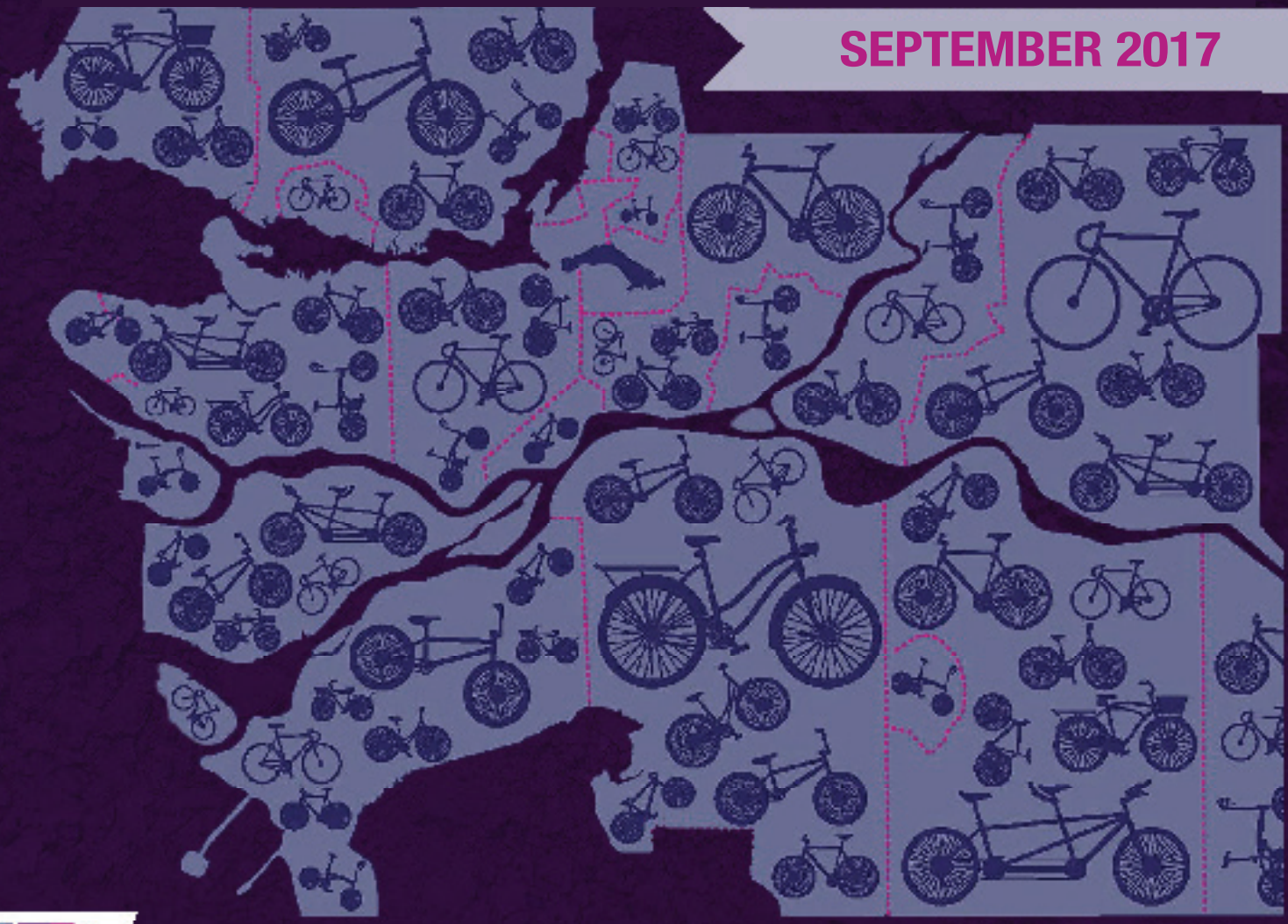
#UNGAP THEMAP

INFRASTRUCTURE IDEAS CATALOGUE

SEPTEMBER 2017



2ND EDITION

Your **Cycling** Connection

CONTENTS

1. INTRODUCTION

Gaps in the cycling network are a major barrier for over 40% of people who are interested but concerned about cycling[1]. Now more than ever, there is a need for a regional approach to implementing bike infrastructure improvements and new facilities across Metro Vancouver. These should include all ages and abilities (AAA) bike routes between and within municipalities, to and from schools and commercial zones, and across major bridges and water crossings.

