The State of Cycling in Metro Vancouver 2016-2021

Benchmarking Our Regional Bike Route Network's Growth, Use, Safety, Health, and Climate Resiliency.

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About this Report

About This Benchmarking Initiative

HUB Cycling is a charitable not-for-profit organization dedicated to promoting cycling for transportation, and bringing its social, economic, health and environmental benefits to residents of the Metro Vancouver region. HUB Cycling's mission statement is "to get more people cycling, more often", which it promotes through communication, education, events, policy engagement, consulting, and research.

In 2020, HUB Cycling completed the "Benchmarking the State of Cycling in Metro Vancouver" project which established a common regional bike route classification system, compiled and coded a GIS data set for the regional cycling network, and provided an initial benchmarking analysis of the network relative to other data sets. In the years since the publication of this first benchmarking report the cycling landscape has changed as the Metro Vancouver region continued to invest in cycling infrastructure and the COVID-19 pandemic changed short- and long-term cycling behaviours.

Given the many benefits of cycling as outlined above, governmental policy makers and planners have continued building high quality cycling infrastructure in the Metro Vancouver area. In conjunction with TransLink, HUB Cycling, other advocacy groups, and academic researchers have informed the development of such infrastructure to improve its effectiveness. As a result, Metro Vancouver's active transportation bike route network is growing and improving at an accelerating pace, and is well on its way to being of high quality and connectedness throughout our urban region.

It is the goal of this report to expand upon the findings of the benchmarking report that HUB Cycling released in 2020, and to investigate additional ways that the Metro Vancouver cycle route network can be improved upon to increase ridership, and to increase the safety and wellness of people who cycle throughout the region.

This report is designed to achieve three purposes:

1. To compare Metro Vancouver's physical cycle route network as it was at the end of 2016 with the end of 2021, in accordance with comfort ratings established in the original State of Cycling GIS mapping project.

2. To analyze how cycling behaviours have changed over time since the first State of Cycling benchmarking report based on Canadian Census and other information sources.

3. To build upon HUB Cycling's first State of Cycling benchmarking report by analysing for the first time a range of health and climate-change related factors and to more robustly assess the strengths and weaknesses of the cycle route network relative to major deterrents and motivators of cycling, setting a new baseline for future benchmarking analyses.

About This Benchmarking Initiative

With the first benchmarking project we didn't anticipate that a global pandemic would impact just about everything in our lives in the intervening years. In this second benchmarking analysis, we analyzed the following topics in the context of the pandemic's impacts on overall commuting rates and patterns:

- *Improvements to the cycle route network over time*
- *Changes in cycling rates, in particular cycle commuting*
- *Demographics and cycling rates / trends*
- *Cycling education direction and impacts*

For this second analysis, we have also added a focus on interrelated safety, health and wellness, and climate resilience topics directly impacting the network's accessibility relative to the current state, and future development, of our region's public cycling infrastructure:

- *Pollution and air quality*
- *Noise*
- *Heat*
- *Tree cover*
- *Slopes*

This research also includes topics that call for increasing attention in decision-making about future development of the network, given their growth and value in making cycling more accessible to everyone:

- *Disabilities and cycling accessibility / safety*
- *The growth of electric-assist cycling*

About This Benchmarking Initiative

Data Gaps and Analysis Limitations

While we now have a high quality data set about the nature and level of comfort for all segments of the Metro Vancouver cycle route network, other key data sets needed for a robust benchmarking analysis of the network are either incomplete, disaggregated, or non-existent. This research effort brought to light the need to start or improve / expand the collection of certain data throughout Metro Vancouver. The collection of the following data sets would allow for a much better understanding of how infrastructure improvements impact cycling rates, who is cycling where and when, what are trends in bicycle types and trip purposes, how safe do people feel cycling on different infrastructure types, and how safe are people when they cycle anywhere on the network.

- **2016 CYCLE ROUTE DATA:** The initial State of Cycling benchmarking project completed by HUB Cycling and TransLink generated GIS data by comfort classification for the regional network as of the end of 2019. For this second benchmarking project, we chose to do a comparative analysis of 2016 and 2021 data to match the years for which Canadian Census "Trip to Work" data is collected. HUB Cycling benefited from research completed by Angie Weddell [#2] in which she extrapolated from HUB's 2019 GIS data set to create a fairly accurate proxy GIS and comfort rating data set for 2016. It is Ms. Weddell's 2016 data set that we used for comparison purposes in this report.

- **CYCLING VOLUMES:** There is currently only cycling volume data collection at a limited number of locations and limited times of day and year. This limits our collective ability to look at how many people are using what facility types when.

- **CYCLIST DEMOGRAPHICS:** Data on who is cycling outside of adult commuter cycling is only collected on a limited basis. This means that we do not know enough about youth cycling numbers and trends, nor do we have sufficient data about gender, age, race, and other demographics.

- **NON-COMMUTER CYCLING:** The Canadian Census survey only provides data about people who report cycling as their primary commuting mode. It doesn't provide data on cycling trips for other purposes, nor data about who rides on what facility types. Initiatives like Pedal Poll 2021 and TransLink trip diaries are positive efforts to provide data about network use, but they are not sufficient for a full understanding of cycling trends and demographics in Metro Vancouver.

- **SAFETY:** Collision data regarding cycling is limited to what is reported to ICBC - and hence involves a motor vehicle for which an insurance claim may be made. There are no sufficient data sets about falls and collisions not involving motor vehicles, unreported collisions with motor vehicles, near misses, or perceptions of cycling safety.

How To Use This Report

While this report is focussed on the Metro Vancouver area cycle route network, the findings of the report can be applied to cities around the world, and can act as a unique information source to inform the design of effective cycling infrastructure. It portrays the progress in the regional network from governmental investments to date, and the benefits those investments have generated. It also informs decision-making for the siting and design of future infrastructure investments.

Based on your stakeholder position related to our regional cycling infrastructure, HUB Cycling hopes you consider the following in light of this report:

Elected government representatives and staff, especially transportation planners and engineers:

- *Understand the findings of the report and recommendations*
- *Analyze the routes within your own municipality and understand their strengths and weaknesses*
- *Use the findings of the report to inform improvements to existing infrastructure and to plan new infrastructure*

People who cycle:

- *Use this report to optimize the routes you choose to ride*
- *Engage with policy makers in your community in accordance with these findings to enact positive change to the cycle route network*

People who don't cycle - yet:

- *Think about what barriers exist that prevent you from cycling*
- *Engage with findings or references in the report to address these issues*
- *Visit HUB Cycling's website and see how you can start your cycling journey today*

Numeric citations in the text regarding data sources refer to the References section at the end of this report.

Acknowledgements

First Nations Land Acknowledgement

HUB Cycling recognizes that the regional cycle route network was developed, and that this research was conducted, on the unceded ancestral shared territories of many Indigenous peoples, including 10 local First Nations: q̓íćəy̓(Katzie), q̓ʷɑ:ńƛ̓əń (Kwantlen), kʷikʷəƛ̓əm (Kwikwetlem), máthxwi (Matsqui), xʷməθkʷəy̓əm (Musqueam), qiqéyt (Qayqayt), se'mya'me (Semiahmoo), Sḵwx̱wú7mesh Úxwumixw (Squamish), scəẃaθən məsteyəxʷ (Tsawwassen) and səlilwətaɬ (Tsleil-Waututh). HUB Cycling strives to positively contribute to reconciliation in this region. We are increasing our knowledge about First Nations history and culture, and creating inclusive programs and research to bring the benefits of cycling to First Nations communities as part of our goal to make cycling more equitably accessible to all.

Project Contributors

This project would not have been possible without the support of those contributing their time, expertise, and funding. The following individuals and organizations collaborated to bring this project to fruition.

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- City of Vancouver

Introduction - Setting the Context for Network Benchmarking

Section Overview

Introduction - Setting the Context for Network Benchmarking

HUB Cycling is pleased to release this second State of Cycling Benchmarking analysis of Metro Vancouver's cycle route network to inform future development of cycling facilities in our urban region. It builds upon HUB Cycling's first Benchmarking project, completed in 2019 in collaboration with TransLink and regional municipalities. For this second benchmarking effort, we have expanded the analysis by engaging with diverse academics and institutions, and by sourcing a broader range of health and climate-change related data sets[1]. Through analysis of these newly acquired data sets, the intent of this report is to better contextualize the quality and connectedness of the bike route network to ultimately increase its use and to set new baseline measures for future benchmarking analyses.

As Metro Vancouver continues to grow and new infrastructure is developed, cycling facilities planning should be informed by broad-based research to maximize its effectiveness in increasing cycling. In recent years, policy makers at different levels have increased investment in cycling infrastructure to increase ridership and promote active transportation. This trend has been reflected in a variety of regional and provincial planning documents.

"A Regional Cycling Strategy for Metro Vancouver" published by TransLink in 2011 sets a goal to increase cycling mode share to 15% by 2040 for all trips less than 8 kilometres. It also sets a goal of improving the safety of the network such that by 2040, 50% of all cycling trips will be made by women and that 50% fewer people will be killed or seriously injured while cycling. Another document published by TransLink titled "Moving Towards a Major Bikeway Network" describes plans to build 850 kilometres of traffic-protected bikeways to connect the urban centres of Metro Vancouver and form the backbone of Metro Vancouver's evolving cycle route network. The Transport 2050 10-Year Priorities plan more recently has set goals for completing 75% of the Major Bikeway Network and making active transportation the most convenient choice for shorter trips. Additionally, provincial and federal strategies to improve cycling outlined in publications such as the Province of BC's "Move Commute, Connect" active transportation strategy and "Canada's National Active Transportation Strategy" are reflected by active transportation plans developed and adopted by regional municipalities.

While the scope of these reports differ, the message is consistent: To increase cycling rates in the Metro Vancouver region, strategic investments in cycling infrastructure need to be made. Doing this will permit the region to realize the benefits associated with increased cycling for both individuals and the community.

Research has firmly established the diverse health, equity, economic, and environmental improvements experienced by individuals and communities that cycle regularly. Cycling as a form of active transportation has mental health and cognitive benefits as it leads to a high rate of travel satisfaction, improves subjective work performance and mood, all while reducing stress. Cycling is also associated with increases in fitness and decreases in risk of cardiovascular disease, cancer, and all-cause mortality.

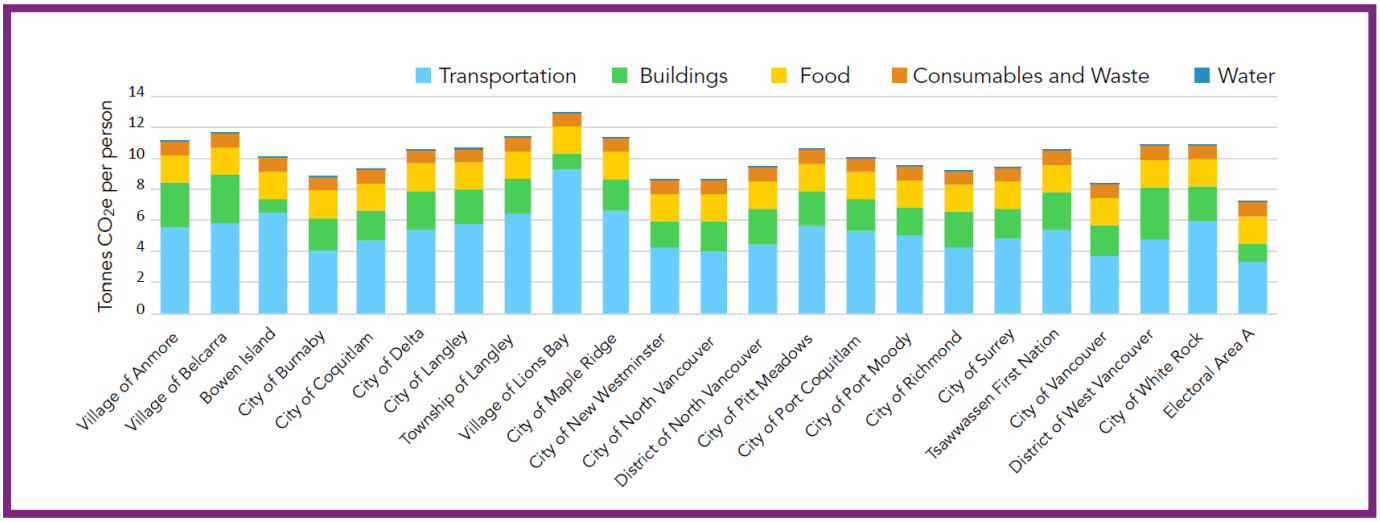
In addition, people who bike more save money on transportation costs. The cost of owning and maintaining a bike is estimated to be $300/year while the cost of owning and maintaining a car is $9,500/year and a one year public transit pass in Metro Vancouver costs approximately $1,250. On a larger scale, research has found that among different policies that promote economic growth, policies that emphasise bike-sharing, cycle parking, cycle training and education, low traffic neighbourhoods, e-bike grants, and increased use of 'cycle-to-work' schemes result in large economic benefits.

Finally, cycling has been found to have positive impacts on the environment. Cycling emissions per kilometre travelled are 30 times lower than travel by a fossil-fuel powered car. In addition, by switching one trip a

day from driving to cycling, urban residents are able to reduce their carbon dioxide emissions by an estimated half a tonne per year, the equivalent of a one-way flight from London to New York. Given the climate crisis, a transportation mode shift to cycling is a feasible way for Vancouverites to engage in a more sustainable behaviour and positively impact the environment.

The chart below demonstrates the urgency of addressing transportation emissions to reduce greenhouse gas emissions in the region. Transportation is by far the single largest producer of greenhouse gasses in Metro Vancouver, with cars and trucks producing 32% of greenhouse gas emissions. This presents a unique opportunity for municipalities to decrease their greenhouse gas emissions via simple changes to transportation infrastructure. The figure below from the Metro Vancouver Regional District shows the consumption-based breakdown of CO2 emissions by municipality, with the transportation component including heavy machinery, rail and boat in addition to cars and trucks. Metro Vancouver explains that generally, larger communities such as Vancouver or Surrey have higher emissions due to their larger populations. Lower density communities with larger homes or those that rely more on vehicles showed higher emissions per person.

Figure 1: Consumption-Based Emissions Inventory of GHG Emissions per person in Metro Vancouver , 2015. Source: Metro Vancouver.



In response to the positive impacts of cycling, cities around the world are adopting more bike friendly measures. In Copenhagen where 56% of all trips are already by bike, the city set aside over $100 million (cad) in 2020 to further invest in cycling. In Africa, countries have partnered with the United Nations to improve cycling infrastructure to prevent cars from reducing cycling mode share across the continent. In Auckland, $525 million (CAD) is being invested in cycling infrastructure from 2018 to 2028.

