

October 2019

Bikeway Concept Designs

Bicycle Route to School and
Bay-to-Bay Trail Connection

*Phase 3 of the Blue Route Hubs Bikeway
Project in the Town of Mahone Bay*

Prepared by:



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1.0 Introduction

1.1 Background

The Blue Route Hubs Bikeway Project is a collaboration between Bicycle Nova Scotia (BNS) and several communities in Lunenburg County, including the Town of Mahone Bay. The project is intended to help communities evaluate their potential to develop bicycle routes that make residents of all ages and abilities feel comfortable cycling in their community and encourage active transportation. The project is broken down into three distinct phases:

- *Phase 1: Develop a proposed bicycle minimum grid*
This phase of the project took place from October 2018 to January 2019. Three projects were proposed to be priorities for improving conditions for cycling within the Town of Mahone Bay.
- *Phase 2: Selection of one route to go forward for concept design*
In January 2019, Bicycle Nova Scotia met with the stakeholder committee. The group selected the route that would connect the east and west neighbourhoods to provide a comfortable cycling route to school. The steering committee also asked that additional neighbourhood roads be looked at in order to provide a complete cycling connection through town between the Bay-to-Bay trail accesses on Fauxburg Road and Clearway Street.
- *Phase 3: Concept designs for the selected route*
This phase of the project extended from February 2019 to October 2019. Draft concept designs of the cycling route to school were presented to the steering committee in June 2019. Their feedback was used to refine those concepts and additional concepts were developed for the Bay-to-Bay trail connection.

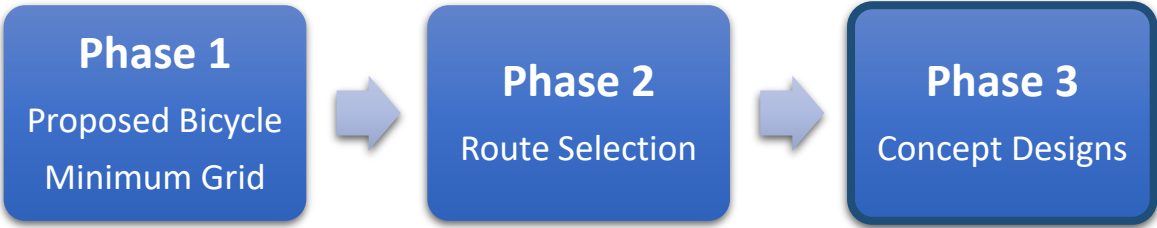


Figure 1- Blue Route Hubs Bikeway Project Process

1.2 Study Area

Figure 2 shows both the proposed roads for the cycling route to school as well as the additional pieces that connect the trail on each side. The cycling route to school uses Kinburn Street, Clairmont Street, Spur Street, Main Street and Clearway Street. To complete the trail connection on the north side, Clearway Street is considered past the school, up to the trail access. To connect to the trail on the south side, the proposed route uses Pond Street, Hedge Row, Pleasant Street and Fauxburg Road. Aside from encouraging trail traffic to enter town, the trail connection route should also give cyclists the option to avoid problem trail crossings including the one on Main Street at Longhill Road.

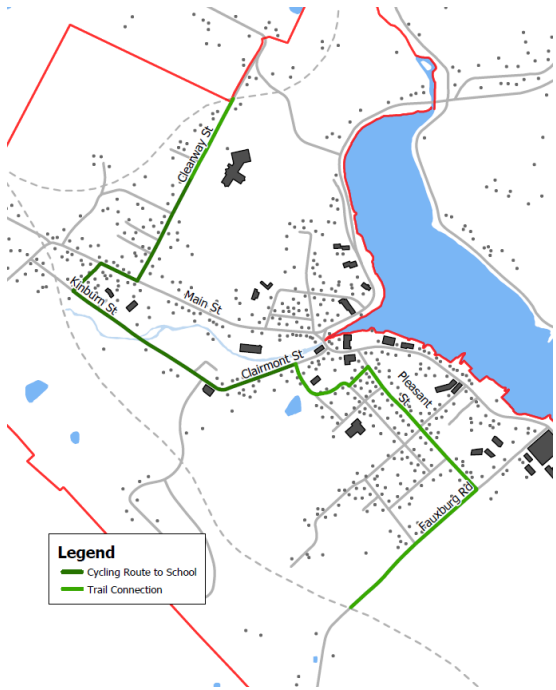


Figure 2- Proposed Cycling Routes

The study area for the project includes all roads within the cycling route to school and most roads along the connection between the Bay-to-Bay Trail accesses. Pond Street and Hedge Row were not looked at as part of the study as the initial assessment and discussion with the steering committee indicated that they were quiet roads that were unlikely to pose a barrier to cycling. However, this overall route should be considered when developing the wayfinding sign package.

1.3 Project Objectives

The following project objectives were identified:

1. Develop a bicycle route that improves the attractiveness, safety and comfort of cycling to school for students.
2. Develop an intuitive cycling connection through town between the Bay-to-Bay trail accesses on Fauxburg Road and Clearway Street that encourages both recreational and tourist use.
3. Identify improvements that can be made as part of this project for pedestrians including those with mobility aides.

The proposed concepts were developed with these objectives in mind. Other goals of the project included conducting a conceptual cost estimate, shown in Appendix A, and developing plan view and cross-section drawings of the concepts (Appendix B) to assist with visualization.

2.0 General Principles of Bikeway Design

Under current traffic conditions in Mahone Bay, cyclists share the road with motor vehicles and do not have any designated space. Under such conditions, traffic speeds and volumes generally provide a good indicator of the comfort and safety of cyclists sharing the road, and what types of infrastructure change should be considered. The following principles generally apply:

- Cyclists can be mixed with motor vehicles when traffic volumes and speeds are low (30 km/h).
- Cyclists should be separated from motor vehicles when motor vehicle volumes are high and/or speeds are high, typically over 30 km/h.
- Higher comfort is needed for accommodating younger or otherwise more vulnerable cyclists.
- There is a significant gain in safety for both pedestrians and cyclists when motor vehicle speeds are low. According to the World Health Organization, "pedestrians have been shown to have a 90% chance of survival when struck by a car travelling at 30 km/h or below, but less than 50% chance of surviving an impact at 45 km/h."¹

For this study, guidance from the Transportation Association of Canada will be considered in proposing roadway changes. Both TAC guidance and NACTO's All Ages and Abilities guidance will be considered for facility selection.



Figure 3- Chapter 5 of TAC's *Geometric Design Guide for Canadian Roads* (left) and NACTO's *Designing for All Ages and Abilities* (right)

¹ World Health Organization. Road Safety Facts-Speed. Available from: https://www.who.int/violence_injury_prevention/publications/road_traffic/world_report/speed_en.pdf. [accessed June 13, 2019].

3.0 Data Collection

3.1 Traffic Volumes and Speeds

Traffic volume and speed data was needed in order to assess the current conditions for cycling on the study roads. The town had data that was collected by TIR for Main Street in 2015 as well as more recent data on several town roads collected through their speed display devices.

To supplement the existing data, Bicycle Nova Scotia retained WSP in April 2019 to collect traffic volume and speed data on Clairmont Street, Kinburn Street, Clearway Street, Pleasant Street and Fauxburg Road. Figure 4 shows the Average Annual Daily Traffic (AADT) and 85th percentile speeds, as collected by WSP and TIR on the study roads. The 85th percentile speed is the speed that 85% of motorists are driving at or below, and is often seen as a good indication of what the speed limit should be posted at. The speed display device data was not used for this assessment as it had significant discrepancies compared to the data collected by WSP and TIR using more traditional methods.

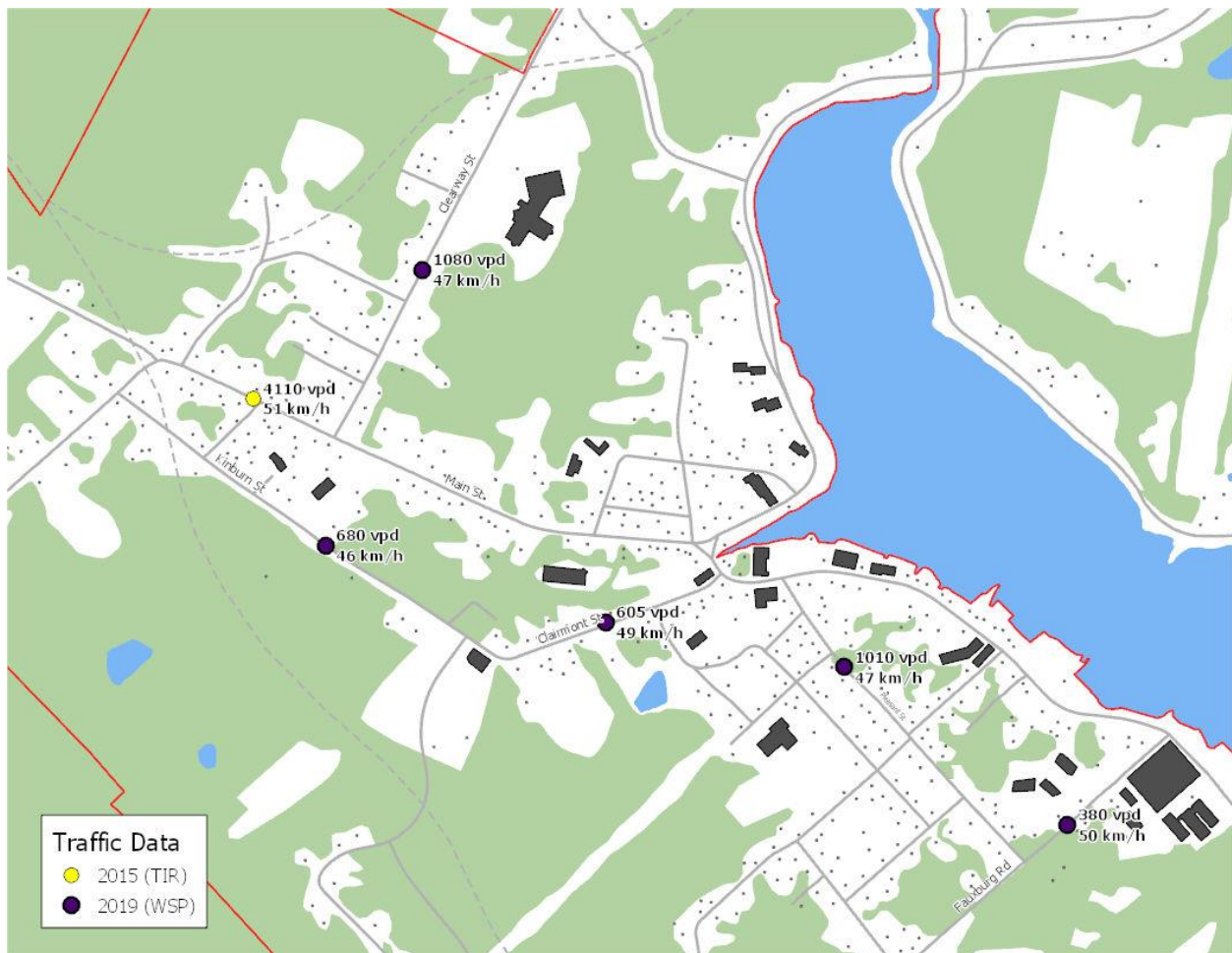


Figure 4: Study Area, showing the AADT and 85th percentile speeds

Several findings were made based off this data:

- All the roads have operating speeds that are higher than desirable for bicycles to share the road with cars.
- Kinburn Street, Clairmont Street and Fauxburg Road all carry low volumes of traffic.
- For Clearway Street and Pleasant Street, a closer look at the peak hour volumes should be undertaken. For Clearway Street in particular, the traffic volumes may be concentrated at specific times of the day due to the school acting as a key destination.
- Due to the function, speed and traffic volumes on Main Street, it is desirable to provide cyclists with designated space with separation from motor vehicles by a vertical barrier.

3.2 Other Data

Mapping data from Geonova was available including orthophotos and property data. Topographic survey was not available for any of the study roads. Bicycle Nova Scotia took physical measurements at the site for each of the roads, and these were used to develop the high-level concept designs in this study.