UnGapTheMap aims to create a safer, more connected bike network that would encourage more people to cycle more often. Hundreds of kilometres of bikeways, including new protected infrastructure, are needed across Metro Vancouver and HUB Cycling is actively defining and prioritizing these improvements. Together, alongside the provincial government, TransLink and municipalities, UnGaptheMap is filling critical gaps in the network, and influencing the policies, laws, education, and promotion needed to support the fastest-growing mode of transportation in the region.

A major part of the campaign is to engage in the design, rationale, and implementation of bicycle infrastructure planning, a process that is often highly technocratic and difficult for the general public to fully understand. The purpose of this catalogue is to provide HUB Local Committees and other stakeholders with a consolidated and simplified overview of some of the best-practice cycling infrastructure, in the hope of better determining the specific types of infrastructure recommended on and off the road. Lastly, it is important to note that given the variety of bicycle infrastructure, this catalogue is not comprehensive, as other valuable design ideas may be added and modified in the future.

1. (TransLink, 2011). A Regional Cycling Strategy for Metro Vancouver.

2. DETERMINING CYCLING INFRASTRUCTURE

Within Canada, transportation planners and engineers refer to various roadway design guidelines to assist in determining the type and location of bike infrastructure found within our streets. Chapter 5 - Bicycle Integrated Design from Transportation Association of Canada's (TAC) Geometric Design Guide for Canadian Roads (2017[2]) and Bikeway Traffic Control Guidelines for Canada (2012), as well as a variety of 'best-practice' guidebooks may be referenced across BC municipalities[3].

One of the central tools found within most of these documents is a 'Pre-Selection Nomogram', a graph that classes cycling infrastructure into various categories according to traffic volumes and speeds (Figure 1).

Generally, Class I & II cycling facilities provide a high to moderate degree of physical separation between people cycling and motor vehicles, appearing on highways, arterial, and collector roads while Class III cycling facilities provide little to no separation between people cycling and motor vehicles and are most common on local roads.

However, given the range of traffic volumes and speeds associated with each road type, some classes of infrastructure may appear on multiple types of roads. For example, a painted bike lane may be appropriate on both a collector or arterial roadways, depending on a variety of circumstances.

Importantly, infrastructure tools and manuals are one of many factors that assist in determining cycling infrastructure. The type and location of bike infrastructure is also affected by road widths, visibility, adjacent land uses, terrain (ideally no more than 3-5% grades), urban versus rural contexts, and other political and economic issues.

