Interactive Mapping Tools:

Identifying Opportunities to Improve Cycling Infrastructure Connectivity

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BikeOttawa.ca

Citizens for safe cycling since 1984

Executive Summary

Introduction

Cycling is increasingly seen as a practical transportation choice for people of all ages and abilities. Our approach to planning cycling infrastructure should also adapt to accommodate cycling for everyone. The cycling network in Ottawa includes infrastructure of varying quality and safety, and in some places, critical connections are missing. To optimize the utility of future additions to the network and appeal to all ages and abilities, it is important to make planning decisions that prioritize high-quality cycling connections.

This is an exciting time for cycling. Much of our older infrastructure needs to be rebuilt, which allows us to redesign our public spaces, based on current insights into environmental stewardship, public health, demographic shifts, and efficient transportation systems. Cycling ridership numbers are steadily increasing; nearly 5% of the population inside the Greenbelt now uses a bicycle to go to work. Ottawa is also undergoing major changes as we expand our light rail system in the coming years. We are about to update our Transportation Master Plan. Importantly, other levels of government are seeing the benefits that come with increased uptake of walking and cycling; federal and provincial funding is now being made available for active transportation, and has been used to enhance and accelerate Ottawa's cycling plan.

Cycling adoption can be increased by developing a low-stress network that is comfortable and where the perceived level of danger is low. There is a massive opportunity to increase cycling uptake in Ottawa by building infrastructure that appeals to those who prefer protected bicycle facilities. This group accounts for a large minority of the population in all areas of the city.

The Mineta Transportation Institute in the United States recognizes this varying range of comfort in traffic by assigning four classifications of traffic stress to cycling facilities. The "level of traffic stress" (LTS) system assigns a rating from 1 to 4 calibrated to the population willing to tolerate the stress experienced while using particular infrastructure. LTS forms the basis for a series of new mapping tools created by Bike Ottawa, which are available at maps.bikeottawa.ca.

Methods

To document cycling conditions and inform updates to map data, Bike Ottawa gathered over 600,000 photos of the city's roadways in the summer of 2017. These were uploaded to Mapillary, which is a platform for storing and sharing GPS-tagged street-level images.

This report makes use of the community-driven OpenStreetMap (OSM) as a source of geospatial data. Data such as the names and shapes of streets come from the City of Ottawa Open Data project. For this report, Bike Ottawa added and verified data in the map, including speed limits, number of lanes, presence and type of parking, roadway classifications, and

presence and type of cycling infrastructure. Bike Ottawa then created software tools to calculate LTS for every roadway in Ottawa based on these map attributes.

The results are presented in the form of maps that show different levels of stress for the entire National Capital Region, and can be used as input for tools to find safe bike routes, as well as to detect vital links that could greatly improve route connectivity. Using the new routing tool, we can find a route and estimate the amount of time needed to travel between two locations by way of the shortest route that adheres to a maximum LTS.

Building upon that, we have created maps showing the maximum distance that can be travelled from a given point of origin (for example, a transit station) in a set amount of time. Such a map is called an isochrone ("equal time") map, and it can be used to identify good or poor connectivity in the cycling network, originating from a single point.

Using these maps, Bike Ottawa undertook an analysis of three case studies:

- cycling to the Bayshore transit station
- cycling to Hilson Avenue Public School
- cycling to leisure destinations such as recreation and shopping in Greenboro/South Keys

In all cases, an isochrone analysis was be used to identify the catchments, or service areas, of the locations under study. Where the isochrone was very limited in size, this is an indication of barriers to cycling or "missing links". Based on the missing links we identified, we made specific recommendations on how the situation may be improved to encourage more uptake of cycling in the immediate area. Often, these recommendations are simple measures such a curb cuts, improving the pathway surface conditions, or installing wayfinding signage. Other measures, such as redesigning an intersection or providing a protected cycle facility are more expensive, and just as necessary.

Outcomes

People who bike often prioritize the safety of the route above all else. The value in these maps is that users can set a maximum level of traffic stress comfort. The routes plotted will not exceed that level of traffic stress. In doing so, the maps often reveal missing links in infrastructure that are barriers to a safe and pleasant journey by bike. Therefore, these maps can be used to make planning decisions to address the gaps. The maps can also be used as a measure of success: when the safe low-stress routes are approximately the same distance as the most direct routes, this is a sign of a complete and user-friendly cycling network.

This method of identifying missing links in the local cycling networks should prove to be generally useful to the City of Ottawa as we renew our Transportation Master Plan and Ottawa Cycling Plan. By providing this new tool for analyzing our current cycling network and identifying areas for improvement, Bike Ottawa is hopeful that staff and residents alike will be able to identify and prioritize opportunities for making Ottawa an even better city for cycling.

Acknowledgements

This report was made possible through the efforts of the Bike Ottawa Data Group.

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Photo credits, unless otherwise noted: Hans Moor, Heather Shearer

About Bike Ottawa

Bike Ottawa is a not-for-profit incorporated, independent, membership-based organization founded in 1984. We are a volunteer association made up of cyclists who work for safer cycling in the Ottawa area. The organisation promotes greater bicycle use and enjoyment, cycling safety and awareness, safe and pleasant bicycle route and road conditions, and an overall increased respect for cyclists.

Bike Ottawa is directed by a volunteer board whose members are experienced and committed cyclists. We also have the support of several active committees focused on all aspects of promoting cycling: advocacy, data, events, reports, and special *ad-hoc* working groups.

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1 Introduction

1.1 Maps as a tool to improve the built environment for cycling

Urbanism and environmentalism have become important trends in recent years. We are seeing these trends reflected in planning: density, livability, walkability, “8-80”, and complete streets are becoming mainstream words and phrases. In keeping with this shift towards environmentally-sustainable transportation, we are also seeing a demand for a high degree of safety, and calls for a “Vision Zero” approach[1] on our streets. Cycling is no longer seen as a sport for the fit and fearless; it is mainstream practical transportation for people of all ages and abilities. Our approach to planning cycling infrastructure should also adapt to accommodate cycling for everyone.

Over the last decade, the City of Ottawa has developed a substantial network of bicycle infrastructure. However, the network includes infrastructure of varying quality and safety, and in some places, critical connections are missing. To optimize the utility of future additions to the network, it will become increasingly important to evaluate the methods being used in making planning decisions.

To make cycling an appealing choice, routes must be direct, but they must also feel safe. For example, painted bike lanes on arterial roads come with a relatively high degree of traffic stress. These types of lanes may be acceptable to the small percentage of the population who is currently cycling, but will not attract new people to bicycling. In this report, we will use a Level of Traffic Stress method to demonstrate how planning decisions affect the adoption of cycling.

Bike Ottawa has developed a series of maps that perform bicycle route calculations based on level of traffic stress. Different visualization techniques will be presented. An overview will be given of how these calculations are done, including technology used and data gathering methods. We will apply this traffic stress visualization method to with several different examples in the City of Ottawa.

By nature, cycling is an activity where attention to detail in the built environment is critical to creating routes that intuitively and seamlessly flow between key destinations. By focusing on these case studies, we can make specific recommendations for the focus areas. However, these recommendations also apply more generally as an approach to improving connectivity to transit, to schools, to shopping, and between neighbourhoods city-wide.

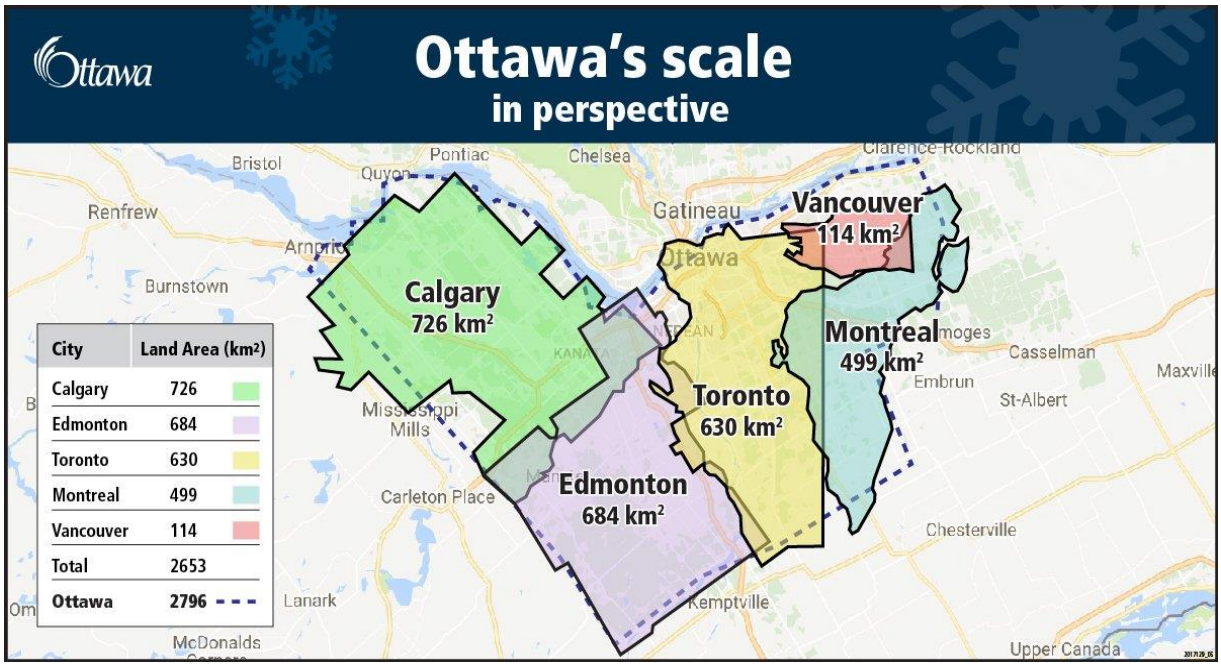
WHY MAPS?

Maps are an essential tool for making informed planning decisions. Maps are a structure for organizing data, with limitless capacity.

[1] A design philosophy placing life safety before other considerations with the goal of zero traffic deaths or serious injuries (Tingvall, 1997).

1.2 Areas of study

Ottawa is an exceptionally large municipal area, covering 5716 km^2. While the majority of this area is farmland and forest, the sheer area of this city presents many challenges to providing a well-connected cycling network. For this analysis, we will focus on the area inside Ottawa's greenbelt. According to the 2016 census[2], this area had a population of 429 195 in 2016, and covers 173 km^2. This gives Ottawa's inner area a density of 2481 pop./km^2, which is typical of North American cities, but which is also not so different from the kinds of densities seen in the world's most bike-friendly cities in western Europe.



Ottawa is larger in area than several of Canada's most populous cities combined. Image: City of Ottawa.

Figure 1-1: Ottawa's scale in perspective.

While the maps we have developed cover the entire city, for the purposes of this report we have chosen to focus on three case studies to demonstrate our approach:

- cycling to transit at the Bayshore LRT station
- cycling within a 1.6 km radius of selected elementary schools, i.e. the zone where children are not bussed to school
- cycling to leisure activities and retail in Greenboro, a neighbourhood with a low-stress cycling network, but that remains an island isolated from the rest of Ottawa

[2] Data source: Statistics Canada National Household Survey data retrieved from Census Mapper (von Bergmann & Cervantes, 2018) for census tracts inside the Greenbelt.

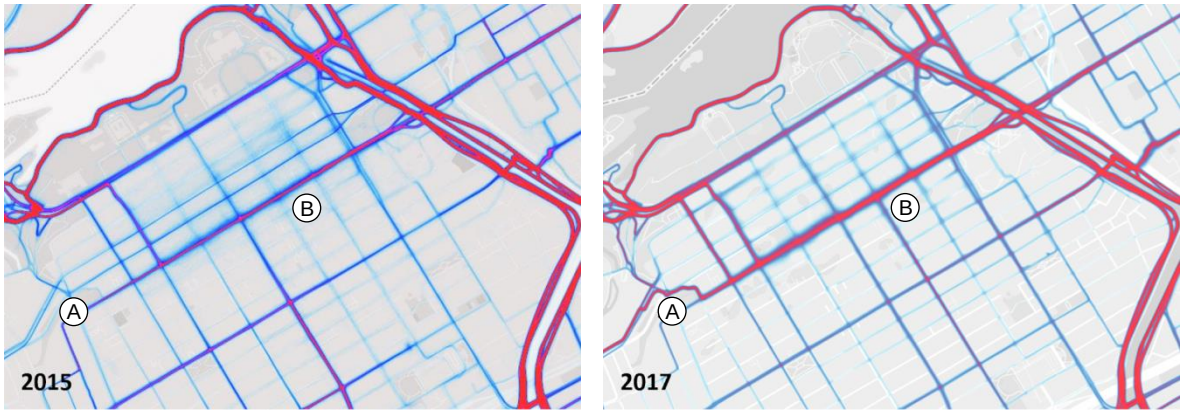
1.3 Using maps for informed decision-making

Maps are an essential tool for making informed planning decisions. While many people may think of maps as being just a static representation of the roads that are present, we think of them as being a living database. Information on maps includes the layout of the road (or path) and its name.

But maps can be much more than a static representation of the roads. We can also layer in data like transit routes and schedules, what the road surface is made of (and its condition), how well-used it is for various modes for various trip types at various times of day, what the collision rate at an intersection is, whether the route is plowed in winter or floods periodically, points of interest like benches and drinking fountains, how many stop signs are present, and images of locations over time. It's even possible to layer on data such as flow of bicycle traffic. Maps are a structure for organizing data, with limitless capacity.

From this wealth of information, we can derive some useful insights about how a route is used. For example, we can identify:

- high traffic stress locations that are still well-used by people cycling
- neighbourhood "islands" that aren't well-connected to the rest of the network
- the impact that an improvement to one stress-point has on the overall system



Heatmap information shows how new links affect traffic patterns.[3] For example, the Nanny Goat Hill connection (A) opened in late 2015. In 2017, this route is now popular with cyclists travelling between the Scott St. multi-use path and the Laurier Ave. segregated bike lane. The O'Connor St. bidirectional segregated bike lane (B) connects Laurier Ave to the Glebe neighbourhood and opened in the fall of 2017. Prior to this, O'Connor St was virtually unused by cyclists.

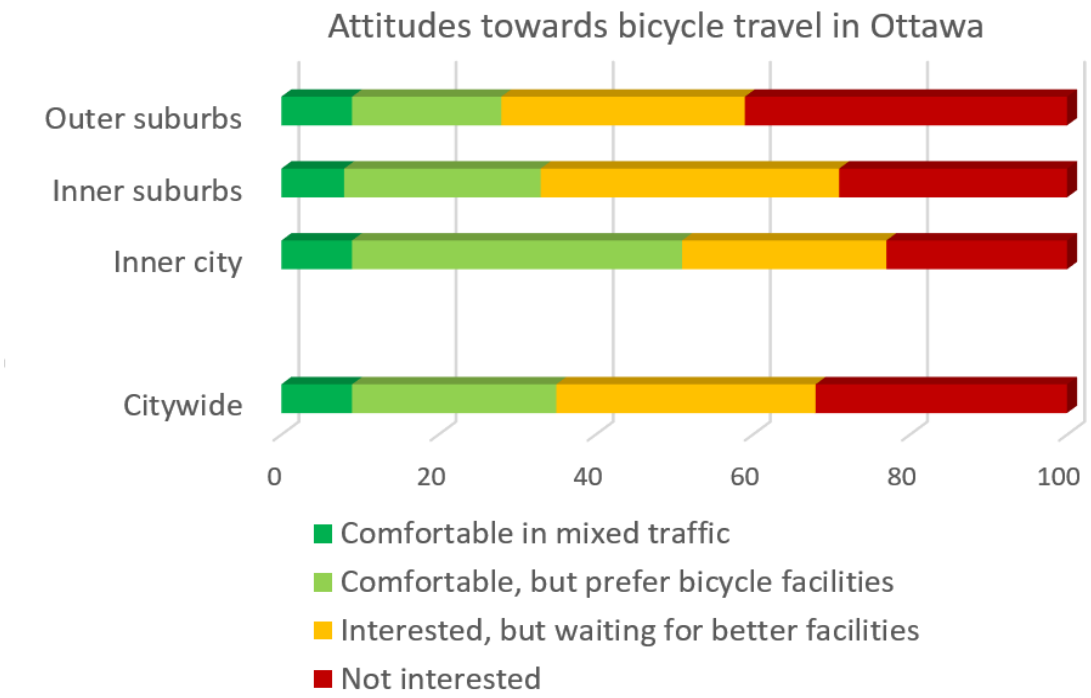
Figure 1-2: Effect of local improvements on cycling network use.

[3] Data source: Strava Global Heatmap (Strava, 2018).

1.4 Level of Traffic Stress (LTS)

Cycling adoption can be increased by developing a low-stress network that is comfortable and where the perceived level of danger is low. People have different tolerances for traffic stress, and can be identified broadly as belonging to four groups based on their level of comfort: those comfortable cycling in mixed traffic; those who are comfortable, but prefer to use dedicated cycling facilities; those who are interested in cycling, but who are waiting for better facilities to be available; and those who are not interested in cycling at all.

There is a huge potential to increase cycling uptake in Ottawa by building infrastructure that appeals to those who prefer bicycle facilities and to those who are waiting for better infrastructure. This latter group makes up a large minority of the population in all areas of the city (see Figure 1-3), and represents the largest opportunity to increase cycling mode share.



