City of Whitehorse

Bicycle Network Plan 2018

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Appendices

1.0 Introduction and Background

The purpose of the Whitehorse Bicycle Network Plan is to establish a long-term vision for cycling, increase transportation choices in the city and ultimately increase the percentage of residents using a bicycle for transportation year-round. The Bicycle Network Plan identifies future cycling routes with a focus on providing facilities that are comfortable for people of all ages and abilities (AAA) and meet the recommended geometric design guidelines for Canadian Roads published by Transportation Association of Canada (TAC) in 2017.

Whitehorse is a growing city and is anticipating 15,000 new residents in the next 25 years. Population increases add pressure to existing transportation networks.

Cities across North America are increasingly focusing on expanding their bicycle networks as a key strategy to increase levels of cycling and decrease vehicle travel. A complete and interconnected network of safe bicycle routes throughout the community is critical infrastructure necessary to support and encourage more cycling. It is important that bicycle routes are direct, safe and provide connections to key destinations within the community. Cycling has been shown to reduce stress, increase physical health, reduce vehicle infrastructure demands, improve air quality, provide equity in transportation and foster liveable communities.

It is important to note that the Bicycle Network Plan is a flexible living document. For the proposed routes, crossings and infrastructure projects that make up the bicycle network, there is a level of flexibility regarding the specific locations, corridors and facility types that are recommended. The Bicycle Network Plan presents recommendations and suggestions based on the public engagement process and discussions with City staff, TAC Guidelines and best practices. Building on these recommendations, the City will need to review the feasibility and desirability of each infrastructure project within the context of the overall transportation network. The implementation of the Bicycle Network Plan may also require ongoing public engagement as new projects are considered.

1.1. Benefits of Cycling

The City recognizes that more trips made by cycling will result in a more balanced transportation system that supports a healthy and liveable community and is cost effective, and efficient in terms of the community's infrastructure investments. There are significant quality of life benefits that are associated with cycling outlined below:

Equity

Improving cycling conditions can improve equity by providing transportation options for all community members, particularly residents that do not have access to a motor vehicle. This includes children and youth, some seniors as well as people that may have a physical condition preventing them from driving or not have the income to own or operate a vehicle. Having an established bicycle network can help to increase the affordability of transportation for people cycling and encourage more people to cycle.

Economic Benefits

The City's budget can benefit from financially sustainable transportation solutions. Constructing bicycle facilities are less expensive per kilometre than the cost to construct vehicle road infrastructure. Whitehorse budgets $1.5 million per km of two lane road. By comparison, the cost of installing an off-road multi-use pathway is $600,000/km. By installing appropriate bicycle facilities, residents receive a safe, enjoyable and convenient cycling option, reducing vehicle congestion. Fewer motor vehicles on the road reduces infrastructure wear and tear, and reduces the need for expanded roadways.

Health Benefits

Cycling can be enjoyable. Cycling for transportation and recreation is an effective way to support mental and physical health and build a healthier and happier community. The World Health Organization has identified physical inactivity as one of the main risk factors for global mortality, and as an underlying factor for many chronic diseases. Cycling increases physical activity levels, which can reduce the risk of heart disease, diabetes, cancer as well as mental illness. Providing cycling routes with direct access to schools and other community facilities can help encourage and build cycling skills at a young age. This can promote healthy behaviours and a lifestyle that can continue into adult life.

Environmental Benefits

Cycling has many environmental benefits as it can assist in reducing vehicle trips, congestion, air pollution, and can help to reduce greenhouse gas (GHG) emissions. Cycling increases the transit catchment areas. Cycling has a relatively low environmental impact and generates virtually no GHG emissions or air pollution, minimal noise and light pollution, and may reduce demand for impervious surface area (pavement) through more efficient use of existing road space. Promoting cycling can also help in efforts towards climate change mitigation while supporting the protection and improvement of the city's natural environment.

Quality of Life

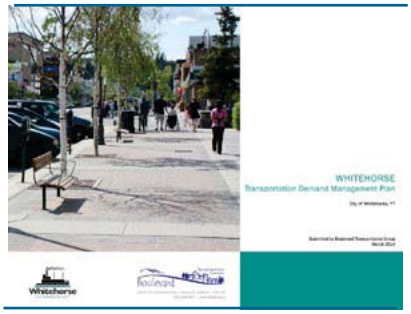
A bicycle-friendly community can foster liveability, with residents experiencing a stronger sense of place and freedom of mobility. Communities that support cycling can also contribute to safer streets and trails, with increased activity and improved social interactions.

Safety

Bikeable environments contribute to a safer transportation system by making cycling a more visible and viable mode of travel. Streets that are designed for slower vehicle speeds feel safer for people cycling. Studies have shown that slower motor vehicle speeds exponentially increase survival rates for people cycling when they are involved in a collision with a motor vehicle. When cycling rates increase, rates of collisions with motor vehicles decrease. This is known as the "safety- in-numbers" principle. As a result, locations with the highest levels of people cycling are also the safest places to cycle.

1.2. Policy Context

There are several existing policy and planning documents that helped to inform the Bicycle Network Plan including:



Transportation Demand Management Plan (2014)

The focus of this document is to identify ways to encourage more sustainable travel habits, with a focus on promoting active transportation. The document identifies mode share targets for 2036 and targets a 3% increase in cycling mode share **(Figure 1).** To improve cycling options in the city it identifies several actions including:

- Developing a trails and active transportation plan
- Improving priority routes between neighbourhoods and Downtown
- Reviewing maintenance practices
- Expanding bike trip end facilities
- Engaging community groups

The Plan also includes a list of cycling related infrastructure projects that were reviewed and considered as part of the development of the Bicycle Network Plan.

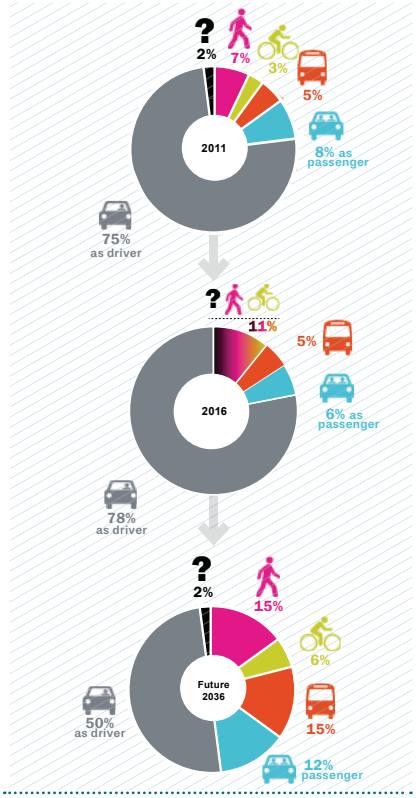
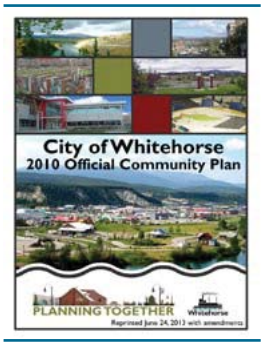
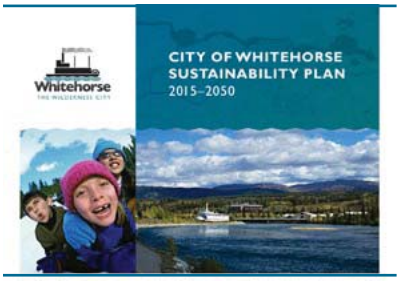


Figure 1 | Existing and Proposed Mode Share Targets (Transportation Demand Management Plan)



2010 Official Community Plan (2010)

The Official Community Plan (OCP) has several objectives and policies that outline the important role of cycling. Objective 12 focuses on increasing and improving pedestrian and cycling transportation options and notes the importance of developing a city-wide Active Transportation Map (including cycling) to help guide infrastructure decisions.



Sustainability Plan

(2015 – 2050)

The Sustainability Plan was developed in 2015 building off previous sustainability plans and strategies developed by the City including the Integrated Community Sustainability Plan and the Strategic Sustainability Plan. The Sustainability Plan outlines a vision, goals and strategies for moving towards a more sustainable community. One of these strategies focuses on efficient, low-impact transportation by addressing known gaps in the bicycle network.

Other plans and policy documents that were reviewed as part of the development of the Bicycle Network Plan include:

- City-Wide Transportation Study (2004)
- Trails Plan (2007)
- Downtown Parking Management Plan (2011)
- Snow and Ice Control Policy (2015)
- Commuter Map and Education Materials (2016)

Additional City Policy Documents Underway in 2017/2018

At the time of the development of the Bicycle Network Plan, the City started working on a Transit Master Plan and a Parking Management Plan. Both documents support multi-modal transportation and the Transportation Demand Management Plan targets. The City plans to start the Official Community Plan update in 2018.

External Documents and Planning Processes

The **Transportation Association of Canada** (TAC) has published a new Geometric Design Guide for Canadian Roads (June 2017). The chapter *Bicycle Integrated Design* provides design parameters and specific guidelines for the safe accommodation of vehicles, cyclists and pedestrians on linear road elements and at intersections. The selection of appropriate bikeway facilities is based on vehicle speed and volumes.

Yukon College has developed an Ayamdigut Campus Master Plan (2015) with transportation to the campus being a major component of the plan. Therefore, it is important that the routes identified in the Bicycle Network Plan are contiguous with the routes to College lands. The College is working towards full university status. This will increase the importance and access to the campus as a key destination.