4.0 Proposed Concept Designs

4.1 Kinburn Street and Clairmont Street

Bicycle Facility Selection

Clairmont Street and Kinburn Street form the bulk of the east-west connection to Clearway Street. Clairmont Street has a sidewalk on one side, and developments including housing, businesses and a parking lot located adjacent to it. Kinburn Street is less developed with only a few houses alongside it, and has a rural cross-section with no sidewalk. Traffic conditions on both roads are fairly similar, with Clairmont Street carrying an AADT of 605 vehicles/day with 85th percentile speeds of 49 km/h, and Kinburn Street carrying an AADT of 680 vehicles/day with 85th percentile speeds of 46 km/h. Generally, shared bicycle-car operation is suitable when traffic volumes are below 1000 vehicles per day and speeds are around 30 km/h. Based on this, the current traffic volumes on Clairmont and Kinburn Street are suitable for bicycles sharing the road with cars but the operating speeds are higher than desirable.

Generally, traffic calming would be recommended on a road with these types of volumes in order to get the speeds to a level suitable for bicycle-car sharing. However, Kinburn Street is also home to a fire station, which means that traffic calming would regularly impact emergency vehicle travel. The rural cross-section also limits the types of suitable traffic calming. Due to these speeds, another option would be considering a more separated facility such as a bicycle lane or pathway. However, a separated option would add significant cost, which does not seem justifiable given the existing low-volume nature of the roadway.



Figure 5- Clairmont Street near Main Street (left) and typical Kinburn Street cross-section (right)

A third option of piloting advisory bicycle lanes was also considered. Advisory bicycle lanes are an innovative treatment that have been used extensively in some European countries. They use one central vehicle lane for two-way travel and two bicycle lanes, painted with dashed lines. When two motor vehicles approach each other in opposite directions, they would have to move into the bicycle lane to pass each other, after yielding to any cyclists. Advisory bicycle lanes are included as a bicycle facility type in the 2017 TAC *Geometric Design Guide for Canadian Roads*. They are a new facility type for Canada, with only a few installations to date. TAC guidance suggests that advisory bicycle lanes may be suitable on roads with speeds between 30 to 50 km/h, and volumes less than 4,000 vehicles per day.

Based on Clairmont Street and Kinburn Street's traffic conditions as well as their constrained cross-section, piloting advisory bicycle lanes is the recommended treatment. Advisory bicycle lanes are a low-cost treatment that would increase motor vehicle awareness of cyclists, provide wayfinding and potentially improve comfort for cyclists. Since advisory bicycle lanes have not been used frequently in Canada, it is recommended that the project be developed as a pilot with measurements taken before and after of key characteristics. Quantitative measurements would include vehicle operating speeds, motor vehicles volumes and bicycle volumes. Qualitative ones could include surveying residents on their opinion of the comfort and safety of travelling by different modes before and after the installation. There are also legislative considerations around advisory bicycle lanes, as their operation does not follow the rules of the road as outlined in the Nova Scotia Motor Vehicle Act. These considerations are discussed in more detail in Section 5.0.

Cross-sections

In developing the recommended cross-sections, guidance from both the TAC *Geometric Design Guide for Canadian Roads* and the CROW (Dutch) *Design Manual for Bicycle Traffic* were considered. The CROW manual was consulted as the Netherlands is the jurisdiction that is most experienced with this type of treatment. Design guidance from both manuals on widths is shown below in Table 4.1.1.

Table 4.1.1: Advisory bicycle lane design guidance

Guidance	Central Car Travel Lane	Bicycle Lanes
2017 TAC Geometric Design Guide for Canadian Roads	Recommended: 3.0-5.7 m Practical Lower Limit: 3.0 m	Recommended: 1.8-2.1 m Practical Lower Limit: 1.5 m
2016 Dutch (CROW) Design Manual for Bicycle Traffic	Recommended: 2.2-3.8 m, or 4.8- 6 m Minimum: 2.2 m	Recommended: 2.0-2.25 m Minimum: 1.7 m

The CROW manual differs from TAC guidance as it differentiates between two types of profiles for advisory bicycle lanes. The first type could be used on wider roads and would use a central vehicle lane of 4.8-6 m (5.5 m is recommended), enough for most vehicles to pass each other within the lane. This profile could use a 30 km/h or 50 km/h speed limit. The second type, used on roads with narrower widths, use a central car travel lane between 2.2-3.8 m and does not allow two vehicles to pass without entering the bicycle lanes. This second type of road should have a posted speed limit of 30 km/h. Dutch guidance does not allow central car travel lanes between 3.8-4.8 m, as it may cause driver confusion as the expected behavior is not clear.

Clairmont and Kinburn Street are both on the narrower side for an advisory bicycle lane treatment. Based on the two manuals, it would be ideal to use 2.0 m advisory bicycle lanes, which is the recommended minimum width from the Dutch CROW manual and falls within TAC's recommended range. Based on TAC, widths in the range of 1.5-1.9 m can also be used. For the central travel lane, given the narrow cross-section, a 3.0 m central travel lane width seems reasonable as it is TAC's practical and recommended lower limit and falls within the CROW manual's recommended range for their narrower profile.

Clairmont Street has a typical width of 6.6 m. The recommended cross-section on Clairmont Street would be 1.9 m advisory bicycle lanes, with a 3.0 m central lane for car travel.

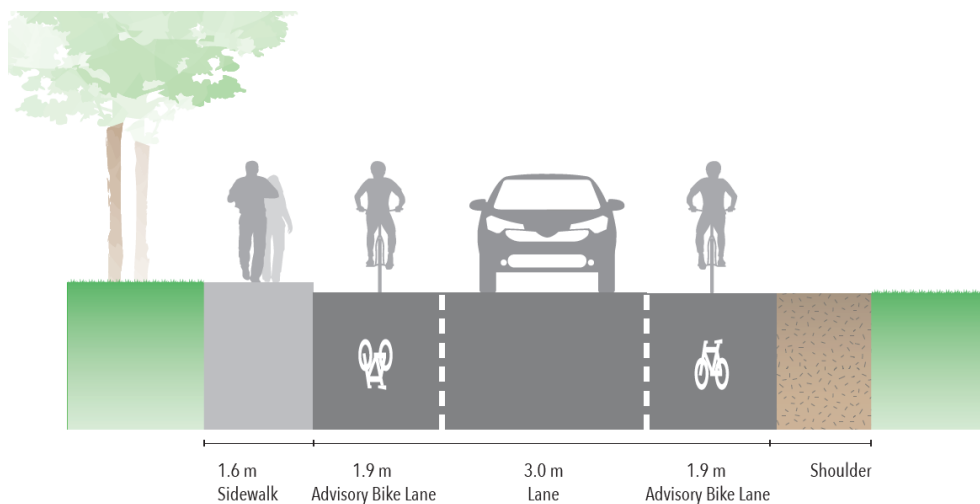


Figure 6- Proposed Cross-section for Clairmont Street

Kinburn Street is narrower, with a typical width of 5.8 m. For Kinburn Street, it is recommended to use 1.5 m advisory bicycle lanes with a 3.0 m central lane for car travel. This would require a small amount of road widening on Kinburn Street to reach 6.0 m, which can likely be accomplished through shoulder paving. Where the existing road width is already wider than 6.0 m, such as at the bridge, it is recommended that the extra width be given to the advisory bicycle lane, up to the ideal width of 2.0 m.

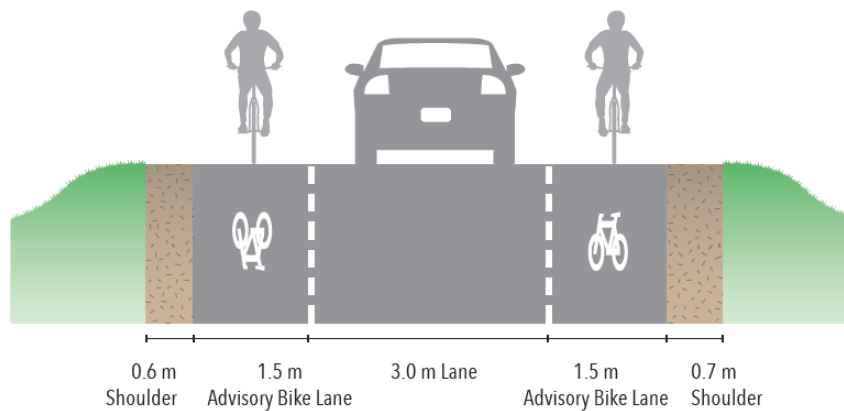


Figure 7- Proposed Cross-section for Kinburn Street

Additional Design Considerations

Currently, the town allows on-street parking on both sides of Clairmont St and Kinburn St. There are also a few areas alongside the road where the gravel shoulder has been widened out for parked cars. In order to accommodate the advisory bicycle lanes, on-street parking should no longer be permitted along the extents of the bicycle lanes, which would be from the NSLC parking lot to Pond Street. Parking can continue to be permitted on the gravel shoulder, as long as the shoulder is wide enough to accommodate the car, without having to use any of the space of the advisory bicycle lane and taking into consideration the potential hazard caused by the opening of car doors

Another consideration is the sightlines along the horizontal curve at the fire station. Advisory bicycle lanes are not recommended where sightlines are restricted. With two cars approaching in the same central travel lane, there is potential risk of a head-on collision. In this case, there are two options. The first would be to widen out the road along the curve to allow the cross-section to transition to painted bicycle lanes and two vehicle lanes, instead of two advisory bicycle lanes and one vehicle lanes. However, this option would be fairly expensive. A second option would be to transition to shared bicycle/car operation. This would mean discontinuing the advisory bicycle lanes, adding a centerline and using "sharrow" pavement markings to indicate the shared use. Considering both safety and cost, the second option is recommended at this location.

For tourists entering the town from Clearway Street or Fauxburg Road, Clairmont Street provides a good termination point for cyclists to park their bicycles and enter the town. For that reason, it is recommended that a wayfinding kiosk and bike racks be provided. An ideal location to add the kiosk and bike racks would be on the west end of the parking lot. If the town does not have enough right-of-way to develop that space along the edge of the parking lot, they could consider re-purposing the west-most parking stall in the lot. An alternate location for the bike racks and wayfinding kiosk could be along Pond Street.

As per Dutch guidance, Clairmont and Kinburn Street should have a posted speed limit of 30 km/h. The proposed profile has a narrow central travel lane that only accommodates one vehicle, thereby requiring both drivers to move over into the advisory bicycle lane. Legislative considerations on how to post a 30 km/h speed limit are discussed in Section 5.0.

*Alta's Lessons Learned: Advisory Bicycle Lanes in North America*² notes that "signs do not appear to be critical to the success of a facility". However, given Mahone Bay's tourism and the lack of general familiarity with this facility type, it is recommended that a sign, such as the one in Figure 8, be used to show the expected operation of the facility.

A final aspect that was considered was whether a sidewalk should be built on Kinburn Street from the fire station to the NSLC parking lot. The town has criteria for when a sidewalk should be built on a road, and staff noted that Kinburn Street was unlikely to meet the criteria. As a walking route, Kinburn Street is not as attractive as the parallel Main Street route, which has a sidewalk as well as many destinations, compared to Kinburn Street which has little development. However, those pedestrians who do travel on Kinburn Street are likely to use the advisory bicycle lanes. As part of the pilot, the town should consider measures to evaluate pedestrian use on Kinburn Street, including quantitative measures like pedestrian volumes and qualitative ones like pedestrian comfort and interaction with other users. The town can reassess the need for a sidewalk based on this data. Pedestrian use should also be considered from the legislative perspective, especially if the town has to go through the Innovative Transportation Act, which involves drafting legislation, as discussed in Section 5.0. For example, the drafted legislation could allow pedestrian use of the advisory bicycle lane in the absence of a sidewalk.

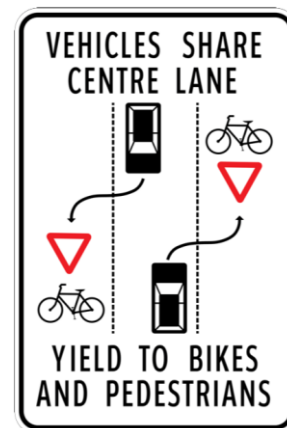


Figure 8-Advisory Bicycle Lane sign

² Alta Planning and Design. *Lessons Learned: Advisory Bicycle Lanes in North America*. Available from: https://altaplanning.com/wp-content/uploads/Advisory-Bike-Lanes-In-North-America_Alta-Planning-Design-White-Paper.pdf. [accessed September 17, 2019].

4.2 Connection between Kinburn Street and Clearway Street

Route Selection

The connection between Kinburn Street and Clearway Street will involve some travel along Main Street before reaching a north-south connection. The choice of the north-south connection impacts the recommended concepts on Main Street (Section 4.3) as well as the Clearway/Main intersection (Section 4.4). In the initial project steering committee meeting, both Spur Street and the NSLC parking lot were brought up as potential options for making the connection. Spur Street is the closest formal north-south connection. It is a narrow road with a rural cross-section located to the west of Clearway Street. There is also an informal but more direct connection through the NSLC parking lot, which was frequently used as a shortcut by motorists, pedestrians and cyclists until a gate was added at the south exit.