Attitudes towards cycling vary across the city[4]. In all parts of Ottawa, a majority of people would be interested in cycling for at least some trips, if safe cycling infrastructure was present. People in more urban parts of the city have a higher interest in cycling, perhaps due to the shorter travel distances that come with density, or due to increased access to safe cycling infrastructure.

Figure 1-3: Attitudes toward cycling.

[4] Data source: City of Ottawa Commuter Attitudes Survey (RA Malatest & Associates, 2013).

The Mineta Transportation Institute in the United States recognizes this varying range of comfort in traffic by assigning four classifications of traffic stress to cycling facilities[5]. The "level of traffic stress" (LTS) system assigns a rating from 1 to 4 calibrated to the population willing to tolerate the stress experienced while using particular infrastructure:

- LTS 1: a level that most children can handle
- LTS 2: tolerated by the majority of the adult population
- LTS 3: tolerated only by cyclists who are "enthused and confident", *i.e.* the kind of people who are currently cycling in Ottawa
- LTS 4: only tolerated by those who are "strong and fearless"

CARE-FREE CYCLING

When a cycling network is built right, a bike becomes an irresistible choice: people can relax and simply experience the joys and benefits of travelling by bike.

Those who are interested in cycling but waiting for facilities could be expected to be comfortable using infrastructure with an LTS 2 rating. However, in Ottawa today, it is not generally possible to conveniently travel to all destinations using such low-stress infrastructure. Finding a low-stress route often requires a combination of pre-planning, knowing how to navigate through a maze of streets away from main roads, tolerating numerous stop signs on residential streets, detouring to a low stress route, or walking the bike. These are all barriers to broad uptake of cycling.

When a cycling network is built right, a bike becomes an irresistible choice: routes are simple to navigate, direct, and protected from traffic. People can relax and simply experience the joys and benefits of travelling by bike.

1.5 Why this is the right time to improve Ottawa's cycling network

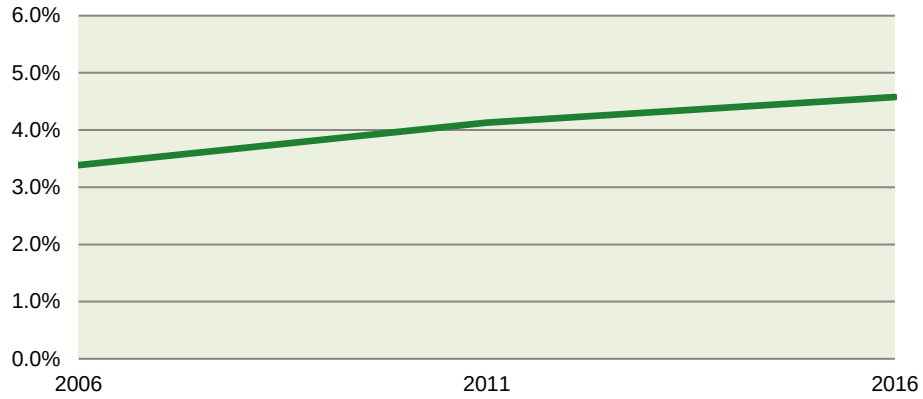
The city is undergoing major changes that affect cycling and planning. After the building boom in the 1960s-70s, much of our older infrastructure needs to be rebuilt, from highway overpasses to sewer systems. This allows the city to redesign many of our public spaces, based on modern insights into public health, environmental stewardship, demographic shifts, and efficient transportation systems.

1.5.1 Increased cycling ridership

Cycling ridership numbers are steadily increasing. Between 2006 and 2016, commuter cycling inside Ottawa's Greenbelt increased by 37% (see Figure 1-4).The latest Statistics Canada census numbers show that nearly 5% of the population inside Ottawa's Greenbelt now uses the bicycle as a transport mode to get to work. Of the approximately 200,000 people who commute

[5] Level of traffic stress system (Mekuria, Furth, & Nixon, 2012).

to work in the inner Greenbelt, 10,000 are choosing a bike as their main mode of transportation. However, as we can see from the cycling attitudes survey (Figure 1-3 above), the potential number is much larger, if a well-connected low-stress network were in place.



The percentage of work commutes made by bike is increasing[6].

Figure 1-4: Commuter cycling mode share inside the Greenbelt.

1.5.2 Expansion of the transit system to include light rail (LRT)

In November 2018, the City of Ottawa will open its new light rail line between Tunney's Pasture and Blair Rd., at an estimated cost of $2.1 billion. The new infrastructure will free the downtown core from heavy bus traffic, making room for improved cycling facilities. In later phases, LRT will connect further east, west and south offering even more people an alternative to the car. Particularly at stations near the periphery of Stage 2 LRT (Baseline, Moodie/Bayshore, Bowesville, and Blair), the bicycle should be supported as an ideal way to bring many more people within reach of Ottawa's LRT system. Connecting to LRT by bike is generally faster than using a local bus. Also, cycling to transit doesn't require the expense and expanse of Park & Ride lots, which work against the high population density that transit needs to thrive.

1.5.3 Expected renewal of the Ottawa Cycling Plan

The City's principal planning guide is the Ottawa Cycling Plan 2013[7] (OCP2013), which is part of the Transportation Master Plan[8]. The Ottawa Cycling Plan will be renewed over the next few years based on new insights into cycling behaviour and the cycling infrastructure that has been

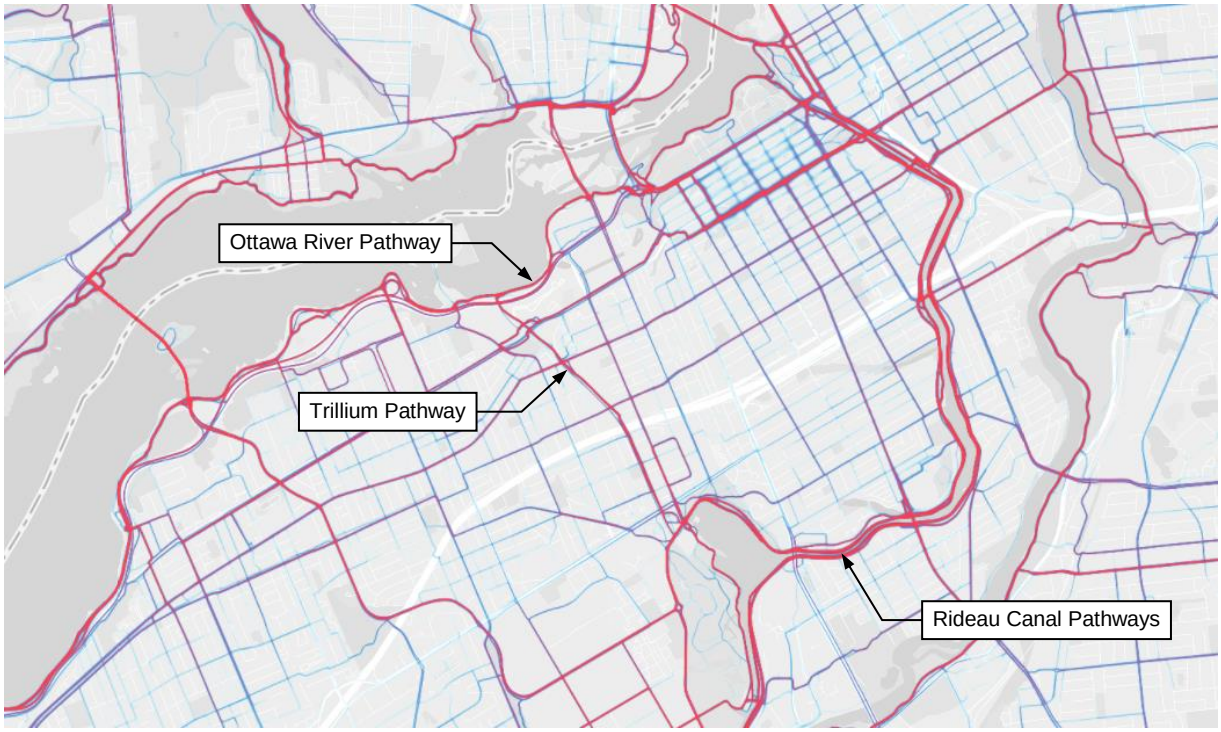
[6] Data source: StatsCan data retrieved from Census Mapper (von Bergmann & Cervantes, 2018) for census tracts inside the Greenbelt.
[7] Ottawa Cycling Plan (City of Ottawa, 2013).
[8] Transportation Master Plan (City of Ottawa, 2013).

built since OCP2013 was approved. With more data available now, such as bike counter and Strava data, it is easier than ever to identify cycling travel patterns.

The next Ottawa Cycling Plan should reflect residents' desire for safety and travel choice. This report's findings suggest methods for providing safer route options, away from arterials, and with a focus on neighbourhoods and separate facilities.

1.5.4 Federal and provincial funding

Other levels of government are now recognizing that vibrant and sustainable communities where people can walk and bike are the key to improved public health and reduced reliance on fossil fuels. To this end, we are seeing investment by other levels of government in walking and cycling, often associated with transit projects. This is a new development in recent years, setting a precedent that will certainly improve walking and cycling rates in communities across Canada.



Strava GPS traces show that the most popular cycling routes are those which are completely separated from cars[9]. The exceptions are bridges and underpasses, which must be used when no car-free alternative exists nearby. Although routes along waterways tend to take a meandering path, the extra distance is less burdensome since there tend to be fewer stops.

Figure 1-5: Cycling travel patterns near downtown Ottawa.

[9] Data source: Strava Global Heatmap (Strava, 2018).

2 Overview of Methods

2.1 Data sources

No public datasets exist that include the accurate data needed to estimate the level of traffic stress for all streets and paths in Ottawa. As an example, there is no map in the city that includes the availability or configuration of on-street parking. However, crowd-sourced data can approach the required comprehensiveness through small efforts by a large number of people.

This report makes use of the community-driven OpenStreetMap (OSM) as a source of geospatial data. OSM was selected because of its open source goals: it is the map equivalent of Wikipedia, allowing everyone to modify the map, and making the map data available under the Open Database License[10]. It's also possible to update OSM in real time, to ensure that the map data reflects actual conditions on the ground. Much of the data contained in OSM is derived from City of Ottawa Open Data.

To document cycling conditions and inform updates to OSM data, Bike Ottawa gathered over 600,000 photos of the city's roadways from the perspective of a cyclist in the summer of 2017. These were uploaded to Mapillary[11], which is a platform for storing and sharing GPS-tagged street-level images.

Figure 2-1: OpenStreetMap is a well-developed repository of geospatial data

[10] OSM license terms (OpenStreetMap Foundation, 2018).
[11] Mapillary license terms (Mapillary AB, 2018).

2.1.1 OpenStreetMap tagging guide

OpenStreetMap treats map data as a collection of lines and shapes with corresponding metadata describing what the object represents, which could be anything from the location of a tree to a municipal boundary, to the opening hours of a business. The metadata take the form of "tags" with a name (key) and some piece of information (value). Tags in OSM are defined by conventions to try to keep the data consistent, but there is not a fixed list of tags which can be used.

Working with OSM Canada, Bike Ottawa developed a guide for tagging map data that created standard designations of cycling infrastructure for the LTS calculations. The guide is included here as Appendix A, and can be retrieved online at: https://github.com/BikeOttawa/OSM-Bike-Ottawa-Tagging-Guide/blob/master/README.md

The guide extends the existing OSM conventions to provide additional information relevant to cycling, and with a particular focus on examples from the city of Ottawa. Importantly, the guide adheres to the OSM practice to "map what's on the ground" and the LTS analysis is done without modifying the map.

Bike Ottawa then created custom software[12] that uses the OSM tags to determine LTS for different roadway or path segments. The analysis results can be presented in the form of maps that show different levels of stress for the entire National Capital Region, and can be used as input for tools to find safe bike routes, as well as to detect vital links that could greatly improve route connectivity.

2.1.2 Mapillary

To develop a more complete repository of information on the street-level conditions in the city of Ottawa, Bike Ottawa volunteers collected photos of the street network (including multi-use pathways) in the National Capital Region, and stored the photos on Mapillary. Photos were collected using GPS-enabled cameras. Photos taken every two seconds was found to be a good balance between capturing information and not being burdensome to upload. This allows everyone to see the conditions of the infrastructure from a cyclist's perspective, especially those areas which commercial services such as Google Street View have not documented. The Mapillary platform allows anyone to contribute, the updates are updated instantly and images usable by anyone (under CC BY-SA 4.0 license)[13]. Google's Street View does not have these features.

[12] Bike Ottawa source code for the LTS model and the LTS, routing, and isochrone services are hosted on GitHub (Bike Ottawa, 2018) at https://github.com/BikeOttawa/stressmodel
[13] Mapillary legal & licensing at https://www.mapillary.com/legal

The information from these photographs was used to update OSM. In particular, the photos provided important details about the width, surface material, and condition of streets and bike paths.

Mapillary also uses the photography to train its artificial intelligence tools, allowing for filters and searches such as, “find all the stop signs in Ottawa.” Bike Ottawa members have additionally tagged roads, multi-use paths (MUPs), and parking space manually, and are still in the process of doing so. This will allow future searches such as, “find all MUPs in the region and add up the total length.”

The contribution of the Bike Ottawa Data Group to the Mapillary repository covers over two thousand kilometres of paths and roadway. Much of this had never previously been covered by services such as Google Street View, and will serve as a useful photo repository for many future purposes.

Figure 2-2: Mapillary is a crowd-sourced street level photo-mapping repository

2.2 Level of Traffic Stress (LTS) model

The Level of Traffic Stress (LTS) system developed by the Mineta Transportation Institute (MTI) assigns a rating from 1 to 4 to cycling facilities based on the stress that would be experienced while using particular infrastructure. The MTI descriptions of typical infrastructure that would correspond to each level of traffic stress is reproduced in Table 2-1.

LTS ratings can be assigned to any individual infrastructure components (such as intersections or roads). In this study, we consider only LTS ratings for paths and roadways, but not for intersections. The rationale for this is twofold: i) intersections make up a relatively small proportion of any given trip ii) the underlying data needed to allow Bike Ottawa to estimate an LTS for intersections is largely incomplete at this time.

It is important to note that intersections cannot be ignored in the real world. Intersections are major conflict points (*i.e.*, many crashes occur at intersections), and are quite often exactly the

point where cycling infrastructure tends to disappear to make room for turning lanes. While it is beyond the scope of this study, Bike Ottawa urges the city to implement protected intersections, grade separation, and to eliminate slip lanes whenever an opportunity arises. Intersections are a major contributor to the feelings of traffic stress when travelling by bike.

Table 2-1: Levels of traffic stress (LTS).

LTS 1	Presenting little traffic stress and demanding little attention from cyclists, and attractive enough for a relaxing bike ride. Suitable for almost all cyclists, including children trained to safely cross intersections. On links, cyclists are either physically separated from traffic, or are in an exclusive bicycling zone next to a slow traffic stream with no more than one lane per direction, or are on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where cyclists ride alongside a parking lane, they have ample operating space outside the zone into which car doors are opened. Intersections are easy to approach and cross.
LTS 2	Presenting little traffic stress and therefore suitable to most adult cyclists but demanding more attention than might be expected from children. On links, cyclists are either physically separated from traffic, or are in an exclusive bicycling zone next to a well-confined traffic stream with adequate clearance from a parking lane, or are on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where a bike lane lies between a through lane and a right-turn lane, it is configured to give cyclists unambiguous priority where cars cross the bike lane and to keep car speed in the right-turn lane comparable to bicycling speeds. Crossings are not difficult for most adults.
LTS 3	More traffic stress than LTS 2, yet markedly less than the stress of integrating with multilane traffic, and therefore acceptable to many people currently riding bikes in American cities. Offering cyclists either an exclusive riding zone (lane) next to moderate-speed traffic or shared lanes on streets that are not multilane and have moderately low speed. Crossings may be longer or across higher-speed roads than allowed by LTS 2, but are still considered acceptably safe to most adult pedestrians.
LTS 4	A level of stress beyond LTS 3.

MTI has specific criteria used to determine the LTS based on the following factors:

- street width, by number of lanes
- width of bike lanes and parking lanes
- speed limit or prevailing speed
- frequency of bike lane blockage
- whether the bike lane is position alongside a parking lane

However, the exact formula for LTS definitions are difficult to apply directly to Ottawa, because data for some for the factors are not available for every piece of roadway in the City of Ottawa.

For this reason, we have used a modified version of the MTI formula, relying on values that were reliably available city-wide, such as speed and class of roadway.

A summary of the modified LTS model used in this report is presented in Appendix B and is available on GitHub at https://github.com/BikeOttawa/stressmodel

Other classification systems for describing the level of traffic stress experienced by cyclists exist, including the Bicycle Level of Service[14] and the Bicycle Compatibility Index[15]. However, in this report, we have adopted the Mineta Transportation Institute LTS system as the basis for evaluating the traffic stress level of cycling facilities, as its use is recommended in the Ottawa Cycling Plan 2013.

2.3 Analysis of acceptable cycling routes

Using the LTS rating assigned to each segment of roadway, it is possible to search the map for safe cycling routes with a given maximum level of traffic stress. Making use of the Open Source Routing Machine engine, Bike Ottawa created a tool which allows users to find a route suited to their level of comfort.