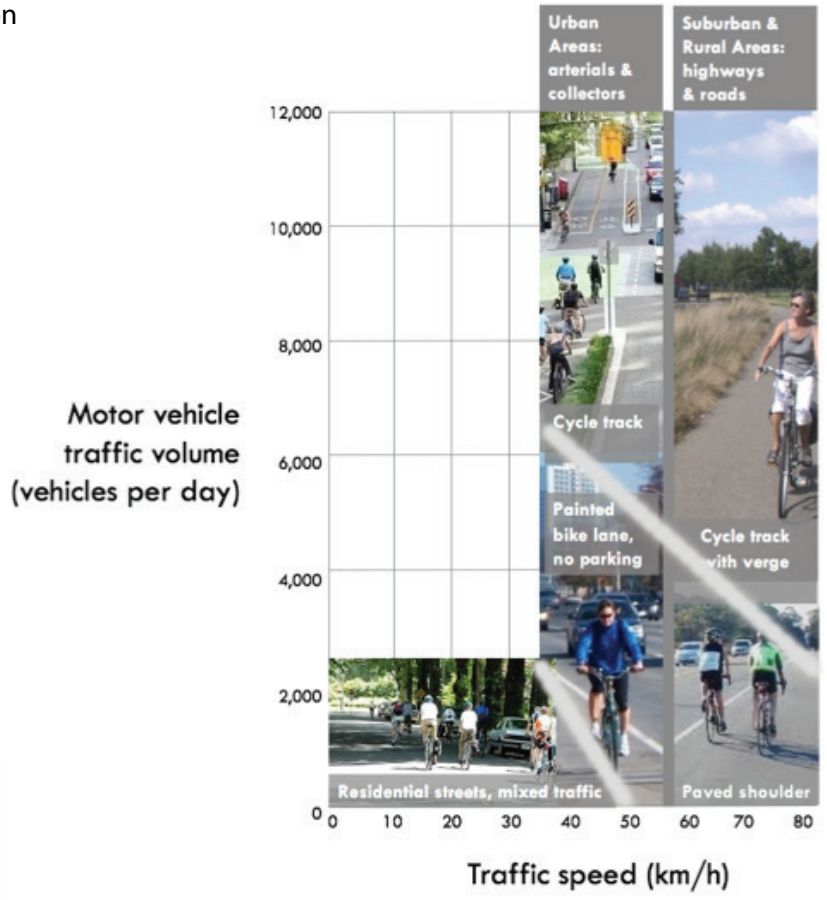
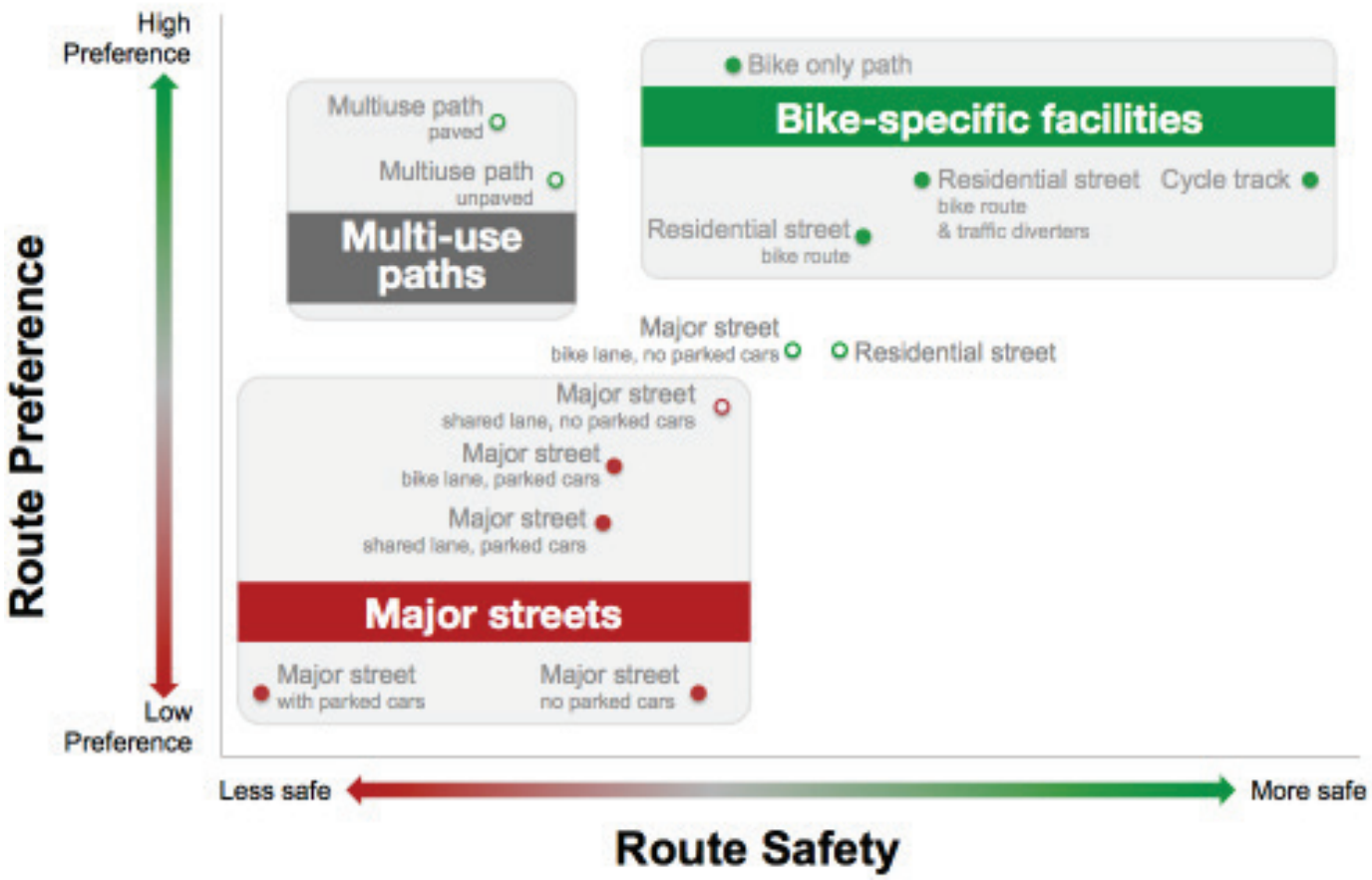