Yukon Government has proposed changes to the Alaska Highway corridor. This may include widening sections of the highway, decreasing and or re-locating access points, re-configuring intersections to change the number of turning and through lanes, increasing speed limits and changing intersection controls. Changes to the Alaska Highway corridor may provide opportunities to enhance the cycling infrastructure along the corridor and improve the connectivity of routes that cross the Alaska Highway. The functional plan included a separated multi-use pathway on either side of the highway.

1.3. Planning Process

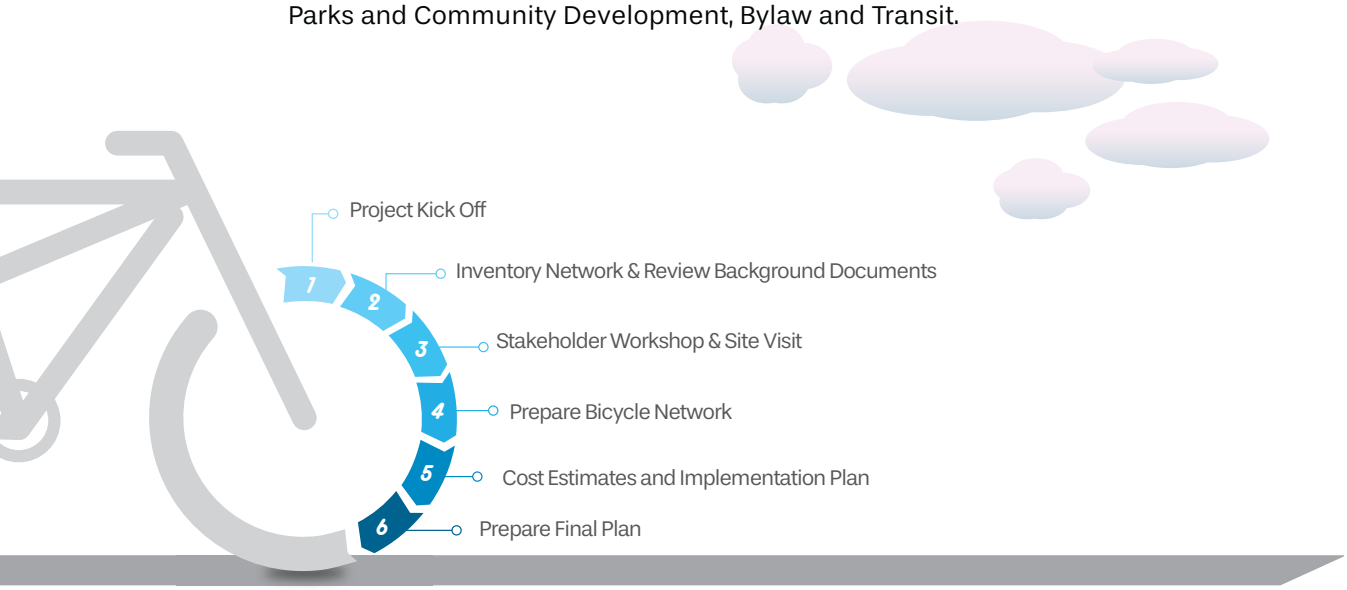
The City of Whitehorse Bicycle Network Plan was developed between May 2017 and December 2017 based on input from residents, stakeholders and City departments.

In June, an on-line survey was posted on the City's website. A Stakeholder Workshop was held with members of the Whitehorse Urban Cycling Coalition (WUCC) to help identify the long-term vision for cycling in Whitehorse, what the long-term bicycle network would look like and to help identify priority projects. Concurrently, the City was developing long term plans for the Marwell and Downtown areas. Feedback regarding the bicycle network was collected throughout the spring, summer and fall at the workshops and interactive displays.

During the planning process, every proposed route was evaluated to determine the most suitable cycling infrastructure based on vehicle volumes, posted speeds, roadway right-of-way and destinations served by the route. TAC guidelines and All Ages and Abilities (AAA) best practices informed the recommended cycling infrastructure. Estimated costs were established for each route segment.

Council reviewed the draft network maps at a Council and Senior Management meeting September 21, 2017. The network maps may be included in the next Official Community Plan update.

The Bicycle Network Plan was reviewed by and received comments from the WUCC and the following City Departments: Engineering, Planning and Sustainability Services; Parks and Community Development, Bylaw and Transit.



1.4. Existing Conditions for Cycling

According to the Statistics Canada 2011 National Household Survey, approximately 3% of Whitehorse residents reported using a bicycle as their primary means of transporation to get to work or school. This is higher than many other North American cities. As seen in **Figure 2,** this number has increased since 2001 – the City installed its first on-street bike lanes in 2005 as part of the Transportation Showcase. The 2016 Canada Survey Statistics combined cycling and walking into an active transportation aggregate. The total percentage has remained constant at 10%.

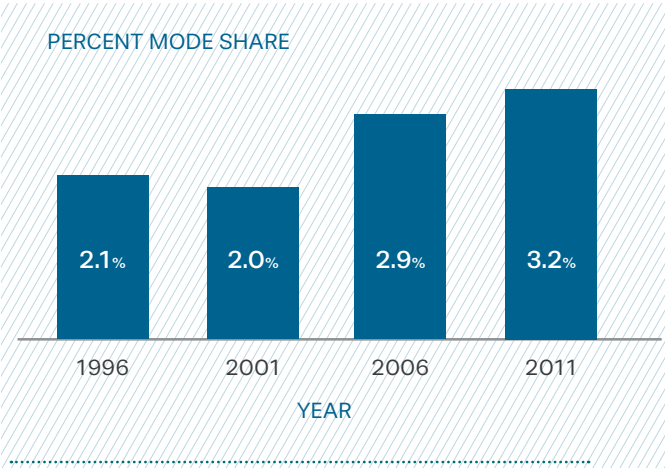


Figure 2 | Whitehorse Historical Cycling Mode Share (Statistics Canada, National Household Survey)

A voluntary on-line survey was launched in June 2017 to determine existing travel patterns, issues and opportunities. The survey link was distributed at the Fireweed market, on the City's webpage and through the Whitehorse Urban Cycling Coalition Facebook group. Two hundred and thirty-eight survey responses provided feedback on current travel patterns, existing conditions as well as issues and opportunities for cycling in Whitehorse. The majority of the respondents were people who currently cycle. Most of the respondents have been cycling in Whitehorse for at least six years (59%). Seven percent started cycling this year, and rest have been cycling for one to six years. **Figure 3** shows the frequency of cycling for all respondents per week based on weather conditions.

- In warm/dry weather conditions, 98% of survey respondents bike at least once a week. The largest group of respondents cycle three to five times a week.
- In wet weather conditions, 77% of survey respondents bike at least once a week.
- In cold/snowy conditions, 47% of respondents bike at least once a week.
- The survey found that people who are new to cycling and started cycling this year tend to cycle less frequently, and tend to cycle in more favourable weather conditions.
- Approximately 43% of the respondents reported that their cycling trips took between 20 minutes and one hour, while 36% reported taking shorter cycling trips (10 to 20 minutes)
- Survey respondents are cycling for several different trip purposes including **exercise and recreation, commute to work or school** and **trail riding (Figure 4).**
- **Downtown** Whitehorse is the most common destination, followed by **trails, pathways and parks and travelling within neighbourhoods.**
- No respondents reported cycling to a transit stop.

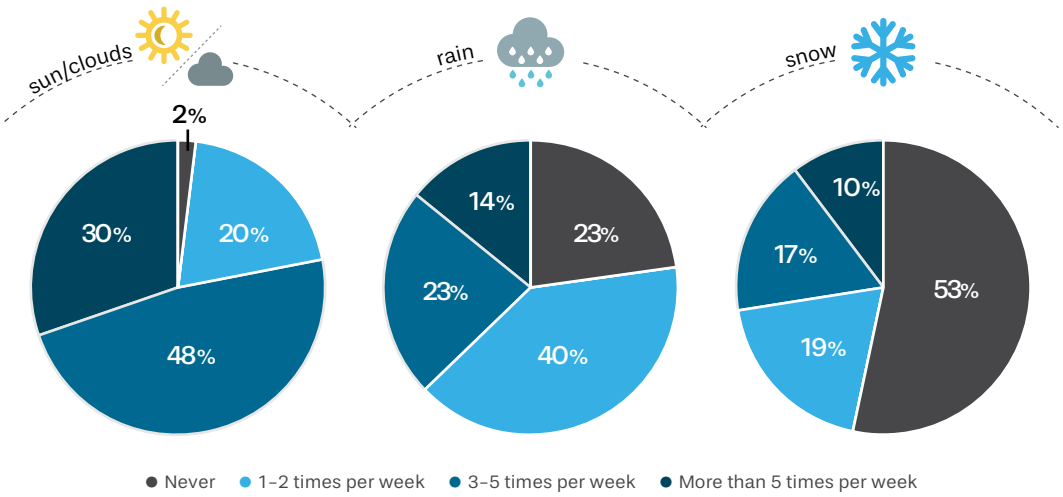


Figure 3 | Cycling Frequency by Weather Conditions (2017 Survey Results)