Building on our Level of Traffic Stress map, this interactive routing map will allow you to see if you can go from A to B on a route that doesn't exceed your level of comfort. Of course, this can mean long detours. The routing engine assumes that you will not ever "walk your bike", even if it means riding far out of your way. Ideally, the route for LTS 1 would not be much longer than the route for someone who is willing to ride absolutely anything. We see the routing engine as being most useful for identifying gaps in the cycling network, as we work towards making a connected low-stress network a reality.

If a route exists that has different levels of traffic stress assigned to different sections, the entire route will be rated as the highest of the segments. For instance, when a bicycle lane ends and leaves cyclists in an LTS 4 environment, the entire trip will be rated as LTS 4.

The Bike Ottawa routing engine is available at https://maps.bikeottawa.ca/routing/

2.4 Analysis of acceptable cycling distances

Using the routing tool, we can estimate the amount of time needed to travel between two locations by way of the shortest route that adheres to a maximum LTS. Building upon that, it's possible to create maps showing the maximum distance that can be travelled to or from a location in a set amount of time. Such a map is called an isochrone ("equal time") map, and it

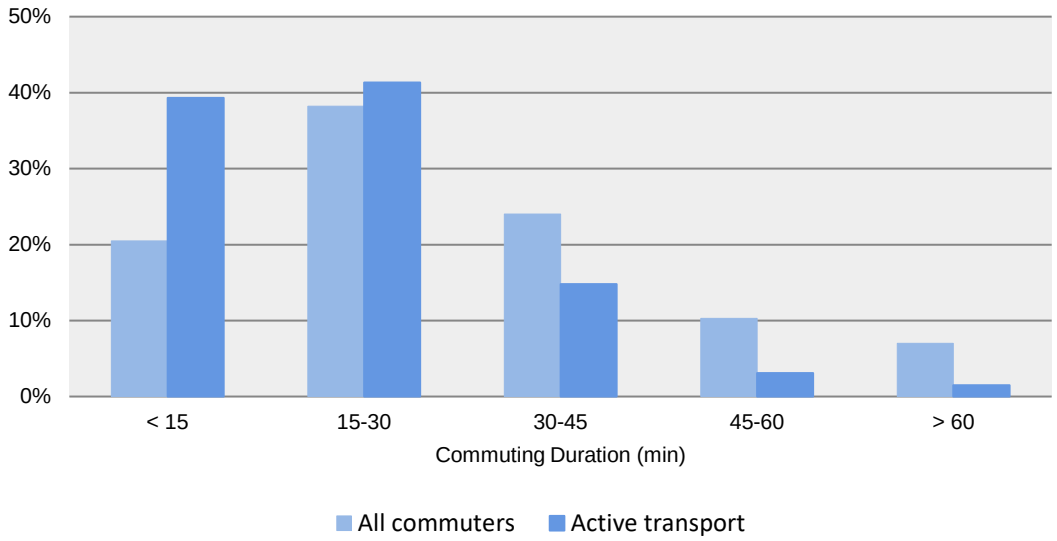
[14] Bicycle Level of Service (Landis, Vattikuti, & Brannick, 1997).
[15] Bicycle Compatibility Index (Harkey, Reinfurt, & Knuiman, 1998).

can be used to identify good or poor connectivity in the cycling network, originating from a single point. The Bike Ottawa isochrone generator is located at https://maps.bikeottawa.ca/isochrones/

In the case studies below, an isochrone analysis will be used to identify the catchments, or service areas, of the locations under study. To make a good estimate of the catchment, it is necessary to identify the amount of time that people are willing to travel to their destination, which includes, for example, making a connection to transit as part of a multi-modal trip.

In the Ottawa area, the 2016 census found that for about 38% of commuters, the time of travel to work was 15-29 minutes[16]. Around 20% of trips were under 15 minutes, and only 7% took more than an hour. For the 11% of commuters using active transport (walking or cycling), 41% have a travel time 15-29 minutes. Figure 2-3 below shows that, despite the different modes of travel, there is a similar distribution of commuting duration. For active transport, where the commuter must provide their own power, this understandably skews shorter. Unfortunately, the census data do not report cycling and walking separately.

These self-reported travel times are consistent with research which shows that commuters have been observed to accept 25-30 minutes of commute time independent of city size or population density[17]. Assuming that cyclists travel at an average speed of approximately 16 km/h (including time stopped), the travel time corresponds to 7-8 km.



Most commutes are in the range of 15-30 minutes, regardless of the mode of travel.

Figure 2-3: Commute duration in Ottawa.

[16] Census data for the entire Ottawa CSD via StatsCan GeoSearch (Statistics Canada, 2018).
[17] Commute duration and city size (Levinson & Kumar, 1997).

Commuting to work is not the only type of trip made by bicycle, though it elicits the longest distance trips. Table 2-2 shows travel distance based on trip purpose as determined from origin-destination surveys for Montreal[18], which would be analogous to travel time. After commuting, the longest trip distances were for leisure activities (referring to the destination, not the trip itself), followed by trips to school and to shopping.

Table 2-2: Travel distance by purpose of trip in Montreal.

	All Trips	Purpose of Trip			
		Work	School	Shopping	Leisure
Mean (m)	3,140	3,886	2,273	2,204	3,360
Median (m)	2,242	3,067	1,550	1,529	2,318
85th %ile (m)	5,517	6,442	4,355	3,926	6,376
% of Sample	100.0	43.6	26.0	14.4	16.0

For the purpose of estimating cycling catchments in this report, a travel time of up to 15 minutes has been adopted as a measure of an acceptable cycling trip. When combined with transit, this allows for an acceptable total multimodal commute time of 30-45 minutes, and a limit of 15 minutes reflects that people are willing to spend less time travelling for other purposes.

[18] Travel distances by active transportation (Larsen, El-Geneidy, & Yasmin, 2010).

3 Case study: bike-friendly access to transit near Bayshore station

3.1 Cycling to transit

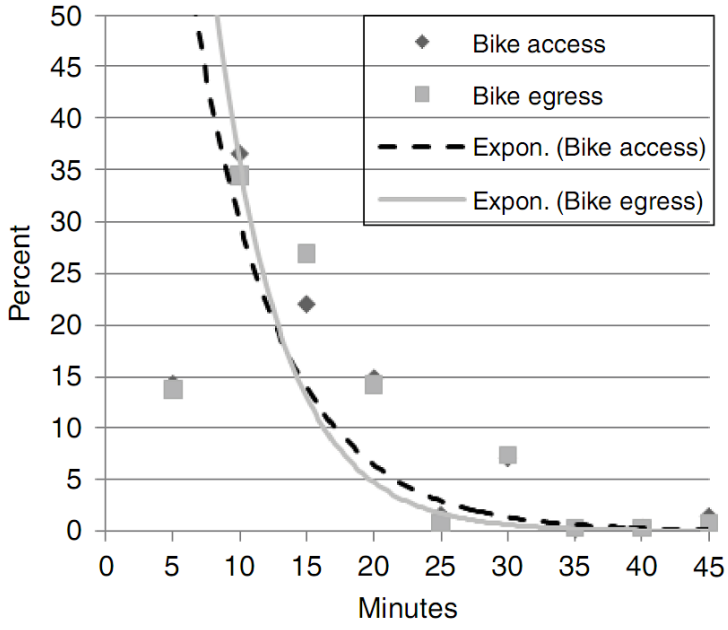
Public transport is a compelling choice for many Ottawa residents. Most residents have walks of five minutes or less to the nearest local transit stop, and residents in the outer suburbs are able to take advantage of express routes into the urban core. While many transit users have access to a motor vehicle as a comfortable, climate-controlled way to go from door to door, with no physical effort required, they choose to use public transport due to factors such as the cost of driving and parking, or convenience of leaving the driving to someone else.

However, public transit in Ottawa today has downsides: using public transport often requires a sacrifice in comfort and time. Transit users must walk to and wait at a bus stop, perhaps passing through unlit areas. Local buses are infrequent, particularly off-peak. Local stops are rarely sheltered from wind and rain, most don't offer seating, and none offer heating. A trip using public transport may require one or more transfers, reducing the reliability of the trip and increasing total travel time.

Combining cycling and transit offers a way to avoid some of that discomfort and inconvenience. Cycling-transit integration would extend the catchment of transit stops on express routes, Bus Rapid Transit (BRT), and LRT, allowing users to avoid transfers from local routes. Where it is possible to transport a bicycle on transit, this applies at both ends of the trip.

Studies of acceptable catchment for multimodal trips have shown that people are willing to bike around 3.2 km[19] (12 minutes at 16km/h) before driving becomes an equally preferable means of accessing public transport. For connections to rail specifically, a study from the Netherlands found that cycling was the main mode of travel to the station for distances between 1.2 and 3.7 km[20] (5 and 14 minutes).

Closer to Ottawa, researchers in Montreal studied user preferences for cycling-transit integration[21]. Figure 3-1 shows the acceptable time of access (from home to transit) and egress (from transit to destination) by bicycle for multimodal trips. Around 85% of respondents indicated that they would accept travel times of 15 minutes or less to or from transit. The researchers note the steeper egress curve, meaning that commuters are willing to accept a longer trip by bike at the home end of the trip.



Distance decay of reported acceptable times for cycling.

Figure 3-1: Acceptable travel times for trip segments.

[19] Stated preferences for bicycle-transit interfaces (Taylor & Mahmassani, 1996).
[20] Accessibility of railway stations (Rietveld, 2000).
[21] User preferences for cycling-transit integration (Bachand-Marleau, Larsen, & El-Geneidy, 2011).

There are considerations beyond travel time which affect uptake of multimodal cycling and transit trips. The most important considerations are a safe route and secure long-term bicycle parking. Of Ottawa commuters who don't currently cycle, 38% reported that they would consider cycling to the nearest transit stop if secure bike parking was available[22]. Transit stations should offer safe and secure bike parking, and bike-friendly amenities such as places to warm up or cool off, lockers to store items such as helmets and winter clothing, and perhaps coffee shops, washrooms, and drinking fountains.

While integrated cycling-transit trips currently account for a very small share of trips in North America, this trip type is commonplace in other countries. For example, in the Netherlands, two decades of investment in routes to train, subway, and LRT stations, as well as a massive growth in clean and safe bike parking, mean that half of the approximately one million train commuters arrive by bike every day, with demand for bicycle parking at stations increasing[23].

3.2 About the Bayshore neighbourhood

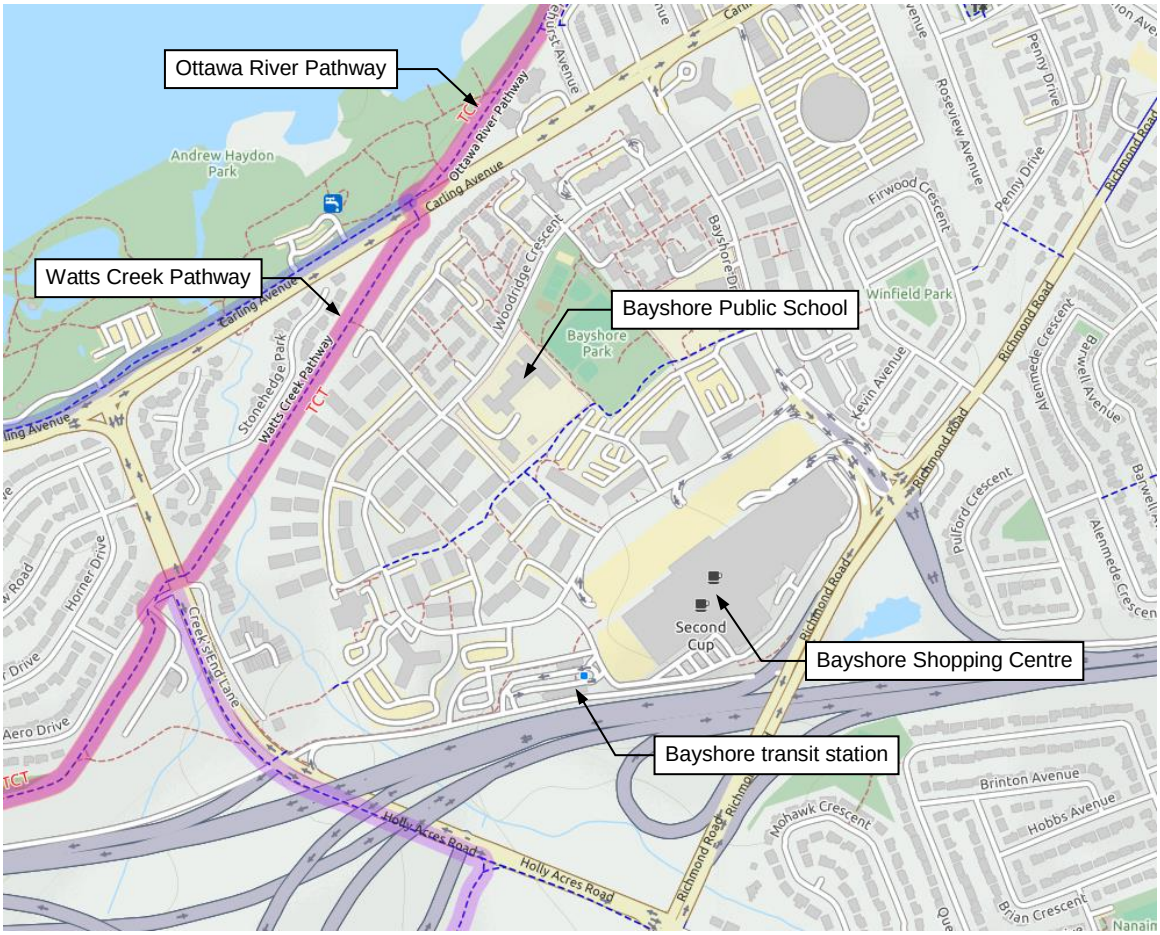
Bayshore is a dense neighbourhood located roughly 10 km west of the central core along the Ottawa River. It was first developed in the 1960s in the former Nepean Township and is located in Ottawa's Bay Ward. In 2016, the neighbourhood had a population density of 11,700 people/km^2, higher than Ottawa's inner area density of 2481 people/km^2[24]. More than half of the dwellings are five stories or more[25]. The population of the neighbourhood is 5775 persons. The neighbourhood offers the following points of interest:

Bayshore Shopping Centre: This mall has 190 stores and is the second-largest mall in Ottawa. Stores specifically important for local residents are pharmacies, banks, a Winners, and a Walmart (which sells groceries). The proximity to transit makes it a retail destination for people outside the neighbourhood.

Bayshore Public School: The primary school has 370 students with a diverse ethnic makeup representative of the local population[26]. It is at the geographic centre of the neighbourhood.

Andrew Haydon Park: Located just outside the neighbourhood proper, across Carling Ave., the park offers access to the Ottawa River, play structures, a picnic area, and a bandshell for outdoor concerts.

[22] Data source: City of Ottawa Commuter Attitudes Survey (RA Malatest & Associates, 2013).
[23] Dutch railways want more bike parking (Pieters, 2017).
[24] Census 2016 data (City of Ottawa, 2018).
[25] StatsCan data retrieved via Census Mapper (von Bergmann & Cervantes, 2018).
[26] Bayshore PS (Ottawa-Carleton District School Board, 2018).



Bayshore neighbourhood with points of interest. Map via OpenStreetMap.

Figure 3-2: The Bayshore neighbourhood.

The following transportation choices are available in the neighbourhood:

Watts Creek Pathway: The National Capital Commission (NCC) multi-use path runs across the neighbourhood, but there is only one connection to the southern residential areas and nothing to the north. This pathway extends from Kanata to downtown. It is unlit and not cleared of snow.

The 417 and 416 highways: The limited-access highways are easily accessible by nearby onramps. Other arterial streets that bound the neighbourhood are Carling Ave, Bayshore Dr., and Acres Rd. All of these have posted speed limits of 60km/hr.

Bayshore transit station: The station is a transfer point for dozens of routes, and is to be part of the city's LRT system in the future. It has a covered walkway to the shopping centre.

3.3 About the Bayshore transit station

The station is a transfer point for dozens of routes, both locally and on the current Transitway system. Among them is route 97, which runs every 15 or 20 minutes and takes 30 minutes to get to the Mackenzie King Bridge stop in the city's central core[27]. Bayshore will be part of Stage 2 of the Confederation LRT line.

The Bayshore transit station is located adjacent to the Bayshore Shopping Centre and accessible via a service road off of Woodridge Cr.. Bike parking is available on the east side of the station, as indicated in Figure 3-6 below. It is covered and has a repair stand (see Figure 3-3).

There are currently no cycle tracks or multi-use paths that connect the transit station to any of the surrounding streets, such as Woodridge Cr., Holly Acres Rd., or Richmond Rd., or connecting to the Bayshore Shopping Centre. Cyclists are prohibited from the Transitway.

Covered bike parking with a repair stand. Photo by Heather Shearer.

Figure 3-3: Bicycle parking at the Bayshore transit station.