Figure 1. Pre-selection nomographs, including this one from the Danish Cycling Embassy, are one of many tools that help to determine the type and location of cycling infrastructure.

2. A hard copy of this document can be borrowed from HUB Cycling's office.
3. Additional bike design guidebooks include the Capital Regional District's Pedestrian and Cycling Master Plan Design Guidelines (2013) and the Ministry of Transportation and Infrastructure (MOTi)'s B.C. Supplement to TAC (2012).

Safety and cycling infrastructure

Over the last decade, protected cycling infrastructure has grown rapidly across US and Canadian cities. Countless studies show that physically separated forms of infrastructure are not only safer[4] but more popular[5] amongst people cycling. According to the BC Ministry of Transportation and Infrastructure (MoTI), off-street facilities can even reduce injury by 30 to 90 percent when compared to roadways without any cycling infrastructure[6]. These types of cycling facilities accomodate all ages and abilities and are supported by HUB Cycling along with municipalities across Metro Vancouver. In conjunction with AAA infrastructure, HUB Cycling is advocating for a Safer Passing Law as one of several proposed improvements to the Motor Vehicle Act. Similar to provinces such as Ontario, Nova Scotia, and New Brunswick, the proposed law would require a motor vehicle to pass a vulnerable road user (a person cycling, walking, using a wheelchair or riding a horse) by at least 1.5 metres.



A study by Dr. Kay Teschke et al. from UBC found a correlation between bike route preferences and actual safety. The graph shows that bike-specific routes are preferred and safer, in addition to cycle tracks, bike-only paths, multi-use paths, and residential street bike routes.

Additional cycling safety resources:

- Cycling in Cities Research Program, UBC.
- City of Vancouver Cycling Safety Study (2015)

4. (Teschke et al., 2012). Route infrastructure and the risk of injuries to bicycles: A case-crossover study. *American Journal of Public Health*, (102)12.
5. (Winters & Teschke, 2009). Route preferences among adults in the near market for bicycling: Findings of the cycling in cities study. *American Journal of Health Promotion*, (25)1.
6. (MOTi, 2015 as cited in RoadSafety BC, 2015). BC Community Road Safety Tool Kit.