- Most of the respondents (53%) said they feel unsafe or very unsafe with the current on-street bicycle facilities in Whitehorse. This was consistent with both people that started cycling this year and those that have been riding for at least six years. Comments reflected a wide range of safety concerns not linked directly to on-street cycling facilities. Cyclists reported safety concerns on multi-use pathways (safety for pedestrians), at intersections and crossings, and with maintenance (line painting, glass, snow and gravel).
- The biggest deterrents to cycling were traffic safety (vehicle volumes, speeds, and intersections), lack of dedicated cycling facilities (on-street cycling facilities and multi-use pathways) and weather.
- When asked to indicate which measures the City should use to improve the cycling environment, the top responses were infrastructure improvements, increased education, and winter maintenance **(Figure 5).**

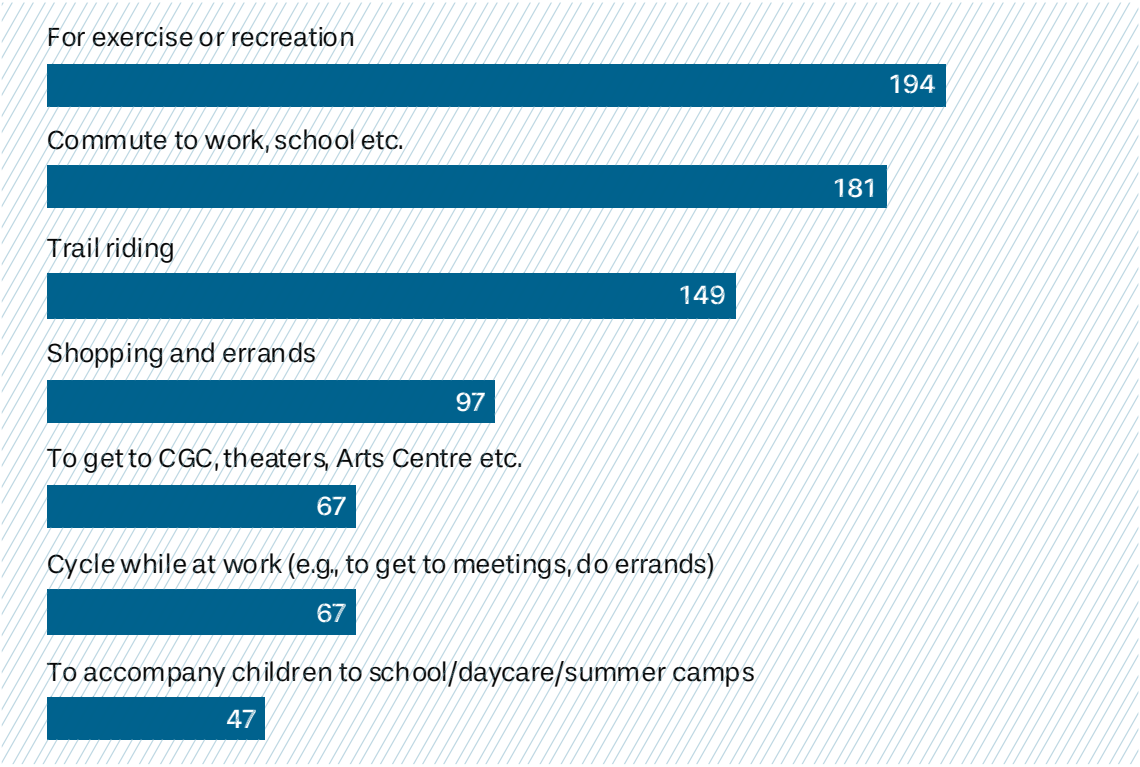


Figure 4 | Reason For Cycling (2017 Survey Results)

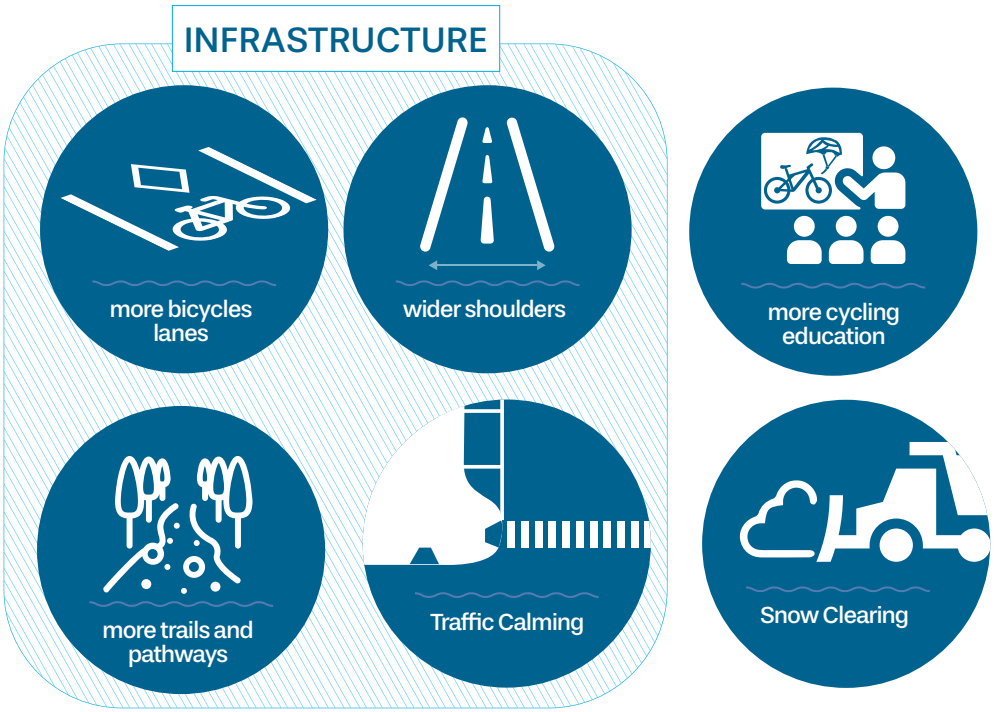


Figure 5 | Opportunities to Improve Cycling (2017 Survey Results)

1.5. Current Whitehorse Cycling Infrastructure

Whitehorse's bicycle network is currently made up of on-street and off-street facilities including painted un-buffered bicycle lanes, wide shoulders, and paved and gravel multi-use pathways. At the time of this Plan, within Whitehorse there are approximately 29 km of paved multi-use pathways and seven km of un-buffered bicycle lanes **(Table 1)**. **Figure A-1 in Appendix A** shows the routes recommended for cycling in Whitehorse, the majority of which are not designated nor signed as bike routes. The photos on the following pages illustrate the variety of the current cycling infrastructure.

The City has installed numerous Class 1 and 2 bike storage facilities, many of which have been locally produced. The City Environmental Grant has supported private property owners with building and installing bike racks. Additionally, the City Zoning Bylaw (2012) has minimum Class 2 bicycle parking requirements based on development type and size. Currently, the number of bike racks and bike storage facilities in Whitehorse is not well documented.

All City transit buses have a front-mounted bike rack capable of carrying two bicycles. At this time they are not able to carry fat bikes. Transit does permit bikes to be loaded inside the bus during non-peak periods. There is no additional charge.

In addition to existing cycling infrastructure, Whitehorse already has a strong cycling culture. Whitehorse has two specialty bike shops, and several general sporting goods stores that sell bicycles. There are also opportunities for residents to order bicycles on-line and find used bicycles through on-line buy and sell platforms.

The specialty bike stores in the city have experienced significant growth in the past five years, particularly in the employment of full-time bike mechanics – the winter employment rate has quadrupled, while in the summer it has tripled. Fat bikes sales have been strong, capturing approximately one-fifth of the mountain bike market.

Infrastructure Type	# of total existing kilometers
Unbuffered bicycle lane	7.4
Buffer bicycle lane	0
Protected bicycle lane	0
Off-street paved pathways	29.0
On-street wide shoulder	22.0
City road network	277.0
Alaska Highway and Klondike Highway	43.3

Table 1 | Existing Infrastructure

Existing Whitehorse Bicycle Facilities

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1 2
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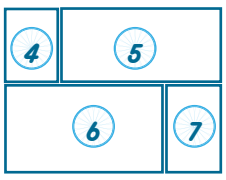
Multi-Use Pathway