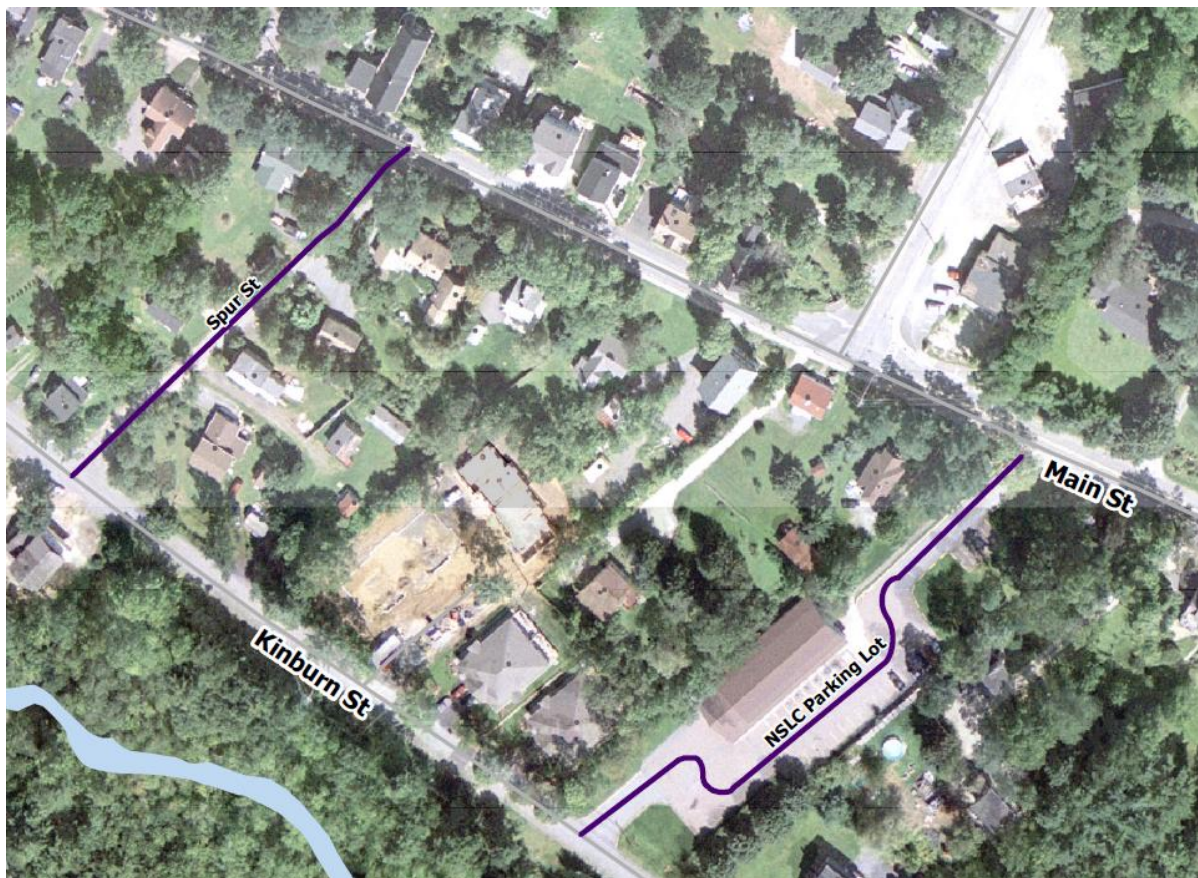


Figure 9: Map showing potential connections between Kinburn Street and Clearway Street

The following three concept options were considered for developing the north-south connection between Main Street and Kinburn Street. Option 3 is the recommended concept.

1. Use Spur Street.
 - a. This option was not preferred as it was less direct, and would require cyclists and pedestrians to use Main Street for a longer stretch. It was also noted that Main Street has more constraints between Spur Street and Clearway Street, compared to between the NSLC parking lot and Clearway Street.
2. Encourage cyclists and pedestrians to cut through the NSLC parking lot, as per previous conditions.
 - a. While this option is more direct compared to Spur Street, it exposes cyclists and pedestrians to some risk, due to vehicles backing in and out of parking stalls. This poses a higher risk for children, who are likely to be even less visible to drivers maneuvering out of parking stalls due to their shorter height. As well, it would likely create a nuisance for NSLC if bicycle and pedestrian volumes were to increase. Overall, this option is not recommended as it is not considered to be an all ages and abilities solution.
3. Develop a multi-use pathway through the NSLC parking lot, along the east side of the property (**Recommended**)
 - a. Option 3 provides designated space for cycling and walking, creating an inviting and attractive space for both cyclists and pedestrians of all ages and abilities.
 - b. Discussion and negotiation with NSLC would be required to acquire land within their property to develop the pathway. The recommended location of the pathway would be along the east side of the property. This would have impacts to some vegetation as well as the loss of some perpendicular parking stalls. Developing a pathway on the west side did not seem feasible due to the close proximity of the buildings, including the NSLC, to the property line.

Cross-Sections

Two cross-sections were developed, with the assumption that the pathway would be built along or near the east side of the NSLC property. The first cross-section is recommended for areas where the pathway location runs through the grass or wooded area of the property and would already be a fair distance from moving or parked vehicles.



Figure 10: Proposed Pathway Cross-section

The second cross-section is recommended for the section that would be developed through the existing paved parking lot. In the latter case, it is necessary to develop a wide buffer space between the parking lot and pathway in order to separate pathway users from moving traffic. Within this buffer space, trees could be planted to add vertical separation and enhance the streetscape, while also preventing cars from attempting to enter the pathway from the parking lot.

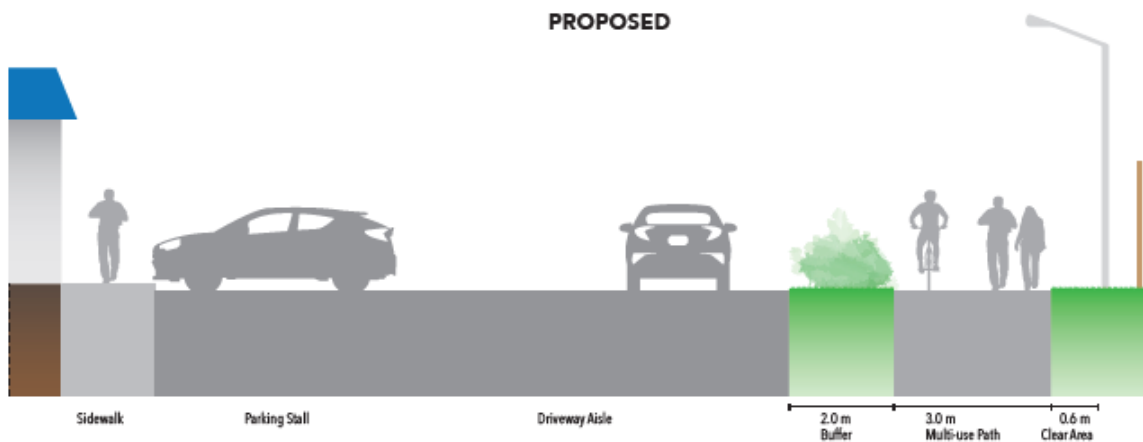


Figure 11: Proposed Pathway Cross-section when Adjacent to the Parking Lot

Additional Design Considerations

There are several additional details that are recommended.

1. *Paved asphalt surface:* This will create a smooth surface that will be accessible to users of all ages and abilities, including those with mobility aides like wheelchairs. For the section at the parking lot, it may be possible to repurpose existing asphalt.
2. *Lighting:* It is recommended that lighting be included along the pathway. This is seen as a critical element to accomplish the project goal of creating a route that children can feel comfortable using to walk and bicycle to school. During at least some of the school year, school start and dismissal times will be when it is dark outside.
3. *Access restrictions for motor vehicles:* Given the history of vehicles shortcutting through the parking lot, it is recommended that bollards be placed on the south end of the pathway to prevent vehicle access.
4. *Pathway access to the NSLC:* An access should be provided for pathway users to exit the pathway to go to NSLC.
5. *Sightlines:* Sightlines should be cleared around all intersections (i.e. Kinburn/pathway, Main/pathway, pathway/NSLC accesses). New trees or vegetation should not be placed in areas that would obstruct sightlines.

4.3 Main Street

Bicycle Facility Selection

A short section of Main Street will make the connection between Clearway St and the NSLC parking lot. Main Street is one of the busiest roads in the Town of Mahone Bay, with 2015 data showing it has an AADT of 4110 veh/day and 85th percentile speeds of 51 km/h. Therefore, vertical separation is needed to develop a bicycle facility that will be comfortable for users of all ages and abilities.

Main Street has narrow travel lanes, and its roadside is constrained due to encroachments by development. Therefore, the recommended option is to develop a multi-use path on one side of the road, which should limit the impact to existing road and roadside uses while still providing a comfortable space for cyclists and pedestrians.

The multi-use path could be developed on the south or north side of the street, but the south side is the recommended option. Either side would have impacts to existing roadside uses. On the north side, two parallel parking stalls as well as some trees would need to be removed, and, on the south side, 4-5 mature trees would be impacted. However, the advantage to the south side is that the existing pedestrian crossing at Clearway Street can be used. Using this crossing would be more intuitive for all road users (pedestrians, cyclists and cars), since it is at an intersection.

Cross-sections

The town has indicated that their right-of-way on Main Street is 66 feet (~20 m). However, no legal land survey was available to indicate the exact boundaries of town property. Given the wide right-of-way, it is likely that the town possesses the space to add a multi-use pathway.

The recommended cross-section would be to develop a 3.0 m pathway with a 1.3 m grass buffer. The pathway width of 3.0 m is TAC's recommended minimum width for shared bicycle and pedestrian use. The 1.3 m buffer provides space for the driveways to ramp down and gives cyclists and pedestrians comfort space from vehicles. Comfort space is particularly important when a pathway is adjacent to a busy roadway, such as Main Street.

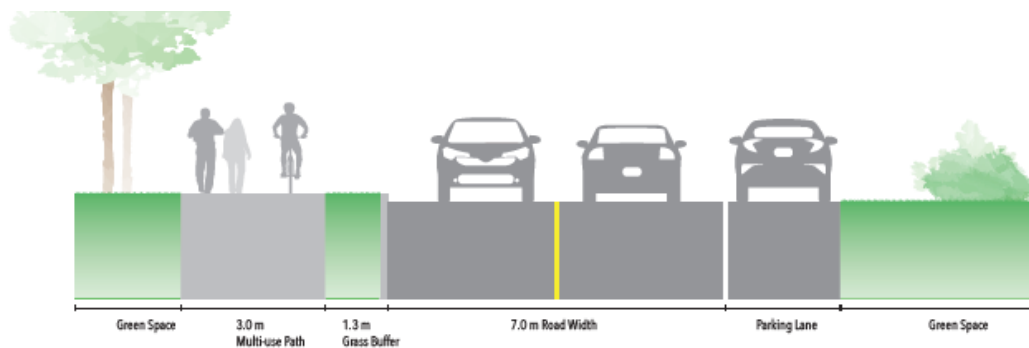


Figure 12: Proposed Cross-section on Main Street

Additional Design Considerations

The town may wish to include a wayfinding kiosk and bike racks along this section of pathway or along the pathway through the NSLC parking lot, as it would give tourists an opportunity to orient themselves to the town, and lock their bike up if they are closer to their destination (compared to continuing on to Clairmont Street).

4.4 Clearway Street

Bicycle Facility Selection

Clearway Street is a road with regional significance. Though within the town, it also transitions to a long-distance rural route that connects to other communities. The road is also an access point to the Bay to Bay trail, and is the best entrance into town for trail users approaching from the east. Most importantly, the town school is located on Clearway Street. School buses travel along the road, with drop-off and pick-up happening on the school property.

Clearway Street has a sidewalk located on the east side from Main Street to the school. From the site visits, the sidewalk appeared to be well-utilized at specific times of the day, particularly by

students who frequently travelled in groups. The sidewalk currently ramps down frequently to accommodate driveways, particularly near Main Street, which reduces comfort and accessibility.