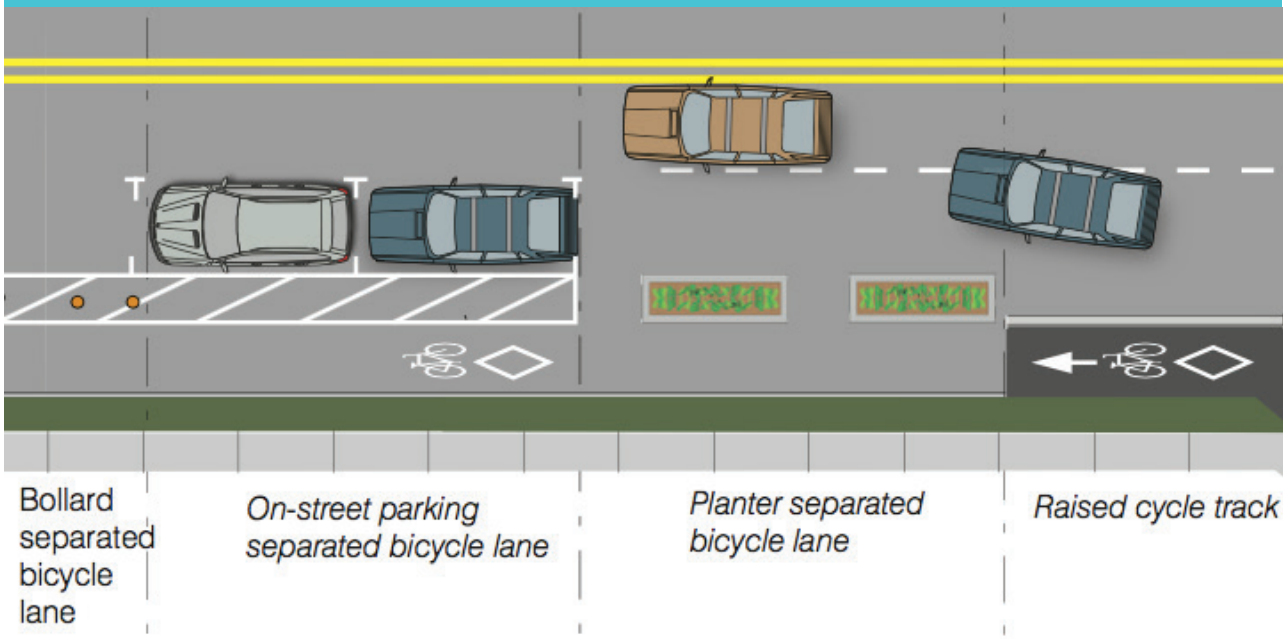
3. ON-STREET INFRASTRUCTURE

On-street, dedicated cycling infrastructure is becoming increasingly varied. However, as illustrated in the previous figure from Teschke et al., there is a clear correlation between levels of safety and the type of cycling infrastructure.

Recently, the City of Vancouver released design guidelines for AAA cycling infrastructure. On streets with low traffic volumes, local street bikeways are recommended, while protected bikeways are suggested on roadways with higher traffic volumes. In some cases, painted buffered and non-buffered bicycle lanes may be acceptable. Off-street pathways are also listed and described in more detail in Section 4.

Painted bicycle lanes on 148 St between 64 and 72 Ave (Surrey)

For protected bike lanes, cities are experimenting with different buffering treatments. Protection may include planter boxes, plastic bollards, and cement curbs, among other designs.



On Union between Gore and Main Street, Vancouver (left) the road was wide enough to maintain vehicle parking on the north side, including a buffer zone to separate moving motor vehicles from the cycling lane and provide space between people cycling and the opening of passenger doors.

On Dunsmuir St., Vancouver (above), the installation of a bi-directional planter-protected bike lane reduced the loss of vehicular space compared to having uni-directional lanes on both sides of the street. Bi-directional bike lanes are only recommended on one-way streets, and must be used with caution due to the increased demand on driver attention at intersections, where they must pay attention to people cycling in both directions. Often, right turn restrictions are used to improve safety. Planter boxes separate people cycling from parked and right turning vehicles, while increasing the greenery found within the streetscape.

The case for protected bike lanes

"Protected bike lanes use physical dividers to separate bike lanes from both cars and sidewalks. They make it pleasant for anyone to bike, just as sidewalks make it pleasant for anyone to walk"

- People for Bikes

Having trouble convincing your municipality that protected bike lanes are in everyone's best interests? People for Bikes has created an infographic explaining that protected bike lanes in US:

- Increase cycling by an average of 71% in year one
- Reduce safety risks by 28%
- Reduce driver stress
- Spur economic growth
- Reduce sidewalk cycling
- Increase pedestrian safety

Local street bikeways

The Adanac-Union Bikeway is one of many local street bikeways across Metro Vancouver, where low traffic speed limits (ex. 30 km/hr), volumes, and traffic-calming measures (see. p. 11-13) make cycling safer.

4. OFF-STREET INFRASTRUCTURE

Off-street cycling infrastructure caters to both recreational and utilitarian bike users and may be most appropriate in lower-density areas, often connecting destinations independently from the road network. Areas could include greenway, railway, and utility corridors, as well as waterfront trails that offer minimal intersections with at grade or separated crossings[7].

It is important to note the difference in utility and safety between paved versus unpaved off-street paths. Paved, smooth surfaces allow for the fullest range of bicycle and tire types, all ages and abilities, and all weather situations, providing the most efficient trips for people using cycling for transportation. Unpaved paths can be hazardous for increased falls and provide a less convenient option for those cycling for transportation. HUB Cycling always prefers paved paths.