Bike Only Pathway in summer; shared pathway in the winter



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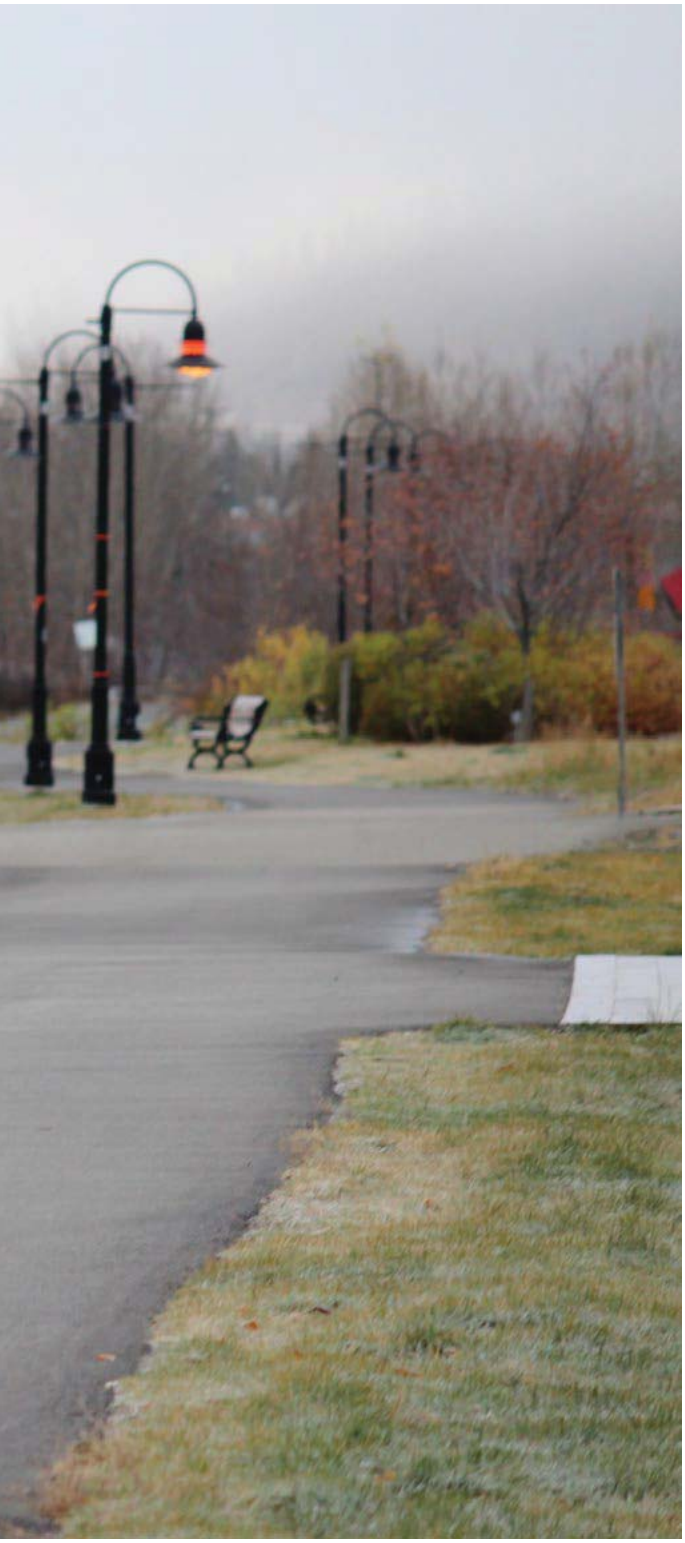
On-Street Un-Buffered Bicycle Lane



2.0
Proposed Bicycle Network

2.1. Network Planning Principles

Developing a complete and connected network of bicycle facilities for all users is a critical component for encouraging more cycling. A well-designed bicycle network needs to be visible, intuitive, and provide connections between destinations and neighbourhoods. It is also important to note that engineering only makes up one component of a successful bicycle network and culture within a community. The most successful bicycle plans have five components – the 5 E's – including engineering, education, encouragement, enforcement and evaluation. Whitehorse will create an environment where more people are encouraged to start cycling and feel safe, comfortable and encouraged to continue **(Figure 6)** .The first step is to make cycling possible, safe and respectable. This phase depends significantly on the built environment to provide the necessary infrastructure. As the cycling plan matures, the focus shifts to encouraging more people to use the cycling infrastructure. Promotion efforts including education and encouragement become more important.

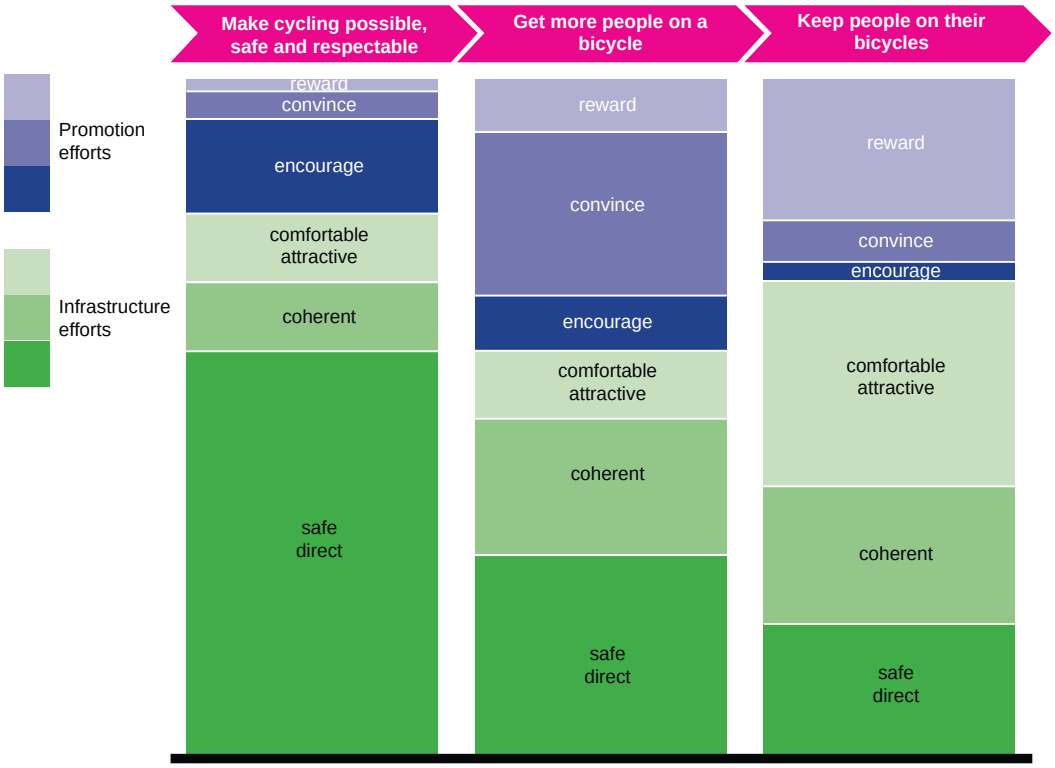


Figure 6 | Sequence of Cycling Strategy Efforts (PRESTO Policy Guide General Framework (2010))

Generally, people who cycle can be categorized into four groups: fearless, enthused and confident, interested but concerned, and not interested in cycling. Studies in other Canadian municipalities have found that:

- Approximately 1% of the population is **strong and fearless** and will ride anywhere, regardless of conditions.
- Between 5% and 10% of the population is **enthused and confident.** This means they are fairly comfortable on all types of bikeways, but will preferentially choose multi-use pathways and low traffic streets.
- The bulk of the population (60%) is **interested but concerned** and are likely to feel the most comfortable cycling on multi-use pathways and low volume streets in favorable conditions. This group is likely to become **enthused and confident** with improved facilities, encouragement, education, and experience.
- Approximately 30% of the population is **not interested** in cycling regardless of the type of network in place.

To gain a significant modal shift to cycling, a bicycle network needs to serve users of all ages and abilities, offering practical route options for those who are interested in cycling, but who may not be comfortable riding on busy streets with high traffic volumes and speeds. Therefore, the bicycle network needs to function as an integral part of a multi-modal system, and consider motor vehicle traffic and movements, pedestrian facilities and human behaviour. As a winter city, a key component of encouraging cycling is ensuring that it is something that can be done safely year-round, and considerations for snow and ice removal and storage as well as lighting need to be addressed in design and for ongoing maintenance.

The long-term bicycle network proposed for Whitehorse was based on five network planning principles, that combine to achieve the goal of providing a safe and convenient bicycle network. These principles build off of guidance outlined in national and international bicycle network planning and design documents including the new TAC Geometric Design Guide for Canadian Roads. These documents focus on looking beyond cyclists as a design vehicle but as people travelling along city streets. The five network planning principles used to develop Whitehorse's Bicycle Network Plan include:

- Comfortable and Safe
- Connected Minimum Grid
- Convenient
- Winter City Design
- Planning Cycle

AAA Bike facilities are suitable for ages 8–80 and designed on:

- Local streets with low motor-vehicle-speeds and volume; or
- Physically separated on busy streets.

Comfortable and Safe

Providing a bicycle network with AAA facilities in Whitehorse would result in an interconnecting system of bicycle facilities that is comfortable and attractive for a broad array of users, ranging from children to seniors.

There are also opportunities to enhance engineering features to not only provide a safer and more comfortable bicycle facility but also enhance the aesthetic of a street. The type of separation used such as planters or landscaped boulevards help to provide additional separation and enhance the streetscape. The design of facilities should also consider the physical dimensions of the bicycle, including bike-trailers and trail-a-bikes, cargo bikes, and other larger cycle-powered bicycles used by vendors and courier companies. With electric assist bicycles becoming more prominent, maximum design speed should be considered. As Whitehorse has significant topography, downhill speeds and stopping distances need to be accommodated.