Closer to home, in Toronto, over 100 kilometres of new bike routes are being installed and existing ones upgraded through a 2023 investment of $30 million. In Edmonton, $100 million has been allocated for new cycling facilities between 2023 and 2026. In Montreal, 200 kilometres of separated bike routes will be added to its already extensive network by 2027 through an investment of $30 million in 2023. These infrastructure investments should greatly increase the number and diversity of people who choose to cycle, since infrastructure has been consistently shown among the strongest influences on decisions about whether to ride.

Metro Vancouver's Bike Route Network

Section Overview

Metro Vancouver's Bike Route Network

In 2019, HUB Cycling and TransLink worked with regional municipalities and the BC Ministry of Transportation and Infrastructure (MoTI) to create a common cycling facilities classification system and develop a detailed GIS data set and map of all cycle routes in the Metro Vancouver region. The State of Cycling data and map allowed stakeholders to see how the Metro Vancouver cycle route network developed between 2016 and 2019 as a result of improvements and additions to the network over the three years.

Since then, COVID-19 related restrictions and disruptions to normal transportation behaviours gave Metro Vancouver, in parallel with other metropolitan regions world-wide, the opportunity to implement pro-cycling policies and infrastructure that may have otherwise been rejected. The result of this was continued growth in the amount and quality of cycling infrastructure in the Metro Vancouver area, although at a decreased rate between 2019 and 2021 (see more below).

In addition to the installation of permanent cycling infrastructure, some Metro Vancouver region governments implemented temporary cycle paths to capitalize on increased interest in cycling and decreased automobile traffic during the pandemic. Some regional municipalities created temporary bike-friendly "slow streets" and ad-hoc new cycle routes during the pandemic lock-down period to encourage people to stay active in a safe manner. While some of these routes were removed at the end of the pandemic, their creation demonstrated that there is potential for a substantial paradigm shift in attitude regarding cycling and the implementation of cycling infrastructure in the Metro Vancouver region.

The Network Comfort Classification System

One of the major features of HUB Cycling's original State of Cycling report was the development of a common region-wide bike route classification system in collaboration with TransLink and all regional municipalities. This classification system enables a consistent approach for describing cycle routes across municipal boundaries. The classification system considers both the infrastructure or "facility" type associated with its perceived and actual level of safety and comfort. The objective classification system is described in the two figures below. The classification system is now being used by governmental and private sector planners designing cycle routes, and to develop improved cycling maps for the public to more effectively plan their cycle routes.

Figure 2: Metro Vancouver Bike Route Classification System - HUB Cycling & TransLink

Comfortable for Most People (green segments): These bikeways are either fully protected from motor vehicle traffic or are on shared roadways with low posted speed limits (i.e. 30 km/h or less) and low motor vehicle traffic volumes (i.e. less than 2,000 vehicles per day).	**Comfortable for Some People** (yellow segments): Most of these bikeways are shared roadways where posted speed limits are higher (i.e. up to 50 km/h) and there is more motor vehicle traffic (i.e. up to 3,000 vehicles per day). Some painted bike lanes and bike accessible shoulders also fall into this category, as well as a small portion of bikeways that are protected from motor vehicle traffic but are narrower in width than is recommended by current design standards.
Comfortable for Few People (orange segments): The majority of these bikeways are painted bike lanes or bike accessible shoulders on roadways with higher posted speed limits (i.e. 50 km/h or greater) and more traffic (i.e. more than 4,000 vehicles per day). Some shared roadways with higher posted speed limits and higher volumes of motor vehicle traffic also fall into this category.	**Comfortable for Very Few People** (red segments): Many of these bikeways are shared roadways where posted speed limits are higher (i.e. greater than 50 km/h) and there are higher traffic volumes (i.e. 6,000 or more vehicles per day). Some painted bike lanes and bike accessible shoulders also fall into this category, including those with adjacent curbside parking and higher speed limits (i.e. greater than 50km/h).

Figure 3: Metro Vancouver Glossary of Bikeway Facility Types - HUB Cycling & TransLink

Bike Path

Uni or bi-directional, segregated off-road facility for the exclusive use of people cycling. May be paved or unpaved.

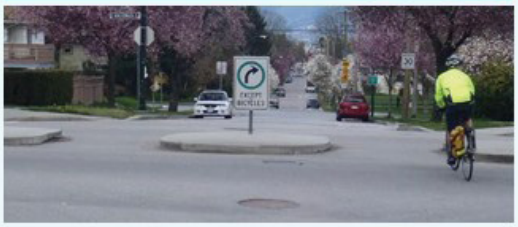
Protected Bike Lane

Exclusive on-road facility delineated by a vertical barrier element providing physical separation from motor vehicles, as well as separation from pedestrians.

Multi-Use Path

Off-road facility that allows for shared use by people cycling and walking. May be paved or unpaved

Shared Roadway



Bikes and motor vehicles share the roadway. May or may not involve diversion and calming of motor vehicle traffic, limiting exposure to motor vehicle traffic.

Bike Lane

On-road bikeway adjacent to a curb or a parking lane and delineated from motor vehicles by a painted line or similar markings.

Bike Accessible Shoulder

Signed and marked, designated on-road paved facility with no curb, located to the right of a general purpose travel lane, and separated by a white edge line or painted buffer. May be shared with pedestrians in rural settings.

Network Classification System Limitations

It is worth recognizing some of the limitations of the bikeway classification system, as these are areas that could be considered for refinement as future updates to this work take place:

1. **Data Sampling:** With over 16,000 bikeway segments, an approach to classification that used sampling and assumptions was required. Substantial data was provided by local government staff and substantial field work was done by HUB volunteers to provide the most accurate assessment possible. However, sampling and assumptions (particularly with regard to traffic volumes) were applied to classify many segments.

2. **Intersections:** Street crossings are important to the overall experience of cycling, because these are instances where paths of travel for people cycling and people driving intersect and therefore where most vehicle-bike conflicts occur. Unfortunately, there is currently insufficient information readily available regarding conditions at intersections across the region. Collecting that information was beyond the scope of this project therefore assessment of intersections was not included as part of this work. Instead, this classification system identifies level of comfort by evaluating bikeway segments in between intersections.

3. **AAA Bikeways:** There are 23 local governments within Metro Vancouver, and there are various ways local governments describe their bikeway networks. One area where there is substantial attention in bikeway planning and design, but no accepted universal definition, is bikeways described as Comfortable for "All Ages and Abilities" (or AAA). AAA represents the highest level of design and comfort for people cycling, beyond the topmost range of the bikeway classification system used for this report which is "Comfortable for Most People". To illustrate the distinction, consider that the City of Vancouver classifies approximately 25% of their bikeway network as AAA, while in this report, 78% of Vancouver's network is classified as "Comfortable for Most."

The Impacts of Cycling Infrastructure Location and Design

Section Overview

The Impacts of Cycling Infrastructure Location and Design

The location and design of cycling infrastructure strongly influences many people's decisions whether to use bicycles for transportation. When someone is deciding to bike or not, they consider many potential motivators and deterrents. Motivators for cycling are factors that encourage cycling through an associated benefit or the removal of barriers to engage in the activity, while deterrents are factors that prevent or make it more difficult to engage in the activity.

For example, bike route types and proximity are fundamental to cycling rates. 2016 research by Meghan Winters, Kay Teschke, Michael Brauer & Daniel Fuller [#17] into bike route characteristics across 24 North American cities found for example that nearness to a high quality bike route is positively correlated with cycling rates. A bike route being 400 metres or less from someone's home was identified as being a positive motivator for cycling, and also as the distance people will generally detour from a direct route in order to access a high quality bike route.

While off-street bike paths are identified as the most preferred route types by cyclists, the network of residential street bike routes is very important for cycling in Vancouver. Easy access to residential street bikeways had strong positive associations with cycling commute mode share, but proximity to painted bike lanes did not have the same association. Proximity to steep slopes is also associated with lower neighbourhood-level cycling mode share, though the association is weaker than for proximity to high quality cycling infrastructure. A full list of major motivators and deterrents to cycling are listed in the table below.

Figure 4: Deterrents to and Motivators for Cycling - Dr Kay Teschke

What Deters Cycling?

Photo credit: Jeff & Jenny Wright

What Motivates Cycling?

Route Features

- routes with heavy car, bus, or truck traffic
- routes with vehicles driving faster than 50 km/h
- routes with glass or debris
- routes with uneven surfaces & potholes

- routes away from traffic noise and air pollution
- routes with beautiful scenery
- bicycle paths separated from traffic for the entire distance
- flat routes

Safety

- motorists who don't know how to drive safely near bicycles
- potential injury from car-bike collisions
- bike theft

- secure bike storage, indoors or under-cover

Convenience

- need to transport bulky or heavy items
- travel distances over 10 km

- cycling takes less time than other modes
- travel distances less than 5 km
- bikes allowed on transit
- end of trip changing, drying, & storage facilities

Weather & Time of Day

- snow or ice on the route
- rainy weather
- poor lighting after dark

- daytime trips

The strongest deterrents are high speed and heavy motor vehicle traffic. The strongest motivator is the existence of a network of connected routes separated from traffic. Research has established that cycling behaviour is more sensitive to deterrents than motivators to cycling. So, in order to most effectively plan and implement cycling infrastructure to influence ridership, planners should prioritise minimizing deterrents. The importance of infrastructure to people's willingness to travel by bike is the reason this report starts with an analysis of the MetroVancouver bike route network.

Angie Weddell, a researcher with Simon Fraser University, completed a Metro Vancouver-specific analysis in 2024 regarding the impact on cycling rates of the proximity of formal bike routes to points of origin and destinations. She found that:

- A **1 kilometre decrease** in the distance to any formal bike route was associated with a **7.2 fold** increase in cycling mode share for all commuters
- For male commuters, the increase was **6.8 fold**
- For female commuters, the increase was **35 fold**
- For specific bikeways types, only "comfortable for most" bikeways were associated with higher rates of bike commuting: **10.2 fold** for all commuters, **8.6 fold** for male commuters, and **49.6 fold** for female commuters.

Equitable access to high quality infrastructure across the region, and across socio-economic population groups, is a high priority for increasing cycling rates. HUB Cycling has completed a separate research report on that topic, Unlocking Equity in Metro Vancouver's Cycling Network, which includes these key recommendations:

1. Adopt an equity-informed design approach for the design and implementation of cycling infrastructure.

2. Define equity scores and prioritize underserved areas.

3. Develop and build a safe, comfortable, and equitable regional cycling network while improving access to transit for underserved areas.

4. Engage and empower vulnerable populations including racialized communities, low-income individuals, and women.

5. Incorporate UNDRIP (The United Nations Declaration on the Rights of Indigenous Peoples) in active transportation planning.

6. Monitor and evaluate equity outcomes to establish mechanisms for monitoring and regularly evaluating the impact of infrastructure improvements.

Metro Vancouver Cycle Route Network Growth

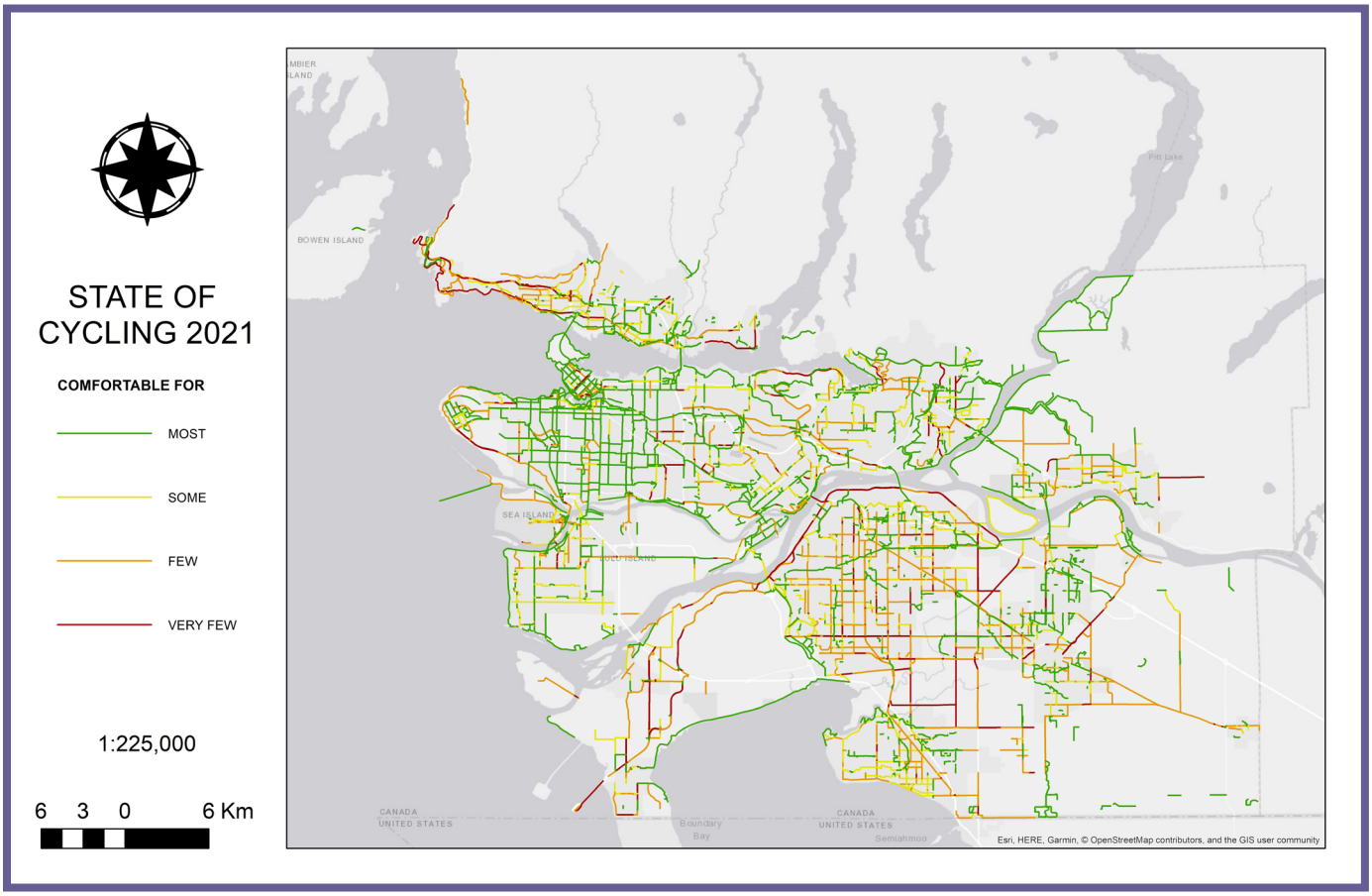
Photo credit: Ken Ohrn

Section Overview

Metro Vancouver Cycle Route Network Growth

Our regional cycle route network is growing and improving in quality and connectedness at an ever accelerating pace. The bike route network as of the end of 2021 is represented in the map below.