7. See Chapter 4-3 and 4-11 of the US DoT's Small Town and Rural Multimodal Networks for additional guidance.

Shared and separated mixed-use pathways (MUPs)

Mixed-use pathways exist adjacent to, or completely removed from, roadways and accommodate people cycling, walking and using other self-propelled mobility devices. Note the considerable difference in user experience and safety between pathways that mix people walking and cycling versus designating paths for each of those uses. HUB Cycling prefers separating walking and cycling wherever it is feasible.

The 1300 to 1600 block of Argyle Ave along the Spirit Trail is a separated mixed-use pathway (West Vancouver)

Stanley Park Causeway separated mixed-use path is wide enough in some sections to accommodate two bike users side-by-side (Vancouver)

Railway Greenway (Richmond)

Fraser Heights Greenway (Surrey)

Cycling highways

Cycle highways are long distance (5-20km), direct, paved, and lit pathways that are separated from vehicles and pedestrians, with minimized stops and intersections, improving intuitiveness, safety, and efficiency.

They can accommodate lots of existing and latent bike users (including e-bikes), while greatly reducing greenhouse gases and are most effective in areas with minimal intersections, providing long-distance/ regional connections such as adjacent to Hwy 1-Lower Lynn interchanges, Hwy 99 to Tsawassen Ferry Terminal, Hwy 1- Port Mann to Central Valley Greenway, Hwy 7- Moody Central to Pitt River Bridge, and Lougheed Hwy- Pitt River Bridge to Maple Ridge Town Centre.

Lochside Trail

29 km, running from Swartz Bay Ferry Terminal and connecting with The Galloping Goose Trail. Sections of the trail are paved, off-street pathways with minimal intersections.

Galloping Goose Trail

55 km, connecting the City of Victoria to Sooke. Running along an old railway line, much of the path is paved and includes several grade separated crossings.

Cycle highway, Germany

Germany has a 100 kilometre cycle highway strategy, including completed segments from Duisburg to Hamm.

Cycle highway, London

Various cycle highways run from the outer parts of London across and into its inner core.

Bike-pedestrian bridges

Bridges currently without cycling infrastructure provide opportunities for new, dedicated AAA cycling facilities. Local examples include Gilbert Road (Richmond), Knight St (Richmond / Vancouver), Pattullo (New Westminster / Surrey), Brunette Interchange (New Westminster/ Coquitlam), and the proposed George Massey Tunnel redesign (Delta / Richmond). Care should be taken to provide high quality wayfinding for people cycling to easily understand the approaches and exits to and from the bridges.

Canada Line Bridge, Richmond

Peace Bridge, Calgary

Cycle Snake, Copenhagen

5. SPOT IMPROVEMENTS ON LOCAL ROADS

Neighbourhood bikeways, bike boulevards, and greenways are generally found on local roads, often nearby busier roadways that are close to commercial and employment uses. These routes generally contain shared bike-vehicle spaces, proper wayfinding, traffic calming and diversions, as well as low traffic volumes and speeds which make them an important component of an AAA cycling network[8]. In fact, HUB Cycling is actively working to improve changes to the Motor Vehicle Act to ensure- among other priorities- that municipalities establish a blanket 30 km/hr speed limit on all local roads with no centre lane, as lower speed limits reduce collision risk and injury severity. Presently, the cities of Vancouver and New Westminster have lowered speed limits on all designated bikeways and selected roadways.

8. (Teschke & Winters, 2009). Route preferences among adults in the near market for bicycling: Findings of the cycling in cities study. American Journal of Health Promotion, (25)1

The following examples are just a few of the common spot improvements that help make these routes suitable for bikes.

Wayfinding

Similar to walking and driving, wayfinding signage helps people cycling to better navigate through the bike network, often highlighting route choices, directions, distances, and destinations. HUB Cycling recommends that all Metro Vancouver municipalities use TransLink's Wayfinding Signage for Utility Cycling in Metro Vancouver. Consistent signage across the region makes it easier for people cycling across municipal boundaries and reduces confusion and staff time for municipal engineering teams.

Wayfinding signs include destinations and distances throughout the 26 km long BC Parkway.

Signage does not just need to be conventional signs on a pole. Research suggests that symbols on the bikeway itself such as wayfinding along Richmond's Railway Greenway which includes old tram schedules - is often read by more people[9].

