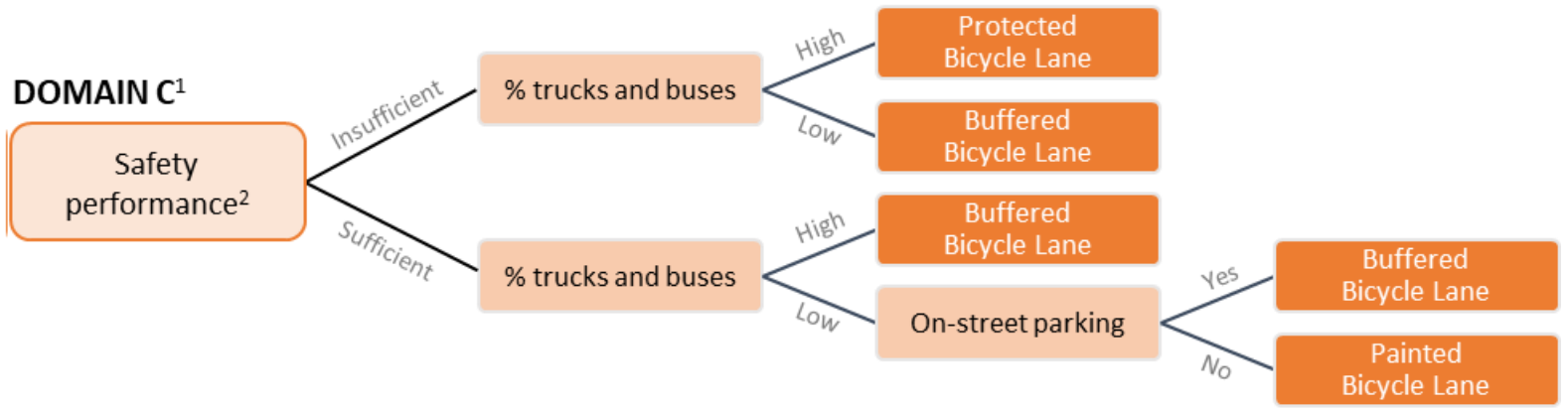

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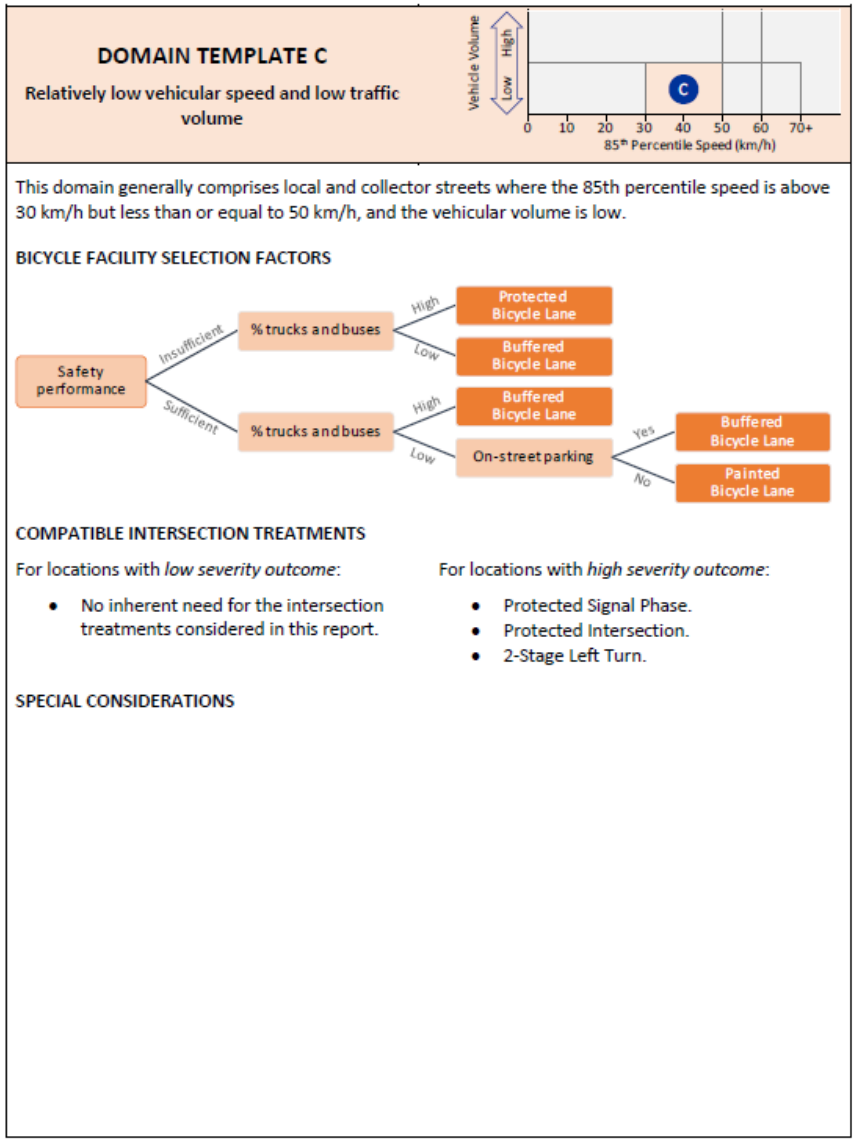