Figure 5: 2021 Metro Vancouver Cycle Route Network Map by Comfort Classification



While the cycle route network is robust, some areas still lack "comfortable for most" facilities which are most effective at increasing ridership. In addition, gaps between "comfortable for most" routes exist throughout the region, and network completeness is another factor that increases ridership.

The map below highlights the breakdown of all cycle routes in the Metro Vancouver area according to their comfort classification. TransLink and municipal goals for the network are to improve all segments so they are "comfortable for most", and to increase connectivity toward developing a complete network for the whole region. TransLink's Major Bikeway Network project plans to improve upon this by installing 850 kilometres of "comfortable for most" routes throughout the region. As of 2021, 250 kilometres of the Major Bikeway Network had been built.

In partnership with TransLink, and with the assistance of University of British Columbia academic researcher Angie Weddell, we have been able to analyze how the cycle route network compares between the years of 2016 and 2021, with some analysis also of the network as it was in 2019. The increases in total kilometres and comfort ratings of Metro Vancouver's cycle route network between 2016 and 2021 are shown in the three figures below.

Figure 6: Metro Vancouver Cycle Route Additions from 2016 - 2021

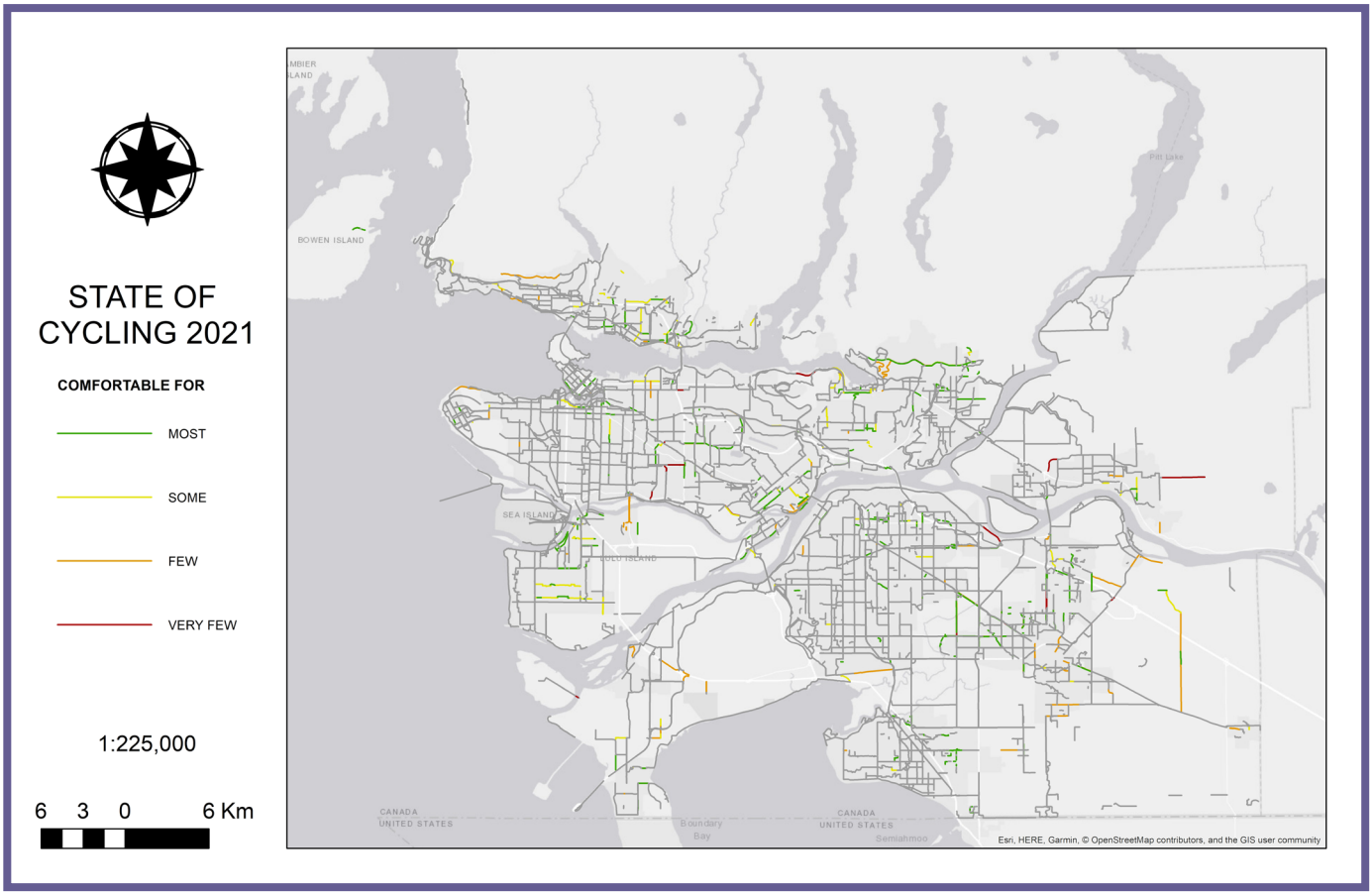


Figure 7: 2016 and 2021 Metro Vancouver Cycle Route Total Kilometres by Comfort Classification

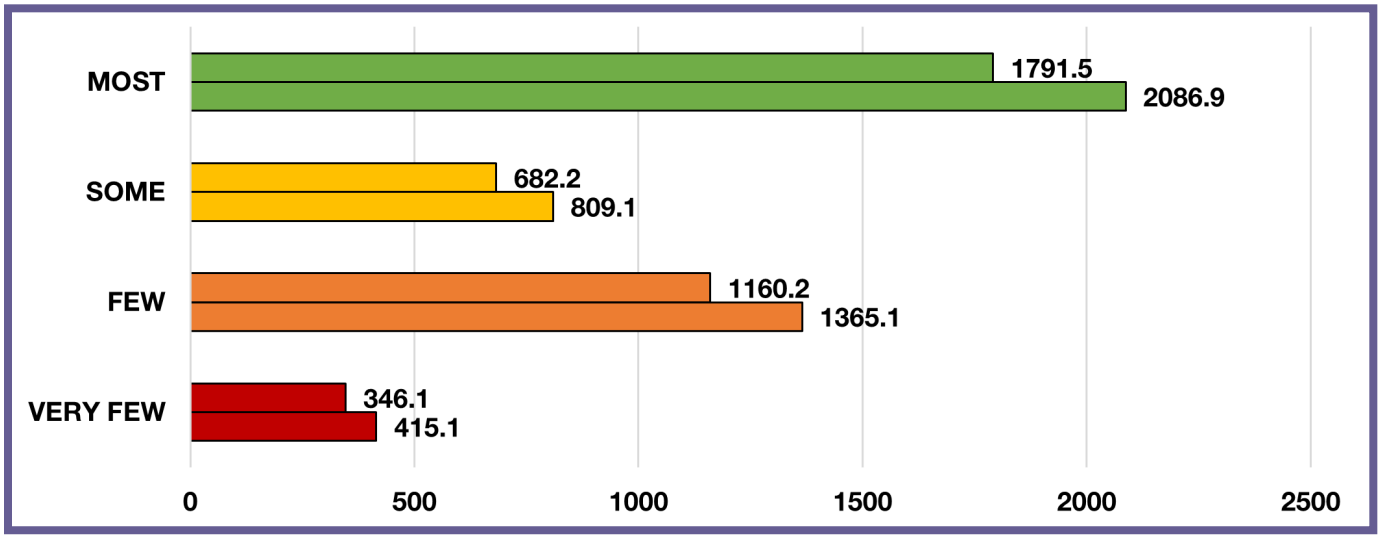
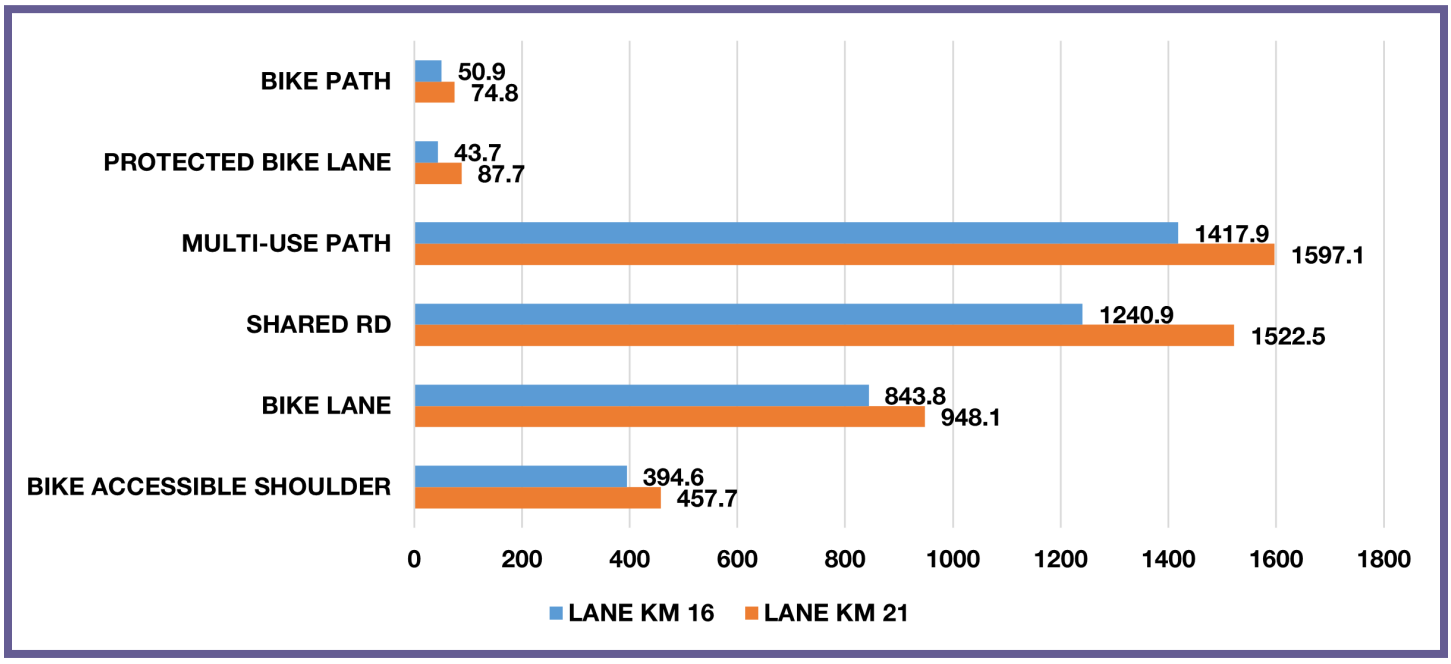


Figure 8: Total 2016 and 2021 Metro Vancouver Bike Network Kilometres by Facility Type

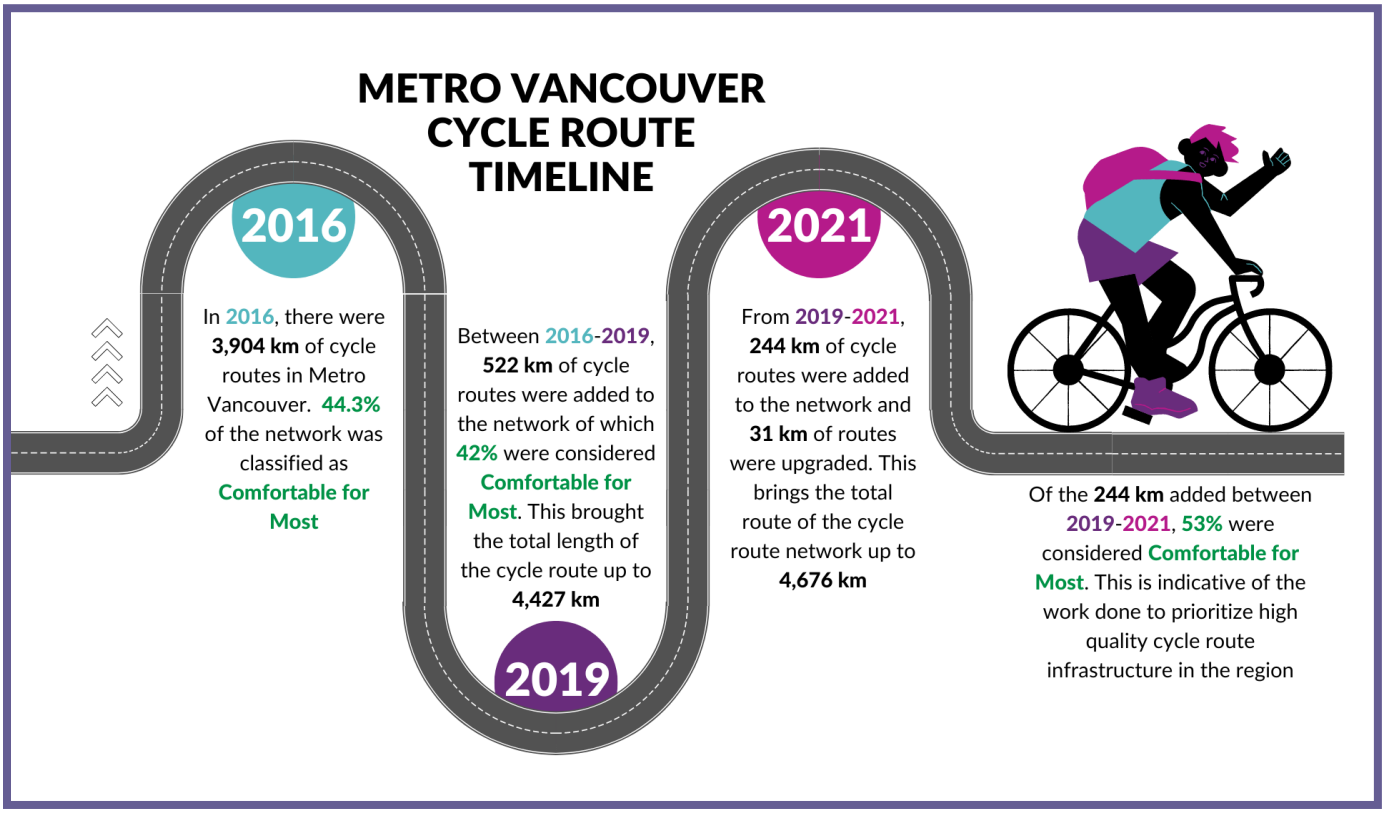


NOTES:

1. There is a discrepancy in total kilometres for network length by comfort level, and by facility type. This is an outcome of the process of extrapolating 2016 numbers from the 2019 GIS data set.
2. Lane kilometres represent the total rideable distance of the network. Facilities that are rideable in both directions were counted twice to represent each travel direction.