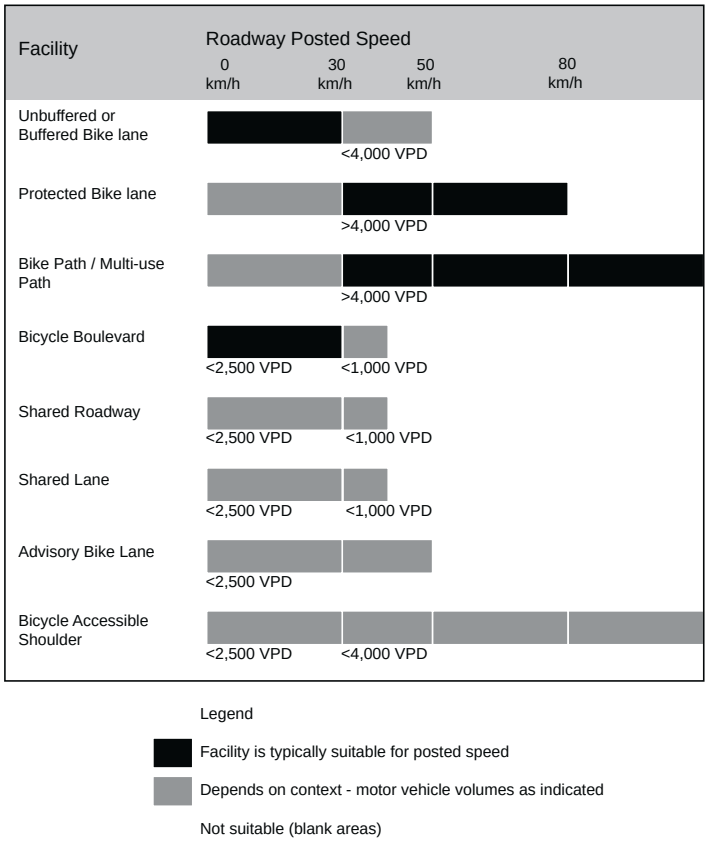
Research conducted at the UBC Cycling in Cities Program suggests that three types of bicycle facilities that are most effective at increasing ridership including:

1. Multi-use pathways
2. Separated bicycle paths
3. Neighbourhood greenways (quiet slow volume and speed streets)

These facilities are preferred by all users and are also the safest types of facilities. Developing an AAA network with multi-use pathways, separated bicycle paths, and neighbourhood greenways provides the highest standard of safety and comfort throughout the network.

The Transportation Association of Canada (TAC) released guidelines in 2017 for selecting the appropriate cycling facility, given motor vehicle speed and volume **(Figure 7).** Other factors such as volume of heavy trucks and transit vehicles influence the facility type that is appropriate, as do physical characteristics such as topography. In general, the preferred grade for bicycle facilities is less than 8%. The City of Vancouver's AAA Guidelines suggest keeping grades to 3% or less on AAA facilities. Steep hills can be very challenging, particularly for young riders, seniors, people who are new to cycling, and some people with disabilities. However, providing bicycle facilities on roads with 8% grades may be necessary, especially if the facility is going to provide connections to key destinations, and will complete the bicycle network overall.

Bikeway Facilities Recommended by Transportation Association of Canada, based on Roadway Posted Speed and Vehicles per Day (VPD)



Source: Geometric Design Guide for Canadian Roads, Chapter 5 - Bicycle Integrated Design (2017)

Figure 7 | Bikeway Facilities Recommended by TAC (2017)

The TAC facility selection framework can be used:

- To select the appropriate cycling facility during new roadway construction and retrofits;
- Identify roadways that are good candidates for a selected cycling facility type;
- Identify target speed limits and potential traffic calming on roadways to allow a particular cycling facility to be installed; and
- To evaluate the appropriateness of existing cycling facility given the roadway conditions.

Whitehorse uses the TAC guidelines to inform roadway construction. The new guideline corroborates the research conducted by UBC Cycling in Cities Program.

Vehicle volumes and speeds play an important factor in deciding the recommended cycling infrastructure. The recommended threshold for providing separated facilities is 50 km/h or 4,000 vehicles per day.

Separated bicycle paths, multi-use pathways and neighbourhood greenways will make up the City's AAA Bicycle Network **(Figure 8)** as follows:

- Multi-use pathways and dedicated bike pathways are recommended where there is enough space in the right-of-way as well as a limited number of intersections, alleyways, and driveways.
- Protected bicycle lanes or separated bicycle paths are recommended on busy streets up to 80 km/h.
- On local streets with reduced speed limits of 30 km/h, neighbourhood greenways and traffic calming measures are recommended.

Intersections are a critical component of the network – a bicycle network is only as comfortable as the least comfortable section of the journey. Intersections along the entire route need to be designed appropriately. TAC has intersection design guidelines that should be implemented during all new construction and all retrofitting. Other design components that increase comfort and safety include appropriate curves, facility

Whitehorse speed limits

- Most local streets 50 km/h
- Whistle Bend 40km/h
- McIntyre subdivision 30 km/h
- Main arterials 60-70 km/h

Whitehorse daily vehicle volumes (5 year average 24 hour count)

- Robert Service Way 10,100
- 4th Avenue 11,500
- Lewes Blvd 19,200
- Quartz Rd 14,200
- Mountain View 8,100
- Range Rd 5,200
- 12th Avenue 4,300
- Hamilton Blvd 12,400

design speed, design speed for vehicles that cross the facility at driveways and intersections, clear right-of-way designations, and ease of getting on/off the facility through the use (or absence) of barriers.

In cases where there is insufficient roadway space and no alternative route can be located, complementary non-AAA facilities such as painted bicycle lanes may be an appropriate compromise to ensure the network is complete and connected. In this case, posted traffic speed should be reduced and traffic calming should be implemented to reduce traffic speed, as per the TAC guidelines.

Connected Minimum Grid

Developing a connected minimum grid network that ensures all urban residents have

Figure 8 | Facility Types

access to a bicycle facility within a short cycling distance was an important principle in developing the proposed bicycle network. This type of network would allow for most residents of Whitehorse to access a safe and comfortable route within a short distance of their home and destinations. Research conducted at the UBC Cycling in Cities Program suggests that people cycling need to be able to access bicycle routes quickly and easily. This study found that cyclists will detour up to 400 metres to find a route with a bicycle facility.

While transitions from one facility type to another are unavoidable, the frequency of transitions along a route should be minimized, the location of the transitions should be carefully planned, and be intuitive to all users of the transportation network.

Convenient

A complete and convenient bicycle network with direct routes to key destinations is critical to making cycling a viable transportation option. Key destinations are shown on **Figures A-2 and A-3 in Appendix A** and include:

- Residential areas
- Commercial destinations
- Key employment areas
- Parks, community centres, and recreational facilities
- Existing multi-use pathways
- Schools and Yukon College

Winter City Design

To support and encourage year-round cycling, winter cities like Whitehorse need effective strategies for designing bicycle infrastructure that can be maintained and used in all seasons. Winter maintenance and snow clearance on bicycle facilities was identified by survey respondents as a barrier to cycling in the winter. Winter conditions can have a strong influence on an individual's decision to cycle. A bicycle facility that might be suitable in the summer months can feel less safe in the winter. Snow stored at the side of the road can make a bicycle facility narrower and people cycling are often required to ride closer to moving vehicles. Also, weather conditions such as ice fog and decreased daylight can reduce visibility and make people cycling feel more vulnerable. Having high quality, physically separated bicycle facilities can help promote year-round cycling and improve the effectiveness of snow clearing and snow storage from the roadway and cycling facility.

Planning Cycle

This Bicycle Network Plan is intended to be a living document, with evaluation and review recommended in conjunction with the OCP. The identification of the network of routes provides an opportunity to incrementally improve the cycling infrastructure when roadways and intersections are planned to be re-constructed. As new developments and destinations are built in the city, access to the cycling infrastructure can be incorporated during the design phase. While some routes have been identified as being of priority, funding opportunities may favour another route or project. Neighbourhood and community groups may propose alternative or additional routes. As infrastructure is built, more emphasis can be focused on the other elements of a successful cycling city – encouragement, education and enforcement. The City will also work to update the plan to include best practice updates and emerging technologies.

The bicycle network maps may be included in the Official Community Plan, and may be incorporated in future transportation planning initiatives (City Wide Transportation Plans, Corridor Studies, Neighbourhood and Area Plans etc.).

2.2. Proposed Network

The guiding principles were used to develop the long-term bicycle network for Whitehorse. The proposed bicycle network is presented in **Figure A-4 in Appendix A** includes:

- Three AAA facility types
  - Multi-use pathways
  - Separated bicycle paths (including dedicated bicycle paths similar to multi-use pathways and protected bike lanes separated by grade or physical barrier) and
  - Neighbourhood greenways
- Two non AAA facility types (Supporting facilities)
  - Painted un-buffered bicycle lanes
  - Gravel pathways

AAA BICYCLE CORRIDOR TREATMENTS

[Left] City of Whitehorse – Multi-Use Pathway | [Right] City of Vancouver – Multi-Use Pathway Separating Users

Multi-Use Pathways

Multi-use pathways are physically separated from motor vehicles by open space or a barrier, depending on the application. They provide sufficient width and supporting facilities to be used by people cycling and other forms of active transportation. Multi-use pathways can have paved or unpaved surfaces. Paved or firm surfaces are often preferable for people cycling and people with mobility aids or strollers, and are easier to maintain in the winter.

Multi-use pathways meet the needs of cyclists and pedestrians where total user-volumes are low to moderate. In areas with high pedestrian or cycling potential, multi-use pathways should be designed to permit future separation by mode. This can be accomplished by designing a wider pathway, and initially only constructing the minimum multi-use width. In the future, additional path width can be added, and modes delineated by paint or barriers. When a separate space is allocated for people cycling, the facility is considered a separated bicycle path.

Multi-use pathways are recommended along corridors where sufficient right-of-way is available and parallel to major streets with minimal driveway access or intersection crossings. There are also a number of proposed multi-use pathway routes that are not adjacent to streets and cross undeveloped areas. In many cases, informal or unpaved trails and pathways already exist. Many of these have been identified as a proposed route with the actual alignment unknown at this time. These routes will need to be reviewed in more detail to ensure factors such as topography and property ownership are taken into consideration.