The average annual daily traffic on Clearway Street is 1080 vehicles per day. During the peak hour, the hourly directional volumes typically exceed 50 vehicles/hour/direction, the threshold that NACTO considers to be the maximum for cyclists of all ages and abilities to share the road with cars. Traffic diversion to reduce volumes on Clearway Street is not feasible due to the road's function as a long-distance route and the limited alternate routes to reach the school. Clearway Street is also a long straight road that shows little indication of the need to slow down. Despite the school zone signs, 85th percentile speeds were measured at 47 km/h, which was similar to non-school zone routes such as Kinburn and Clairmont Streets.

Based on the traffic conditions, road function and cross-section, it's recommended to develop a multi-use path alongside Clearway Street from Main Street to the Dynamite Trail on the east side. This option provides space for cycling and walking that is separated from cars, and should accommodate the target user of children. The option should also intuitively connect to the proposed multi-use path on Main Street. Finally, the option also maintains the rural cross-section on the west side, which was preferred by the steering committee.

Cross-sections

The right-of-way on Clearway Street is 15.24 m. Clearway Street's existing cross-section varies. The majority of the corridor has a sidewalk on one side with a shoulder and ditch on the other side. Near Main Street, there is a small section with sidewalks on both sides. North of the school, the road has a rural cross-section (shoulder and ditches on both sides).

The recommended cross-section would be to develop a 3.0 m multi-use path with a 1.3 m buffer. Lateral clearance of 0.6 m should also be included on either side of the pathway. Depending on the side slope, wider lateral clearances may be needed. The 3.0 m pathway width is TAC's recommended minimum width, which allows for a cyclist to pass two pedestrians walking side-by-side. A 1.3 m buffer is desirable to provide space for the driveways to ramp down within the buffer and provide space for snow storage. This buffer also provides space for landscaping. The town could also choose to plant grass and trees within the buffer. The trees could help change the character of the road, clearly conveying a more developed feel while also improving the streetscape for cyclists and pedestrians due to providing shade and aesthetic value.

Most of the pathway width would come from re-allocating space from the roadway width. It is recommended that the curbside lanes be narrowed to 3.55 m, while the lane next to the shoulder/rural cross-section use a width of 3.3. The remaining width would have to come from building the pathway closer to the property line.

Legal land survey was not available for the corridor, and the exact property boundaries are not known. If the available width is not present, it may be necessary to reduce the width of the buffer or pathway. From the TAC *Geometric Design Guide*, the practical lower limit for multi-use path width is 2.7 m, and the absolute lower limit is 2.4 m. Reduction of the pathway width would increase the likelihood of conflicts between trail users while reduction of the buffer may reduce the comfort of the pathway, especially in the section that has frequent driveways. In constrained areas, these trade-offs will need to be considered when deciding how to reduce the cross-section. Another consideration is that a large portion of the roadway is adjacent to school property; if town right-of-way is constrained, it may be possible to work with the school to achieve the desirable pathway and buffer width alongside that portion.

Additional Design Considerations

As discussed in the above sections and illustrated by Figure 13, Clearway Street has many driveways near Main Street, as well as an extended lowered section at the Saltbox Brewery parking lot. Maintaining a level surface for the pathway across the driveways is considered an important aspect of the design. While the pathway is still recommended to be constructed if a level surface is not considered to be feasible, the comfort and accessibility will be reduced for cyclists as well as pedestrians, especially those with mobility aides. When conducting design, innovative curb types could also be considered in order to achieve a level surface. An example of Dutch design that maintains a level surface (as well as visual priority) for a bike path at driveways can be seen in [this video](#).

Parking is currently allowed on Clearway Street on the east side from Main Street to 147 Clearway Street. This parking is well-used during town festivals and events as well as school events. Narrowing the road width will result in removing the existing space that is currently used for parking. However, it was noted that Pleasant St has a similar width as the proposed width for Clearway Street, carries similar (though slightly lower) traffic volumes as Clearway Street and currently allows parking on one side of the road. Where parking is occupied, the narrow width would require drivers to yield to each other, with one pulling over to the side (for example, into an unoccupied parking stall or driveway) to let the other pass. Where there is no place to pull over (for example, if there is high parking occupancy), then there would likely be operating issues. Pleasant Street is a residential road where this kind of operation may be more expected compared to Clearway Street, which transitions to a rural

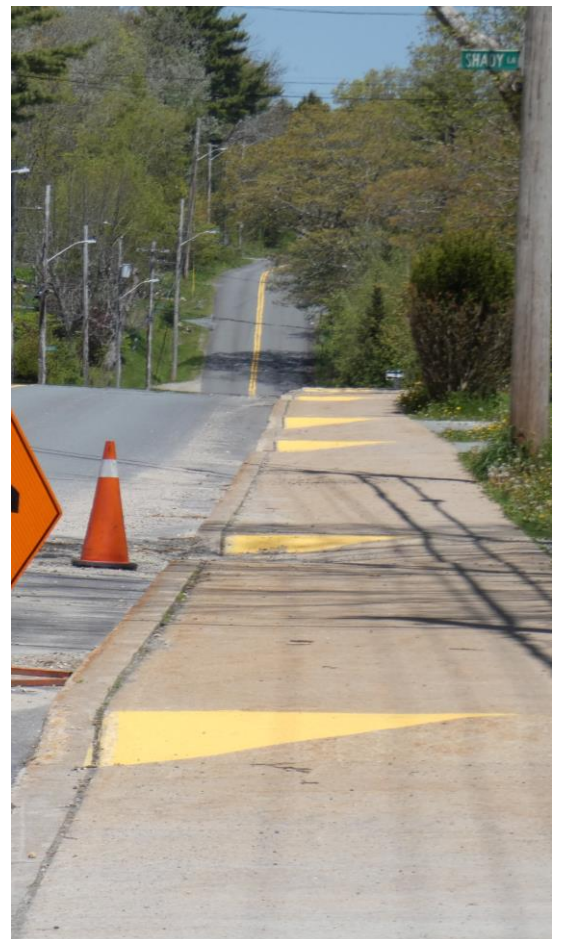


Figure 13: Driveways on Clearway Street

long-distance road. Therefore, allowing this kind of operation on Clearway Street poses a higher safety risk for vehicles. Ideally, parking would be prohibited on Clearway Street after pathway installation. However, based on these factors and knowledge of existing parking use, the town can determine whether parking should continue to be allowed. If it is allowed, it is recommended that the town monitor and assess the use for any operational issues.

4.5 Clearway Street and Main Street Intersection

Crossing Treatment

From the multi-use path on the south side of Main Street, cyclists and pedestrians will make the connection to the Clearway Street multi-use path through the Main Street and Clearway Street intersection. This intersection currently has a signed and painted crosswalk on the east side with an advanced warning sign facing eastbound vehicles. While the crosswalk treatment should be adequate for pedestrians based on the 2015 AADT of 4110 veh/day, the steering committee reported that there are concerns with the safety of this crossing. As Clearway Street is the first significant intersection that motorists encounter when they enter town, it seems likely that existing operational issues may be caused by lack of driver expectation as motorists' transition from driving through rural development to entering the Mahone Bay town centre.

Due to these operational issues as well as the addition of cyclists to this crossing, it is recommended that a raised intersection be built at Clearway Street and Main Street. A raised intersection requires drivers to travel up over a heightened surface as they enter the intersection, physically slowing them down in a manner similar to a speed bump. The raised intersection will create a physical cue to drivers that they are entering the more built-up area of Mahone Bay as well as increase their awareness of pedestrians and cyclists who are crossing or waiting to cross the road. The TAC *Canadian Guide to Traffic Calming* indicates that raised intersections can reduce 85th percentile speeds by up to 10 km/h and cites a study showing drivers yielding to pedestrians went up from 18% to 54%. The town will be making improvements to wastewater and water infrastructure at the intersection in 2021, which presents the opportunity for cost efficiencies if the raised intersection is built as part of the project.

The addition of bicycles to this crossing also provides the need to clearly define right-of-way for cyclists. While Nova Scotia legislation defines pedestrian crossings and the responsibilities of both vehicles and pedestrians at such crossings, these elements are not defined when bicycles are added to a cross-section in their own designated space or when shared with pedestrians. Due to the busyness of Main Street, the nature of the crossing, and the higher speed of cyclists (compared to pedestrians), providing cyclists with unequivocal right-of-way would not be recommended. Instead, it is recommended that a "Yield" sign with "Cyclists Yield" tab sign be added for cyclists, indicating that they must yield to motorists on Main Street. The yield sign should provide cyclists with clear indication that they need to slow down or stop prior to entering the intersection. It is also recommended that the town upgrade their crosswalk

pavement markings to use a zebra crosswalk, to add more conspicuity at the crossing for pedestrians.

Additional Design Considerations

When designing the raised intersection, special attention must be given to ensuring that the sidewalk is differentiated from the raised crosswalk in order to provide proper guidance for visually impaired pedestrians.

4.6 Pleasant Street and Fauxburg Road

Bicycle Facility Selection

Pleasant Street is a residential road, with an AADT of 1010 vehicles per day and 85th percentile speeds of 47 km/h. Due to its road function and traffic conditions, Pleasant Street can be developed as a bicycle boulevard (also known as a local street bikeway), where traffic volumes and speeds can be managed to create a comfortable situation for shared bicycle-car operation.

From a traffic volume side, Pleasant St is on the edge of being suitable for shared car-bicycle operation. The AADT is just above the desirable threshold (1000 vehicles per day). However, unlike Clearway Street, the traffic volume is more distributed throughout the day. The hourly volumes on the road from the counts collected in April 2019 were less than 50 vehicles/hour/direction. For this reason, specific traffic diversion measures are not considered necessary. However, with 85th percentile speeds of 47 km/h, speed reduction measures are recommended.

Fauxburg Road has regional significance, as it leads out of the town to other communities. The road has a rural cross-section and little development alongside it. Fauxburg Road sees the highest 85th percentile speeds in the study area at 50 km/h but also carries the lowest volumes with an AADT of 380 vehicles per day. Similar to Pleasant Street, the traffic speed can be managed using speed reduction measures to create conditions suitable for bicycles to share the road with cars.

Recommendations

Based on the traffic data, the travel speed of vehicles should be managed through traffic calming to improve conditions for cyclists. The traffic calming measures that are recommended are a curb extension for Pleasant Street at Main Street, and a series of speed humps along both Pleasant Street and Fauxburg Road.

Curb extensions narrow a road to reduce crossing distance for pedestrians and often have a speed reduction effect. Curb extensions can be implemented through permanent concrete installations or temporary means, as shown in Figure 14. They are recommended for the Pleasant and Main Street intersection. Since this intersection connects to a main road, the narrowed entrance at Pleasant Street will better convey to drivers that they are entering a neighbourhood road.



Figure 14: Temporary Curb Extension (Left) and Permanent Curb Extension (right) in Halifax, NS

The other traffic calming measure that is recommended are a series of speed humps for both Fauxburg Road and Pleasant Street. Speed humps are a low-cost method of reducing vehicle speeds. It is recommended that the speed humps be placed according to the following criteria, which were adapted from the Ministère des Transports du Québec³ and the City of Vancouver⁴:

- Spacing of speed humps should be 50-90 m apart
- Place under or near lights, where they will be visible
- Do not place on intersection approaches, close to driveways, on curves, where stopping sight distance is not available, or on grades that exceed 8%

In implementing the speed humps, it is recommended that the above sources as well as TAC's *Canadian Traffic Calming Guide* be referenced. TAC's *Canadian Traffic Calming Guide* has detailed information on the use and design of speed humps, including dimensions and winter maintenance considerations. The posted speed limit on both these roads should be 30 km/h. The process to post a 30 km/h speed limit is described in Section 5.0.

Finally, sharrow pavement markings should be used on both roads to increase awareness of cyclists and provide wayfinding.

³ Berthod, Catherine. Ministère des Transports du Québec. Traffic Calming, Speed Humps and Speed Cushions. Available from: <https://nacto.org/wp-content/uploads/2012/06/Berthod-C.-2011.pdf> [accessed September 10, 2019].

⁴ City of Vancouver. Speed humps. Available from: <https://vancouver.ca/streets-transportation/speed-humps.aspx> [accessed September 10, 2019].



Figure 15: Visualization of Proposed Local Street Bikeway Concept on Pleasant Street

5.0 Legislation

The recommended design concepts have two elements that require special consideration in order to comply with existing provincial legislation. The first is the recommended 30 km/h speed limits on Pleasant Street, Fauxburg Road and Clairmont/Kinburn Street. In Nova Scotia, permission from the province is needed to post speed limits below 50 km/h. Nova Scotia Transportation and Infrastructure Renewal (NSTIR) has outlined the following process for applying for reduced speed limits:

- The Local Traffic Authority for the town must make the request in writing.
- The streets must be classified as “local” and the current speed limit on the streets must be 50 km/h.
- There must be plans to make physical changes to the street to reduce travel speeds (85th percentile) to be close to the requested speed limit or current travel speeds (85th percentile) must already be close to the requested speed limit.