Traffic calming measures

Traffic diverters

Bike-permeable traffic diverters on Yukon and 17th, Vancouver (left) are raised features that help to reduce vehicular traffic volumes on neighbourhood bikeways while allowing through traffic for people cycling.

9. (Teschke et al., 2012). Route infrastructure and the risk of injuries to bicycles: A case-crossover study. *American Journal of Public Health*, (102)12.

Traffic medians

Chicanes

Raised crossings

Raised crossings can be installed mid-street or at intersections to show that people cycling and walking have priority over turning motor vehicles.

Curb bulb-out

Curb 'bulb-outs' calm traffic and when paired with raised crossings, enhance the visibility of pedestrians crossing the street (53rd Ave from 200-203 Street, City of Langley). However, they can introduce new conflict for people cycling who may have to move further into the motor vehicle lane. Bike-permeable curb bulges or medians are best.

Elephant feet markings

Elephant's feet may indicate to vehicular traffic that people cycling may use a crossing. In selected jurisdictions, signage accompanying elephant's feet may be required to legally allow people cycling to cross at intersections without dismounting. Please consult your jurisdiction for specific bylaws relating to cycle crossings.

Nelson at Hornby St, Vancouver.

Arbutus and 16th, Vancouver shows the sign "Bikes May Use Crosswalk" and another sign using the term Crossbike. Elephant feet are faded but they are adjacent to the crosswalk lines.

Mini traffic circles

Mini traffic circles may reduce traffic speeds by requiring tighter turning radii while narrowing traffic lanes. There is an important difference between mini traffic circles on local streets and larger traffic circles (or roundabouts) that introduce the risk of road users trying to pass each other. Passing in traffic circles is dangerous. When possible, traffic circles should maintain a tight turning radii but in cases where large trucks are using the road, this is not possible. In these cases, signs should be used to indicate single file use.

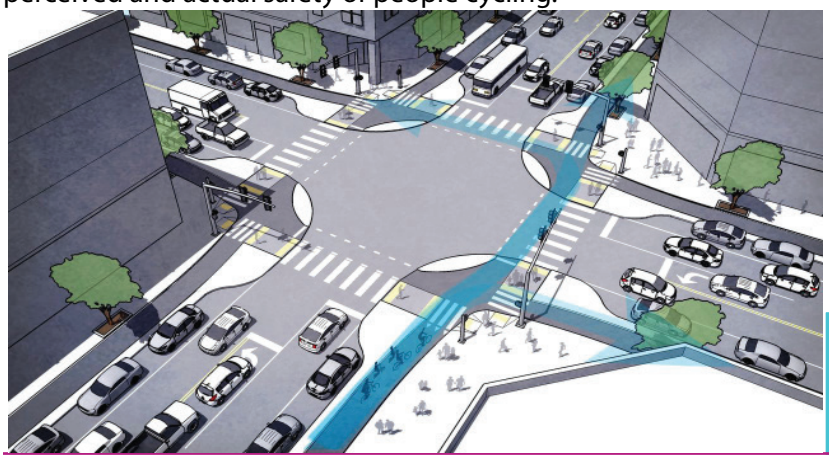
Pavement markings

Shared lane markings or "sharrows" are commonly used along bikeways and indicate that motor vehicles and people cycling must share the road. HUB Cycling is supportive of this type of infrastructure only on low-volume, low-speed routes when accompanied by appropriate signage and traffic calming measures.

6. INTERSECTIONS & SIGNALS

Protected intersections

Intersections are often miniature gaps in a city's bike network, providing people cycling with little - if any - protection or designated space. Nearly four out of five bike collisions take place at intersections in B.C[10]. Ensuring that AAA cycling infrastructure exists through intersections, and including coloured paint[11] and protected barriers[12], greatly enhances the perceived and actual safety of people cycling.



A short video here outlines the design and ratonale for protected intersections. More examples are provided through Alta Planning + Design.

10. ICBC: Cycling Safety.
11. (Jensen, 2008). Safety effects of blue cycle crossings: A before-after study. *Accident Analysis & Prevention* (40)2, 742-750.
12. (Monsere et al., 2016). User behavior and perceptions at intersections with turning and mixing zones on protected bike lanes. *Journal of the Transportation Research Board* (2520).