Some examples of multi-use pathways that are recommended to be built include:

- The north side of 2nd Avenue between 4th Avenue and the Riverfront Trail
- Extending the upper airport trail south beyond Black Street ravine
- Connecting 2 Mile Hill with the Riverfront Trail
- Both sides of the Alaska Highway

Separated Bicycle Paths

Separated bicycle paths are physically separated from motor vehicle travel lanes and may be located on-street within the roadway surface (protected bike lanes), or in the boulevard beside the road (separated bicycle paths, similar to multi-use pathways) offering the benefit of direct routes and segregation from traffic. Whitehorse does not currently have any year-round separated bicycle paths. Two Mile Hill has a seperated bike facility in the summer—in the winter it becomes a multi-use pathway.

There are many types of separated bicycle paths, offering varying types of treatments to provide protection. Types of separation can include: concrete barriers, elevation, bollards, parked cars, and visual surface treatments such as pavers. Separated bicycle paths are separated from the sidewalk, preventing encroachment of people walking onto the bicycle lane.

The increased comfort offered by separated bicycle paths plays a significant role in increasing bicycle ridership, particularly among the interested but concerned demographic. They are an effective way to have people of all ages and abilities cycle on busier streets and have been proven to increase bicycle ridership in other cities.

Separated bicycle paths have been suggested in areas with high cycling demand and potential, and where vehicle speeds exceed 30 km/h and vehicle volumes exceed 4,000 vehicles per day. As one of the highest quality facilities, it is recommended that a network of separated bicycle paths be focused within the Downtown. On-street

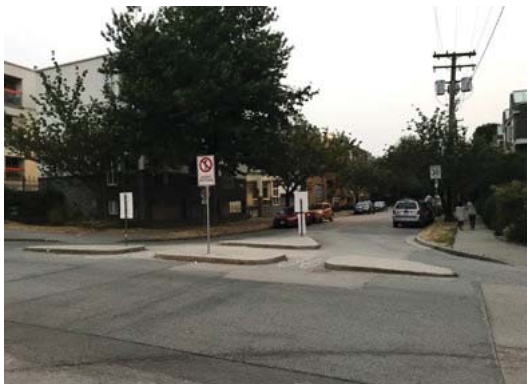
[Left] Malmo, Sweden – Sidewalk Level Separated Bicycle Path
[Right] City of Winnipeg – Street Level Separated Bicycle Path with Parked Cars Providing Protection

parking and access to boulevard parking will be an important design consideration. In many cities, the on-street parking has been used successfully to provide a physical buffer between the travel lane and the bicycle lane. Fourth Avenue is an example of a route where separated bicycle paths may be an appropriate facility. The current unbuffered painted bike lanes would be converted to a protected bicycle facility.

Neighbourhood Greenways

Neighbourhood Greenways refer to shared bicycle routes located on streets with low traffic volumes (TAC recommendation less than 2,500 vehicles per day), low speeds (maximum 40 km/h) traffic calming measures and specialized crossing treatments to discourage through-trips by motor vehicles, and prioritize bicycle connectivity, while accommodating local access They are also referred to as local street bicycle boulevards. Neighbourhood greenways can provide a parallel route to a major road or be used within neighbourhoods on quiet residential streets connecting existing trails and pathways.

The critical locations on neighbourhood greenways are where these facilities intersect major roads. Crossing treatments can be used to assist cyclists, pedestrians and others in crossing major roads, and to minimize potential conflicts with motor vehicles. Typically, median islands, pedestrian corridors, signals, and sensors are considered.



[Left] City of Vancouver – Neighbourhood Greenway with Road Closure for Motor Vehicles
[Right] City of Vancouver - Neighbourhood Greenway with Right in/Right Out for Motor Vehicles

In cases where the existing streets have relatively low traffic volumes and speeds, signage and pavement markings identifying the road as a bicycle route may be the only required improvement.

If volumes and speeds are high, the roads should be further enhanced with traffic calming measures such as speed humps, traffic circles, and traffic diverters. Locations where neighbourhood greenways have been suggested in Whitehorse include:

- 3rd Avenue
- Teslin Road
- Connections between the Escarpment trail and the Riverfront trail including Black Street, Wood Street, and Hanson Street. This provides a good network of east west connections in the Downtown with approximately 400 m between designated routes. Main Street is not recommended as a boulevard, due to the high parking turnover rates.

BicycleLanes

Bicycle lanes are designated exclusively for bicycle travel. Bicycle lanes help to define the road space for cyclists and motorists. A conventional bicycle lane is rarely considered an AAA bicycle facility, and are not recommended by TAC except for streets with posted speed limits of 30 km/h or less, or low volume streets with fewer than 4,000 VPD.

[Left] City of Whitehorse – Bicycle Lane Un-Buffered
[Right] City of Vancouver – Bicycle Lane with Bicycle Push Button

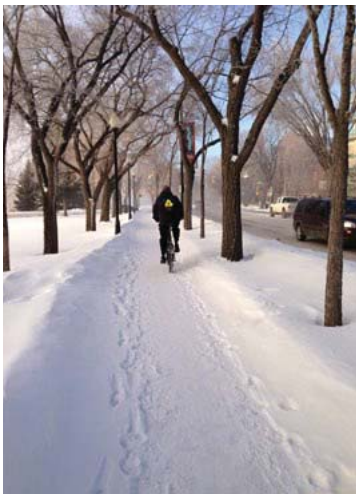
Examples of Bicycle Facilities from Other Winter Jurisdictions

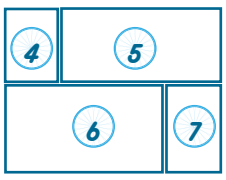
1 2
3

1 Edmonton, Seperated Bike Path

2 Edmonton, Snow Clearing Equipment

3 Edmonton, Multi-Use Pathway





4 Saskatoon, Multi-Use Pathway

5 Winnipeg, Multi-Use Pathway

6 7 Winnipeg, Neighbourhood Greenway

Bicycle lanes can have a painted buffer, located between the bicycle lane and other traffic lanes, and between the bicycle lane and on-street parking. These buffered bicycle lanes are believed to be more comfortable and safe than conventional painted unbuffered bicycle lanes as there is a spatial separation between people cycling and adjacent traffic lanes. Where the bicycle lane is adjacent to on-street parking, the buffer provides a space for the opening of vehicle doors. Buffered bicycle lanes are distinguished from protected bike lanes, as the former does not provide a physical barrier, such as bollards, curbs, or planters. Buffered bike lanes can also be used as a short-term measure when a protected bike lane is not immediately practical. However painted bicycle lanes become invisible in the winter when snow and road debris cover the lines.

Bicycle lanes are suggested on secondary routes where the road right-of-way is not sufficient for a protected lane, or where the traffic volumes and speeds are low. In many cases, the routes identified as bicycle lanes support and complement the AAA network by providing additional connections and direct access to destinations.

Intersections

TAC recognizes that intersections can be challenging and uncomfortable to navigate, and provide guidance on intersection design based on the bicycle facility type and roadway configuration. TAC recommends protected signal phases and a variety of line and pavement markings at small intersections. Protected Intersections are recommended at large intersections with multiple lanes and complex signal phasing.

Upgrading intersections within the city has been identified as an ongoing priority by residents and the WUCC. Through the network planning process, several locations have been identified where intersection enhancements would be required to make existing facilities more comfortable and safe. This includes providing crossings over the Alaska Highway, and improving locations where multi-use pathways cross intersections, particularly along Two Mile Hill and Hamilton Boulevard. Intersection upgrades have been identified throughout the bicycle network and will need to be reviewed by the City in more detail to determine the appropriate design for each intersection.

Transitions Between Facility Types

It is important to note that at locations where one bicycle facility type transitions to another, the transition should be designed to be intuitive and easy to navigate by both first-time users and individuals that have been cycling for years. They should also be intuitive to motor vehicle divers so that they are better able to predict cyclists' movements.

Active Transportation Crossings

Connections to enhance the network and address barriers such as topography and waterways have been identified on the long-term network map and are outlined below.

- Active transportation crossings have been proposed at locations within the city to cross major roadways and the Yukon River. Some of these crossings can potentially take advantage of topography to provide grade separation (similar to the culvert under Hamilton Blvd).
- Two additional stairways or switchback-trails have been proposed on the escarpment – at the southern end of the escarpment to provide a second route to Downtown, and between Marwell and Takhini. A switchback trail has also been suggested in the Black Street ravine as a more accessible option to the existing stairs.

Proposed Active Transportation Network

Figures A-6 and A-7 in Appendix A presents the long term vision of a complete bicycle network with the recommended facility types, including both AAA and non-AAA routes.

Based on Whitehorse traffic speeds and vehicle volumes, the TAC Guidelines recommend only protected bicycle lanes and bicycle paths/multi-use pathways as appropriate cycling facilities. The conventional bike lanes used in Whitehorse should be avoided unless the traffic speed is reduced to 30 km/h.

The existing multi-use pathways are shown in solid green lines and are considered AAA facilities. Spot improvements are required to enhance the safety and comfort of these facilities, primarily at intersections and transitions to other facility types.