The second is the advisory bicycle lane on Clairmont and Kinburn Streets, which should be treated as a pilot project. On the legislative side, advisory bicycle lanes contravene provincial legislation around passing. Consultation with TIR should be undertaken to determine if the town has the legal authority to implement advisory bicycle lanes. If the town does not, the Innovative Transportation Act provides a formal means of piloting projects that do not comply under existing legislation. Under this act, the town can request the province to draft legislation that will allow advisory bicycle lanes to be piloted. Going through the Innovative Transportation Act has

the advantage of allowing other jurisdictions in Nova Scotia to experiment with advisory bicycle lanes as well.

6.0 Wayfinding Signage

For the Bay-to-Bay Trail Connection route, wayfinding signage should be added to provide residents and tourists with guidance on how to travel to and from the trail. This is particularly important because the bikeway route winds through neighbourhood roads, which may not be intuitive routes to those unfamiliar with the area. The forthcoming *Nova Scotia Bicycle Wayfinding Guide*, which is being developed by Bicycle Nova Scotia in collaboration with provincial and municipal stakeholders, provides guidance for bicycle wayfinding signage.

7.0 Next Steps

1. Consultation with TIR should be undertaken on the legislative aspects, particularly the advisory bicycle lanes. As it can take some time to go through the Innovative Transportation Act, it is recommended that these conversations be started as early as possible.
2. Public engagement should be undertaken on the proposed concepts.
3. Detailed design needs to be conducted for all sections.

APPENDIX A

Class 4 Cost Estimate

Mahone Bay Cycling Route to School and Bay to Bay Trail Crossing

Date: October 2019

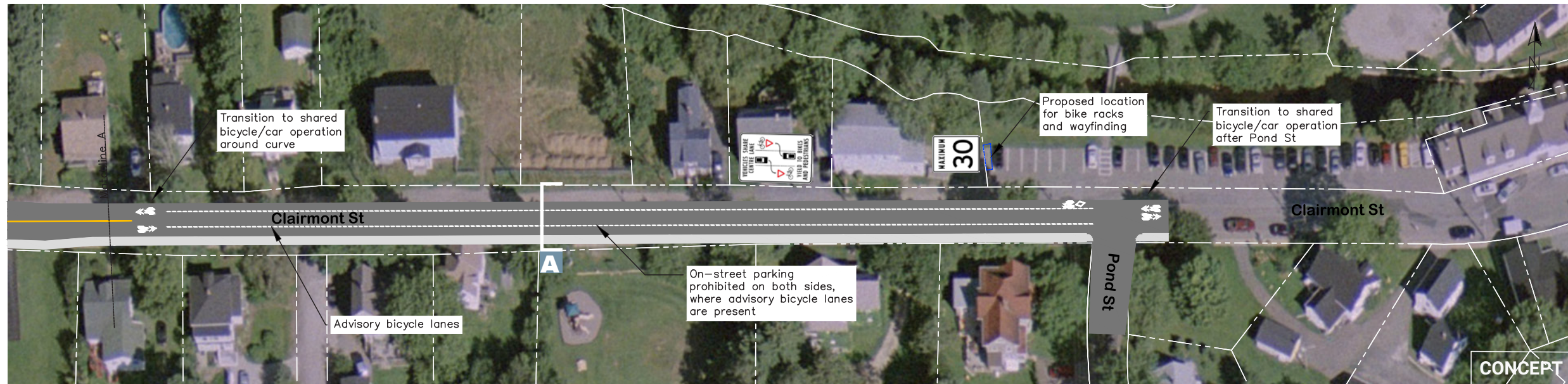
Note: This estimate is approximate only and actual costs may vary significantly. The estimate is based on historical data, primarily from HRM. Costs were not estimated for land acquisition, wayfinding signs, drainage impacts, traffic control, engineering or HST.

Description	Unit	Unit price	Kinburn/Clairmont Street		Connection between Kinburn/Main		Main Street		Clearway Street		Pleasant Street and Fauxburg Road	
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Driveway Ramps	m ²	100		\$ -		\$ -	20	\$ 2,000.00	47	\$ 4,700.00		\$ -
Pavement Markings	LS	LS	1	\$ 2,800.00		\$ -	1	\$ 500.00	1	\$ 1,600.00	1	\$ 1,840.00
Traffic Signs	Each	\$ 500.00	5	\$ 2,500.00	1	\$ 500.00	2	\$ 1,000.00	2	\$ 1,000.00	9	\$ 4,500.00
Shoulder Paving	m ²	\$ 34.00	145	\$ 4,930.00		\$ -		\$ -	70	\$ 2,380.00		\$ -
Bollards	each	\$ 900.00		\$ -	3	\$ 2,700.00		\$ -		\$ -		\$ -
Bike Racks	each	\$ 250.00	4	\$ 1,000.00	4	\$ 1,000.00		\$ -		\$ -		\$ -
Wayfinding Kiosk	each	\$ 7,000.00	1	\$ 7,000.00	1	\$ 7,000.00		\$ -		\$ -		\$ -
Asphalt Removal	m ²	\$ 5.00		\$ -	164	\$ 820.00		\$ -	472	\$ 2,360.00		\$ -
Clearing/Grubbing	LS	LS		\$ -	1	\$ 2,240.00	1	\$ 2,500.00	1	\$ 600.00		\$ -
Mass Excavation and Embankment-Common	m ³	\$ 15.00		\$ -	200	\$ 3,000.00	130	\$ 1,950.00	1673	\$ 25,095.00		\$ -
Trees	each	\$ 550.00		\$ -	7	\$ 3,850.00		\$ -	64	\$ 35,200.00		\$ -
Type 1 Gravel- 150 mm thick	m ²	\$ 13.00		\$ -	280	\$ 3,640.00	234	\$ 3,042.00	1920	\$ 24,960.00		\$ -
Type 2 Gravel- 250 mm thick	m ²	\$ 25.00		\$ -	280	\$ 7,000.00	234	\$ 5,850.00	1920	\$ 48,000.00		\$ -
Type D-HF Asphaltic Concrete - 75 mm thick	m ²	\$ 35.00		\$ -	210	\$ 7,350.00	234	\$ 8,190.00	1920	\$ 67,200.00		\$ -
Trail lights	m	\$ 123.00		\$ -	160	\$ 19,680.00		\$ -		\$ -		\$ -
Utility pole relocation	each	\$ 5,000.00		\$ -		\$ -	1	\$ 5,000.00	4	\$ 20,000.00		\$ -
Utility pole anchor/strut readjustment	each	\$ 1,500.00		\$ -		\$ -	1	\$ 1,500.00	1	\$ 1,500.00		\$ -
Topsoil and Sod	m ²	\$ 20.00		\$ -	164	\$ 3,280.00	102	\$ 2,040.00	832	\$ 16,640.00		\$ -
Curb Removal	m	\$ 15.00		\$ -		\$ -	78	\$ 1,170.00	640	\$ 9,600.00		\$ -
Curb Installation	m	\$ 200.00		\$ -		\$ -	78	\$ 15,600.00	640	\$ 128,000.00		\$ -
Raised Intersection	each	\$ 50,000.00		\$ -		\$ -	1	\$ 50,000.00		\$ -		\$ -
Speed humps	each	\$ 1,500.00		\$ -		\$ -		\$ -		\$ -	12	\$ 18,000.00
Curb extension	each	\$ 10,000.00		\$ -		\$ -		\$ -		\$ -	2	\$ 20,000.00
Subtotal (without HST)				\$ 18,230.00		\$ 62,060.00		\$ 100,342.00		\$ 388,835.00		\$ 44,340.00
Contingency (40%)				\$ 25,522.00		\$ 86,884.00		\$ 140,478.80		\$ 544,369.00		\$ 62,076.00
Total (without HST)												\$ 859,329.80







APPENDIX B

BIKEWAY DESIGN CONCEPT: Cycling Route to School and Bay to Bay Trail Connection

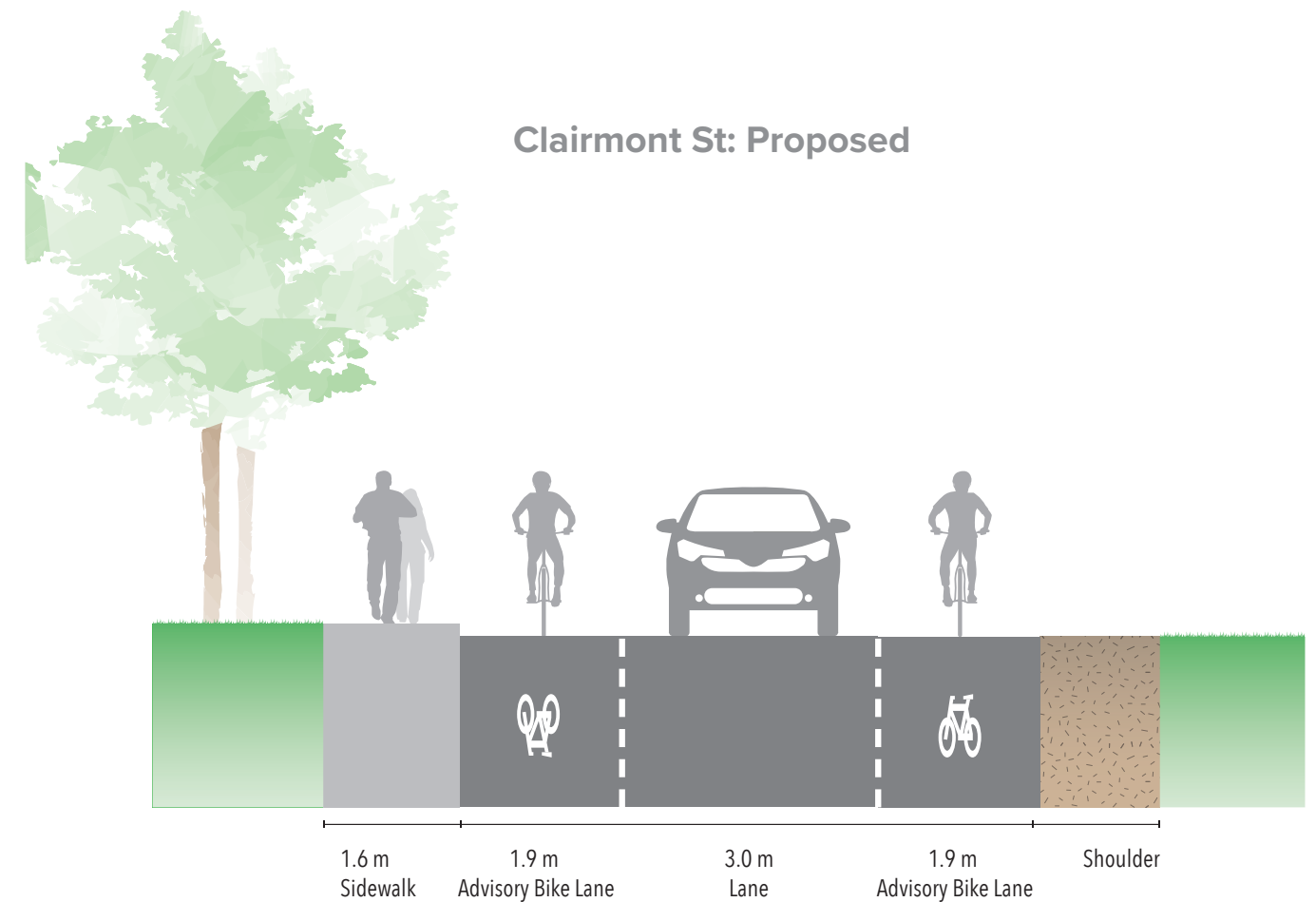
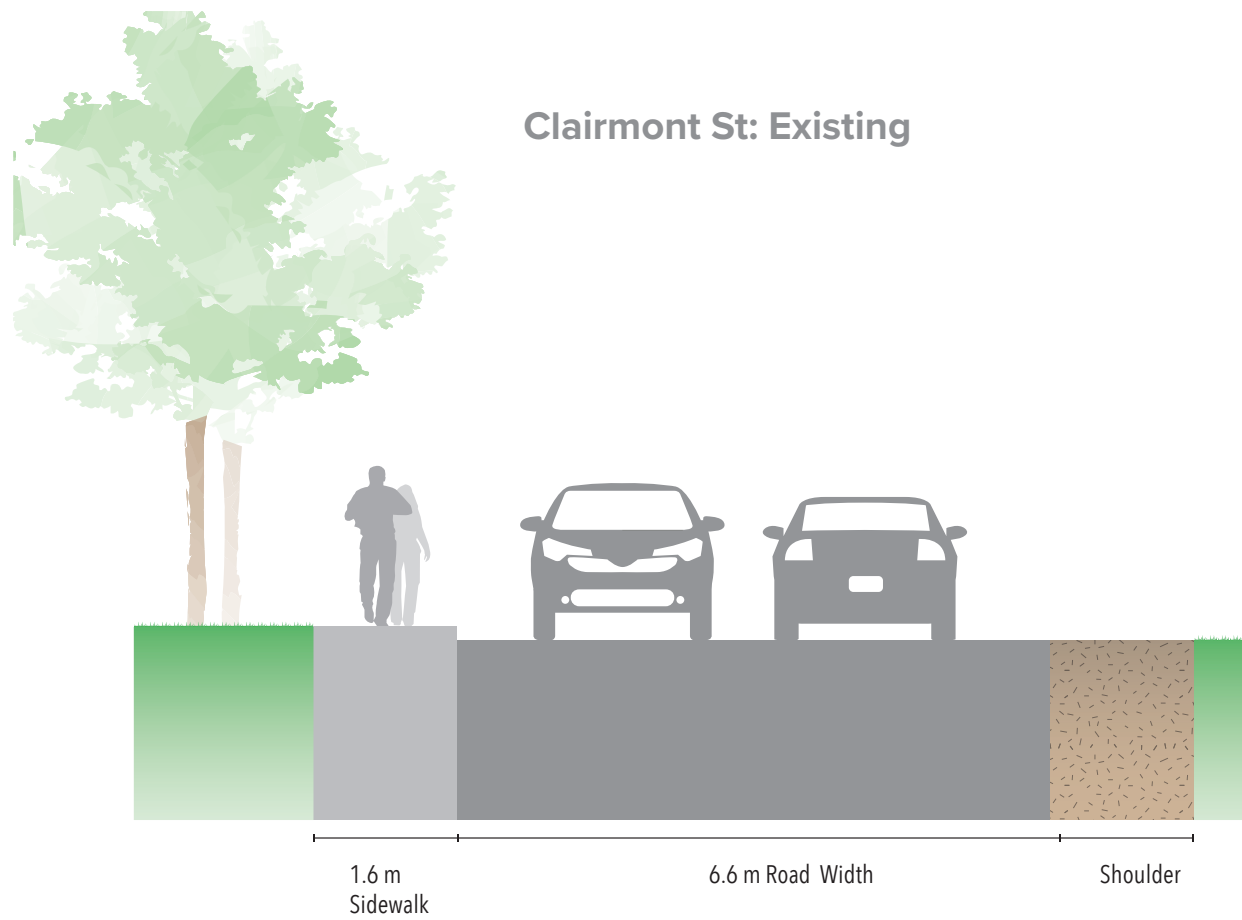
Tile #1: Clairmont St