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BICYCLE FACILITY SELECTION FACTORS

COMPATIBLE INTERSECTION TREATMENTS

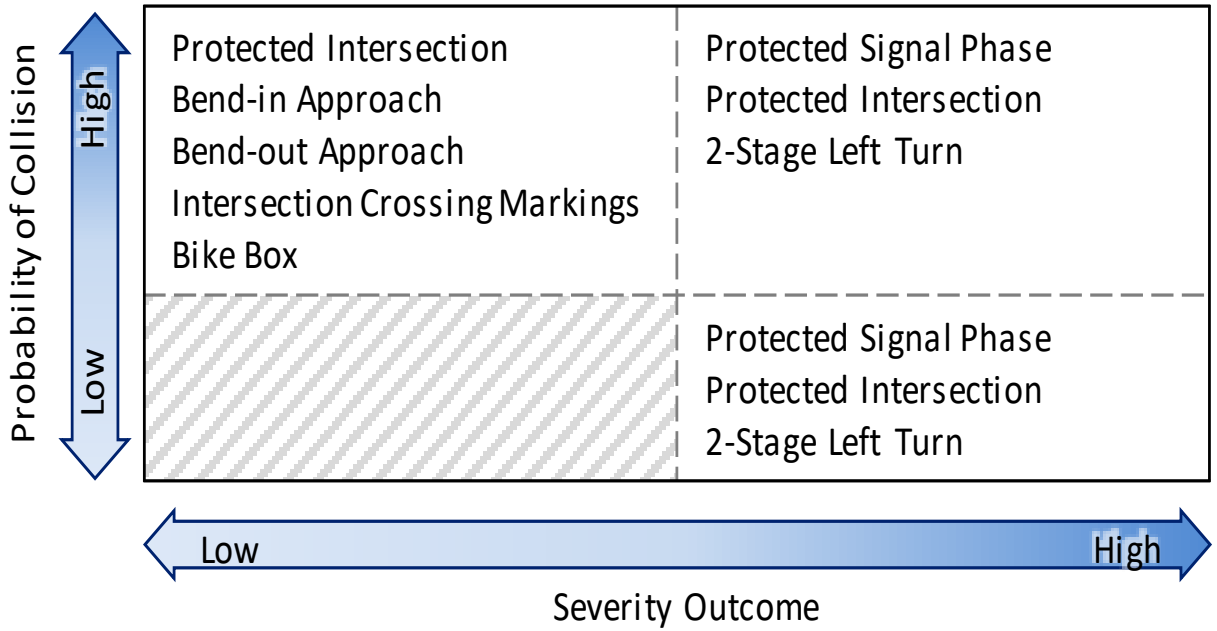
For locations with *low severity outcome*:

- No inherent need for the intersection treatments considered in this report.

For locations with *high severity outcome*:

- Protected Signal Phase.
- Protected Intersection.
- 2-Stage Left Turn.