The existing conventional bike lanes that are suggested to be a part of the network are shown in solid red. These likewise need spot improvements at intersections as well as additional signage. Providing a painted buffer where feasible is recommended.

All proposed routes are shown in coloured dashed lines representing the recommended route and facility type. Road classification, neighbourhood context, existing conditions in the right-of-way width, number of vehicle lanes, traffic volumes, posted speed limit and on-street parking were considered in determining a recommended facility type.

A more detailed assessment of facility type and consultation with adjacent land owners would need to be completed upon plan implementation and facility design. The design of multi-use pathways will need to be considered on an individual basis to provide connectivity, access to destinations and crossing points. On major roadways such as the Alaska Highway and Hamilton Boulevard, providing multi-use pathways on both sides of the road is recommended.

Alaska Highway

The Bicycle Network Plan focused on the urban containment boundary for the City of Whitehorse, along with the Alaska Highway through Whitehorse. For the 9% of the population in low density, country residential areas outside of the urban containment boundry. The Alaska Highway is recommended to be the primary connection to Downtown Whitehorse, with a separated, multi-use pathway on both sides of the highway. TAC has guidance on the design of pathways adjacent to high speed roads including intersection design and width of separation between the pathway and the roadway.

3.0 Implementation Plan

The City of Whitehorse Bicycle Network Plan provides a long-term vision for the bicycle network in the city. Cost estimates based on the proposed facility type are included in this section and Appendix B. This section also provides, considerations for winter design, and a brief discussion on actions and measures to supplement the network to foster a cycling culture in Whitehorse.

Recognizing that the long-term vision will require significant investment, projects will be reviewed and completed as funding and opportunities arise. It is recommended that the City consider allocating a capital budget to enable levering external funding and grants.

3.1. Network Prioritization

The following criteria were used to determine where the City should focus its efforts in cycling infrastructure over the short term:

1. Support greatest cycling potential
2. Improve existing cycling infrastructure
3. Link with other projects

The greatest cycling potential is for trips between 2.5 and 5 km one way. Although Whitehorse is geographically large, approximately 62% of the population live within a 3.5 km radius of Downtown, the largest employment centre **(Figure A-10 in Appendix A)**. It is recommended that providing AAA cycling infrastructure from these neighbourhoods to Downtown, and high quality cycling within Downtown, is a priority. The number of survey respondents (on-line survey) from each neighbourhood is a good indicator of cycling potential. It is no surprise that neighbourhoods closer to Downtown already have more cyclists **(Figure 9)**.

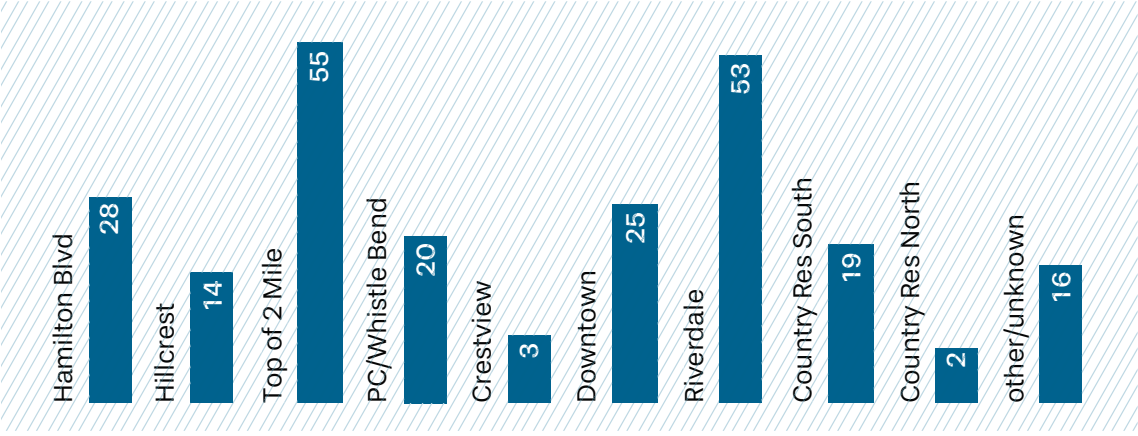


Figure 9 | Geographical Area of Residence of Survey Respondents

It is also recommended that educational facilities (schools and Yukon College) have access to an AAA cycling facility. All of the neighbourhoods within the urban containment boundary are easily two kilometres from a transit stop, making cycling to transit a viable option. Routes to transit stops and bike storage should be evaluated and improvements planned.

The Recommended Short Term Projects 1–5 years

The recommended short term infrastructure projects can be seen in **Figure 10**.

Improve Safety: The City will develop Multi-use Pathway Design Guidelines in 2018, and evaluate the existing multi-use pathways to recommend upgrades for future capital budgets. This project will provide the tools to improve the safety of the existing pathways, primarily at intersections, and ensure that future pathways being built have a consistent design standard.

While bicycle lanes painted on a roadway are not recommended by TAC, improving existing bicycle lanes with painted buffers and increased signage is a good temporary measure to improve the visibility of the bicycle lane. Likewise, the 22 km of wide shoulders provide the opportunity to pilot short term solutions at low costs including, for example, bicycle route signage, painted buffers and temporary dividers where appropriate. TAC can provide guidance on how to reconfigure intersections where a dedicated vehicle right hand turn lane encroaches on the wide shoulder.

Improve Connectivity: Some multi-use pathways are not well connected, forcing cyclists to use sidewalks or roads with poor, or no, cycling facilities. It is recommended that three areas be addressed in the short term:

1. Connect Two Mile Hill multi-use pathway to the Riverfront Trail. Possible options to explore include:
    - A multi-use pathway on an easement adjacent to the service alley for Canadian Tire and Walmart, crossing Quartz Rd at the pedestrian/cyclist activated crosswalk. This route would connect to the Riverfront Trail via a pathway extension from Spook Creek Station.
    - Install a two-way cycle path on the north side of Chilkoot Way, crossing Quartz Rd at the existing traffic light. This route would connect to the Riverfront Trail at Spook Creek Station. A cycle path can be installed as a pilot project using jersey curbs placed on the road surface, allowing evaluation and adjustments prior to becoming permanent. A Chilkoot Way re-design can also enhance pedestrian crossing locations between the large developments in the area.

2. Connect Two Mile Hill multi-use pathway to Black Street

The Two-Mile Hill multi-use pathway currently ends on 4th Avenue, requiring cyclists to transition to an un-buffered bicycle lane that is narrow and in poor condition, with the painted lines disappearing over the winter. The traffic volume and speed exceeds the maximum threshold recommended by TAC. South of Ogilvie Street, the traffic is calmer and slower. An existing paved boulevard along both sides of this section of 4th Avenue could be re-designed as a bicycle path/multi-use pathway. It is recommended that the design continue to Black Street (an east-west Downtown route), to provide an AAA cycling facility from the north to École Whitehorse Elementary School.

3. Connect multi-use pathways along the west side of Lewes Boulevard to Lowe Street

With three schools planned for this section of Lewes Boulevard, separated and direct cycling access to the front of the properties is recommended. A two-way cycle path on the boulevard would connect with the existing multi-use pathways while providing a separate sidewalk for the high number of pedestrians.

On the Downtown side of the Robert Campbell Bridge, cyclists must use the sidewalk to connect to Downtown. A multi-use pathway or separated pathway is recommended on both sides of 2nd Avenue from the bridge to the existing lights at Lowe Street.

Integrate with other projects: The City should integrate relevant bicycle network components into future capital retrofits, and ensure that new developments are designed to incorporate appropriate cycling infrastructure to connect with the proposed Bicycle Network. All intersection improvements should be designed for the proposed routes and facility types, reducing the need to upgrade the intersection as future cycling facilities are budgeted, designed, and built.

Examples of projects that may be relevant in the short term include work on neighbourhood arterial roadways including Lewes Boulevard, Range Road, and 12th Avenue, highway crossings and multi-use pathways as part of the Alaska Highway Corridor upgrades, and new or upgraded signals on 2nd Avenue where proposed east-west cycling facilities cross 2nd Avenue.

The Network Maps should be included in the OCP and future City Transportation Studies.