Adding in 2019 numbers, our analysis indicates that the rate of new permanent cycling infrastructure installations was lower between 2019 and 2021 than it was between 2016 and 2019.

Figure 9: Metro Vancouver's Cycle Route Network Development from 2016 to 2021



The dynamics impacting the rate of development of new cycling infrastructure during the period between 2019 and 2021 are more complex than they would have been had the pandemic not occurred. While cycling became a solution for transportation, exercise, and social interaction during COVID "social distancing", the pandemic also negatively impacted governmental budgets and materials supply chains, and impeded the ability for governmental and private sector staff to complete infrastructure installations.

The focus of some government staff responsible for transportation during COVID shifted to pandemic emergency response, which may have reduced their capacities for creating permanent infrastructure relative to what would have otherwise been the case. What can't be observed by comparing 2019 and 2021 data is how much preparatory work was completed by governmental bodies during that period for the development of new permanent infrastructure in subsequent years.

Figure 10: 2016-2021 Metro Vancouver Network Comparative Analysis by Municipality

	Total Distance of Cycle Route Network (Km)	% of Network Classified as "Comfortable for Most"	Total Distance Added to Network from 2016 - 2021 (Km)	% of Distance Added to Network from 2016 - 2021 Classified as "Comfortable for Most"	% of Population within 400 m of a "Comfortable for Most" Route
Metro Vancouver Region	**4676**	**45%**	**244**	**53%**	**67%**
Vancouver/UBC					
Electoral Area A (UBC)	91.5	32%	8.5	36%	96%
Vancouver	626.9	78%	70.7	64%	90%
Burnaby/New Westminster					
Burnaby	348.2	50%	26.8	94%	70%
New Westminster	106.9	64%	29.1	44%	91%
North Shore					
Bowen Island	1.9	100%	---	---	0%
Lions Bay	6.5	0%	---	---	0%
North Vancouver City	92.1	52%	28.6	57%	91%
North Vancouver District	129.2	46%	62.9	1.7	50%
West Vancouver	214.9	13%	0.1	100%	49%
Northeast					
Belcarra	5.8	100%	---	---	0%
Coquitlam	191.0	49%	38.9	63%	56%
Maple Ridge	96.2	23%	18.7	25%	35%
Pitt Meadows	187.0	78%	10.1	19%	52%
Port Coquitlam	145.0	56%	53.9	17%	84%
Port Moody	93.8	47%	23.4	39%	73%
Southwest					
Delta	372.0	28%	24.8	10%	45%
Richmond	340.4	46%	66.7	50%	58%
Tsawwassen FN	9.7	39%	6.5	59%	0%
Southeast					
Langley City	39.2	44%	11.2	39%	67%
Langley Township	383.5	48%	72.1	37%	60%
Surrey	1132.3	27%	92.5	63%	56%
White Rock	42.7	6%	18.2	2%	21%

Another factor impacting the rates of cycling infrastructure development is the outcome of the 2022 municipal elections, which for some municipalities led to changes in political support for the transition to active transportation. This research project didn't seek to discern how the political positions of elected municipal representatives have impacted cycling infrastructure investments. Those impacts are moderated by the existence of long-term Active Transportation plans and budget allocations implemented by municipal staff. An in-depth analysis of the interplay between the roles of elected officials and the roles of staff on rates of active transportation infrastructure development would be enlightening.

Cycle Route Network Usage

Section Overview

Cycle Route Network Usage

Usage of Metro Vancouver's robust cycle route network can be broken down into two general categories, utility cycling and recreational cycling. Utility cycling encompasses cycling trips made for transport whether that be to or for work, shopping, appointments, or to visit family and friends. Recreational cycling consists of trips made for leisure or sport. While HUB Cycling supports increases in both types, the organization aims to primarily support the growth of utility cycling through education, events, and advocacy that break down barriers and make urban cycling more accessible to all.

To better understand ridership promotion strategies in the region, it is important that we report on use of the cycle route network. The most complete data available for all Metro Vancouver municipalities is Census data on commuting to work, collected every 5 years. It includes data from 25% of households, much more complete than any other cycling data source. Census data on cycling was provided in our first State of Cycling Report and is reported here again.

According to the 2021 Census, the percentage of commuters using bicycles as their primary mode decreased from 2.35% in 2016 to 1.36% in 2021. Unfortunately, the Census only includes data on commuting to work, and omits trips to school, shopping, appointments, and for recreation. According to the 2017 TransLink Trip Diary Survey, fewer than 20% of trips are for commuting to work. There is a further difficulty with the most recent Census in May 2021: it was done during the pandemic before the full population was given their initial vaccination. This was a time period when commuting to work was fundamentally changed, because many people lost work or worked from home, and those who normally took transit sought other modes.

General Commuting and Bike to Work Trends during Pandemic Conditions

The effects of the COVID-19 pandemic on travel behaviour in general, and active transportation in particular, in Metro Vancouver at the time of the 2021 census is a confounding issue for this benchmarking analysis. The Census provides data on how cycle commuter rates have changed with the pandemic. Despite a slight increase in the quality of the cycle route network, an increase in the amount of people close to a comfortable for most cycle route network, and changed attitudes towards personal modes of transportation as a result of the pandemic, Census responses indicate that there was a decline in cycle commuting to work rates between 2016 and 2021, likely a result of more people working from home during the pandemic.

The table below explores how commuter cycling rates have changed in the different municipalities of Metro Vancouver. These trends observed in Canada mirror those around the world. In America, popular cycling commuter cities such as Portland, San Francisco, and Minneapolis each observed drops in commuter cycling rates of over 4 percent.

The pandemic forced many people to work from home, and for some others it led to temporary or permanent employment lay-offs. From 2016 to 2021, the number of people who primarily worked from home increased from 8.2% to 26.5%. Additionally, many people temporarily or permanently lost employment as a result of the pandemic. Those changes greatly impacted overall population travel habits, though not evenly by employment type. For certain job-types, employees still needed to be physically at their worksites (eg: health, food, retail, construction). It is revealing to analyse changes in commuting transportation mode based on employment type, to ascertain what would have potentially been higher overall cycling rates had there not been a shift to working from home and significant loss of employment.

The pandemic significantly disrupted commuting habits for those whose occupations allowed them to work from home or from another non-workplace location. Census Journey to Work data corresponds with expectations of general need to commute to work for different occupational categories. Those in categories that most likely allowed them to work remotely (eg: engineers, lawyers, public administrators) saw a far

Figure 11: Cycle Commuting Rates Changes by Municipality - 2016 to 2021

	% of Commuters who Primarily Cycle to Work (2021)	% Change in Cycling Commuters (2016 to 2021)	% of Cycling Commuters that are Female (2021)	% Change in Female Cycling Commuters (2016 to 2021)
Metro Vancouver Region	**1.86%**	**-0.49%**	**37.17%**	**1.75%**
Vancouver/UBC				
Electoral Area A (UBC)	8.3%	-0.4%	25.4%	-9.7%
Vancouver	5.3%	-0.9%	42.2%	3.1%
Burnaby/New Westminster				
Burnaby	0.9%	-0.2%	24.1%	0.1%
New Westminster	0.9%	0%	16.7%	-6.3%
North Shore				
Bowen Island	2.4%	-0.3%	33.3%	8.3%
Lions Bay	0%	---	0%	---
North Vancouver City	2.2%	-0.4%	31.3%	6.1%
North Vancouver District	2.4%	0%	33.0%	6.7%
West Vancouver	1.7%	0%	23.5%	3.5%
Northeast				
Anmore	0%	-1.0%	0%	---
Belcarra	0%	-4.0%	0%	---
Coquitlam	0.5%	-0.1%	31.3%	9.3%
Maple Ridge	0.5%	0%	26.5%	-6.0%
Pitt Meadows	0.9%	0.3%	28.6%	3.6%
Port Coquitlam	1.0%	0.2%	27.1%	2.1%
Port Moody	0.6%	0%	15.4%	-5.7%
Southwest				
Delta	1.0%	0.2%	29.3%	-14.0%
Richmond	1.2%	-0.1%	27.0%	0.9%
Tsawwassen FN	1.9%	-2.1%	0%	---
Southeast				
Langley City	0.6%	0.1%	14.3%	-8.8%
Langley Township	0.5%	-0.2%	27.1%	0.3%
Surrey	0.3%	-0.1%	22.7%	-3.0%
White Rock	0.6%	-0.1%	50.0%	22.7%

commuting rates, rather than a general decrease in interest in commuting by bicycle.

greater change in general travel mode behaviours than those who were in categories most likely necessitating continued commuting to workplaces (eg: retail, construction, healthcare).

Looking at the age of workers and their travel habits, core working-age employees - those aged 25 to 54 - were more likely to work from home during the pandemic than employees in other age groups. Younger employees were the least likely to work from home, and the work-from-home rate for employees aged 55 and older was between the other two age groups. Full-time employees tended to work from home more than part-time employees, and the higher an employee's level of education, the more likely they worked from home.

During this period, many regular public transportation users who still needed to commute turned to active transportation and automobiles as their travel modes to decrease the risk of exposure to COVID-19. Despite increased interest in cycling during the pandemic, cycle commuting to work rates went down in ten of the most populated cities in Canada. Our analysis of cycling rate changes by occupation below indicates this trend may be due to unprecedented decreases in overall

There are numerous research projects being conducted about COVID and cycling / active transportation perspectives and rates. This is fortunate, because the impacts of the pandemic are important to understand so that transportation and community planners can better approach cycling promotion in a post-pandemic world.

Demographics, Occupation, and Cycling Rates

Section Overview

Demographics, Occupation, and Cycling Rates

Census data analysis enables investigation of who uses the Metro Vancouver cycle route network for commuting to work, and reveals that certain groups were more likely to cycle commute to work than others. This data allows us to better understand individual factors that impact engagement in cycling, as well as broader societal values in relation to cycling. When considering Commute to Work data, it is important to keep in mind that it was reported in 2021 following the deep impacts of the pandemic on daily life patterns. Had the census been completed in 2023, when pandemic impacts had largely subsided, responses may have been different.

Cycle Commuting and Age

As of the 2021 census, people who were 35 years or older accounted for 61% of cycle commuters compared with 54% in 2016. Both older and younger age groups saw a drop in ridership, but this decrease was much less for older cohorts. Census data indicates that younger people saw increased rates in driving or car pooling. Census and National Household Survey responses indicate that there has been a consistent trend in Metro Vancouver of decreasing cycle commuting by younger age cohorts since 1996.

Cycle Commuting, Distance and Time

For both census periods, people living within 5 kilometres of their destinations cycled to work at the highest rates compared to people living further distances (defined by 5 kilometre increments). This is reinforced by separate research showing that shorter distances to destinations is a motivator for cycling and associated with higher cycling mode shares. But between 2016 and 2021, for people who still commuted to work somewhat surprisingly those who needed to ride 5 km or less to work decreased their cycling rates the most. They primarily turned to driving and car pooling instead of cycling. And those who lived further from their workplaces tended to have smaller decreases in ridership between the two census years. This may be an indicator that those who commute by bike to work longer distances are "committed" cyclists less likely to reduce their cycling rates in the face of changing environmental factors, but this is not clear from the data.

Cycle Commuting, Education, Occupation and Income

Consistently across census periods, those in the highest education categories tended to have the highest cycle commuting rates. Not surprisingly, those with a trades or apprenticeship certificate had the highest rate of driving or carpooling, which corresponds with regularly changing worksites and large equipment inherent in many trades jobs.

Cycle commuting rates seen in the 2021 census were between 1.2% and 1.3% for the education categories of "no certificate, diploma or degree", "secondary school or equivalent", "trades or apprenticeship", and "college diplomas and certificates". Cycle commuting rates increased to 2.1% for those with "bachelor's degree or university certificate" and 3.9% for "Degree in medicine, dentistry, veterinarian, optometry or degrees above the undergraduate level".

The **lowest work from home rates** during the pandemic were for the following employment categories:

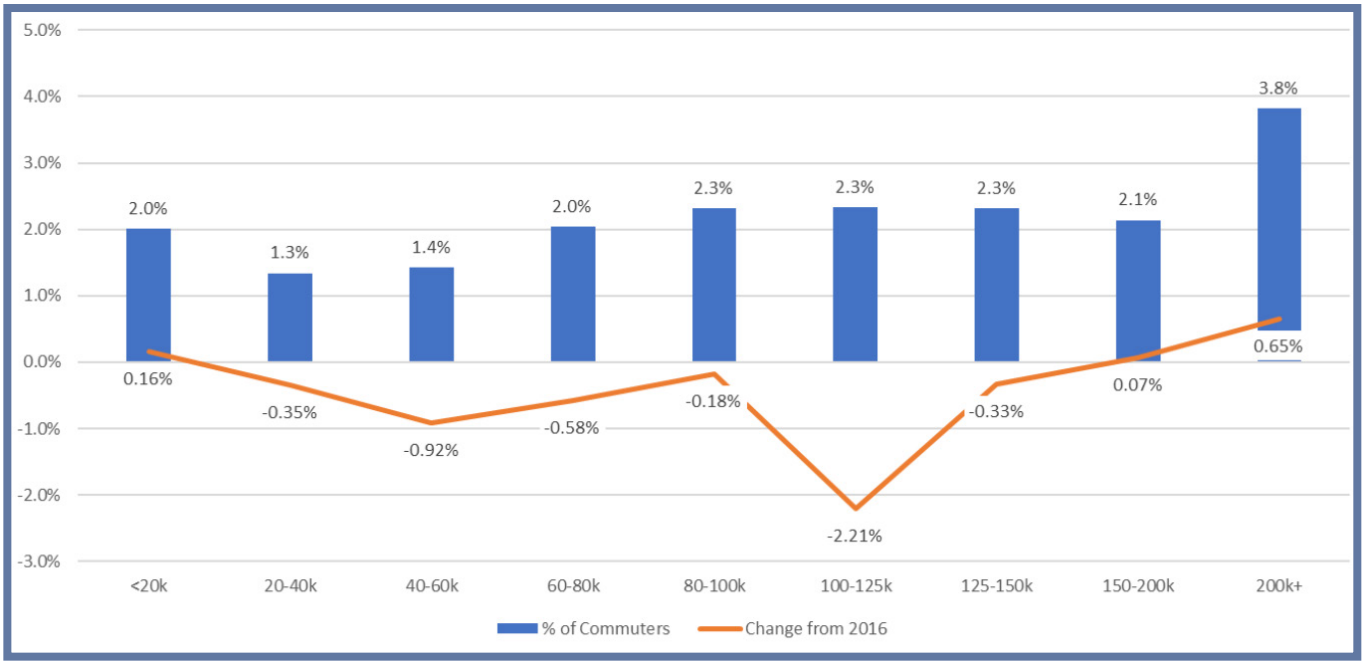
- Construction
- Manufacturing
- Retail trade
- Transportation and Warehousing
- Health care and social Assistance
- Accommodation and food services

Whereas the **highest work from home rates** were for:

- Information, culture and recreation
- Financial services
- Professional and technical services
- Public administration

The following table shows cycling rates for people in different income brackets between the two census periods.