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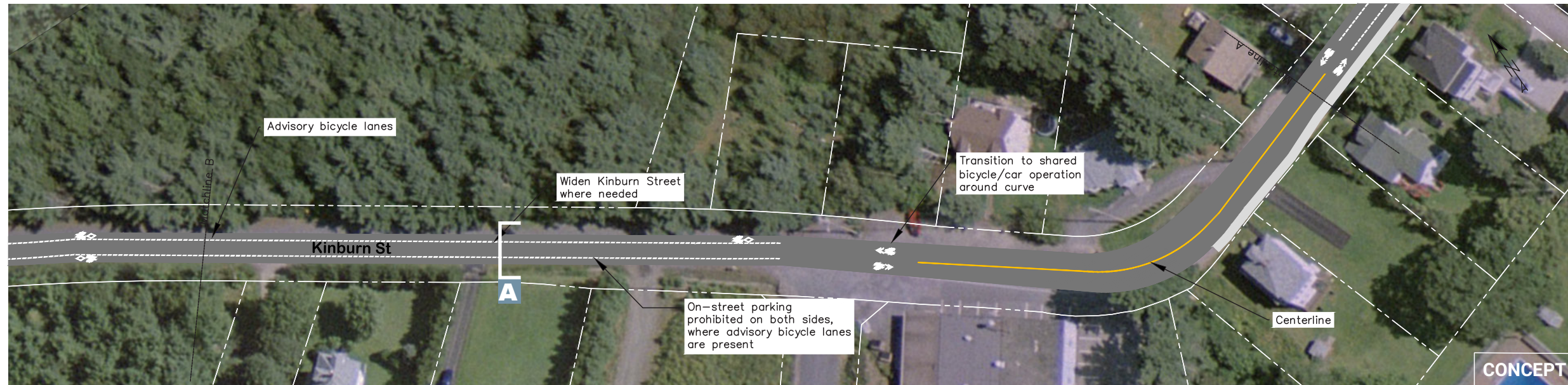
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-  Sidewalk/Concrete
-  Multi-use Path
-  Grass Buffer
-  Existing Curb
-  Property Line

Section A



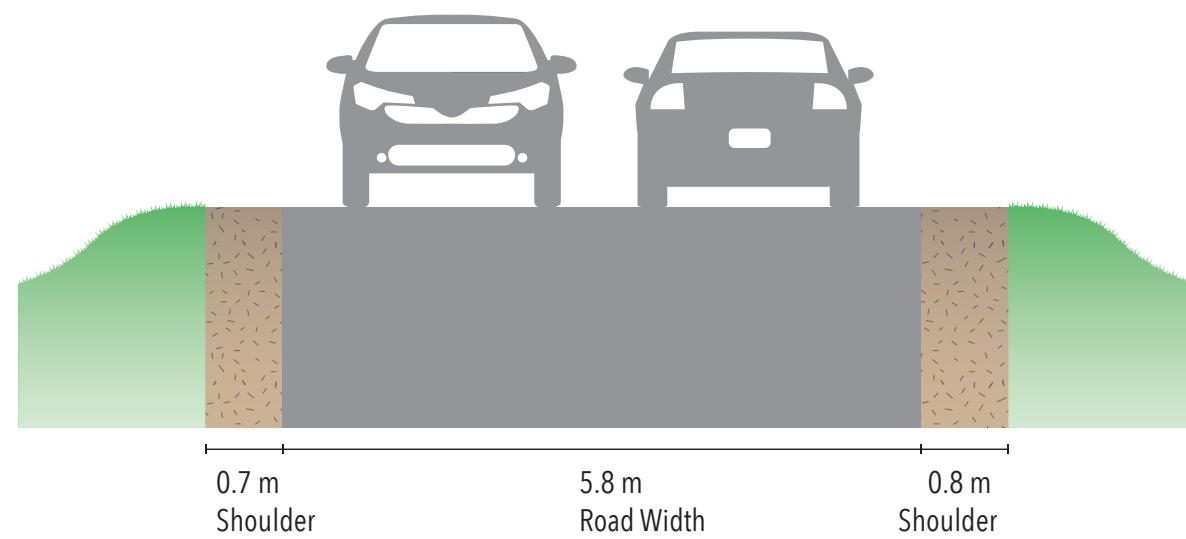
BIKEWAY DESIGN CONCEPT: Cycling Route to School and Bay to Bay Trail Connection