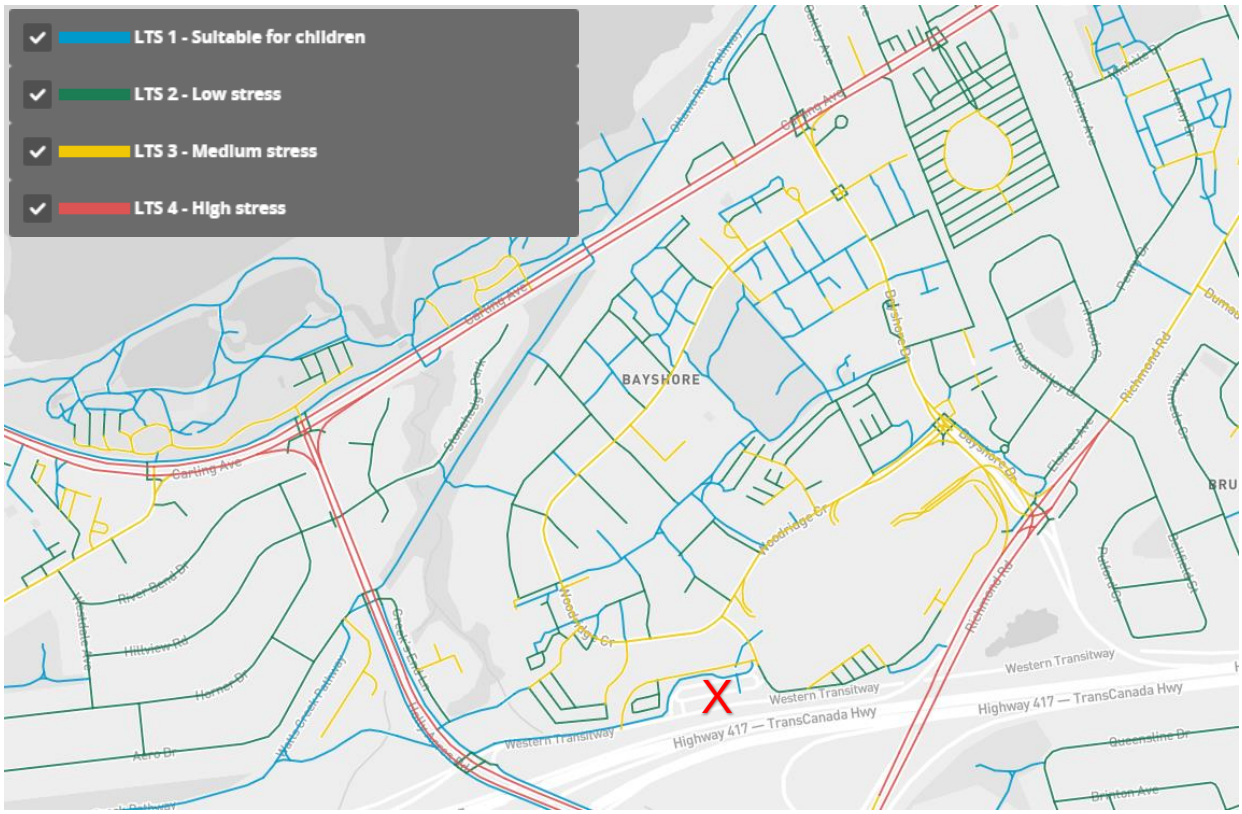
[27] Route 97 timetable (OC Transpo, 2018).

3.4 Bayshore LTS Map

Figure 3-4 presents a map of the Bayshore neighbourhood showing the level of traffic stress of streets and paths in the area. The neighbourhood is bounded by high-stress arterial streets: Carling Ave. to the north, Richmond Rd. to the south, and Holly Acres Rd. to the west are all rated as LTS 4; and to the east, Bayshore Dr. is rated as LTS 3.

Within the neighbourhood, streets are more amenable to cycling. Many of the LTS 2 streets running through the neighbourhood are private laneways with little or no motor vehicle traffic. LTS 1 paths run through the centre, and the Watts Creek Pathway is shown to the northwest.

Portions of Woodbridge Cr. near the Bayshore Shopping Centre are rated LTS 3 because of the configuration of on-street car parking. This means that cycling routes with a maximum LTS 2 require going around these sections.



The Bayshore transit station (indicated by a red 'X'), is not generally reachable without using some roads of at least LTS 3.

Figure 3-4: Bayshore LTS map.

3.5 Isochrone analysis of Bayshore transit station

Figure 3-5 is the isochrone map for Bayshore transit station. It shows the range a person could cycle within 15 minutes if they were comfortable with LTS 2 conditions. Clearly, the Bayshore neighbourhood itself is well-covered. Making use of the pathways and private streets, the entire area lies within the 9-minute isochrone.

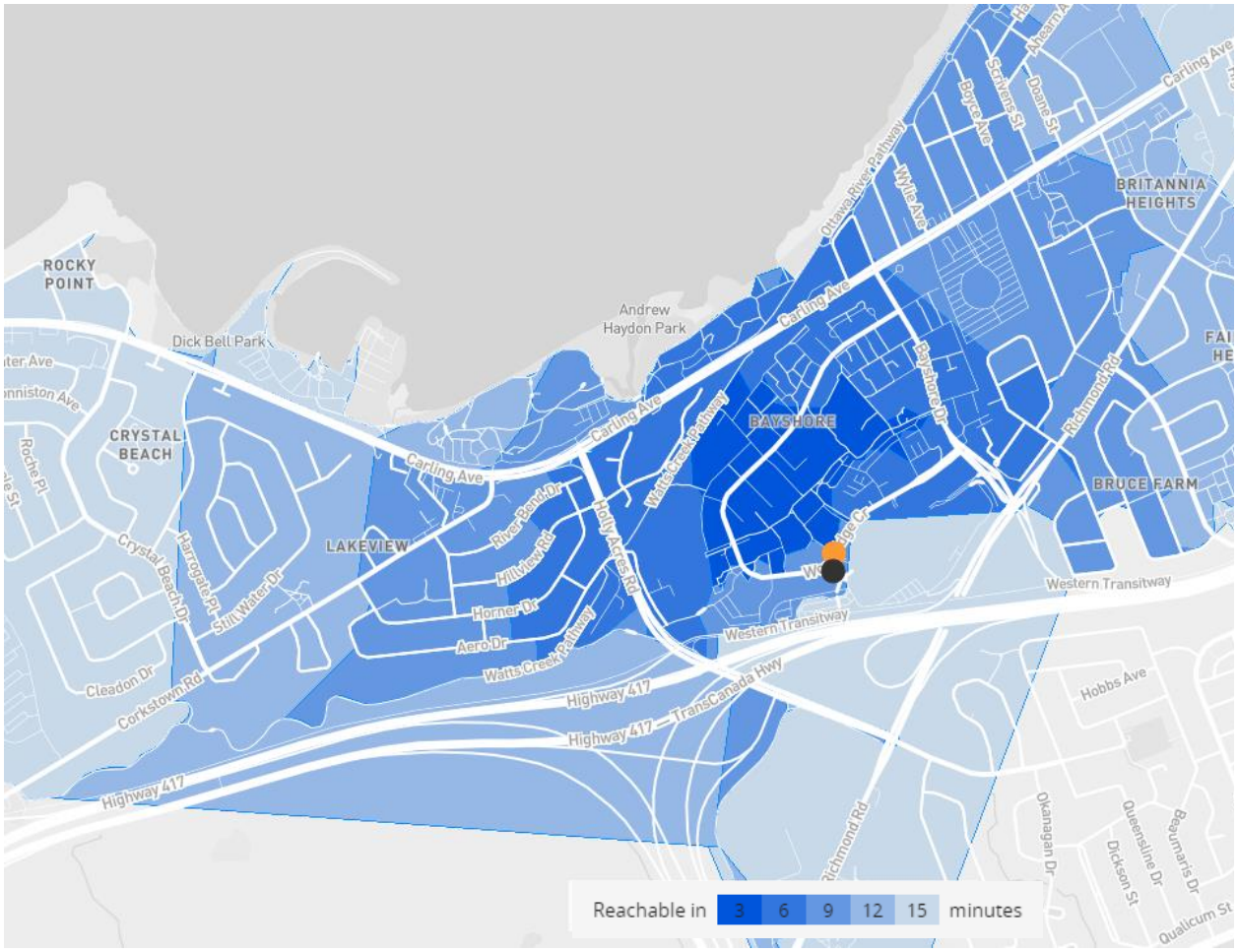


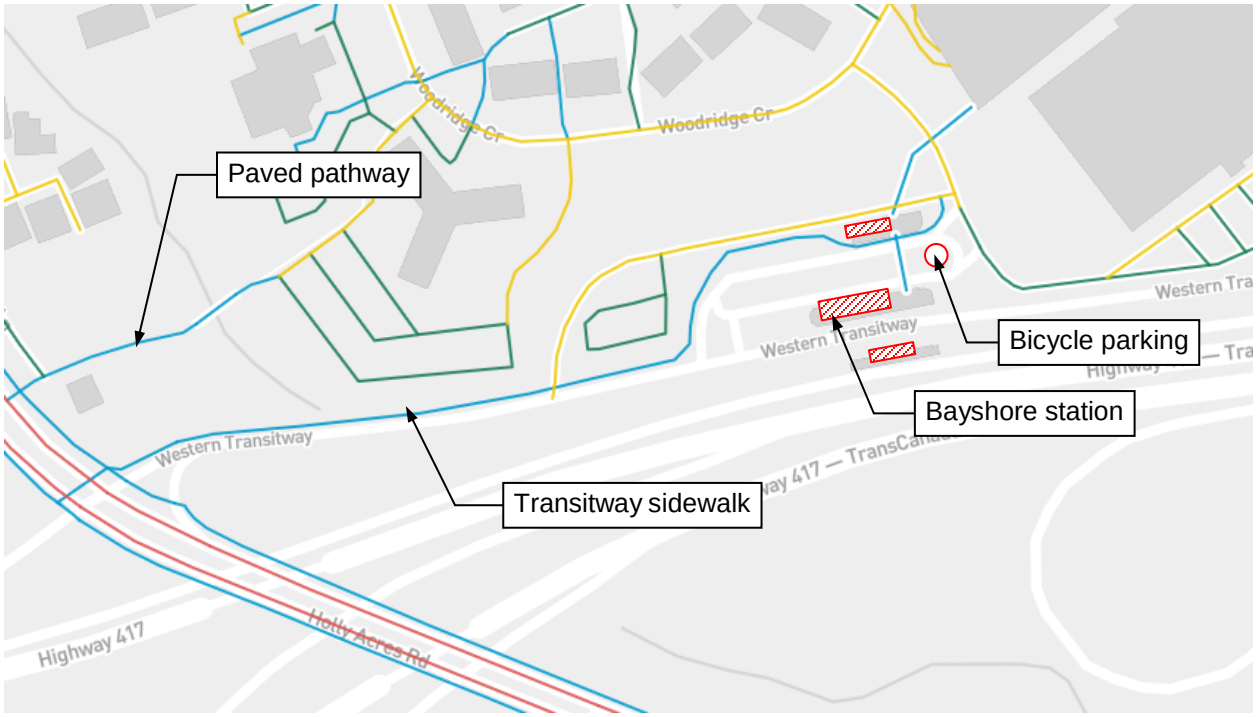
Figure 3-5: Bayshore transit station isochrone map, at LTS 2 level of traffic stress.

The nearby neighbourhoods of Crystal Beach and Bruce Farm are within 15 minutes of the Bayshore transit station, though they are better served by the Moodie and Pinecrest stations, respectively. By contrast, the neighbourhood of Qualicum, to the south, is much closer, but is not in range because of the lack of a low-stress connection to the multi-use paths that travel under the 417 highway, along Holly Acres Rd. across to Nanaimo Dr.

3.6 Findings

3.6.1 Access to bike parking at the station

The bicycle parking at the station is in a safe location and is covered. However, it is not accessible by bicycle from any direction without dismounting. Figure 3-6 shows the LTS map for approaches to the station.



Approaches to the Bayshore transit station are either high stress routes or not bike accessible.

Figure 3-6: Bayshore transit station access.

The access road from Woodridge Cr. north of the station is rated LTS 3, and the high level of bus traffic and shopping mall traffic makes cycling daunting and potentially dangerous. The access road also serves some loading docks for the Bayshore Shopping Centre, so truck traffic can be expected. This one section means that any access to the transit station from the north requires LTS 3.

From the south and west, cyclists are prohibited from the Transitway, but this route would provide a direct connection to the MUPs along Holly Acres Rd. Cyclists could potentially connect to Holly Acres Rd. via a paved pathway located at the end of Creeks End Ln., but the pathway is unsigned and requires crossing the private parking lot of an apartment building on Woodridge Cr. More likely, cyclists will ride illegally on the sidewalk or portions of the Transitway to access the station.

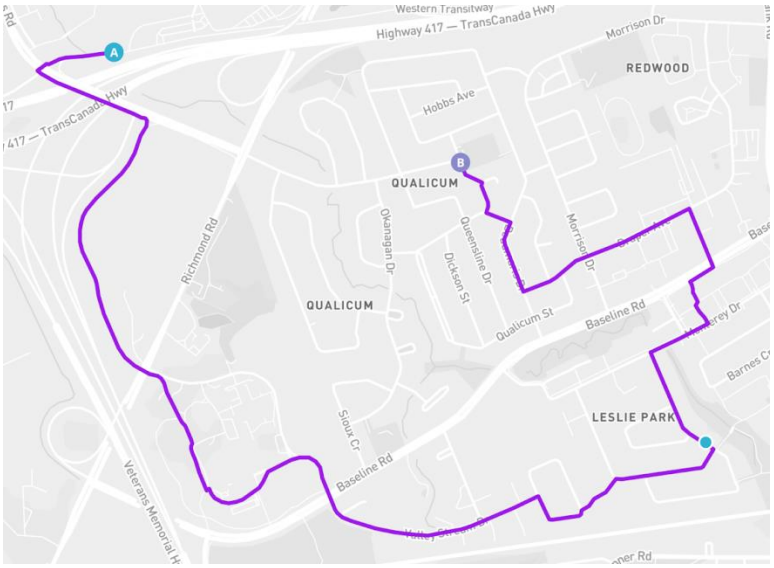
3.6.2 Woodridge Cr. as a barrier to cycling

Cycling access to the Bayshore transit station requires going through the aforementioned LTS 3 access road from Woodbridge Cr. However, the adjacent section of Woodridge Cr. is also labelled as an LTS 3 due to the parking configuration, lack of cycling facilities, and class of roadway. This limits access by bike to both the transit station and Bayshore Shopping Centre.

The northern portion of Woodridge Cr. is labelled as LTS 2 because of the low posted speed limit of 40km/h, but the width of the road likely yields much faster actual speeds. It is therefore unlikely to be considered as an LTS 2 in practice by cyclists riding there. In this way, the main street running through the entire Bayshore neighbourhood becomes a barrier to cycling.

3.6.3 Service for neighbouring communities

The nearby Qualicum neighbourhood is isolated from the transit station despite its proximity. The Qualicum Community Building is roughly at the centre of the neighbourhood and is a 1.5km walk from the Bayshore transit station. However, biking at LTS 2 requires going 5.5 km around the outside edge of neighbourhood to reach the same destination, as illustrated in Figure 3-7.



Indirect route generated due to missing links in the network.

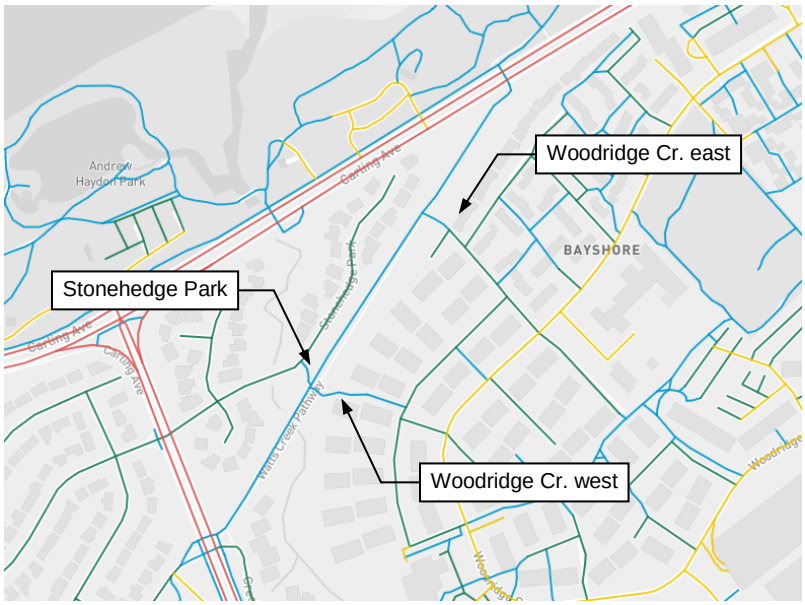
Figure 3-7: LTS 2 route from Bayshore to Qualicum.

As already noted, the large detour required to travel from Qualicum to Bayshore is due to the missing connection at the intersection of Holly Acres Rd. as it crosses Richmond Rd. to Nanaimo Dr. Cyclists headed southeast are expected to use an on-street painted lane, which is crossed by a right-turn slip lane. At this location, as shown in Figure 3-8, Holly Acres Rd. is six lanes across, including turning lanes, and is easily rated LTS 4.

Figure 3-8: Holly Acres Rd. southbound, approaching Richmond Rd.

3.6.4 Watts Creek Access

The Watts Creek Pathway is an essential connection to the northwest corner of the neighbourhood, and is also a low-stress route to other parts of the city. As shown in Figure 3-9, there are three entrances to the Watts Creek Pathway from the neighbourhood. However, all three are unlit, and the pathway isn't cleared of snow, which means that access is only seasonal and not accessible by everyone. There is also no wayfinding signage showing entrances to the path or from the path to the neighbourhood.



Watts Creek Pathway connections are unsigned and inaccessible.

Figure 3-9: Access to the Watts Creek Pathway.