Figure 12: Bicycle Commuting by Income Bracket - 2016-2021



Motivators for cycle commuting for different income groupings aren't reported, but for those earning less than $20,000 annually affordability may be a strong reason. The reasons for those in the $20-40,000 and $40-60,000 income brackets having the lowest proportionate cycling rates are not obvious, as affordability might also be a motivator for these groups.

While some working in certain higher income professions were able to transition to working from home, in general Census Travel to Work data indicates that higher income population groups tend to cycle commute at higher rates. At the high end of the income spectrum, those earning more than $200,000 annually have by far the highest proportionate cycling rate and affordability is not as likely to be a motivator for this group. There is a similar rate of cycling for the income groups in the middle and higher end of the income bracket spectrum

Cycling Accessibility and Equity Seeking Groups

Section Overview

Cycling Accessibility and Equity Seeking Groups

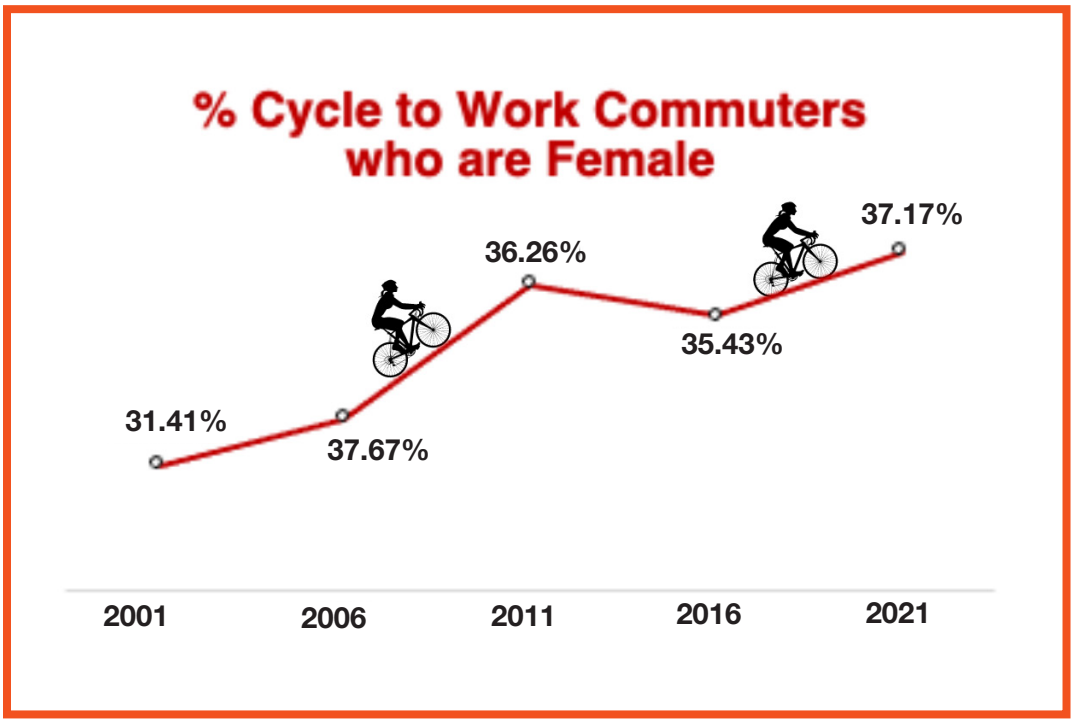
Metro Vancouver is home to a highly diverse population that defines our region and gives it a distinct personality. It is a priority of HUB Cycling that systemic oppression of specific groups be minimized regarding cycling accessibility, so that barriers are eliminated and cycling is equally accessible to all. With this in mind, it is important that this research looks at the needs of each demographic group in our community when considering the design and implementation of cycling related infrastructure and programs.

Cycle Commuting and Sexual Identity

The relationship between gender and commuting choices is complex, as people who identify as women tend to be more concerned about safety and security, have different employment patterns, and may play different roles than those identifying as men in family mobility. Note that the 2016 census surveyed based on sex, whereas the 2021 census sample used for this data analysis asked people to respond based on gender identity (no one identified as anything other than man or woman in the data available for this analysis). Between the two census years, female cycle commuting dropped less than males (-0.2% drop vs. -0.7%). However, female cycle commuting rates still remained lower than males (1.5% to 2.1%). As has been observed elsewhere, in census tracts with higher cycling rates there tended to be a more equal distribution of cycling between women and men. Cycling tends to be higher where cycling routes are more comfortable for all, and this allows more women to cycle. Thus one of the most effective ways to promote gender equality in cycling is to improve bike infrastructure, and this in turn will increase cycle mode share as a whole.

Analysis of gender differences in the cycle route network has established that women use the cycle route differently than men. 2012 Australian research found that on average women are more reluctant than men to cycle on routes that are not "comfortable for most" (#22). Typically women take part in less cycle commuting to work in favour of other utility trips, and take shorter trips on average. Given this information it is important to design the Metro Vancouver cycle route network with women in mind, addressing both their needs directly related to cycling and needs related to societal values and attitudes that impact their ability to cycle. While the Metro Vancouver region has not yet approached gender equality in cycling usage, the region is trending in the right direction as the percentage of work commuter cyclists who are female has increased since 2001. In addition, their commuting rates did not seem to fluctuate as much as total cycle commuting during the pandemic.

Figure 13: Proportions of Canadian Cycle to Work Commuters who are Female



Female ridership varies broadly around the world. In the Netherlands and Japan, female ridership makes up 54% and 56% of all cycle trips, respectively. By comparison, in the USA, females comprise only 30% of cyclists and in England they comprise only 26% of cyclists (#35).

One approach to mitigating the gender gap in cycling is to advance research on usage of the Metro Vancouver cycle route network. By analyzing which routes are used more or less by women, researchers and decision-makers can better meet the needs of this vulnerable population and increase their ridership moving forward. In addition, further research can begin to establish the relationship between gender non-binary people and cycling, as this group is poorly understood and likely also uniquely impacted by cycling motivators and deterrents.

Cycling, Racial Identity, and Ethnicity

Racial and ethnic minorities are under-represented in usage of the Metro Vancouver cycle route network as observed in commuting to work mode share data in the region. Between 2016 and 2021, there were only small changes in ridership based on people's racial identity. Metro Vancouver Census respondents who identify as white account for the most cycling and car/carpool usage for work commutes, and the least amount of walking and public transit use. A 2018 study by Yu and Teschke found that recent immigrants commute by active modes more than the general population, but their rates of active transportation declines the longer they have been in Canada [(#18)].

A social equity report published by the League of American Bicyclists found that compared to white bicyclists, the fatality rate for Hispanic Americans and African Americans was 23% and 30% higher respectively. The reason for this is likely an insufficient investment in high quality cycling infrastructure in racialized communities and societal trends that discourage racial minority groups from cycling. This finding mirrors global trends. In England, communities with a higher proportion of non-white residents had a lower rate of bicycle commuting. Robust research specific to Metro Vancouver on equity gaps in the network as it pertains to race and ethnicity would help inform policy and practice.

Photo credit: https://www.hasebikesusa.com/

Cycling and Disabilities

The use of Metro Vancouver's cycle route network by people with disabilities is not yet well understood. With the advent of e-mobility and overall growth of cycling, there is an increasing range and quality of adaptive cycling vehicle types. They enable more people with physical and neuro-cognitive disabilities to ride.

But the perceived safety, comfort and accessibility of the bike route network is likely even more of a factor in encouraging or discouraging cycling by people with different abilities. Bike route choices and facilities design would be better informed if we understood more about the motivators and deterrents of cycling for this vulnerable population. This is another area where more research focus would be beneficial, but in the meantime it is an additional strong reason for continuing to improve the network toward it all being classified as "comfortable for most".

Bike Routes and Transit Accessibility for People with Disabilities

Where bike routes and transit stops are adjacent, their design to ensure transit is accessible to people with disabilities is emerging as a consideration by TransLink and regional municipalities. The matter came before the BC Human Rights Tribunal, and the Tribunal ruled that a municipality was liable for adding cycling infrastructure that impeded access to a bus stop for a local resident who is legally blind.

TransLink is engaging with stakeholders knowledgeable about abilities and accessibility to consider developing guidelines for transit stop and bike facilities design so Skytrain and buses may be safely and easily used by people with limited mobility and who may use mobility devices, people with impaired vision or hearing, and people with other disabilities. This design consideration further emphasizes the complexity of bike route infrastructure planning and construction, and the need for this work to be fully informed by research and stakeholder engagement. (#37)

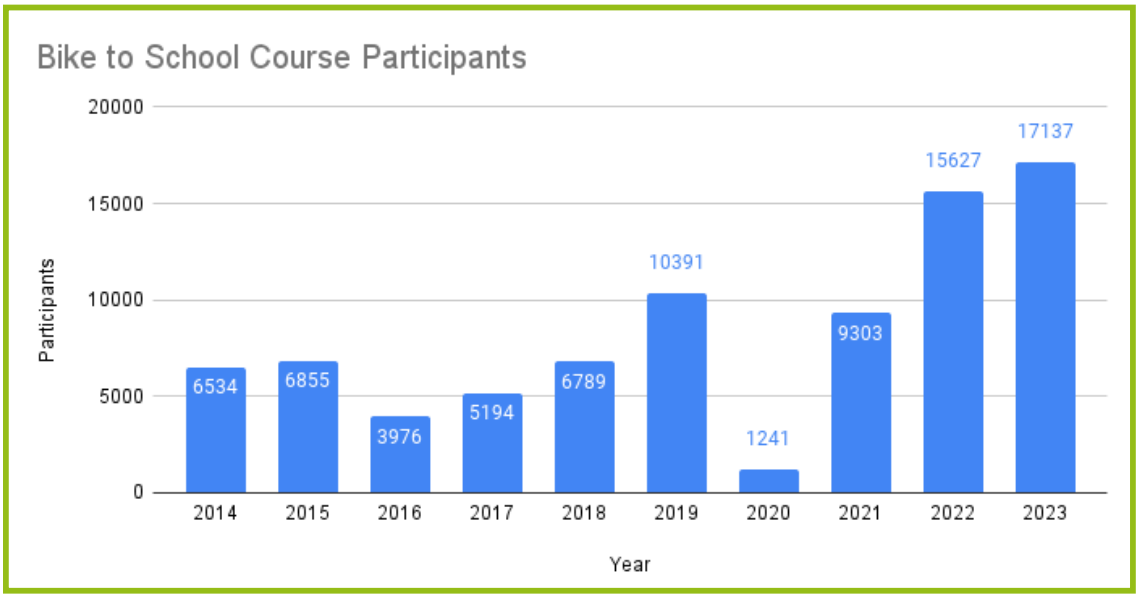
Youth Cycling

Section Overview

Youth Cycling

Our bike route network is intended to serve the region's population for generations to come. Introducing youth to bikes as a viable form of life-long transportation, rather than as just an activity of childhood, is an important element of getting our bike route network used immediately and over the long-term. Research conducted in New Jersey cities illustrates that youth who are introduced to active transportation are more likely to continue travelling to school using active transportation over time [# 38]. Families with 3–15 year-olds in four low-income New Jersey cities were followed for two to five year periods. Children who walked, bicycled, or skateboarded to/from school at least one day/week were classified as active commuters. Those who engaged in active transportation during the first time of study were 7 times more likely to use active transportation when studied at later dates. This research also showed that high cycling rates by children correlate with high cycling rates by their parents, and that the quality of bike route infrastructure highly impacts youth ridership rates.

Figure 14: Number of Youth Who Received Urban Cycling Courses in Metro Vancouver



HUB Cycling provides practical urban cycling education to youth through public schools in nearly every Metro Vancouver municipality, and increasingly in municipalities in other BC regions. The Learn2Ride course for grades 4 and 5, and the Ride the Road course for grades 6 and 7, are both designed to encourage youth to understand bicycles as a form of transportation, and enable them to cycle safely and effectively on city and town cycle route networks throughout their lifetimes. Municipal engineering and transportation departments, along with TransLink and the BC Ministry of Transportation and Infrastructure, fund HUB Cycling's youth active transportation cycling courses.

Figure 15: Numbers and Percentages of Schools and Students Who Received Active Transportation Cycling Courses in 2022 and 2023

District	Cities	Total # of Elem Schools	# of Schools Hosting Courses (22/23)	# of Gr 4/5	# of Gr 6/7	% of Schools Hosting Courses (22/23)	% of Gr 4/5	% of Gr 6/7	Total % of
	Metro Vancouver Totals	455	300	18,712	13,515	66%	45%	32%	77%
35	**Langley (Township and City)**	36	14	1,428	1,428	39%	43%	7%	50%
36	**Surrey, White Rock**	103	57	6,495	6,495	55%	59%	0%	59%
37	**Delta**	25	12	1,080	1,080	48%	49%	0%	49%
38	**Richmond**	38	37	0	0	97%	0%	100%	100%
39	**Vancouver, UBC**	78	71	295	295	91%	4%	94%	98%
40	**New West**	11	11	922	922	100%	96%	100%	100%
41	**Burnaby**	43	24	2,380	2,380	56%	64%	0%	64%
42	**Maple Ridge, Pitt Meadows**	23	15	157	157	65%	7%	71%	78%
43	**Anmore & Tri-Cities**	61	33	3,656	36,56	54%	82%	0%	82%
44	**North Vancouver (City & District)**	25	19	1,640	1,640	76%	69%	15%	84%
45	**Bowen Island, West Vancouver**	12	7	659	659	58%	64%	0%	64%

NOTE: New Westminster presents a unique case, where a private benefactor is funding courses in addition to the City, so that nearly all youth receive both Gr 4/5 and Gr 6/7 courses. As such, it's percent total is 100 when it appears it should be 196.

Youth and Cycling: Journey to School Data

When analyzing usage of the cycle route network, it is important to account for the region's youngest members. Promoting cycling to the youth of the Metro Vancouver region is particularly important as it can instill positive cycling habits more likely to persist into adulthood, as demonstrated by the New Jersey research example.