SPECIAL CONSIDERATIONS



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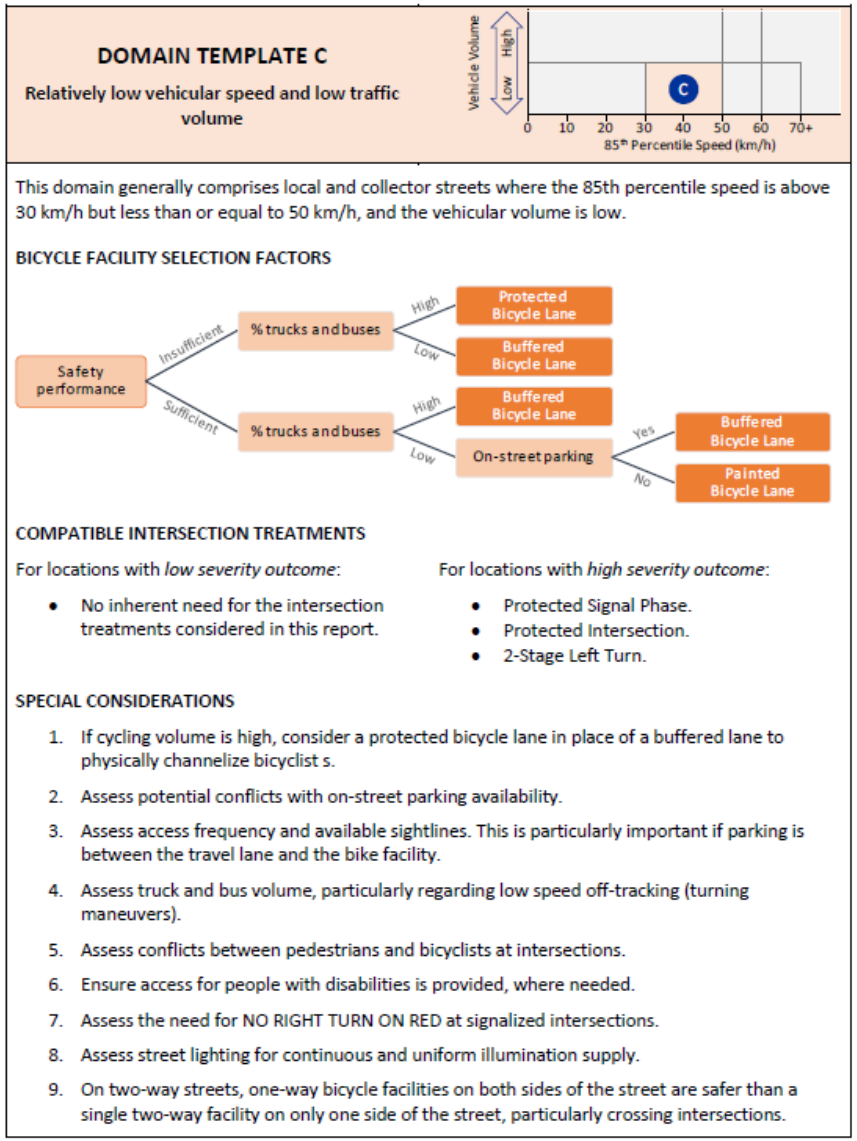

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SPECIAL CONSIDERATIONS

1. If cycling volume is high, consider a protected bicycle lane in place of a buffered lane to physically channelize bicyclist s.
2. Assess potential conflicts with on-street parking availability.
3. Assess access frequency and available sightlines. This is particularly important if parking is between the travel lane and the bike facility.
4. Assess truck and bus volume, particularly regarding low speed off-tracking (turning maneuvers).
5. Assess conflicts between pedestrians and bicyclists at intersections.
6. Ensure access for people with disabilities is provided, where needed.
7. Assess the need for NO RIGHT TURN ON RED at signalized intersections.
8. Assess street lighting for continuous and uniform illumination supply.
9. On two-way streets, one-way bicycle facilities on both sides of the street are safer than a single two-way facility on only one side of the street, particularly crossing intersections.

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Gap Analysis

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Data gaps

Knowledge gaps

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Data gaps

- Collision and other surrogate safety data
- Bicycle and pedestrian volume data
- Vehicular traffic by vehicle type

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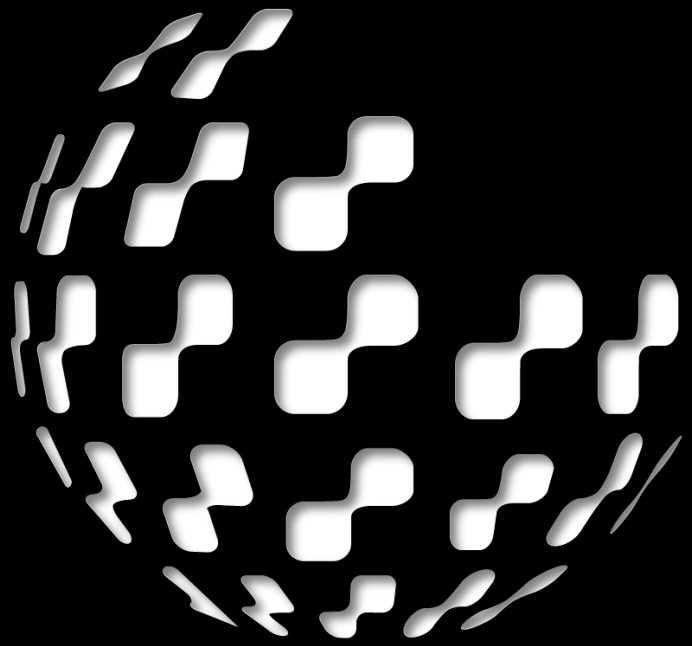
- Bicycle and pedestrian volume data
- Vehicular traffic by vehicle type

Knowledge gaps

- Safety performance by facility type including seasonality
- Safety impact of different parameters (traffic volume, % trucks, frequency of access points)
- Thresholds at which safety is impacted

Conclusions

- Bicycling continues to grow in many Canadian jurisdictions and more infrastructure is being implemented to accommodate users
- Limited robust understanding about the safety performance of bicycle infrastructure types.
- Additional research is needed on the safety performance of intersection treatments.
- There are extensive data and knowledge gaps associated with the safety performance of bicycle infrastructure in Canada
- Much work is needed to close the identified knowledge gaps (traffic volume, % truck/bus, and access density thresholds at which bicycle facilities perform differently).



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