In the northwest corner of the neighbourhood, homes along Stonehedge Park are isolated from the central area. At LTS 2, access to this portion of the community is only possible via the Watts Creek Pathway and along Holly Acres Rd. Although the as-the-crow-flies distance from the Bayshore transit station is about 400m, biking requires a 1.3km ride (which includes 50m of walking, and crossing Holly Acres Rd. twice).

Woodridge Cr. eastern entrance: This is the only established paved pathway connecting the Watt's Creek MUP to the Bayshore area. It is awkward, unlit, and unwelcoming. From Woodridge Cr., access is via a private street and parking lot. It requires going around a garbage bin and over a curb (see Figure 3-10).

Woodridge Cr. western entrance: An unpaved desire line connects the Watts Creek path to Woodridge Cr. The route is not landscaped, though it is clearly being used. Access from Woodridge Cr. is via a private street.

The only paved connection from the Bayshore neighbourhood to the Watts Creek Pathway. The curb cut is hidden behind the garbage bin and not aligned with the path. Photo by Heather Shearer.

Figure 3-10: Woodridge Cr. eastern entrance to Watts Creek Pathway.

Stonehedge Park entrance: This is an official entranceway protected by a gate. The edge of the Watts Creek Pathway is demarcated by a fence between the city and NCC properties, and a gate connects Stonehedge Park to the path. However, the actual gate has been blocked by a combination lock (see Figure 3-11). This lock is different than other padlocks used by the NCC, so has probably been installed by local residents to limit access from others outside the neighbourhood.

Access to the path is blocked from the north by a gate, which appears to have been locked by a resident. Photo by Heather Shearer.

Figure 3-11: Stonehedge Park entrance to Watts Creek Path

3.7 Recommendations

3.7.1 Access points to Bayshore Station and Bayshore Shopping Centre

Woodridge Cr. needs cycling infrastructure if it is to ever become an appealing route for residents who don't currently cycle, but who are waiting for safe infrastructure. Ideally, the infrastructure would be protected from traffic. A cycletrack would serve this purpose, and parking bays could be provided to consolidate some on-street parking. The Stage 2 LRT study dated June 13, 2015 references improvements to Woodridge as needing further study.

Further areas where access to the station could be improved with minimal effort would be to improve the connections to Holly Acres by providing wayfinding signage, and by explicitly allowing cycling on the sidewalk that runs parallel to the western Transitway, perhaps through use of signage or painted symbols. In future, this sidewalk should be upgraded to a MUP.

3.7.2 Better connections to surrounding neighbourhoods

Neighbourhoods near Bayshore should be better connected. To the north, connections to the Watts Creek MUP are crucial. Existing desire lines and access points could easily be improved with small amounts of paving, better wayfinding signage, and curb cuts along the most direct cycling routes to Bayshore Station.

To the south, a connection to Qualicum is more challenging; the intersection of Holly Acres and Richmond road is a barrier to safe and pleasant cycling here. There are MUPs along Holly Acres, but they are in poor condition and don't connect in an intuitive way to nearby streets. Improving this intersection and these MUPs would help showcase cycling as a mainstream transportation choice, and would provide residents south of Richmond Rd. with much better access to transit and to the Watts Creek pathway system.

3.7.3 Year-round 24 hour access to the Watts Creek pathway

The Watts Creek MUP is one of the most popular cycling and walking routes in Ottawa. Despite this, it sees a level of service far below what would be expected on any street, particularly one that saw comparable use. There is no lighting, and there is no plowing in winter. The NCC has identified winter maintenance as detrimental to the lifespan of paths, due to factors such as the use of heavy equipment. Installing lighting is also relatively expensive. However, considering the popularity of this path, and the feeling of improved personal safety that comes with having lighting, we encourage the City of Ottawa to partner with the NCC to make this path more useful to more people by providing lighting and winter maintenance.

4 Case Study: Bike-Friendly Routes to Schools

4.1 Biking to school

Biking to school is an inexpensive and scalable alternative to providing buses or requiring that parents provide transportation, and active transport is an excellent opportunity to include physical activity in elementary schools[28]. Cycling gives a child a sense of freedom, responsibility, and adventure while improving their health and well-being. While younger students might not be expected to ride on their own to school, they could bike with older siblings, friends, or parents, which would encourage the parent to continue onwards on their own bike. After school, having a bike allows the student to explore the neighbourhood and embark on their own adventures, as age and maturity allow.

The decision to bike to school is affected by individual influences (demographics, household characteristics, schedules, etc.), the social environment (public policies and economic forces), and the built environment[29]. Parents' concerns about the safety of the journey can be a major

[28] Physical activity in elementary schools (McKenzie & Kahan, 2008).
[29] Literature review on active transportation to school (Weigand, 2008).

factor in determining whether a child bikes to school, though it has been found that the children themselves may not share their parents' perceptions of unsafe roads[30]. When parents have fewer safety concerns, children are much more likely to walk or bike to school.

BIKE TO SCHOOL

Kids who bike to school will benefit from being more independent and more physically active. The biggest barrier to biking to school is not distance. Rather, it is the safety of the route between home and school.

Distance is a frequently-cited barrier to cycling to school[31], and the range that a child can travel varies greatly with age and experience. Studies of walking to school show that for a given distance, increasing age increases the likelihood that a trip will be made by active transport[32]. However, research specifically measuring distances cycled to school based on student age is sparse, and we could find no meta-study which controlled for the other factors listed above. For the purpose of this report, it is assumed that students are able to travel 3 km if the built environment allows it (keeping in mind that cycling is more efficient than walking, this approximately is the distance a high school student would be expected to walk, and is approximately three times the distance an elementary student would be expected to walk).

Most students are physically able to walk and bike the distances needed to get to schools, but they are generally inexperienced about the hazards that cars pose. In particular, children and young teens have difficulty with parked cars. Weaving in and out from between parked cars is a risk. Most students will have been told to (and do) stick to the sidewalks and pathways.

4.2 About the Westboro neighbourhood

Hilson Avenue Public School is situated in the fast-growing area of Westboro, west of Ottawa's downtown in Kitchissippi Ward. The school's main English-language program has a catchment area that includes the nearby neighbourhoods of Island Park and Wellington West, covering approximately 7km^2 and with a population of about 21,600. There are many single family homes here, but the properties are generally small, and so the area retains good density. The catchment for the Middle French Immersion program covers 20km^2 and includes Mechanicsville, Hintonburg, Civic Hospital, Carlington, McKellar Heights, and Carlingwood.

The area around Hilson Avenue Public School is already rich with students who walk to school. Crossing guards (e.g., at Island Park/Byron and Churchill/Byron), low volume residential roads, and multi-user paths help, but the layout of the neighbourhood as a permeable grid of local streets is the overriding factor in making active transportation trips for students generally safe.

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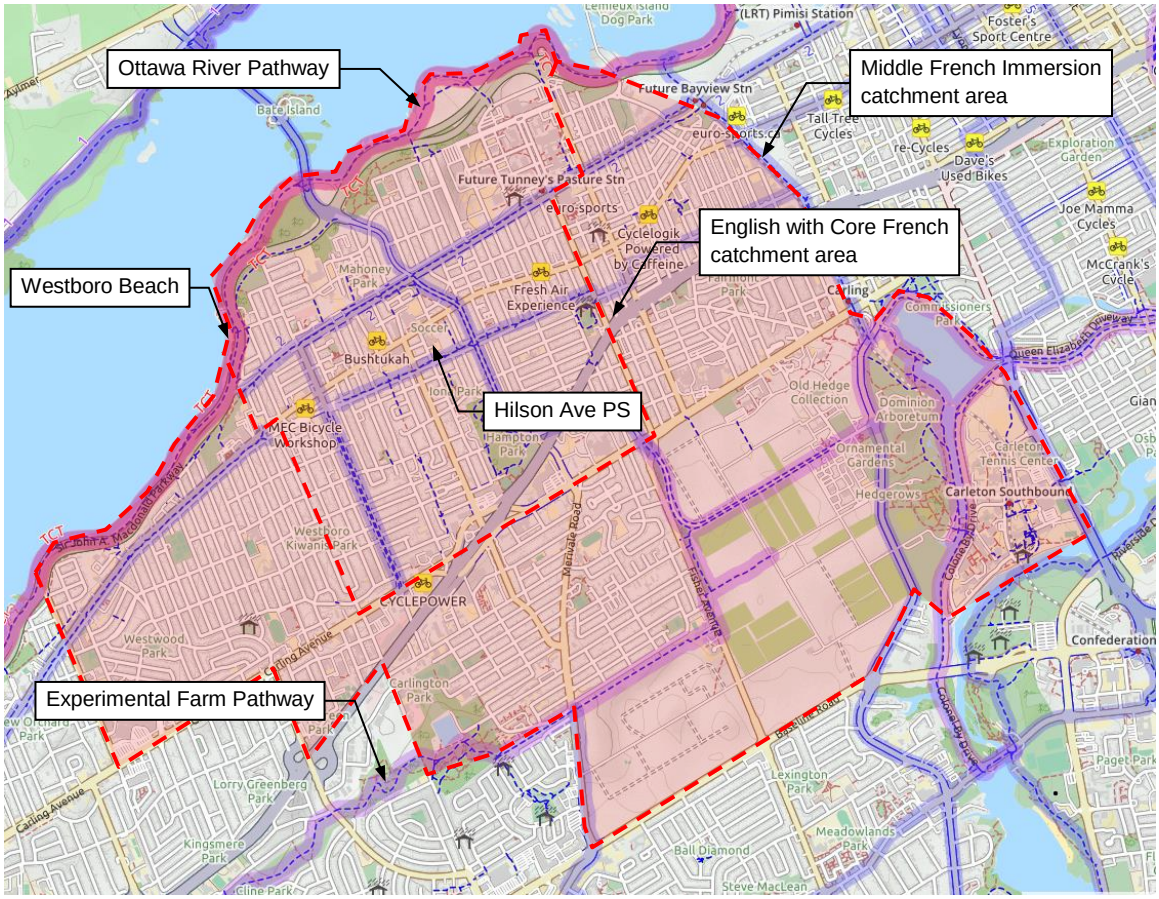
[30] Parents' perceptions of neighbourhoods (Timperio, Crawford, Telford, & Salmon, 2004).
[31] Barriers to biking to school (Dellinger, 2002).
[32] Children's mode choice for the school trip (McDonald, 2008).



Westboro neighbourhood with points of interest. Map via OpenStreetMap.

Figure 4-1: The Westboro neighbourhood and surroundings.

Westboro and surrounding areas offer the following points of interest and transportation choices:

Richmond Rd. / Wellington St. West: A traditional mainstreet, Richmond Rd is highly walkable and offers retail, food, and office space. Hilson Avenue PS has a Walk Score of 88[33].

Westboro Beach: The beach is accessible by bicycle by way of the Ottawa River Pathway, or from the neighbourhood via a pedestrian underpass on Lanark Ave.

Island Park Dr.: A low-speed residential street, Island Park has narrow bike lanes on each side and connects to the city's east-west bikeway on Scott St., the Ottawa River Pathway, and the Champlain Bridge. The street is very high volume, however, and, given its connection the Champlain bridge, it is often gridlocked at peak times.

[33] Walk score (Walk Score, 2018).

Westboro transit station: Westboro station is located approximately 800m away from Hilson Avenue PS. It will become part of the Confederation Line when the Stage 2 LRT is completed.

Highway 417 and SJAM Parkway: Access to the 417 is via onramps at the Carling Ave/Kirkwood Ave intersection. The Sir John A Macdonald Parkway runs along the Ottawa River, and can be reached via Island Park Dr.

4.3 Hilson Avenue PS LTS Map

Figure 4-2 presents an LTS map of the area immediately around the school. The blue LTS 1 lines, especially noticeable along Byron Ave. and Churchill Ave., provide safe access to children of all ages. The green LTS 2 lines show good residential routes that largely have low traffic volumes, but riding here requires some knowledge of road usage or parental supervision. Students trying to bike from the north and south must navigate several busy roads, including Scott St., Kirkwood Ave, and Richmond Rd.. For those students who fall within the Middle French Immersion catchment area, Carling Ave is also a potential barrier.

The safest paths are often not intuitive. Going from Van Lang near Scott and Churchill, where many students reside, the safest way would be the Scott St. MUP; however, there are very few places to cross Scott St. safely that lead to routes heading south toward the school.

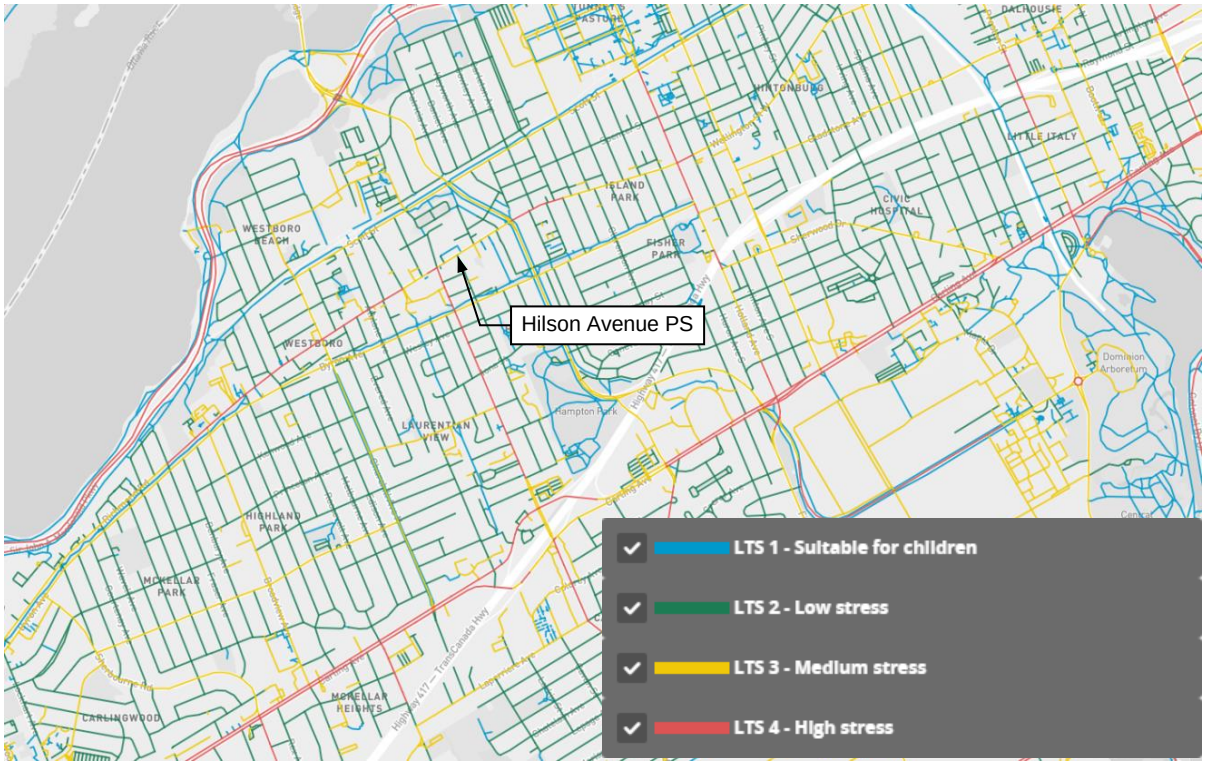


Figure 4-2: Westboro LTS map.

4.4 Isochrone analysis of Hilson Avenue PS

Figure 4-3 shows travel times to Hilson Avenue PS along roads that a rating of LTS 2 or better. It is interesting to note that the area covers approximately the middle French immersion catchment area within 15 minutes, with the exception of Carlington, which has significant access problems at Carling Ave. and the 417. However, the LTS 2 rating is suitable for adults, older students, or students accompanied by parents. To have a better picture of the routes available to students, Figure 4-4 shows the LTS 1 map for Hilson; the range of travel is very restricted.

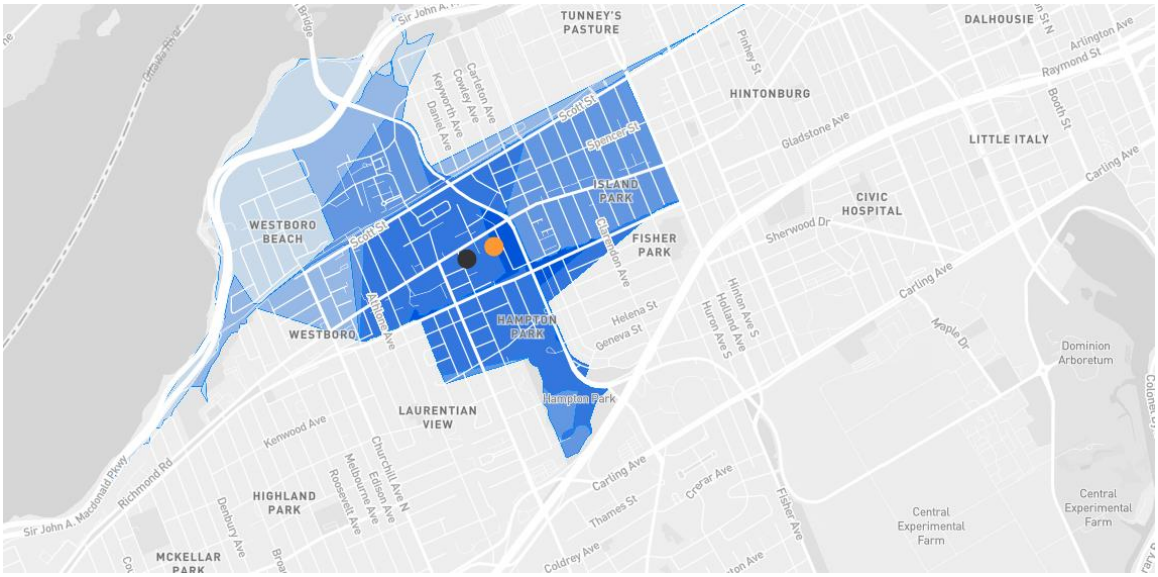


Figure 4-3: Hilson Ave PS isochrone map at LTS 2.