A 2021 national research project spearheaded in Metro Vancouver by Dr. Meghan Winters of Simon Fraser University provides a local perspective about youth cycling [#33]. Sixty-five elementary schools in the Vancouver School District and 97 schools in the Surrey School District were surveyed to examine trends in active transportation to and from school. The findings of the project are detailed in the table below.

Figure 16: Cycle to School Rates for Vancouver and Surrey Elementary School Students - 2021

	Number of Elementary Schools Surveyed	Number of Students Surveyed	% of Students Who Cycle to School	% of Municipality that Cycles to Work
Vancouver School Board	65	13,166	3.5%	5.3%*
Surrey School District	97	23,941	1.3%	0.3%

To build on this analysis, this benchmarking research used data above in conjunction with other data sets to investigate differences in cycle commuting among students in different schools within the same municipality. We identified a correlation in Census Trip to Work data between student cycle rates and adult cycle commuting rates in City of Vancouver neighbourhoods.

Schools in areas with above average adult cycle commuting in Vancouver had a student cycle rate of 5.4 %, while schools in areas with below average cycle commuting had a student cycle rate of 2.2%. We additionally found that there was a positive correlation between the amount of “comfortable for most” networks within 400 metres of a school and student cycle rates. Schools in Vancouver with over 1 kilometre worth of “comfortable for most” facilities within 400 metres of the school had a student cycle rate of 4.2%, compared to a 2.4% cycle rate for those with lower amounts.

These trends were not mirrored in Surrey, as there was no correlation between commuting to work rates or cycle route infrastructure and student cycle rate. This could be a product of low cycle rates and less cycling infrastructure in areas surrounding Surrey schools. This implies that one of the most effective ways of improving student cycle rates is to focus on improving cycle infrastructure.

We did identify evidence that engagement in cycling among the youth in Metro Vancouver varies by area. Investment in improving cycling infrastructure near schools and improving parental attitudes towards cycling can play strong roles in improving youth ridership. Research has found that daily support by parents for youth to engage in active transportation led to increases in actual active transportation rates among youth, even after controlling for variables such as age, sex, distance to school, and perceptions of safety. Perhaps a next step for improving youth engagement in cycling would be education campaigns directed to parents regarding the broad lifetime benefits of youth cycling and active transportation.

Use of the Cycling Network for Purposes other than Commuting

Section Overview

Use of the Cycling Network for Purposes other than Commuting

Commuter travel is an important benchmark for cycle ridership. However, commuting to work cycling trips account for only a portion of the total cycling trips taken in Metro Vancouver. When recreational centres and gyms were impacted by pandemic restrictions, people started to cycle more for recreational purposes. As estimated through bike counter data, this led to an overall 4% increase in cycling in Vancouver between 2019 and 2021 and a 22% increase in cycling on weekends. Similar to demographic trends in commuting, by using the 2013/2014 Canadian Community Health Survey we know that most people who cycle for leisure tend to be younger, male, higher income, and identify as white. This further highlights the importance of addressing the cycling needs of vulnerable populations as mentioned earlier in the report.

As Metro Vancouver is limited by the quantity and quality of data available to assess changes in cycling as a result of the pandemic, we must look at other metrics and data from outside of Metro Vancouver to shed a light on how the pandemic changed cycling in the region. During the pandemic, 25% of Americans surveyed by a PeopleForBikes study said that they cycled for the first time in a year or more because of the pandemic. This trend was mirrored north of the border as Metro Vancouver and the rest of Canada experienced a well-documented increase in demand for bikes during the pandemic that caused a nationwide bike shortage. In addition, bike counter data in Metro Vancouver showed increases in summer cycling counts indicative of increased recreational cycling. Rates of cycling for recreation could be better understood in the Metro Vancouver region with increased data collection and analysis, enabling more strategic improvement of cycle infrastructure relative to recreational riders' needs.

Bike Share Programs in Metro Vancouver

Section Overview

Bike Share Programs in Metro Vancouver

Public bicycle share programs such as Mobi by Rogers (formerly Mobi by Shaw) in Vancouver, and by Lime in Richmond, North Vancouver, West Vancouver, and Coquitlam, play an impactful role in cycling in the region by providing easily accessible and affordable rental bikes in selected areas. Bike share programs can be found in cities around the globe and primarily serve the purpose of increasing cycling rates, facilitating multi-modal public transportation trips, and reducing automobile traffic congestion. Mobi by Rogers launched in 2016 in Vancouver and the bike share program now includes a fleet of 2,000 bikes and 500 e-bikes housed at 250 stations across Vancouver.

While the Mobi bikeshare system is only found in Vancouver, it is important to note its positive impact on cycling as the bike share system was responsible for 2,715,227 km travelled by bike in 2022. In addition, a Mobi report stated that 82% of members said that the bike share system increased how much they cycled and that the bike share replaces one in five trips otherwise taken by a car. To increase equitable access to bike share, Mobi by Rogers offers a “community pass” to reduce financial barriers for lower income populations. HUB Cycling is highly supportive of bike share programs in Metro Vancouver because of their positive impacts on cycling rates in the region.

The Growth of E-bikes

Section Overview

The Growth of E-bikes

E-bikes have become a major component of Metro Vancouver's cycling landscape. A study conducted just before the pandemic found that 4.2% of vehicles on the cycle route network were e-bikes. As a result of the pandemic bike boom and the BC E-bike financial incentive program, which provides income-qualified rebates for residents of BC purchasing E-bikes, this number has likely grown significantly since. When discussing trends in e-bike behaviour and usage, it is important to distinguish an electric assist bicycle from other modes of electrified transportation. Electric assist bikes require riders to pedal, which triggers an electric engine to augment human power. Electric assist bikes are generally permitted on formal bike routes, whereas purely throttle-powered electric bikes are not.

There are many benefits to using electric assist bikes for utility or recreational purposes. Because they require physical exertion by users, electric assist bikes are associated with the same health benefits as conventional bikes, given they increase the distances people ride and can improve fitness levels of users. This is important as electric assist bikes offer an active alternative to passive modes of transportation for people who are unable or unwilling to ride a conventional bicycle for some or all transportation purposes. This switch from passive modes of transportation to electric assist bikes also has positive benefits on the environment as electric assist bikes are associated with much lower emissions than cars as well as different forms of public transportation. In addition, electric assist bikes make access to cycling more equitable as they are relatively inexpensive compared to owning a car and make cycling accessible for those who are older or who have disabilities.

The behaviour of e-bike riders differs somewhat from that of conventional cyclists, which is important to understand to better promote e-bikes and accommodate their needs along the cycle route network. Research has established that a greater share of e-bike trips are made for utility purposes compared to conventional bike trips. In addition, e-bike users tend to make more and longer trips each week. The latter is likely a function of increased speed compared to conventional cycling as e-bikes have been found to be 30% faster than conventional cyclists. The increased speed plays a role in route selection and load carrying as e-bike users are less deterred by hills than conventional cyclists.

Electric assisted cycling will very likely continue to grow in popularity as more quantities and types come on the market, and new Transit Oriented Development housing options allow for few or even no car parking spaces for building residents. It is important to expand the monitoring and evaluation of the usage and safety of e-bikes, separate from conventional bikes, to inform future development of the Metro Vancouver cycle route network.

Cycling Comfort and Safety

Section Overview

Cycling Comfort and Safety

In the creation of an effective cycle route network, no attribute is as important as the safety of each route. This message is echoed in research related to deterrents to cycling as studies have found perceived danger of routes is the biggest deterrent to cycling. Injury research has shown that people judge the safety of routes well, so perceived safety and actual safety typically match. The adoption of the Vision Zero strategy by provincial, regional and local governments is intended to bring together all of B.C.'s road safety partners towards the ultimate goal of zero traffic fatalities and zero serious injuries. The safety of various route types, described below, was used in the comfort classification of routes we used in this report.

At non-intersection points along a cycling route, there are a variety of factors that influence the incidence of cycling crashes and the sense of safety for cyclists. The first of these is the presence of infrastructure that physically separates cyclists from motorists and pedestrians. Protected bike lanes, residential street bikeways, and bike paths have consistently been found to be safer than busy streets without bike infrastructure, sharrows, painted bike lanes, bike accessible shoulders, and multi use paths. In addition, safety is decreased for cyclists along routes where motorists travel at speeds greater than 30 km/h. Downhill sections and construction along routes also increase crash risks for cyclists.

Where streets meet along a cycling route, intersections of busy streets are the least safe, and intersections between local streets where speeds and traffic volumes are lower are considerably safer. Uncontrolled intersections (no stop signs or traffic lights) and traffic circles have been found to be particularly dangerous for cyclists. Entering an intersection in a direction opposite to motor vehicle traffic is also more dangerous. Research has established infrastructure to improve cycling safety at junctions, by providing protected time and space, and by slowing motor vehicles at crossings. Examples include protected intersections with traffic signals for people on bikes, raised crossings, and tunnels under roads.

Improving lighting is another way to increase cycling safety. Crash rates are higher at dusk and at night than during the day, which can often be attributed to a lack of visibility. Lighting positively impacts safety beyond a reduction of crash incidents alone, as it can improve cyclists' sense of personal safety and security as well. Planners, engineers and other municipal staff staff should consider a variety of factors such as tree cover, neighbourhood characteristics, and end of trip facilities when designing lighting infrastructure along cycle routes.

One of the most effective ways to improve cycling safety is to increase the number of cyclists along cycling routes. This is often referred to as the "safety in numbers" effect and is likely a result of drivers being more aware of cyclists on the road as there are simply more of them. The safety in numbers effect is another benefit of promoting cycling in the region.

Collision Rates

To examine cycling safety, we calculated the collision rates for seven subregions in Metro Vancouver. We compared the rates calculated in our first report (2013-2017) to the most recent 5-year period for which data was available, 2018-2022. Collision data was provided by ICBC (Insurance Corporation of BC). It is limited to collisions with motor vehicles resulting in injuries or deaths of people on bikes. Collisions with motor vehicles typically involve the more serious injuries and are responsible for most cycling deaths. However, total injuries to people on bikes are undercounted, because falls and collisions with infrastructure or other route users are not included.

The source of data on the number of trips (used to calculate the injury "rate") was the same in both time periods: TransLink's 2017 Trip Diary Survey. This data has the advantage of including trips for more than just commuting to work; it also includes trips to schools, shops, and for personal business and social purposes. It does not include recreational trips with the same start and end point. Unfortunately the survey is done infrequently, so the only data near in time to the time periods of interest was from 2017. This means that differences in cycling rates over these time periods are not taken into account.

The rates shown in the table below suggest slight reductions in the collision rate in almost all subregions in the most recent 5-year period..The differences in collision rates between the two time periods are relatively small, especially in comparison to the considerably larger differences between the subregions. The highest collision rate (in the Northeast sector – Maple Ridge, Pitt Meadows, Coquitlam, Port Coquitlam, Port Moody, Anmore, Belcarra) is more than 3 times higher than the lowest rate (in Burnaby & New Westminster). This highlights the potential for large improvements in safety.

Figure 17: Rates of Cyclist Collisions involving Injury or Death over Two 5-year Periods

Cyclist collisions with motor vehicles per million annual cycling trips		
	2013 to 2017	**2018 to 2022**
Metro Vancouver Total	25.1	22.4
Vancouver/UBC	22.0	19.3
Burnaby/New West	17.8	16.2
North Shore	27.7	26.3
Northeast	58.8	50.9
Southwest	29.3	30.0
Southeast	39.3	33.1

Collision data from ICBC Trip data from 2017 TransLink Trip Diary Survey

Cycling and Other Traffic Deaths

There are few cycling deaths each year in Greater Vancouver, so few that calculating fatality rates or reporting number of fatalities by subregion is not appropriate. ICBC data over the most recent 20 years available (2002 to 2021) indicate that there were 39 cyclist deaths resulting from collisions with motor vehicles, about 2 cycling fatalities per year on average. Most (85%) of the victims were male. In the same 20-year period in Greater Vancouver, there were:

- 118 deaths of motorcyclists (6/year, 97% male)
- 367 deaths of pedestrians (18/year, 52% male)
- 449 deaths of motor vehicle occupants (22/year, 69% male)

The number of deaths has declined somewhat for motor vehicle occupants, but there is no clear pattern for other road users.

The goal of Vision Zero is to eliminate all traffic deaths. This has now been reported in some Scandinavian cities, including Oslo and Helsinki. With about 40 traffic deaths per year in Greater Vancouver (all transport modes combined), there is work to do to achieve that goal here.

The Cycling Network and Slopes

Many parts of Metro Vancouver are far from flat which presents a variety of challenges to cyclists in the region. The first of these is that the presence of major slopes in a cycle route is a deterrent to cycling and directly linked to usage of the network. In a survey conducted in Seattle and the surrounding area, hills along routes were found to be the second highest barrier to engaging in cycling and walking, only behind too much traffic. The survey also found that this barrier was much more impactful for people who are generally less physically active, which is important to consider when attempting to inspire new cyclists. In Vancouver research, small hills were not a deterrent but steep ones were. These results stress the importance of grades when designing bike routes. E-bikes can also help address this challenge.

Major slopes on a route can also increase the impacts of pollution exposure, another deterrent of cycling especially for vulnerable populations with pre-existing heart or lung conditions. When someone cycles uphill, they must work harder which increases ventilation

resulting in greater inhalation of pollutants. One way to mitigate this effect is by moderating cycling effort up a hill. But, for those without high fitness levels or for those who have to endure very steep climbs, it is difficult to minimize pollution exposure. Options for avoiding increased exposure to pollutants along hilly routes is to modify routes to minimize slopes, or to build bike routes away from high pollution sources. The relationship between pollution and the cycle route network is explained in more depth in the next section of this report.

Finally, the slope of a cycle route has implications on safety. Hills can be dangerous while cycling due to increased speeds and reduced visibility. In a study examining route infrastructure and risk of injuries, researchers found that the chance of injury while cycling downhill was double that of flat routes. Reductions in safety along downhill sections further increase in wet conditions that reduce traction, and hence increase the time it takes for cyclists to stop and increase the likelihood of falls and collisions. The effects of slopes along bike routes in relation to usage, pollution exposure, and safety should be considered along with other factors in bike infrastructure location and design.