Signalizations

Protected bicycle signal phases usually run separately from vehicular traffic signals, allowing people cycling dedicated time to ride through the intersection. These types of signals often accompany dedicated cycling facilities, as seen at Cornwall and Burrard and along Hornby and Dunmsuir Streets (Vancouver).

Pushbutton signs

Pushbutton signs people cycling and pedestrians are often found along bikeways, providing safer and more efficient crossings at intersections involving higher traffic. volumes and speeds.

Bus islands

Bus islands reduce conflict between pedestrians and people cycling by providing separate facilities for each mode.

Bike boxes

Bike boxes provide a designated space in front of vehicles at signalized intersections, allowing people cycling to safely wait and leave the intersection to move straight through or turn left before vehicular traffic, such as this example in Vancouver.

Intersection loop detectors

In-street magnetic loop detectors allow people cycling to simply stop their bike over top of the loop to activate the crossing signal. These are in use in Vancouver.

Intersection photo detection

This is another way for people cycling to be identified to change the signal and is more affordable than the pushbuttons and loop detectors.

7. INFRASTRUCTURE FUNDING

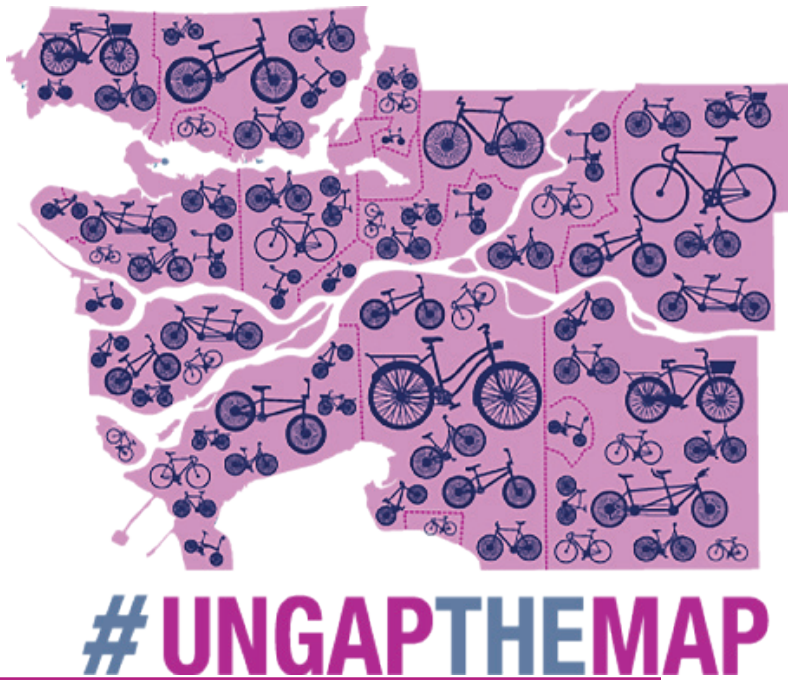
In order to create a safer cycling network, get more people cycling, and ensure UnGapTheMap is successful, it is crucial that municipalities access the cost-sharing initiatives provided by regional, provincial and federal funders. Below are a few funding sources that should be considered by your local city staff.

Level	Name	Funder	Upcoming Deadline
Provincial	BikeBC	Province of BC	TBD
Regional	TransLink Bike Infrastructure Capital Cost Sharing (BICCS) Program	TransLink	TBD
Provincial	New Building Canada Fund - Small Communities Fund	Province of BC	Rolling
Federal	Federation of Canadian Municipalities' Green Municipal Fund	Federation of Canadian Municipalities	August 1, 2017

For up-to-date infrastructure funding information, please contact HUB Cycling or your local city staff.

8. UNGAPPINGTHEMAP

It is our hope that this catalogue has provided you with a simplified overview and understanding of best-practice bike infrastructure. Furthermore, as HUB Cycling committee members, you bring valuable local knowledge to the planning process. While each municipality may approach the design and implementation of infrastructure differently, it is important to remember that many variables, including technical, physical, and economic can greatly influence the design and location of certain types of infrastructure. Please consult this catalogue when approaching city staff and councillors in your efforts to get more people cycling, more often.



Additional sources :
RoadSafety BC's Community Road Safety Toolkit
Pembina Institute (2015). Cycle Cities: Supporting cycling in Canadian cities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