Tile #2: Kinburn St

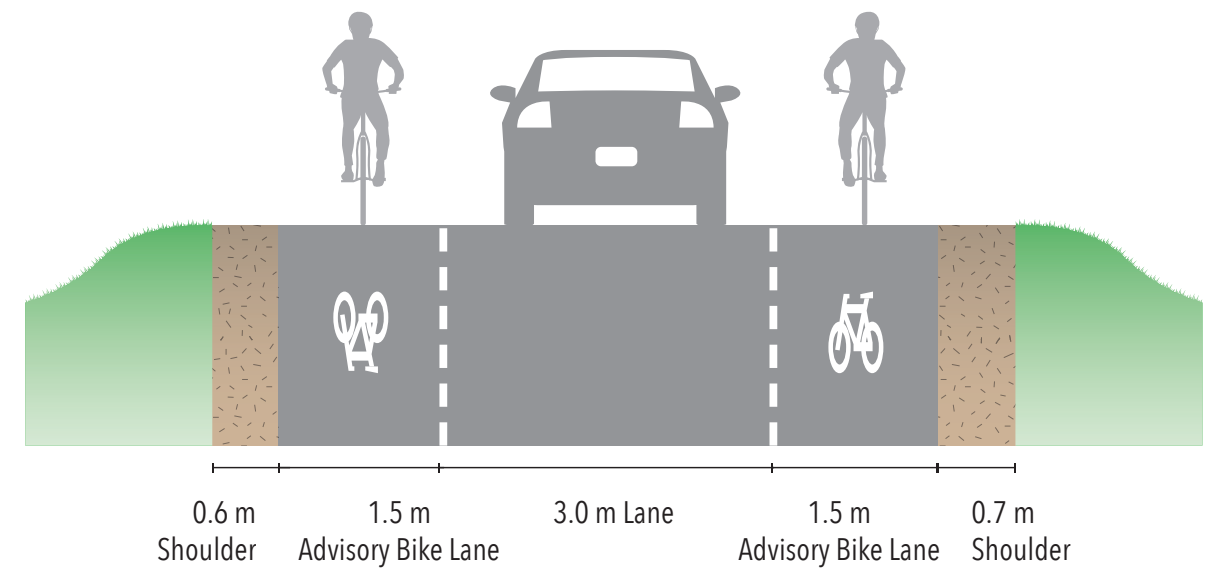


Section A

Kinburn St: Existing

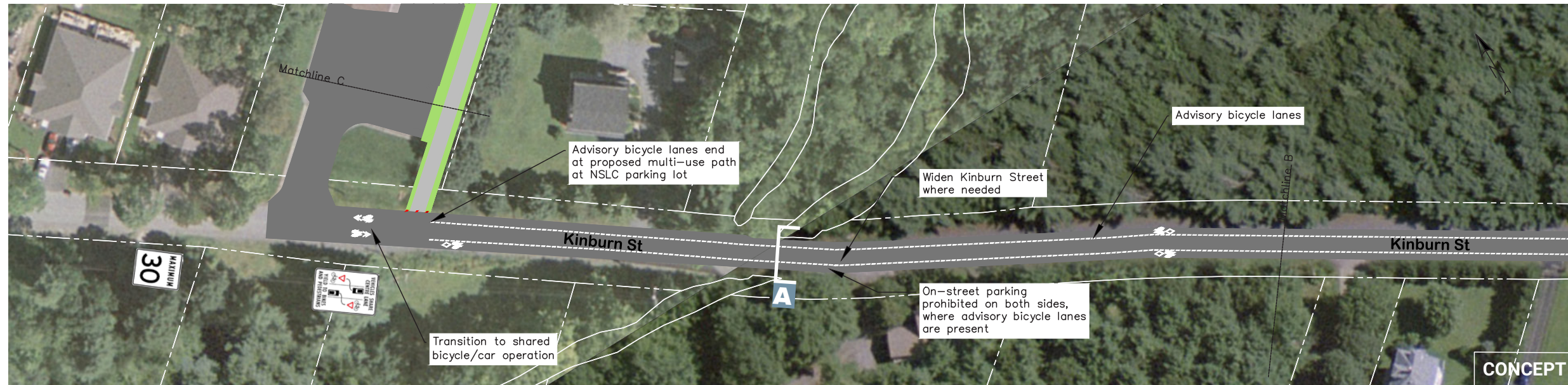


Kinburn St: Proposed









BIKEWAY DESIGN CONCEPT: Cycling Route to School and Bay to Bay Trail Connection

Tile #3: Kinburn St

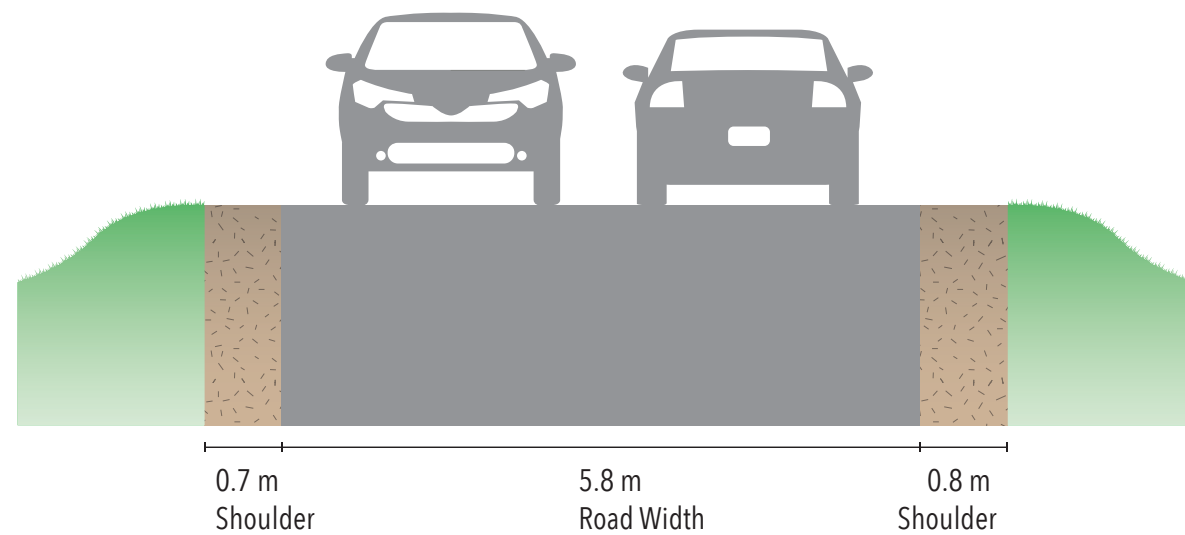


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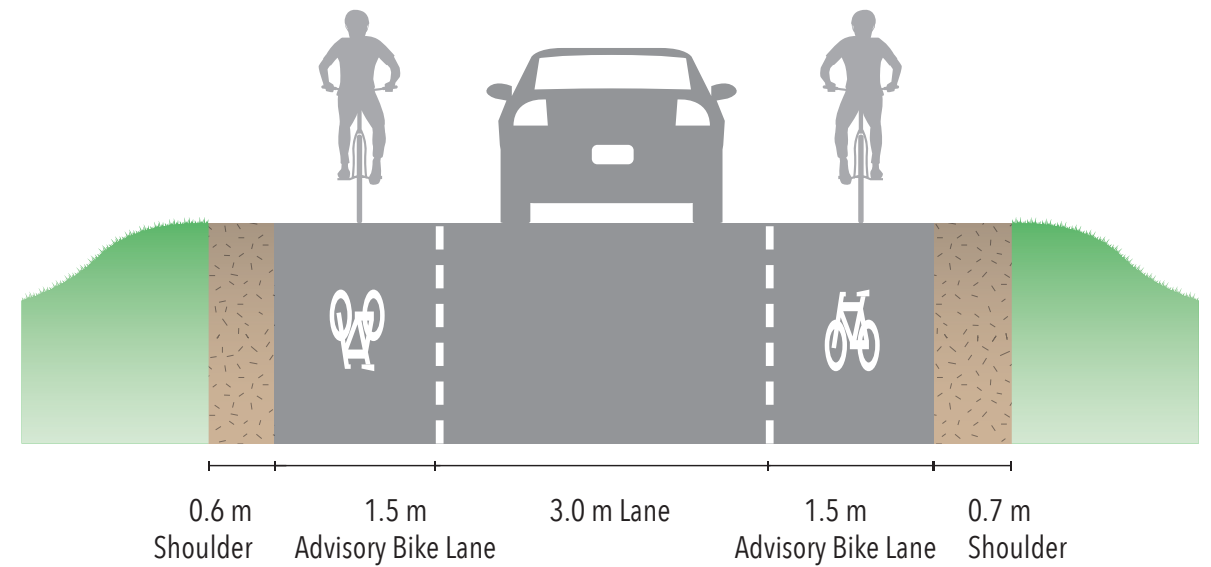
-  Bike Lane
-  Sidewalk/Concrete
-  Multi-use Path
-  Grass Buffer
-  Existing Curb
-  Property Line

Section A

Kinburn St: Existing

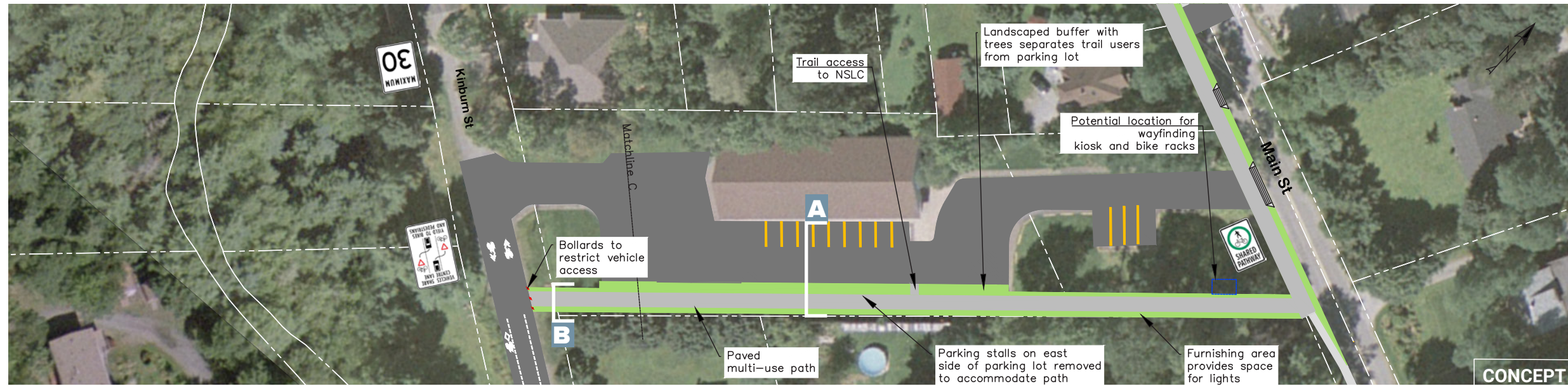


Kinburn St: Proposed



BIKEWAY DESIGN CONCEPT: Cycling Route to School and Bay to Bay Trail Connection

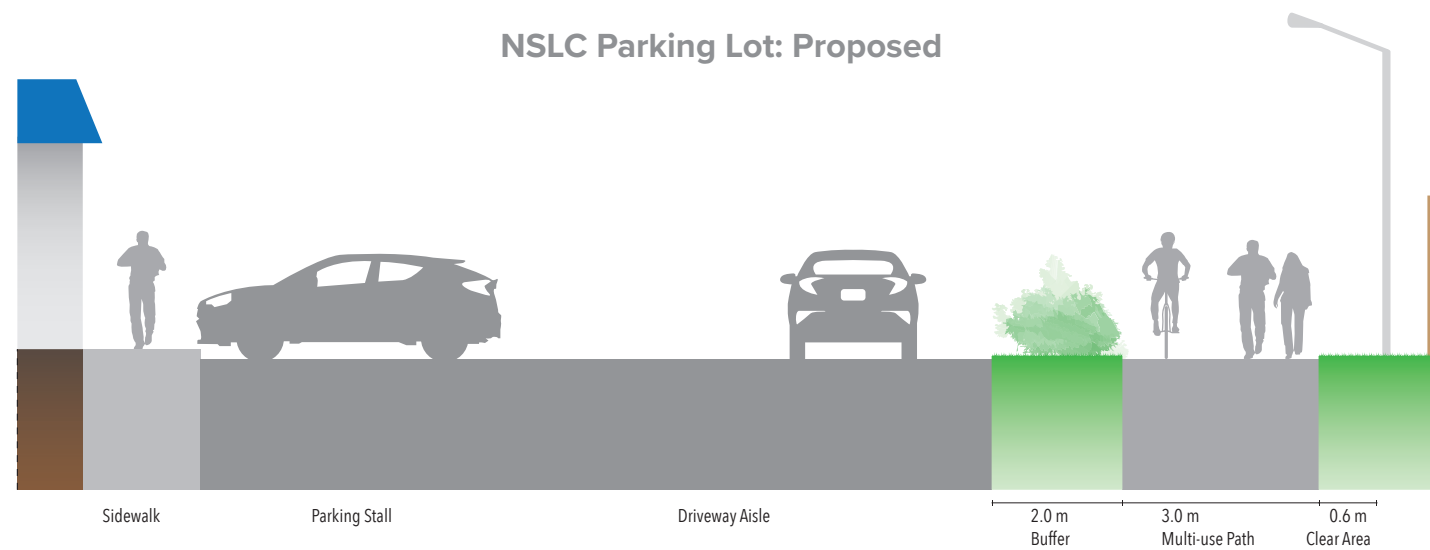
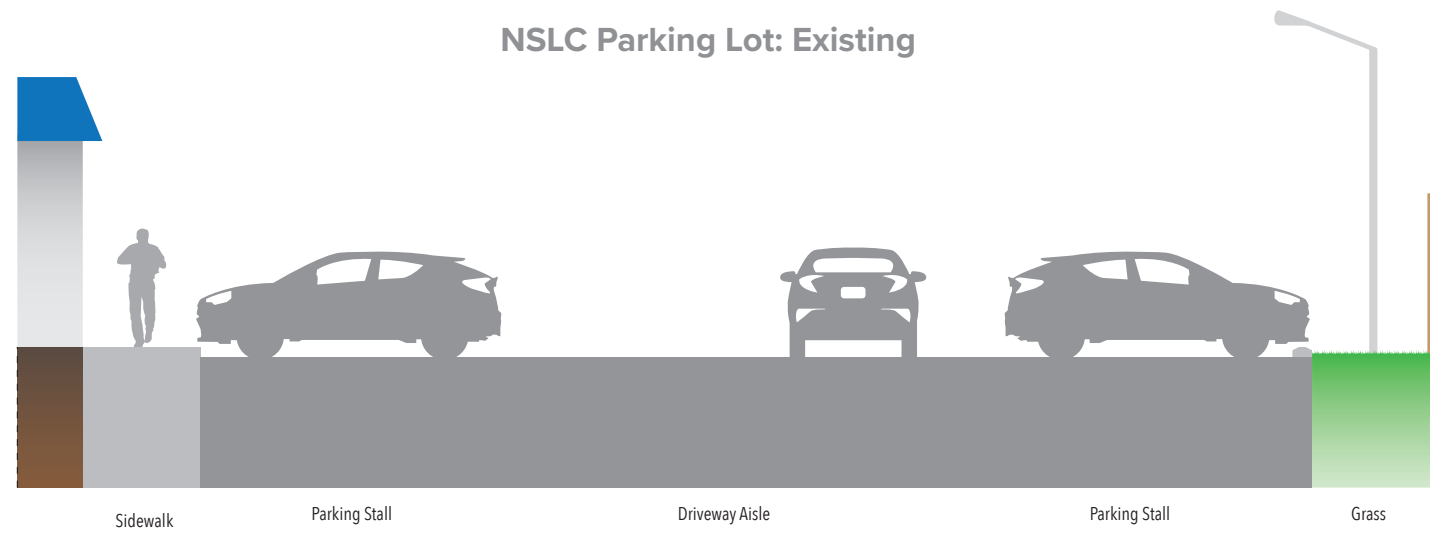
Tile #4: NSLC Connection



LEGEND

- Sidewalk/Concrete
- Multi-use Path
- Grass Buffer
- Existing Curb
- Property Line