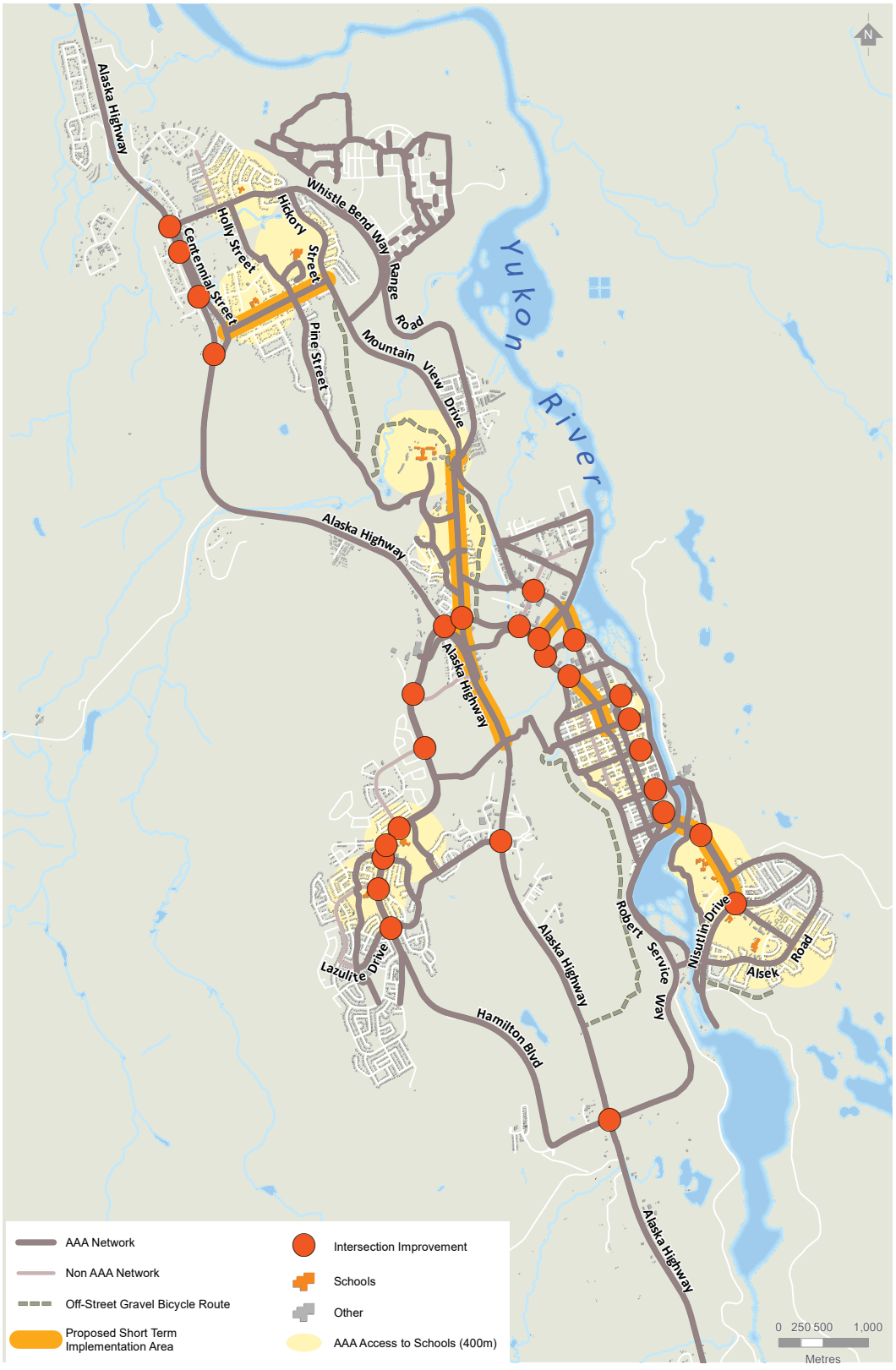


Figure 10 | Proposed Short-term Bicycle Network Priority Projects

3.2. Cost Estimates

Conceptual capital costs (Engineering D Level Estimates in 2017 dollars) for actions outlined in the Plan were developed based on the unit cost assumptions summarized in **Table 2,** which do not include any detailed engineering. These cost estimates are based on retrofitting an existing right-of-way with a bicycle facility or installing a new multi-use pathway on an existing City owned property. Any required land acquisition has not been included in the cost.

The capital cost estimates by road segment outlined in **Appendix B** are for planning purposes only and should be refined for detailed budgeting. Projects such as intersection upgrades and grade separated crossings require a more detailed review to determine the cost for construction. As a result, the cost estimates for these projects has not been included. A list of the proposed intersection crossing improvements and new crossings/stairs are also provided in **Appendix B.**

Facility Type	Unite Rate (cost per km)
Paved Multi-Use Pathway (3 metre width)	$600,000
Gravel Multi-Use Pathway (3 metre width)	$300,000
Separated Bicycle Path	
Within road right-of-way with bollards	$700,000
Within road right-of-way with cement barriers	$1,000,000
Elevated / curb separation adjacent to sidewalk	$2,000,000
Neighbourhood Greenway	$50,000
Bicycle Lane – painted lines	$200,000

Table 2 | Conceptual Capital Costs for the proposed cycling facilities in Whitehorse

3.3. Designing for Winter Maintenance

As Whitehorse is a winter city, designing infrastructure that can be maintained year round is an important consideration. The City should consider the following strategies to ensure safe and comfortable cycling year-round in Whitehorse:

- Design bicycle routes to facilitate snow removal, snow storage and drainage. One of the best ways to facilitate the removal of snow from bicycle routes is thoughtful roadway and bicycle facility design. Conventional bicycle lanes at the edge of the roadway often become the area for snow storage and can accumulate debris and gravel. Several roadway planning and design considerations can be taken to avoid this situation, including:
  - Plan new or renewed roadways with sufficient right-of-way to provide enough space for a bicycle lane and an adequate snow storage space on the road side.
  - Provide a wide bicycle path buffer.
  - Restrict on-street parking during snow events.
  - Provide bicycle lane widths to accommodate small truck snowplows and invest in a vehicle to maintain separated bicycle paths.
  - Design separated bicycle paths that can be accessed by snowplows.
  - Evaluate whether grade-separated bike facilities with a roll-over curb is a better solution than a boulevard separated path, in terms of snow clearing and cyclists comfort level.
  - Provide appropriate signs and markings:
    - Signs and markings on the pavement will be covered during the snow periods. Ensure that signage is placed to adequately reinforce the presence of cycling infrastructure.
    - Reduce annual maintenance: install recessed thermoplastic pavement markings to reduce pavement remarking requirements.

- Consider wind breaks through strategic planting of shrubs and trees, or use berms and other topography to provide some shelter and relief from the wind.
- Lighting should be adequate on routes, particularly at intersections and steep grades or corners. All lighting should be night-sky friendly.
- Review and update the current snow removal requirements. The City currently prioritizes snow removal on selected multi-use pathway, while other trails are packed and groomed by snow machine. No on-street facilities are currently maintained. With the development of new cycling infrastructure, the City should determine which facilities will be maintained in the winter, the maintenance practices (packed or plowed), and the priorities for maintenance. Snow fencing or other wind breaks strategically placed can reduce snow drifting.
- Designate and prioritize a winter bicycle network for snow removal. The bicycle network should be treated like the rest of the roadway network — with the highest demand bicycle routes receiving the first and most thorough snow treatment and other bicycle routes being treated in subsequent order, depending on their network importance. The City has some routes identified in the Snow and Ice Control Policy — these should be updated as new facilities are added to the network.
- Review and update current operating procedures for snow removal on bicycle facilities, including current departmental responsibilities, employed contractors and existing machinery and procedures. As the climate changes, the challenges to provide safe cycling infrastructure may shift: more freeze-thaw cycles may increase the risk of black ice; changes in snow fall frequency and volume may require different snow clearing equipment and practices; and best practices for winter maintenance are evolving in Canada. With warmer temperatures, winter cycling is predicted to become more popular.

3.4. Beyond the Network

Once the infrastructure provides a safe, connected network, a range of supporting measures are important to encourage cycling in Whitehorse – raise awareness, provide education and outreach, provide end-of-trip facilities, and review policies and regulations.

Placemaking

It is important to note the opportunities to use the streets within Whitehouse as a way to enhance neighbourhood placemaking. Transportation corridors are typically the city's largest land use and are public spaces. Designing these corridors as public space will increase the attractiveness of the corridor and support active transportation. Providing places to rest, interesting things to look at, boulevard trees, and wayfinding signage add positive aspects to the feeling of place.

Increase Awareness

Approaches to increasing awareness can include enhanced wayfinding and signage, trip planning tools, and route maps. Mapping and wayfinding are key components of a network. It is recommended that the City explore ways to identify and name routes, along with route signage to highlight key destinations and distances.

Education and Outreach

Education and encouragement initiatives can include providing information to the public on the benefits of active transportation, hosting events to promote active transportation, skills-building programs, promotional campaigns and supporting programs that teach skills and awareness of road safety, walking and cycling, and public education campaigns.

End of Trip Facilities

Access to amenities such as secure bike parking, showers, lockers and emergency bike repair stations help to make cycling a more convenient form of transportation.

Policy and Regulation

During policy reviews, the City should identify policy direction and actions that specifically support walking and cycling in Whitehorse. There are also opportunities to work with partners to review the **Motor Vehicle Act** and recommend updates to accommodate cycling. There is the opportunity to reduce speed limits in neighbourhoods and on arterial roads, which may change the type of cycling infrastructure that would be required to meet the TAC guidelines.

Partnerships

Achieving a modal shift to include a high percentage of cycling is strengthened through partnerships. The City should seek ways to bring the following partners to the table: Yukon Government including Highways, Health, Education and Community Services, Whitehorse businesses, RCMP, insurance companies, and cycling advocacy groups.

3.5. Conclusion and Next Steps

The Whitehorse Bicycle Network Plan provides a list of long-term infrastructure projects to enhance and encourage cycling within the city. Recognizing that the long-term vision will require capital investment, as well as a shift in some policy directions, the City will continue to work towards providing cycling facilities outlined in the Plan that are comfortable for people of all ages and abilities (AAA) and meet the recommended geometric design guidelines for Canadian Roads published by Transportation Association of Canada (TAC) in 2017. The Bicycle Plan is a step towards implementing the vision for cycling in Whitehorse, but it is not the last.

Appendix A

Proposed Network Maps

The maps in the Bicycle Network Plan show proposed locations and facility types. These are conceptual, and may be adjusted or moved as detailed planning and engineering designs and budgets are developed.