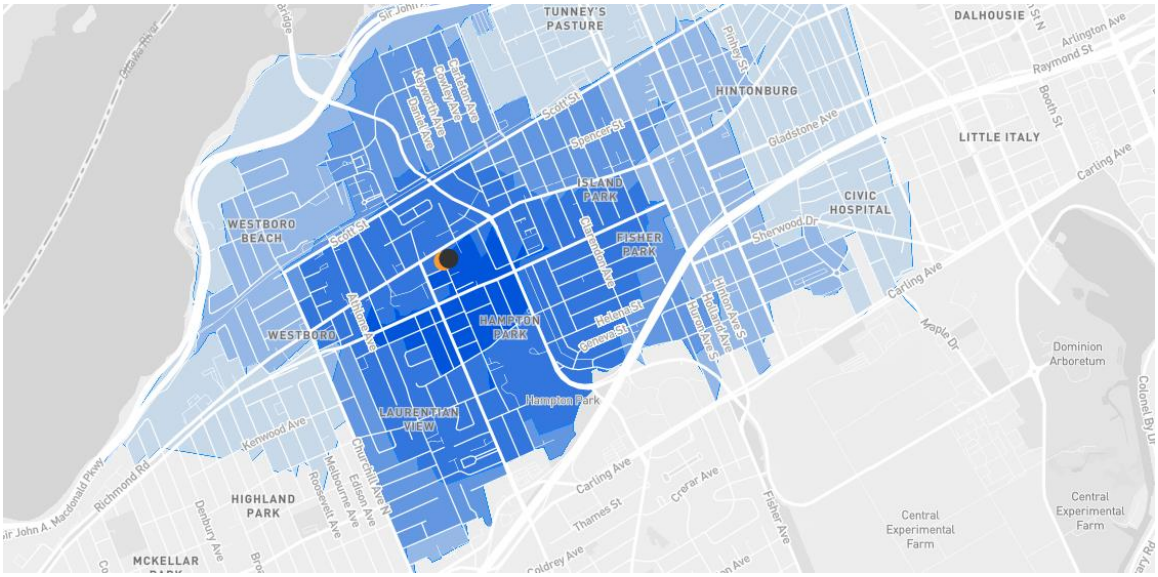


Figure 4-4: Hilson Ave PS isochrone map at LTS 1.

4.5 Findings

4.5.1 Broken link at Westboro transit station

Where child-friendly cycling facilities do exist, there can still be broken links in the network. Westboro Station intersects the Scott St MUP and does not provide an obvious, child-friendly route through the bus-only roadways. Students must either cross at Athlone before Westboro station and walk to McRae or Clifton with no sidewalks and heavy truck traffic, or else cross at Lanark, continue to Island Park via a hidden pathway, and backtrack to a safer route north.

4.5.2 Churchill and Byron intersection

Churchill is conveniently fed by the large residential areas of Laurentian View and Highland Park, however there is a missing link once students arrive at Byron. The intersection at Churchill and Byron has heavy truck traffic and the crossing is at the top of a hill, which can limit the visibility for both southbound cars and smaller students attempting to cross at the intersection, as seen in Figure 4-5. There is a crossing guard positioned at the south-west corner to serve nearby Churchill Alternative school. Unfortunately, the guard is not positioned to assist northbound students accessing the Byron MUP from the Churchill cycle tracks.

The view looking north from Churchill Ave and Byron Ave. The steep hill reduces visibility of southbound vehicles which might be turning left. Photo by Yaro Shkvorets via Mapillary.

Figure 4-5: Churchill and Byron intersection.

Furthermore, the Churchill Ave cycle tracks end well before the intersection and leave students to mix with the traffic. Most students in this situation would likely move onto the sidewalk and use the crosswalk, but this still leaves them exposed to fast moving southbound traffic turning eastbound onto Byron with its associated visibility problems.

4.6 Recommendations

4.6.1 Better connections between Churchill cycle tracks and Byron MUP

This intersection suffers from heavy traffic, much of which is turning at positions of poor visibility. The northbound Churchill cycle tracks end abruptly and mix the cyclist with cars and trucks turning right as well as southbound vehicles coming uphill and turning left onto eastbound Byron. The crossing guard helps with crossing over Byron on the west side but not over Churchill on the north side due to a focus on assisting students attending Churchill Alternative.

Churchill Ave is identified as a spine cycling route from Carling Ave to Scott St. in the Ottawa Cycling Plan, but the cycle tracks currently end just south of Byron Ave. We recommend prioritizing the extension of the Churchill cycle tracks to meet the Byron Linear Park MUP, to provide a safe connection between these important low-stress routes.

Figure 4-6: End of the Churchill cycle track, approaching Byron.

4.6.2 Improved cycling connections between Carlington and Westboro

Carling Ave. presents a very stressful situation for even the most traffic-hardened cyclist. Currently, the only way for a student to travel from Carlington without mingling with traffic on the road would require traveling long distances on sidewalks through some of the most hostile traffic routes anywhere in Ottawa. Some of the crossings require walking across three lanes of traffic with slip lanes, where drivers often look to their left for oncoming traffic without checking for pedestrians crossing from the right.

There are a limited number of places to pass under the 417 in the area, the most direct being Kirkwood Ave, which has an LTS of 4 and is unsuitable for students (and unwelcoming to any cyclist). Some additional consideration for cyclists should be given to allow them to safely make connections across Carling Ave. and the 417.

4.6.3 Cycling connection through Westboro transit station

Westboro transit station is poorly designed for eastbound traffic in spite of the MUP connections at either end. It presents a barrier for students with few safe alternatives. There has been some discussion of changing the design of the Scott St. MUP, however unless the design of the alternative is much improved, children will avoid taking bike lanes on Scott St. Some consideration of cyclists and pedestrians should be made here.

4.6.4 Education and promotion

Despite these barriers, the area around Hilson Avenue PS is conducive to arriving by bike or on foot. Since it is often parents' perceived level of safety that prevents students from biking to school rather than actual safety problems, promotion of the safe routes in the area could increase the likelihood of children cycling. Even if children didn't grow up biking to school, by the time that they are in Grades 4 and above, children should increasingly be able to travel to school on their own or with friends.

5 Case Study: Bike-Friendly Neighbourhoods

5.1 Neighbourhood biking

Cycling for trips other than the work or school commute is a simpler form of transportation cycling, for many reasons:

- **Flexible timing.** Often, the neighbourhood bike trip will be for a purpose that is not tied to a particular time of day, such as to go shopping or to visit a playground. Flexible timing is one of the key factors which promotes bicycle use[34]. It means that people can choose to make bike trips when the weather is pleasant, rather than on a pre-determined schedule. Neighbourhood trips can also be timed to avoid peak traffic hours, making cycling possible for children and less stressful for adults.

- **Less preparation needed.** Commuting a long distance to work by bike can often mean a full wardrobe change and styling session on arrival. This simply isn't necessary when wearing the casual clothing that works best for biking to recreation or errands. Moreover, the trip to work or school often means being prepared for a full day: you must carry lunch, papers, personal electronics, etc., with you. Neighbourhood trips, such as going to a recreational activity, are often much simpler to pack for, and may not require bringing anything at all.

- **Flexible destinations.** The neighbourhood trip means choosing destinations that are easy and safe to get to by bike, rather than going to a fixed destination that may not be reachable on well-lit, bike-friendly routes. The neighbourhood cycling trip will tend to be to a local destination, such as a nearby restaurant, not to a similar one across town.

- **Little consequence if there is a mechanical problem.** Short, local trips can also reduce anxiety related to mechanical issues. Since most neighbourhood trips will be close to home and not on a fixed schedule, worries about how to deal with a problem such as a flat tire are reduced. Walking becomes an option, help may be nearby, and the consequences for being late or cancelling the trip may be lessened.

- **Wayfinding and personal safety.** Some people are not at ease riding alone, for a variety of reasons that are often related to feelings of personal security. Though these concerns rank below worries about safety when interacting with motor vehicles, a large minority report that they would be encouraged by better lighting or are currently discouraged by the possibility of crime[35]. Due to the social nature of many types of neighbourhood trips (shopping, dining, errands, recreation destinations), it's often possible to make the trip with a companion.

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[34] Successful bicycle promotion (Fernandez-Heredia, Monzon, & Jara-Diaz, 2014).
[35] Influence of individual perceptions (Akar & Clifton, 2009).

5.2 The South Keys/Greenboro area

The South Keys/Greenboro area is located south of the downtown core in Gloucester-Southgate Ward. The neighbourhood is different than other inner suburbs in Ottawa, in that it has an extensive network of paths connecting most of the homes to nearby schools and parks. More unusual still, the paths weren't fit in along the kinds of sites that are unsuitable for any other purpose, such as hydro corridors, ravines, rail lines, major roads, or waterways. It is explained by the transportation trends that were in vogue during its development: first, building for the car, then, building for the new Transitway concept.

Developed in the mid- to late-1960s, the South Keys neighbourhood was built on the east side of Bank St. in south Ottawa. There was no shopping mall, no Transitway, and no pathway network; it was made up of single family homes and a divided two-lane road for the 10 km drive into downtown. In the early 1980s, Hunt Club road was extended, connecting to Bank and to a new interchange at the Airport Parkway. The extension supported the next wave of home building in the area, and the South Keys neighbourhood was joined by Greenboro, expanding eastward to Hawthorne Rd.

Greenboro was initially planned as a model community for transit-oriented development. Looking at the maps today, you can clearly see how the linear greenspace forms a right-of-way to allow a dedicated busway to be run right through the center of the neighbourhood. As a condition of allowing the development, such a busway was built in the mid-1980s, and was maintained by OC Transpo. However, as the neighbourhood was constructed through the 1990s, changes were made to the plans to include lower densities, more parkland, and schools.

Ultimately, these densities were not sufficient to support dedicated neighbourhood busway transit, and in 1995 the Regional Municipality of Ottawa-Carleton advised the City of Ottawa that it would dispose of the busway property. Ottawa had no interest in acquiring the property for

transportation services, and would only be interested in acquiring the property as parkland if the Region would remove asphalt, and install pathways and lighting first. The community broadly supported removing the busway in favour of a pathway system, and so, at the Region's expense, the busway was removed and converted to a pathway in 2001[36].

Today, the neighbourhood still features reasonably high density considering that it is mainly single family, semi-detached, and row homes with ample access to greenspace. The pathway network is extensive and connects to most parts of the neighbourhood. Pathways are lit, and are all plowed in winter. The paths greatly increase permeability of the neighbourhood to pedestrians and cyclists, and trips on the paths can be more direct than car trips on the labyrinth of streets. In many ways, Greenboro has the potential to be a model community for making active transportation appealing.

This highly connected network of pathways links most streets in the neighbourhood to schools and parks.

Figure 5-1: Greenboro Pathway signage.

[36] Acquisition of Greenboro Busway (City of Ottawa, 1999).

Satellite view of the former busway before and after conversion to pathways.

Figure 5-2: Greenboro Busway.

The neighbourhood offers the following points of interest and transportation choices:

South Keys Shopping Centre: Located on the west side of Bank St., opposite the South Keys neighbourhood, the shopping centre includes grocery and clothing stores, and a movie theatre. It serves residents beyond the neighbourhood, as Bank St is a popular motor vehicle commuter route to the south of the city.

Pine Grove Forest: The Pine Grove area of the NCC Greenbelt begins just south of Hunt Club Rd. It includes hiking, cycling, cross-country ski trails, and the Conroy Pit off-leash dog park.

South Keys/Greenboro neighbourhood with points of interest. Map via OpenStreetMap.

Figure 5-3: The South Keys/Greenboro neighbourhood.

Hunt Club Rd.: A major arterial in the south end of the city, Hunt Club Rd. connects to highway 417 in the east and to highway 416 in the west. Hunt Club has on-street, painted bike lanes, except for the segment between Bank St. and Cahill Dr., where an asphalt-paved, shared sidewalk of varying quality is present.

South Keys and Greenboro Transit Stations: Residents can access the Transitway at either station, at the southwest and northwest corners of the neighbourhood, respectively. Greenboro station is also a stop on the O-Train Trillium Line.

5.3 South Keys/Greenboro LTS Map

Figure 5-4 presents the LTS map for the South Keys/Greenboro neighbourhood. Most routes are typical LTS 2 residential streets, though the neighbourhood is threaded with LTS 3 streets. These streets have a higher stress level due to faster-moving traffic and buses. Bank St, Hunt Club Rd, and Hawthorne Rd are largely LTS 4 and surround the neighbourhood on three sides, and the Walkley Yard and rail line bounds it on the north.

Cutting through the neighbourhood, however, are the LTS 1 pathways which are located in the former busway right-of-way. These paths provide safe alternatives to cycling on the street, and several crossings are signalized.

Figure 5-4: South Keys/Greenboro LTS map.

5.4 Isochrone analysis of South Keys/Greenboro

Though a 15-minute isochrone corresponds well with willingness to travel for work or leisure, people are not willing to travel quite as far for shopping trips. As Table 2-2 showed, the mean distance of cycling trips for shopping purposes is 2.2 km, which is around an 8-minute ride. For the following analysis of neighbourhood cycling, we will focus on distances within the 6-9 minutes isochrones.

The major neighbourhood destinations for shopping and leisure errands in Greenboro are the South Keys Shopping Centre, the Greenboro Plaza, and the Conroy Mall. To provide a sense of the overall neighbourhood connectivity, we will look at each of these destinations.

5.4.1 South Keys Shopping Centre

South Keys is a major retail destination in the area, and includes grocery stores, movie theatre, restaurants, financial services, electronics, home decor, and clothing stores. Its LTS 2 isochrone map is shown in Figure 5-5. The 9-minute isochrone corresponds to 2.4 km at our assumed 16 km/h average speed. The contour reaches nearly 2 km into the neighbourhood, meaning that available routes are somewhat direct. However, connectivity outside the neighbourhood is poor.

It's worth noting that the mapping tool was not able to connect directly to the shopping centre. The nearest point located on an LTS 2 or lower route was on the east side of Bank St. at Cahill Dr. To reach the shopping centre, cyclists will need to dismount and walk.

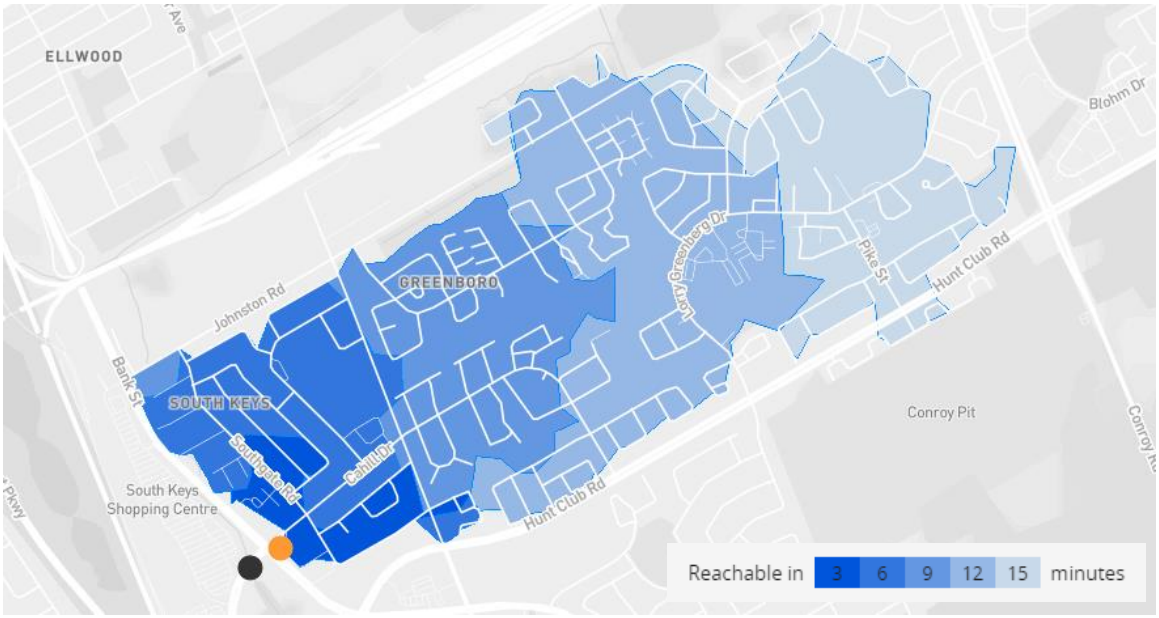

Figure 5-5: South Keys Shopping Centre isochrone map.

5.4.2 Greenboro Plaza

Greenboro Plaza (see Figure 5-6) is a smaller strip plaza which includes a convenience store, dentist, hairstylist, pharmacy, butcher, and physiotherapist. Residents of Greenboro (west of Conroy Rd) and South Keys are largely within a 9-minute ride of the plaza, and almost all with a 12-minute ride.