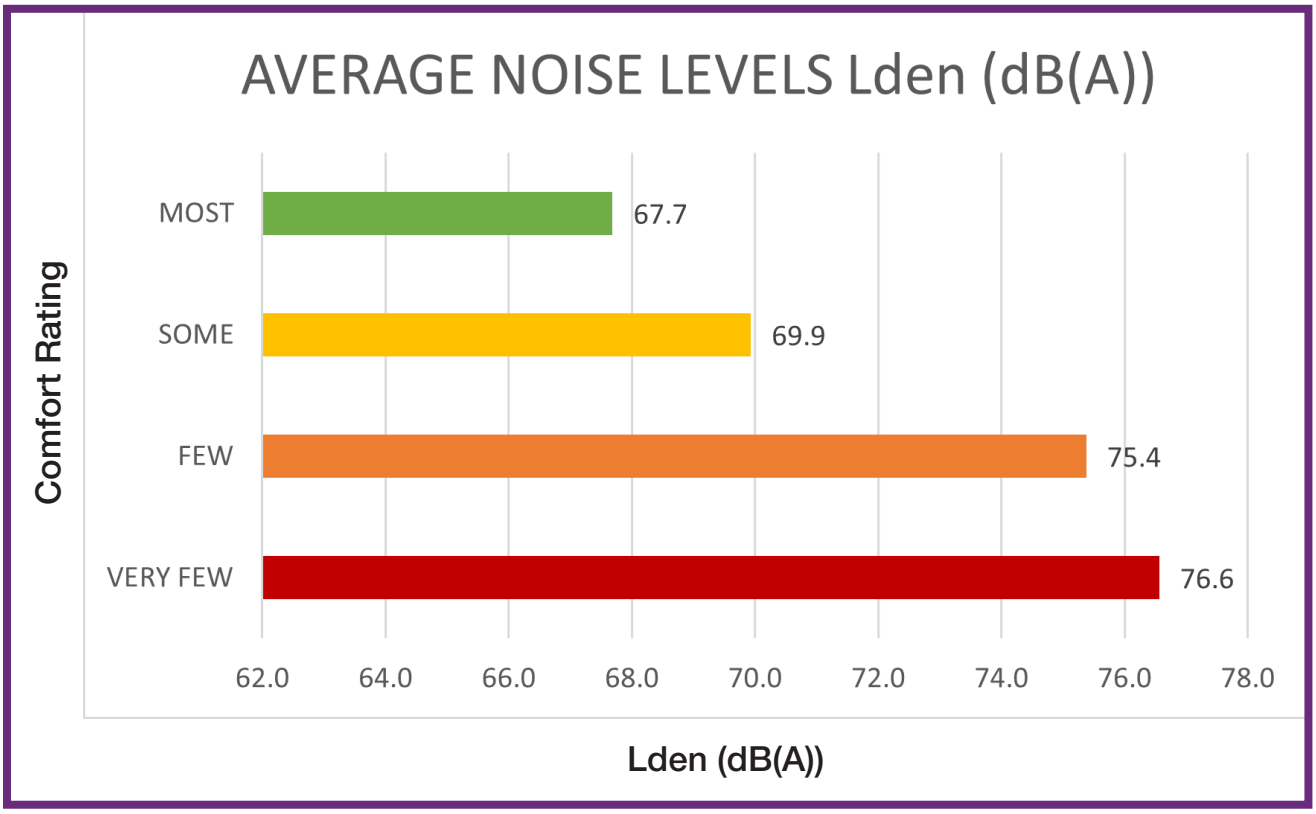
Noise Impacts and Mitigation

As much as possible, cycling infrastructure siting and design should consider minimizing the exposure of people cycling to excessive noise. Traffic and constructionare some of the major sources of noise in the Metro Vancouver region that deter cycling. These sources can be problematic as short term exposure to high levels of noise has been associated with decreased cognitive performance and altered brain activity patterns. In addition, we know that excessive noise along cycle routes can be a deterrent to cycling comfort.

Cyclists are generally more exposed to noise than are motorists. Given the nature of cycling being an outdoor activity (vs driving and transit which are enclosed), it is difficult for cyclists to avoid noise exposure. A recent study looking at the average noise levels experienced by cyclists in Paris, Copenhagen, and Montreal found that the average noise levels along cycling routes were 73.4 dBA, 68.4 dBA, and 70.7 dBA, respectively. Noise levels along cycle routes are further elevated near city cores. A Toronto study found that the average noise level from 7 measurement stations along cycle routes in the city core was 81.8 dBA. More importantly though, this study found that the type of cycling infrastructure and the separation of cycle routes from traffic had a significant impact on noise exposure. This was true during the busiest times of the day and in the noisiest areas of the city.

To better visualize how all of this relates to Metro Vancouver's cycle route network, HUB Cycling partnered with Dr. Michael Brauer, Professor in the School of Population and Public Health at the University of British Columbia (UBC). Using modelled noise data provided by Dr. Brauer, HUB was able to identify areas and characteristics of the network associated with higher noise levels.

Figure 18: Average Noise Levels and Network Comfort Classification Correlations

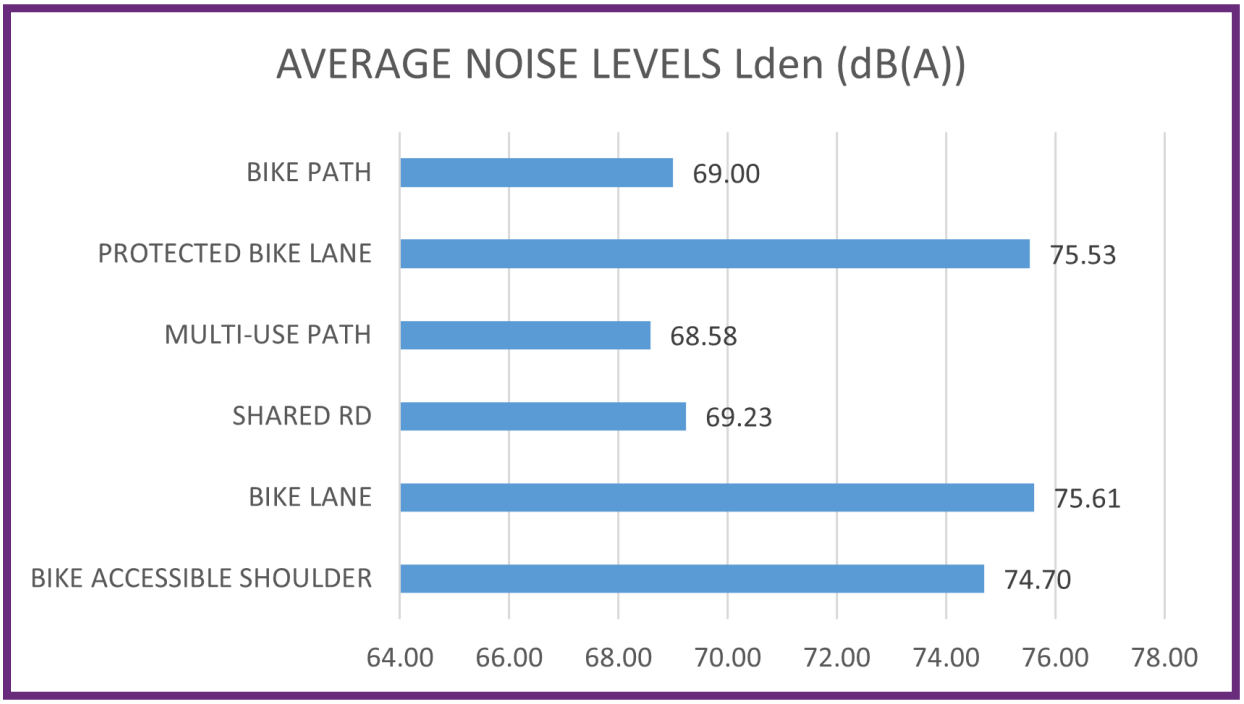


There is a negative correlation between the comfort of a cycle route network and noise levels experienced on it. This is illustrated in the chart above and likely a product of the type of facility associated with cycle route networks as "comfortable for most" networks are more often bike paths and multi-use paths, which are more separated from traffic. Bike routes that are on roads are approximately 8 dB(A) louder than routes away from roads.

Generally speaking, as the amount and speed of traffic increases, so does noise exposure. This is why we see that freeways and major arterial roads are much louder than local roads. Electrically powered cars, which are becoming more common on roadways each year, have much quieter engines but at high speeds they still produce significant tire noise. There is a much slower shift to electrification for transport trucks, so distancing bike routes from truck arterials would likely provide the longest lasting benefits.

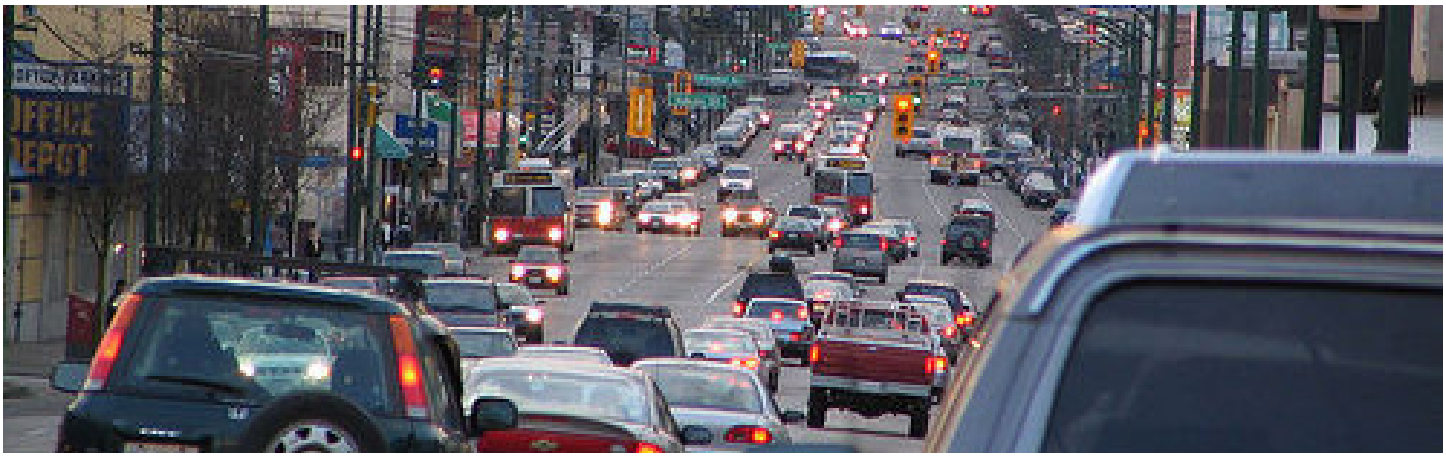
Tree belts may assist in reducing noise exposure experienced by cyclists. Research measuring the effects of tree belts on traffic noise reduction found that a 5 metre dense belt of trees resulted in a 3 dB(A) reduction in noise, and a 10 metre dense belt of trees resulted in a further 3 dB(A) decrease in noise. The study also found that trees were better at attenuating noise levels than synthetic barriers such as noise walls. Noise levels can therefore be mitigated on cycle routes through buffers of trees separating sources of noise and cyclists.

Figure 19: Average Noise Levels and Network Infrastructure Type Correlations



Cycle routes and facilities can be planned to minimize noise exposure to cyclists. Where bike routes are necessarily near roadways with high automobile and truck traffic, noise barriers such as tree cover and fencing mitigate the negative impacts of noise.

For cycling infrastructure planners and engineers, decisions about mitigating noise exposure may pose a "trade-off" as related increased costs reduce funding available for other improvements to the cycle route network. Applying a tool to assess the extremity of noise impacts, and the number of people affected, in specific locations could provide a means for determining when extra costs are warranted to minimize noise exposure for people cycling on public infrastructure.



Pollution Impacts and Mitigation

Current research on the health effects of exercise in polluted environments have generally come to the conclusion that the health benefits associated with exercise outweigh the potential harm caused by exercising in moderate levels of pollution. Still, levels of pollutants associated with Metro Vancouver's urban environment may present a challenge for those who are concerned about health outcomes related to cycling in a polluted environment. This factor is not well understood in relation to vulnerable populations who are at a greater risk of experiencing adverse health effects from pollution, including children, pregnant women, older adults, and those with preexisting heart and lung issues.

To broadly understand air quality levels in Metro Vancouver, we can consult the Air Quality Health Index (AQHI). The AQHI provides hourly assessments of air quality relative to levels of particulate matter (PM2.5), ground level ozone (O3), and Nitrogen dioxide (NO2). Based on these levels, the AQHI reports an air quality score, risk level, and associated message. Generally the air quality of Metro Vancouver is quite good as most days throughout the region are associated with low air quality health risks. It is important to note that there is significant variation in air quality levels across the region at any given time. Additionally we see that the worst air quality days in the region are usually associated with wildfire events which are often unpredictable and impact areas of the region differently.

Figure 20: Metro Vancouver Regional District Air Quality Health Index Health Risk Levels

Health Risk	Air Quality Health Index	Health Messages	
		At Risk Population*	General Population
Low Risk	1-3	**Enjoy** your usual outdoor activities.	**Ideal** air quality for outdoor activities.
Moderate Risk	4-6	**Consider reducing** or rescheduling strenuous activities outdoors if you are experiencing symptoms.	**No need to modify** your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.
High Risk	7-10	**Reduce** or reschedule strenuous activities outdoors. Children and the elderly should also take it easy.	**Consider reducing** or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very High Risk	Above 10	**Avoid** strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	**Reduce** or reschedule strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.

Figure 21: Definitions of Pollutant Types

$PM_{2.5}$	A mixture of solid particles and liquid droplets containing dust, soot, dirt, or smoke.
UFP	Particulate matter much smaller than PM2.5
O_3	Pollutant produced via the combination of nitric oxides and other chemicals in the presence of sunlight
NO_2	Highly reactive gas typically emitted from the burning of fuels
CO	Poison gas typically emitted from cars and forest fires
BC	Component of particulate matter, emitted from burning of fuels

Using the map of the Metro Vancouver cycle route network and modelled pollution data courtesy of Dr. Michael Brauer, cycle routes adjacent to more congested and busy roadways are subject to higher levels of nitrogen oxides, a common pollutant emitted by cars.

In addition to the amount of traffic on the road, pollution exposure is also determined by a cyclist's proximity to a road. In a study conducted in New Zealand, researchers found that cycling 7 metres away from the road resulted in a reduction in exposure to UFP and CO of 32% and 21% in comparison to cycling on a road. Cycling 19 metres away from the road on a cycle path resulted in a further 9% reduction in UFP and 32% reduction in CO exposure.

Trees and other plants in urban environments can remove a variety of pollutants from the air including particulate matter, ground level ozone, nitrogen dioxide, and carbon monoxide, which improves air quality. Importantly for cycling, trees around sources of pollutants can improve air quality in the immediate area. Researchers out of Australia found that areas with high levels of urban forestry had lower levels of particulate matter pollution than areas without it. This was especially true for areas with dense tree cover within 100 metres of the sampling points used in this study.