As before, the isochrone map is sharply bound by Hunt Club Rd., and the neighbourhood to the south is not reachable within 15 minutes despite being located roughly a kilometre away.

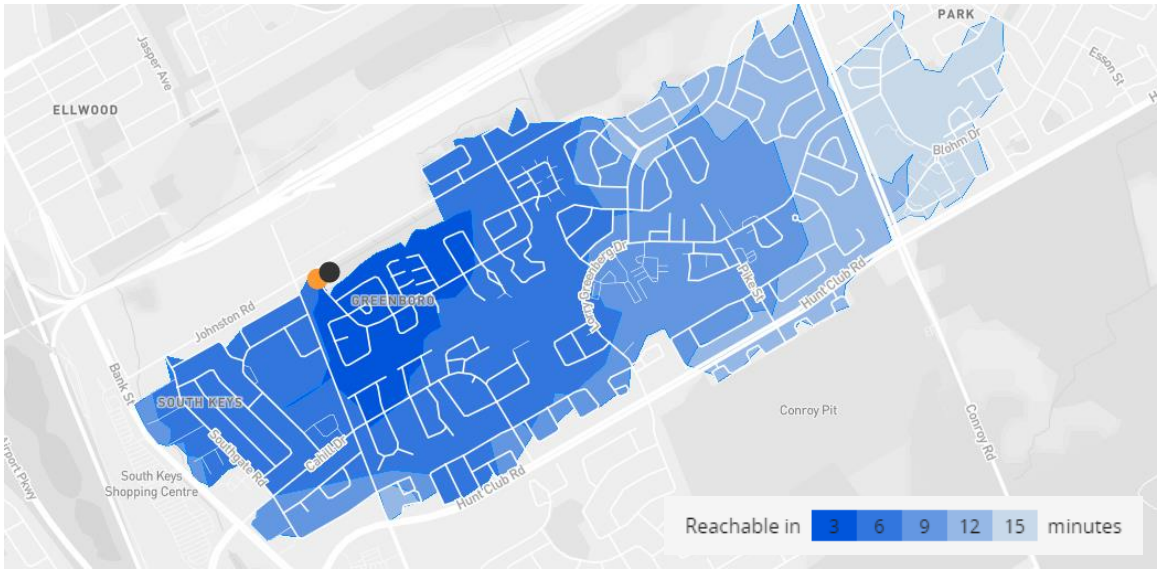

Figure 5-6: Greenboro Plaza isochrone map.

5.4.3 Conroy Mall

Conroy Mall (see Figure 5-7) is located on the east side of Conroy Rd., and contains a pharmacy, dentist, salon, restaurants, and music and karate classes. It is most easily reached by residents in the east end of Greenboro and the surrounding Hunt Club Park area.

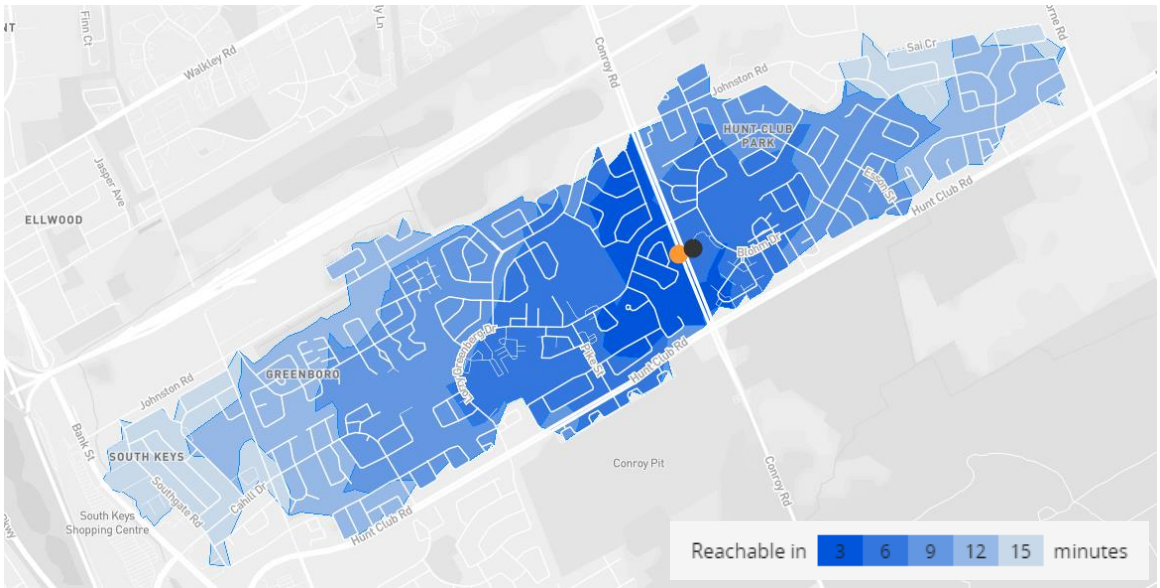

Figure 5-7: Conroy Mall isochrone map.

5.5 Findings

5.5.1 Hunt Club Rd. as a barrier to cycling

Not surprisingly, this busy arterial bounding the neighbourhood discourages cycling. Worsening the problem, the street grid across this major road is discontinuous. The local streets that intersect Hunt Club either do not cross to the south side, or are themselves high-traffic LTS 3 streets. Consequently, Hunt Club Rd is a hard barrier against cycling from the south.

5.5.2 Off-street pathway continuity

The paved pathways built in the former busway knit the neighbourhood together. As is visible in the fairly even concentric rings of the above isochrone maps, there is a somewhat direct route available to most destinations in the area. The controlled crossings at higher-stress streets such as Lorry Greenberg Dr. and Conroy Rd. are not directly captured by the LTS model, but their presence makes these intersections more comfortable for adults and accessible for children.

5.5.3 Walkley Yard

Even more than the arterial roads surrounding the South Keys/Greenboro neighbourhood, the rail line and Walkley Yard cut these residents off from the surrounding city. There are no crossings at any level of traffic stress between Bank St and Conroy Rd.

5.6 Recommendations

5.6.1 Widen the Albion MUP

The multi-use path on the east side of Albion Rd. leads directly to the Greenboro Plaza, but is narrow and in poor condition. This path should be widened and repaved to improve it for cycling. This would be a very affordable improvement, and is not currently indicated on any plans.

5.6.2 Albion Rd. Pedestrian/Cycle Bridge

Albion dead-ends at the railway to the north of the neighbourhood. These tracks are a major barrier, since the only safe way to cross them is to use the Sawmill Creek pathway. However, accessing the pathway adds an unacceptable detour distance and the pathway is unreachable on low-stress infrastructure. The neighbourhood is surrounded by busy roads, and even connecting through South Keys station is difficult by bike, requiring walking in the station.

Ottawa’s ultimate cycling network plan identifies that a bridge for walking and cycling be built over the tracks to connect the Greenboro and Heatherington neighbourhoods. We recommend that this bridge be a included in the next edition of the Ottawa Cycling Plan, since connecting these neighbourhoods will be an essential step towards providing residents with the fine-grained connectivity that is needed to support widespread uptake of active transportation.

5.6.3 Greenbelt Access

The barrier created by Hunt Club Rd prevents residents from accessing the Pine Grove forest and greenbelt trails. A segment of pathway along Lorry Greenberg Dr. connecting the busway paths to Sable Ridge Dr. could fill in the missing link between Greenboro and neighbourhoods to the south. The asphalt-paved sidewalk on the west side could be widened into a full MUP.

Furthermore, Conroy Rd. is indicated in the Ottawa Cycling Plan as a cross-town bikeway from Walkley Rd. to beyond Leitrim Rd., but the multi-use path currently extends only as far south as Hunt Club Rd. Completion of the additional segments should be prioritized to provide access to the major pathways and spine routes to the south.

5.6.4 Access to South Keys Mall and beyond

The barrier created by car traffic on Cahill Dr. and Daze St. will prevent most people from biking to South Keys Mall. Crossing Bank St. is also daunting. Making these streets appealing to the majority of people will require a protected lane on Daze St., a suitable crossing at Bank St., and some cycling-friendly interventions such as traffic calming or bike lanes on Cahill Dr.

Figure 5-8: Signage on the far side of this intersection prohibits through traffic, but (brave) cyclists are permitted to cross Bank here to access South Keys Mall.

6 Conclusions

People who bike often prioritize the safety of the route above all else. The value in these maps is that users can set a maximum level of traffic stress comfort. The routes plotted will not exceed that level of traffic stress. In doing so, the maps often reveal missing links in infrastructure that are barriers to a safe and pleasant journey by bike. Therefore, these maps can be used to make planning decisions to address the gaps. The maps can also be used as a measure of success: when the safe low-stress routes are approximately the same distance as the most direct routes, this is a sign of a complete and user-friendly cycling network.

These tools are useful for highlighting barriers in the cycling network that are preventing more widespread adoption of cycling. Based on the missing links we identified, Bike Ottawa made specific recommendations for improvements to encourage more uptake of cycling in the immediate area. Often, these recommendations are simple measures such a curb cuts, improving the pathway surface conditions, or installing wayfinding signage. Other measures, such as redesigning an intersection or providing a protected cycle facility are more expensive, and just as necessary.

This method of identifying missing links in the local cycling networks should prove to be generally useful to the City of Ottawa as we renew our Transportation Master Plan and Ottawa Cycling Plan. By providing this new tool for analyzing our current cycling network and identifying areas for improvement, Bike Ottawa is hopeful that staff and residents alike will be able to identify and prioritize opportunities for making Ottawa an even better city for cycling.

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8 Appendix A – OpenStreetMap Tagging Guide

OSM Bike Ottawa Tagging Guide

Table of Contents

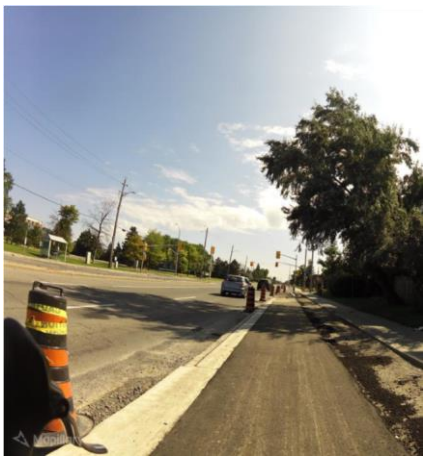
Off-Road

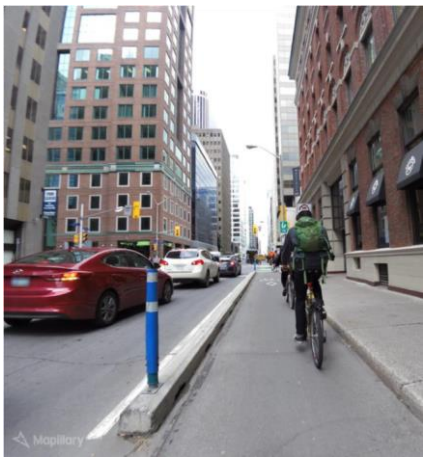
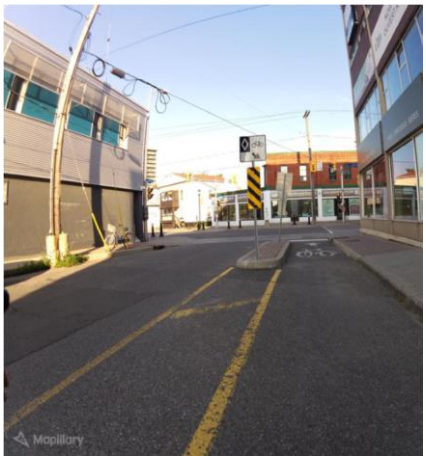
Feature	Description	OSM Schema	Mapillary Photo
Paved Multi-Use Path (MUP)	Typically 3m wide, may be wider. Mixed bike and foot traffic.	way highway=path width=* smoothness =* segregated=no surface=asphalt centreline=yes	
Twinned Path	Typically >4.5 m wide. Separated bike and foot traffic	way highway=path surface=asphalt segregated=yes	
Walkway	Typically <3m wide. May not have curb cuts. Intended primarily for foot traffic, though bikes are not prohibited	way highway=footway bicycle=yes	

Feature	Description	OSM Schema	Mapillary Photo
Unpaved Multi-Use Path (MUP)	Typically 3m wide. Mixed bike and foot traffic. Often a stonedust surface, but sometimes dirt.	way highway=path surface=fine_gravel bicycle=yes	
Desire line	Well-worn path in a direct line between popular destinations. Also known as a goat path.	way highway=path path=desire	
Singletrack	Recreational in purpose, may be meandering or direct. Most often maintained by users. Often includes technically challenging sections, but some sections may be appropriate for transportation	way	

Feature	Description	OSM Schema	Mapillary Photo
Track road	Also known as doubletrack. Typically direct, but surfaces are often too rough for comfortable cycling. Motor vehicles such as ATVs are often permitted, but track roads are typically not used by conventional cars. May not be maintained.	way	
Boardwalk	May be recreational in purpose, but some sections are suitable for transportation	way highway=path bridge=boardwalk surface=wood	

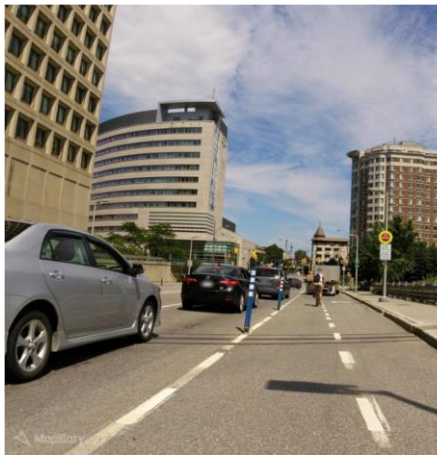
Physically Protected

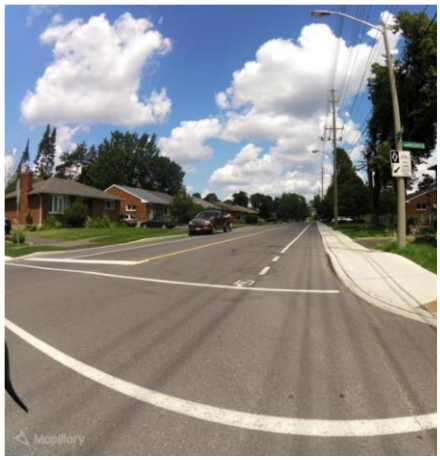
Feature	Description	OSM Schema	Mapillary Photo
One way protected lanes	Also known as cycletracks. Separated from the roadway by elevation, pedestrians not permitted.	way highway=cycleway oneway=yes	
One way protected lane, on only one side of a two-way road	Also known as a cycletrack. Not all roads have cycletracks on both sides. Separated from the roadway, pedestrians not permitted.	way highway=cycleway cycleway:right=lane oneway=yes	
Bidirectional protected cycletrack	Separate way for the cycletrack.	way highway=cycleway oneway=no	

Feature	Description	OSM Schema	Mapillary Photo
One way physically protected bike lane	The bike lane and roadway share a continuous surface but are separated by substantial treatments that may include: - planters - concrete sleepers - jersey barriers - parked cars	way highway=cycleway oneway=yes	
Contraflow lane with separation	If the separation is only paint or flex posts, see contraflow lanes in the "Painted Spaces" section. On one-way streets where there is a physical form of separation.	way highway=cycleway oneway=yes	
Service strip	Asphalt strip, resembles a cycletrack, but is typically narrow and in poor condition, with no intersection treatments, and may include utility poles. Intended as a low-maintenance surface for snow storage. Also provide width and smoothness tags.	way shoulder=service_strip Width = * smoothness = *	

Feature	Description	OSM Schema	Mapillary Photo
Shared sidewalk (signed)	A standard sidewalk, sharing designated by signage. Surface is often concrete, rather than asphalt. Add the sidewalk tag to the highway=* way	way sidewalk:both/left/right:bicycle=yes	

Painted Spaces

Feature	Description	OSM Schema	Mapillary Photo
Buffered bike lane	Not to be confused with a protected bike lane (described in the previous section). The bike lane and roadway share a continuous surface but are separated by flimsy treatments that may include: - flex stakes - double paint line	way cycleway=lane cycleway:buffer=yes	
Painted bike lane, on a divided road	A single line of paint delineates the bike lane. Bike symbol may be painted in the lane. The lane is reserved for bikes by posted signage.	way cycleway:right=lane	

Feature	Description	OSM Schema	Mapillary Photo
Painted bike lane, on an undivided road	A single line of paint delineates the bike lane. Bike symbol may be painted in the lane. The lane is reserved for bikes by posted signage.	way cycleway=lane	
Advisory bike lane	Dashed lines delineate bike lanes on each side of the street, and this functions like any other bike lane for cyclists. The remaining roadway is too narrow for two way motor traffic. Motorists may enter the bike lanes when encountering an oncoming vehicle, but must give priority to cyclists.	way lanes=1 cycleway=lane	
Pocket bike lane	Painted lane positioned between a right-turn lane and a through lane. Right turn lane length can be quite variable. The cycleway:middle tag is an invention, since there is no convention for this situation.	way - cycleway:middle=lane	

Feature	Description	OSM Schema	Mapillary Photo
Contraflow lane no separation	On one-way streets, only a yellow line separates two way bike traffic. If there is physical separation in the form of a barrier or vertical discontinuity, see the entry on contraflow lanes with physical separation.	way cycleway=opposite_lane	
Shoulder, not signed as a bike lane	A single line of paint delineates the shoulder. No signage or bike symbols present. Parking on the shoulder is typically permitted.	way shoulder:left/right/both shoulder:surface=yes/no	
Traffic-calming parking lane	Resembles a bike lane or paved shoulder, but is typically narrow and, unlike a paved shoulder, includes a curb. Intended to visually narrow the road and calm traffic speeds. Not specifically intended for cycling, but may be functional. Parking is typically permitted.	way -tag like any other shared road with/without parking	

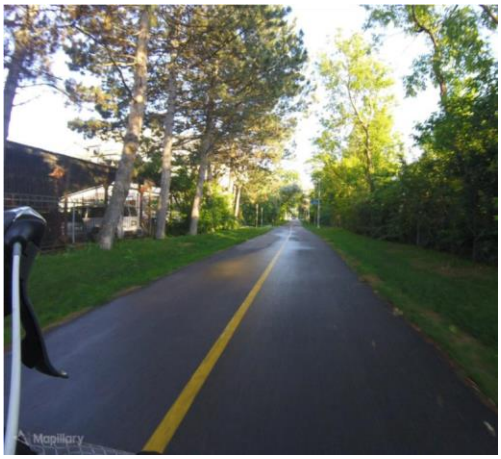
Mixed Traffic

Feature	Description	OSM Schema	Mapillary Photo
Dooring zone	Unique in Ottawa. Painted warning that cyclists should avoid riding close to parked vehicles.	way cycleway=mixed_traffic otherwise, tag like any other shared street with parking	
Super sharrows	Green backgound for enhanced visibility. Indicates lane position cyclists should use on roads where no cycling infrastructure is present.	way cycleway=mixed_traffic	
Sharrows	Bike symbol indicates lane position cyclists should use on roads where no cycling infrastructure is present. Require frequent repainting and may be very faded; it's still of interest to know which roads are intended to have sharrows.	way cycleway=mixed_traffic	

Feature	Description	OSM Schema	Mapillary Photo
Shared bus/bike lane	Cyclists will often have these lanes to themselves, but sometimes will need to navigate amidst buses. Designated by signage.	way cycleway=share_busway	

Smoothness

Read more on the wiki. Always a subjective call. Here are some more cycling-specific interpretations of the keys.

Feature	Description	OSM Schema	Mapillary Photo
Excellent	Fresh flawless pavement	way smoothness=excellent	
Good	Decent on skinny tires - Asphalt with a few cracks and bumps - Flawless stone dust	way smoothness=good	

Feature	Description	OSM Schema	Mapillary Photo
Intermediate	A bike with sturdy tires and wheels would be preferred by most. - Bumpy but not hazardous pavement. - Stonedust with some minor washouts. - Well-packed featureless dirt.	way Smoothness =intermediate	
Bad	Pavement with jarring bumps, alligatoring, or large cracks. Coarse gravel or stonedust with washouts that require alertness. Dirt trail with small stones or some small roots.	way smoothness =bad	
Very_bad	A mountain bike, perhaps with front suspension, is a more comfortable choice here. This is the worst pavement condition that Ottawa has. - Pavement with hazardous bumps and cracks large enough to swallow skinny wheels. - Stonedust with hazardous washouts. - Rocky surface, such as an ATV trail. - Dirt trail where stones or roots require attention.	way Smoothness =very_bad	

Feature	Description	OSM Schema	Mapillary Photo
Horrible	Dangerously broken pavement that should be fixed immediately; this is not a tag that will often apply to paved surfaces. - Trails with large stones or roots that may require dismounting or suspension	way smoothness= horrible	
Very Horrible	Rough-edged stones, many exposed roots, suitable only for fatbikes or full suspension	way smoothness= very_horrible	
Impassable	Almost nobody would be able to ride this	way smoothness= impassable	

Lane Configuration

Feature	Description	OSM Schema	Mapillary Photo
One Lane	Advisory bike lane streets where cars must use bike lane to pass by each other. Single-lane bridges.	way lanes=2	
Two Lanes	Most residential streets consist of two lanes.	way lanes=2	
Multiple Lanes	Includes turning lanes	way lanes=5	
Width	Most designated MUPs have a width of 3m, though some are wider. Walkways are typically 2m	way width=*	
Speed limit	Only show if the speed is posted different than 50.	way maxspeed=40	

Parking

It's possible to get into deep detail on street parking; we are mainly concerned with whether it is present, or saying definitively that it is absent.

Feature	Description	OSM Schema
Left	Parking, left side	way parking:lane:left=parallel
Right	Parking, right side	way parking:lane:right=parallel
Both	Parking, both side	way parking:lane:both=parallel
No Parking	No Parking	way parking:lane:both=no_parking
No Stopping	No Stopping	way parking:lane:both=no_stopping

Flooding

Feature	Description	OSM Schema
Flood Prone	Use `flood_prone=yes` If the flooding is a predictable annual event, you may wish to add conditional access restrictions to indicate times of the year when the way should be avoided.	way access:conditional=no @ May 1-15

Plowing

Feature	Description	OSM Schema
Maintained	If maintained, `seasonal=no`	way seasonal=no
Not maintained	If not plowed, `seasonal=yes` and add a conditional restriction of `access:conditional=no` @ Dec-Mar to indicate the period when the way is typically unavailable	way seasonal=yes access:conditional=no
Poorly maintained	If poorly plowed, add a conditional restriction of `smoothness:conditional=bad` @ Dec-Mar	way smoothness:conditional=bad

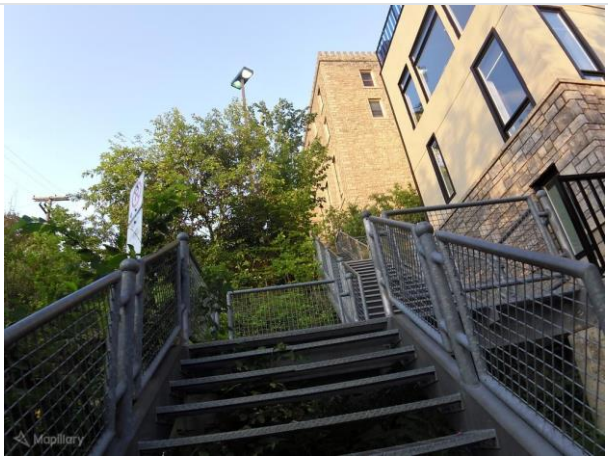
Filtered Permeability and Pinch-Points

Feature	Description	OSM Schema	Mapillary Photo
Chicane no channel		node	
Chicane with channel		node	
P-Gate		node barrier=cycle_barrier bicycle=yes motor_vehicle =no	
Block/Boulder/Planter		node barrier=block bicycle=yes motor_vehicle =no	
Bollard		node barrier=bollard bicycle=yes motor_vehicle =no	

Feature	Description	OSM Schema	Mapillary Photo
Split-path entrance		node	

Force Dismounts

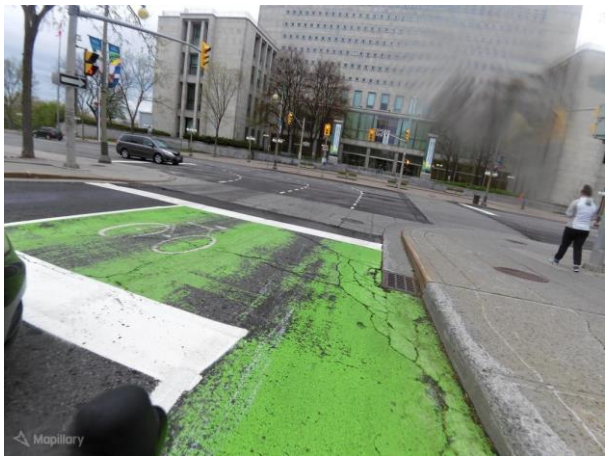
Feature	Description	OSM Schema	Mapillary Photo
Narrow Gate	Very narrow gate (<90 cm gap)	node barrier=cycle_barrier bicycle=yes/dismount maxwidth=0.5	
Swing Gate	Hinged gate that can be opened and closed. Usually closed.	node barrier=swing_gate bicycle=yes/dismount	

Feature	Description	OSM Schema	Mapillary Photo
Stairs with no trough		way highway=steps ramp=no bicycle=dismount	
Stairs with trough		way highway=steps ramp=yes ramp:bicycle =yes bicycle=dismount	
Lock crossing		way bridge=yes surface=wood bicycle=dismount	 

Curb cut needed		node bicycle=dismount	

Intersections and other Road Crossings

Feature	Description	OSM Schema	Mapillary Photo
All-way stop		node	
Two-way stop		node	
Yield		node	
Traffic circle, no bypass		node way	
Traffic circle, with bypass		node way	
Pedestrian Crossover	Also known as PXOs. These are mid-block crossings, designated by several different signage treatments. They are not crosswalks, which are located at intersections. Cyclists may use PXOs, but are required by law to walk their bike.	node	

Feature	Description	OSM schema	Mapillary Photo
Bicycle box	Also known as an advanced stop line (ASL). ASL nodes are located before the actual junction node, and are always connected to their junctions by the Way they're on.	node cycleway=asl	
Jug handle	These are places for the cyclists to pull off to the right, out of the stream of traffic, and await an opportunity to cross the road.	node cycleway=asl	
Cyclist only left turn lane		node way	
Cycleway crosses highway		node way	

Other tags for ways not shown

Feature	Description	OSM Schema	Mapillary Photo
Truck route		way hgv=yes	
Trucks prohibited		way hgv=no	
Bridge		way bridge=yes	
Tunnel		way tunnel=yes	

Feature	Description	OSM Schema	Mapillary Photo
Lighting		way lit=yes	
Operator		operator operator=NCC/City of Ottawa/Ville de Gatineau	
Official name		way name=*	

Points of Interest (Nodes)

Feature	OSM Schema
Bicycle Parking	amenity=bicycle_parking capacity=N
Drinking Water	amenity=drinking_water
Bench	amenity=bench
Waste Basket	amenity=waste_basket
Bicycle Repair Station	amenity=bicycle_repair_station
Bicycle Share Station	
Bicycle Counter	man_made=monitoring_station monitoring:bicycle=yes

Signs

Feature	Description	OSM schema	Mapillary Photo
Share the road	Useful to tag as an advocacy target	node traffic_sign=*	
Single file	Useful to tag as an advocacy target	node traffic_sign=*	
Bike route	May be useful as wayfinding, but many are generic.	node traffic_sign=*	
Walk your Bike	A permissive sign that indicates you may walk your bike. This sign does not make dismounting mandatory. Tagging them will be useful for indicating areas where legal road crossing facilities have not been provided.	node traffic_sign=*	

JOSM Tips & Tricks

- Enable "Parking Lanes" style in JOSM to easily see existing parking tags
- Apply filter `highway=*` in JOSM (tick checkbox in Inverse column to hide everything but roads) to avoid clutter and annoying landuse areas that stick to roads
- Use Google Streetview since you need to look sideways at signs. Just open it in another tab and quickly jump back and forth. Takes a few seconds for each block. If you see parked cars right away - easy. If no cars around - check for sign posts and closest hydro poles. If still nothing - then parking is allowed.
- Don't bother with conditional parking. If parking is allowed at any point during the day then from stressmap point of view parking is allowed
- Cut ways if needed, when rules differ between blocks (In JOSM Ctrl-select road and node and press "P")
- If you have several roads with identical parking rules - just Ctrl-select them and add same tags

Tasking Manager

References

Before starting this OSM Cycling Task, read the following references to be familiar with the cycling OSM scheme.

- OSM Bike Ottawa
  Guide LTS
- Scheme

Tasks

Task 1 - Parking Lane Configuration and Speed Limits (Beginner)

Mark as `done` in the Tasking Manager.

```
maxspeed
parking:lane:left
parking:lane:right
parking:lane:both
```

Possible values: `parallel` , `marked` , `no_stopping` , `no_parking` , `fire_lane`

More description of parking tags: https://wiki.openstreetmap.org/wiki/Key:parking:lane#Parking_position

Task 2 - Biking Conditions (Advanced)

Mark as `validated` in the Tasking Manager.

```
highway smoothness parking:lane:left/rightboth shoulder:left/right/both cycleway cycleway:buffer
```

9 Appendix B – Summary of LTS Cycling Level of Traffic Stress Model

This is a console application that takes an OSM file and performs an analysis on the ways (streets) based on the information stored in their tags. The arguments are as follows:

```
node main.js -f osmfilename -d outputpath [-p prefix][-v][-z]
```

where:

- osmfilename is the path to an OSM file to be processed.
- outputpath is the directory where the output files will be created.
- prefix is the prefix to be appended to the start of the output filename. The default is 'level_'.
- -v requests verbose output to the console.
- -z requests that a level 0 file also be generated that includes the highways where cycling is not permitted.

See the usage output for an up-to-date list of options.

9.1 Installation

Clone and install dependencies:

```
git clone https://github.com/BikeOttawa/stressmodel.git
cd stressmodel
npm install
```

9.2 Example

```
node main.js -f ~\maps\myosmfile.osm -d \var\www\stressmap\data -p lts_ -z
```

will analyze the specified OSM file and produce 4 output files in geojson format in the \var\www\stressmap\data directory. The files will be named lts_1.json, lts_2.json, lts_3.json and lts_4.json and each will contain the streets for the corresponding LTS level (1-4). An additional file called lts_0.json will be generated that includes non-cycling highways.

If you are using stressmap to display the files, you should generate the files with the default value for the prefix "level_". This data should be placed in the app/data directory. For more information, see the documentation for stressmap.

9.3 Summary of LTS flow and logic

The summary below is a plain-language overview of how the model functions. For the most accurate understanding of the Bike Ottawa LTS map, users should refer to the code on the Bike Ottawa GitHub repository. This model looks at roads as a single unit and does not take travel direction or intersection approaches into account. Notes that “lane” refers to a single lane of motor vehicle traffic, and can include turn lanes. The model exports four levels of traffic stress, using a logic models that mirrors the Mineta Institute approach as closely as possible.

Gather information about ways where cycling is permitted, and make assumptions:

Tags that are exported for analysis include: ['access', 'bicycle', 'construction', 'cycleway', 'footway', 'highway', 'lanes', 'maxspeed', 'parking', 'service', 'shoulder'], as long as they are associated with something that has a length of greater than “0”.

Ways that have a tag are collected, number of lanes is collected. Maxspeed is collected, or if not defined, is assumed to be 40 km/h if the way is tagged as national (*i.e.,* NCC property), or is assumed to be 100 km/h if the way is tagged as a motorway, or is assumed to be 80 km/h if the way is tagged as a primary or secondary highway, or otherwise is assumed to be 50 km/h.

Separated paths and separated bike lanes are identified. Mixed traffic conditions are identified. Places where biking is permitted are identified.

Identify all ways that are separated from motor vehicles:

Separated paths, cycleways, cycletracks, contraflow lanes, and footways where cycling is permitted, whether existing or under construction, are identified by their tags. All of these are classed as LTS 1, because they are separated from motor traffic.

Ways that are not separated from motor traffic are then subjected to further analysis.

Roads with parking and a bike lane

The logic determines whether parking and bike lanes are present or not.

i) Residential roads: The residential tag is used as a proxy for traffic volume. All residential roads with a maximum speed equal to or under 40 km/h and a bike lane are assigned to LTS 1. Exceptions:
   - If there are three or more lanes, the way is assigned to LTS 3.
   - If the bike lane and parking lane occupy less than 4.1m, the way is rated instead as LTS 3, since there is a high potential for dooring.

- If the bike lane and parking lane occupy less than 4.5m, the way is rated instead as LTS 2, since there is a potential for dooring.
- BUT if the speed is actually between 41-50 km/h, the LTS will be increased to LTS 2
- If the speed is between 51 km/h and 65 km/h, the LTS will be increased to LTS 3.
- Any residential road with bike lanes and parking where the maximum speed is over 65 km/h will be assigned LTS 4.

ii) Other roads with parking and a bike lane are all assigned to LTS 3.

Roads with no parking and a bike lane

The default value is LTS 1. Except:

- If there are three lanes with a median (*e.g.*, a common configuration is one lane each way, separated, plus a left turn lane), then use LTS 2
- If there are more than three lanes, plus a median, then use LTS 3.
- If the bike lane is less than 1.7 m wide, use LTS 2
- If the maximum posted speed is between 51-64 km/h, use LTS 3
- If the maximum posted speed is over 65 km/h, use LTS 4
- If the road is anything other than residential, use LTS 3

No cycling facilities are present

Analysis determines that the way is mixed traffic. Service roads (such as in a parking lot) are assigned to LTS 2.

- **40 km/h roadways:** Roads with a speed limit of up to 40 km/h and three or fewer lanes are assigned to LTS 2 if residential, or to LTS 3 if non-residential. Roads with five or fewer lanes are assigned to LTS 3. Roads with six or more lanes are assigned to LTS 4.
- **41-50km/h roadways:** If residential and there are two or fewer lanes, the road is LTS 2. Otherwise, if there are 3 or fewer lanes and/or the road is not residential, the road is LTS 3. If there are more than three lanes, the road is LTS 4.
- **Roadways where the speed limit is 51 km/h or greater:** Set to LTS 4 (typically, these would be roads posted at 60 km/h and higher, with no cycling facilities).

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