With all of this in mind, there are ways in which transportation planners can design routes to minimize pollution exposure for cyclists. When cycle routes need to be parallel with major roadways in order to provide direct and convenient connections and access to destinations, planners and engineers should consider siting infrastructure some distance away from the roadway. Finally, policies that promote public transportation and reduce automobile traffic, and which promote the adoption of electric-powered automobiles, will lead to broader reductions of pollution exposure for everyone.

Trucks - A Case Study in Noise and Pollution

The pollution and noise exposure experienced by cyclists from transport trucks is disproportionately high compared to other vehicles on the road. In a study conducted in Minnesota, it was found that the number of trucks, although infrequent, was the most important variable in determining black carbon exposure and particulate numbers. In addition it found that trucks passing by cycle routes were associated with large increases in particulate matter exposure.

Research in Vancouver has established that levels of nitrogen oxides, black carbon, and ultrafine particulates are more strongly associated with the amount of trucks on a road in comparison to car traffic. In regards to noise pollution, the US Federal Highway Administration found that one truck travelling at 90 km/h sounds as loud as 28 cars travelling at the same speed.

Climate Vulnerability and the Cycle Route Network

Section Overview

Climate Vulnerability and the Cycle Route Network

Rain Events and Flooding

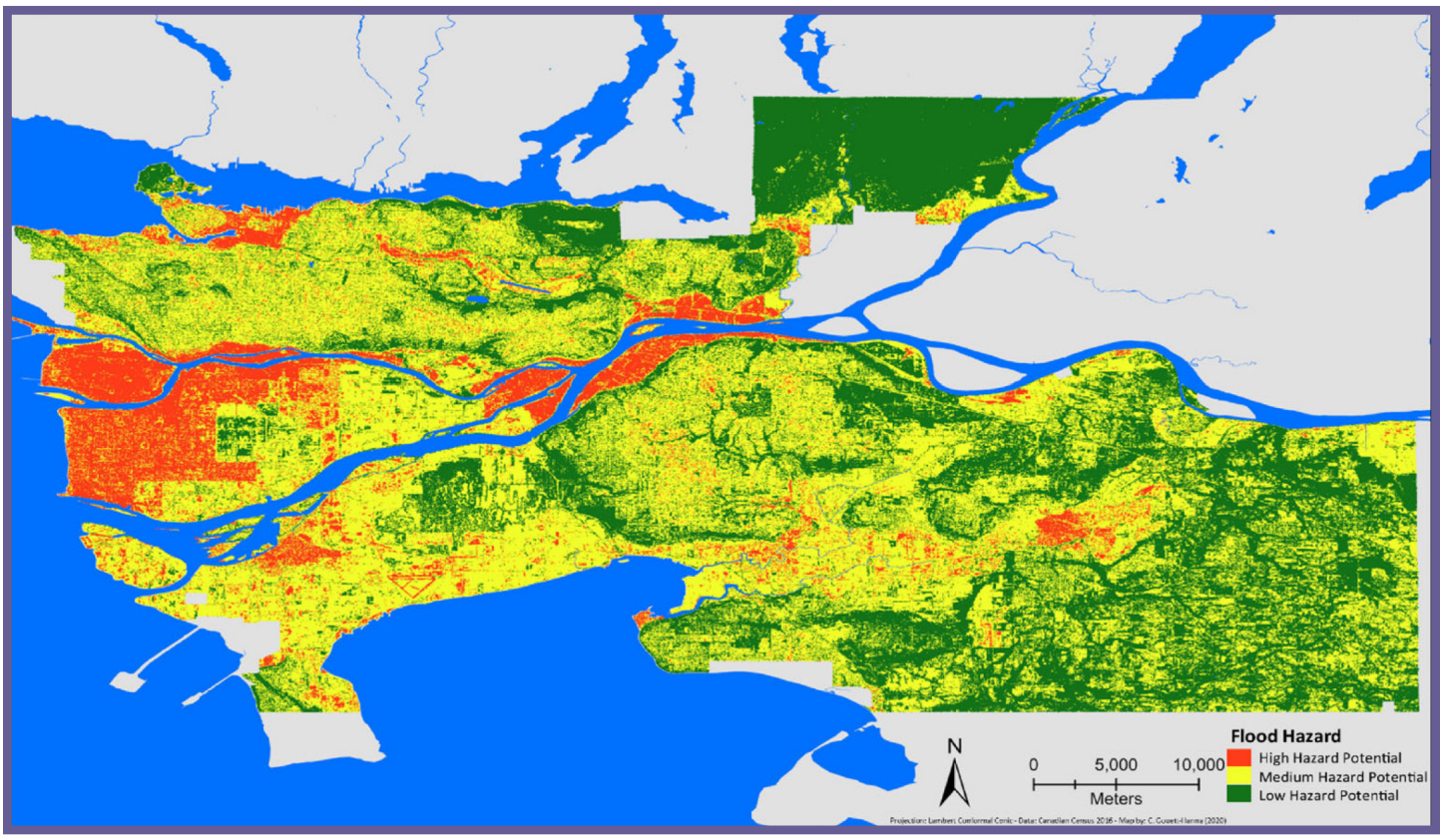
Climate change has resulted in a steady rise in average temperatures over the last century, and an increase in the incidence and severity of extreme weather events such as heavy rainfall resulting from atmospheric rivers. This is compounded by Metro Vancouver's already rainy climate. This makes it important to build cycle route infrastructure that is not only resistant to flooding but aids in the collection and dispersion of rainwater in the area. Accomplishing this is no easy task and requires considerable planning.

Characteristics of a cycle route segment can be broken down into three categories when considering how resilient it will be to extreme weather events:

- The first involves how the characteristics of infrastructure with which cyclists directly interact, and how they play a role in the management of water. For example, the implementation of technological devices that collect and manage rain water, and the quality of the surface of a cycle route segment, either aid or impede climate resilience.
- The second involves how the environment associated with a cycle route plays a large role in the dissipation of rainwater. For example, green spaces lining cycle routes can absorb water and permit cycle routes to better function during extreme weather events. Also whether a cycle route is elevated above adjacent infrastructure or not plays a large role in how water will flow and affect the cycle route network.
- The third considers the cycle route segment's location in context of a region's geography and sub-climates. Different areas of the region are associated with different risks for flooding which needs to be considered when designing major bike network elements of the region's cycle route network.

In applying this information to the Metro Vancouver region, we analysed the following map created by Gouett-Hanna et al. [#76] highlighting the flood hazard risk for each census dissemination area (D.A.) in the region. The map displays a hazard index for each D.A. which considers elevation, slope, soil type, land cover, precipitation, Normalized Distance Vegetation Index, Topographic Wetness Index, and proximity to river channels.

Figure 22: Metro Vancouver Flood Hazard Map - Gouett-Hanna et al.



In general, areas spaced away from bodies of water, covered with more vegetation and soil than built environments, and at high elevations had decreased flood risks. As a result, the analysis found that Richmond had the most D.A.'s with a high flood risk and the highest hazard index while cities like Langley and Coquitlam had the lowest. Interestingly, the City of Vancouver had a high hazard index but only a small amount of D.A.'s in the highest flood risk classification. This illustrates how much flood hazards can change within a small area and highlights the importance of meticulously planning cycle routes with flood hazards in mind.

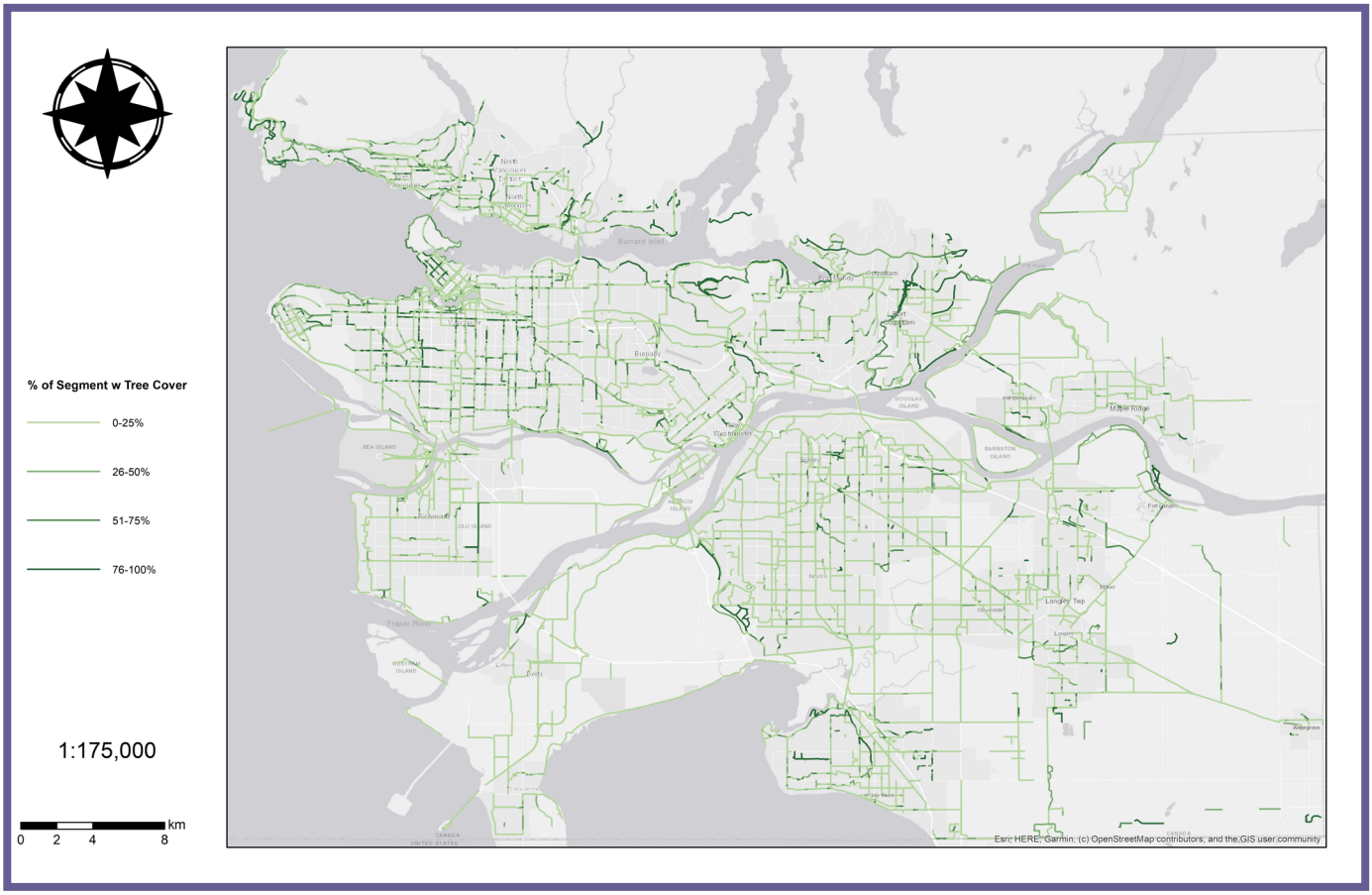
Heat and Tree Cover

Metro Vancouver's urban forest helps make the region uniquely beautiful. This itself has been found to make cycling more attractive and to boost ridership. In many ways, Metro Vancouver's tree coverage is the unsung hero of the cycle route network as it mitigates the effect of a variety of deterrents on ridership in the region (as previously explained in the Pollution and Noise sections of this report). But tree cover varies highly between urban sub-regions and individual streets.

People often report temperature or fear of being sweaty as a barrier to engaging in cycling. Trees provide a cooling effect via shading which blocks the sun's radiation. In addition, trees release moisture which aids in local temperature moderation. These two effects result in urban forests being 1.6 degrees celsius cooler than other areas and perceived to be even cooler as tree canopy blocks the sun's radiation. This suggests that new bike routes should be placed under tree cover as much as possible, and that trees should be planted along existing bike routes where they aren't already present. Even where they do not provide direct shade cover, the presence of trees adjacent to a cycle route can play a role in reducing local temperatures.

Shade cast by a single tree can feel **10-15ºC** cooler compared to standing in the sun on a hot day

Figure 23: Metro Vancouver Bike Route Network Tree Cover Percentages



NOTE: While this analysis doesn't confirm specifically where bike routes have shade cover, the higher percentage of tree cover related to a bike route segment indicates a higher likelihood of partial or full shade.

Unfortunately, many cycling trips follow paths along busy roads and through urban areas away from effective tree cover. These areas are often considered heat islands and experience higher temperatures as buildings, paved surfaces, and other infrastructure absorb and re-emit the sun's radiation. Trees along these routes can still positively impact temperature. Tree coverage reduces the amount of radiation that reaches the ground which works to reduce the temperature of urban heat islands.

The degree to which trees can reduce temperature through shading depends on a variety of factors including leaf area, leaf thickness, shape of the tree, and height of the tree. This highlights the importance of selecting specific types of trees when designing a cycle route or urban area to best mitigate the effect of temperature. This is of growing importance regarding the climate resiliency of the cycle route network, given increasing average temperatures and more frequent "heat domes" due to global warming.

Benchmarking Our Regional Bike Route Network

Section Overview

Benchmarking Our Regional Bike Route Network

HUB Cycling is pleased to have had the opportunity to lead this benchmarking research about the Metro Vancouver bike route network, and to engage with a broad group of enthusiastic collaborators in doing so. We again thank all the people and organizations that contributed to this project in so many ways.

This benchmarking project analyzed the evolving quality, comfort, safety, and completeness of the network relative to our initial Benchmarking project in 2019. It highlighted health and climate-resilience factors that impact the network's comfort, safety, and accessibility. It also identified where we are missing data and lacking research into key topic areas.

HUB Cycling developed this report primarily for the purpose of informing those directly involved in funding, planning, and building cycling infrastructure. It is our goal that it will prompt additional attention to, and research into, the range of relevant health, safety and climate resiliency factors we have highlighted through this collaborative research endeavour. We sincerely hope that our focus and findings are helpful to future infrastructure planning.

This report is also intended to be a valuable and accessible resource for people who cycle for transportation and recreation in our urban setting, so they may understand all the factors that should be considered in network infrastructure design. They will then be better able to engage at the local and regional level in promoting improvements to cycling infrastructure.

As we observed, there are many topics highlighted in this report for which additional data collection and research would be of great benefit. It would support decision-makers in better understanding the dynamics related to cycling comfort, safety, and accessibility. HUB Cycling and our research collaborators hope this Benchmarking report will spur new targeted research, and we look forward to directly contributing to research efforts where opportunities arise. HUB Cycling welcomes opportunities for dialogue with stakeholders about our focus for, and findings from, this research.

Please contact HUB Cycling about the State of Cycling Benchmark #2 report at research@bikehub.ca.

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