Section A

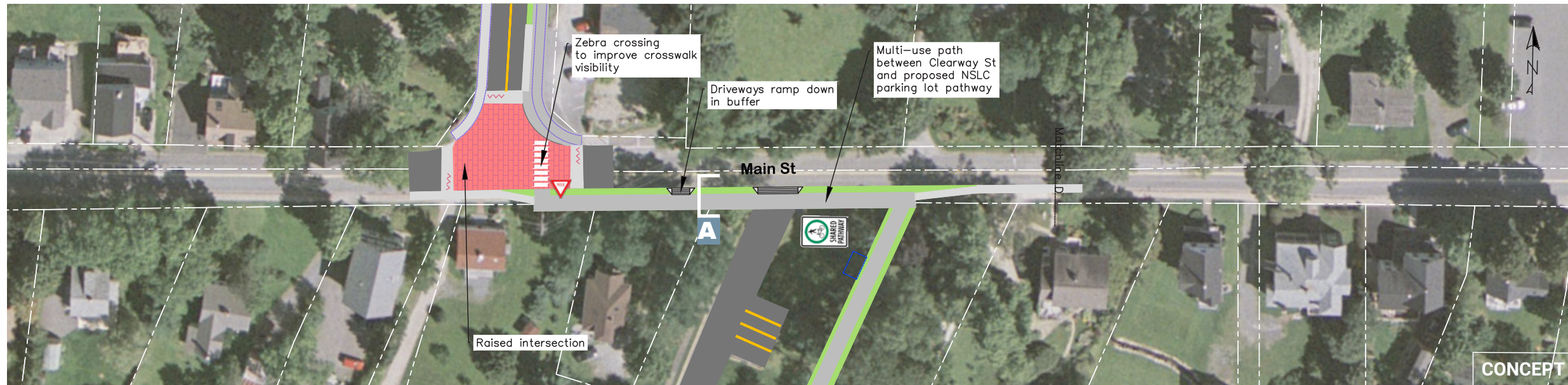


Section B



BIKEWAY DESIGN CONCEPT: Cycling Route to School and Bay to Bay Trail Connection

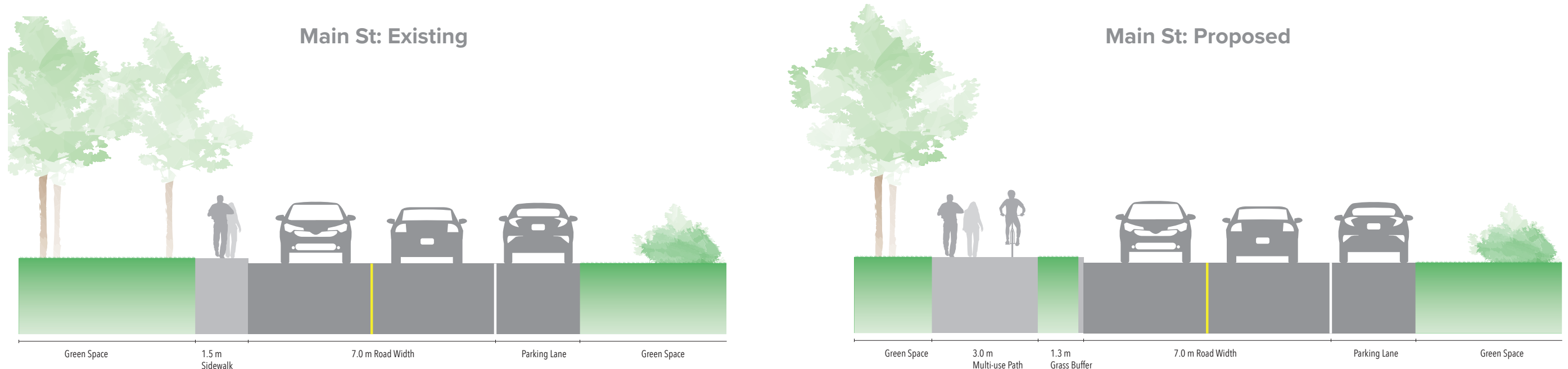
Tile #5: Main St.



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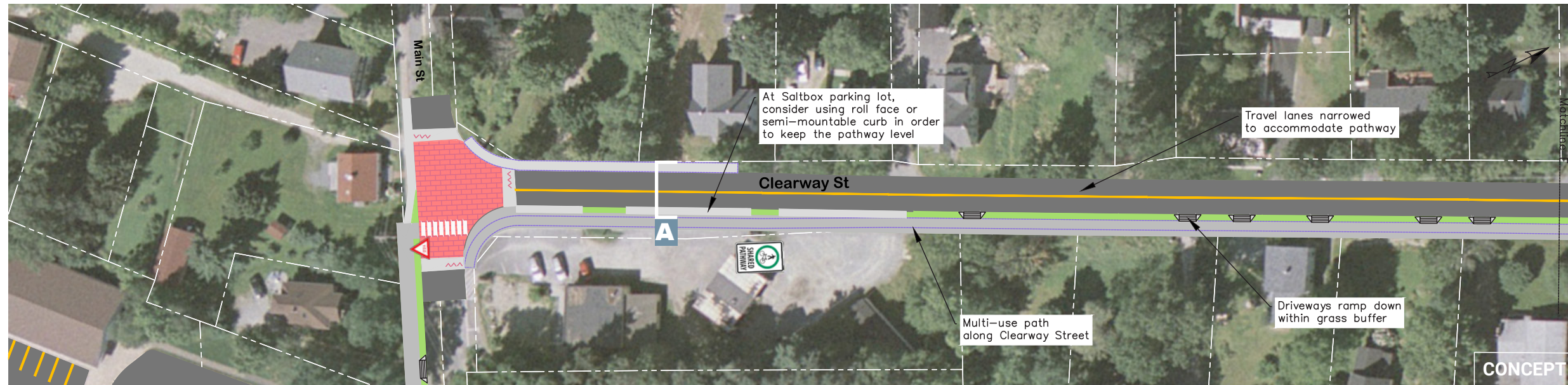
- Sidewalk/Concrete
- Multi-use Path
- Grass Buffer
- Existing Curb
- Property Line
- Raised Intersection

Section A



BIKEWAY DESIGN CONCEPT: Cycling Route to School and Bay to Bay Trail Connection

Tile #6: Clearway St.

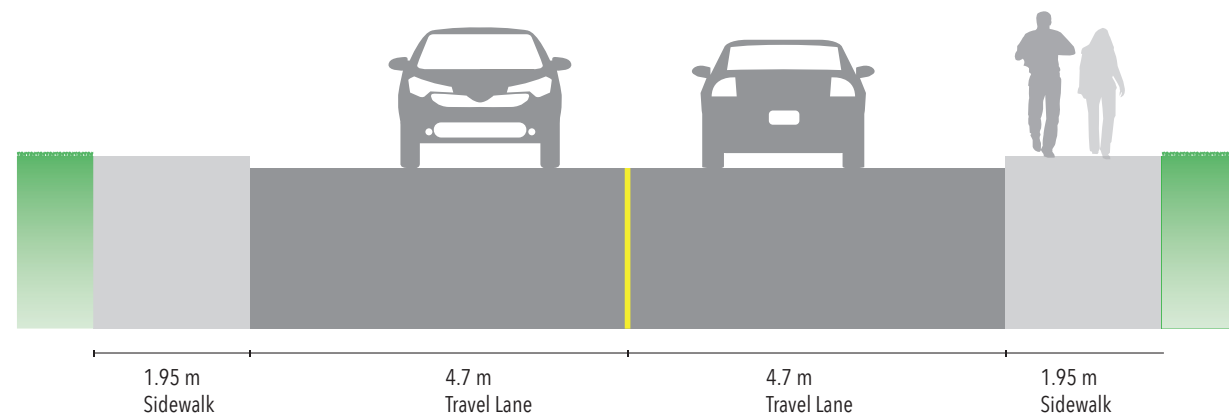


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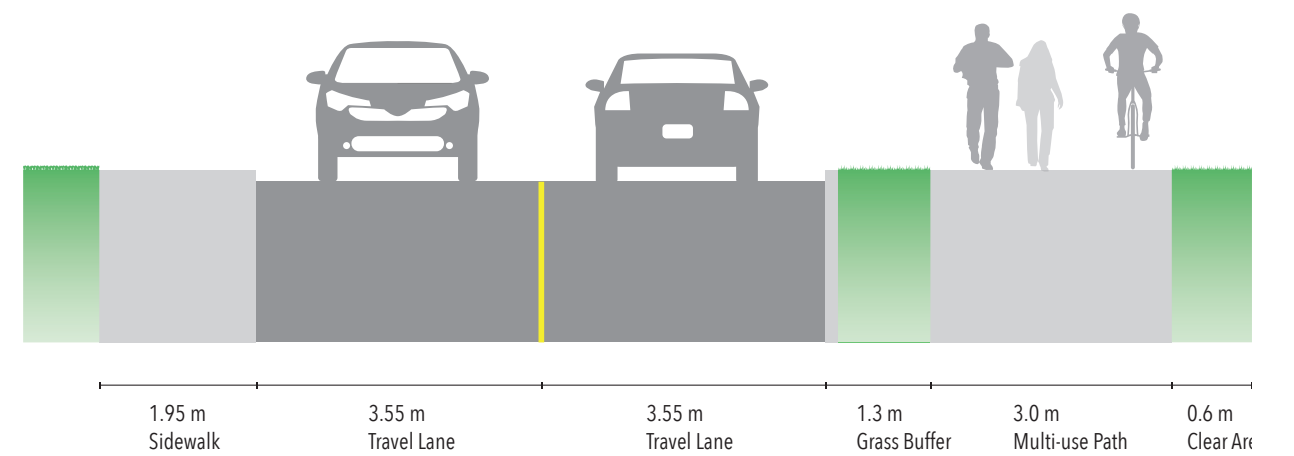
- Sidewalk/Concrete
- Multi-use Path
- Grass Buffer
- Existing Curb
- Property Line
- Raised Intersection

Section A

Clearway St: Existing

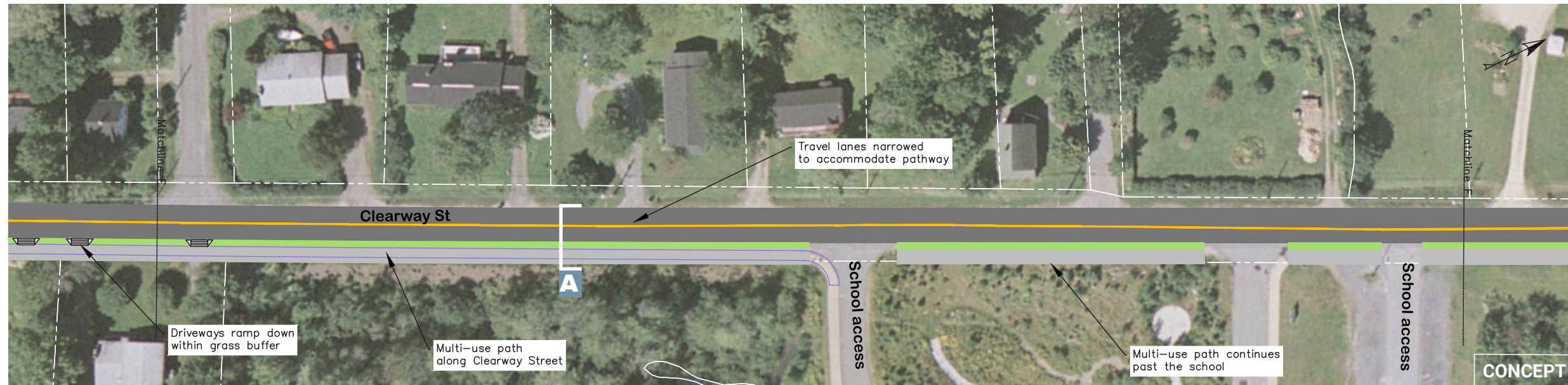


Clearway St: Proposed



BIKEWAY DESIGN CONCEPT: Cycling Route to School and Bay to Bay Trail Connection

Tile #7: Clearway St.

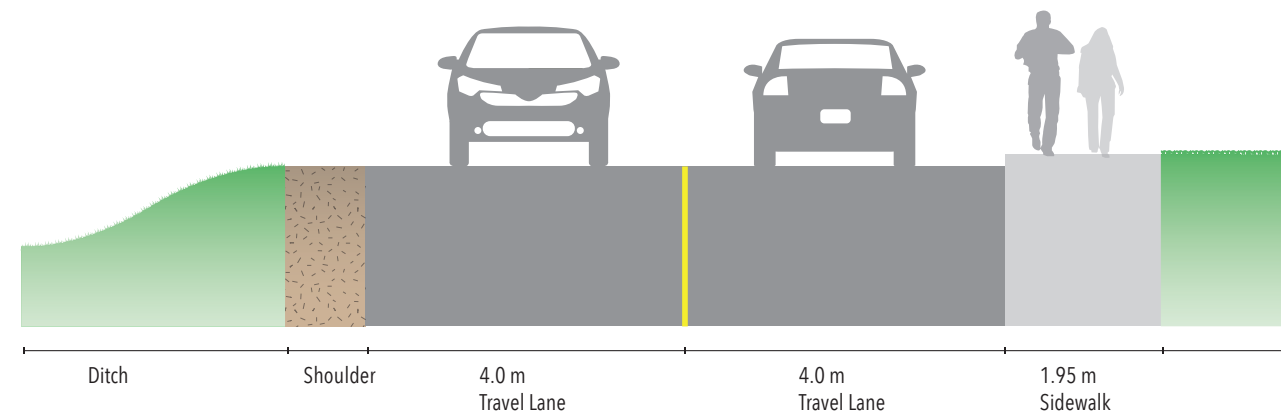


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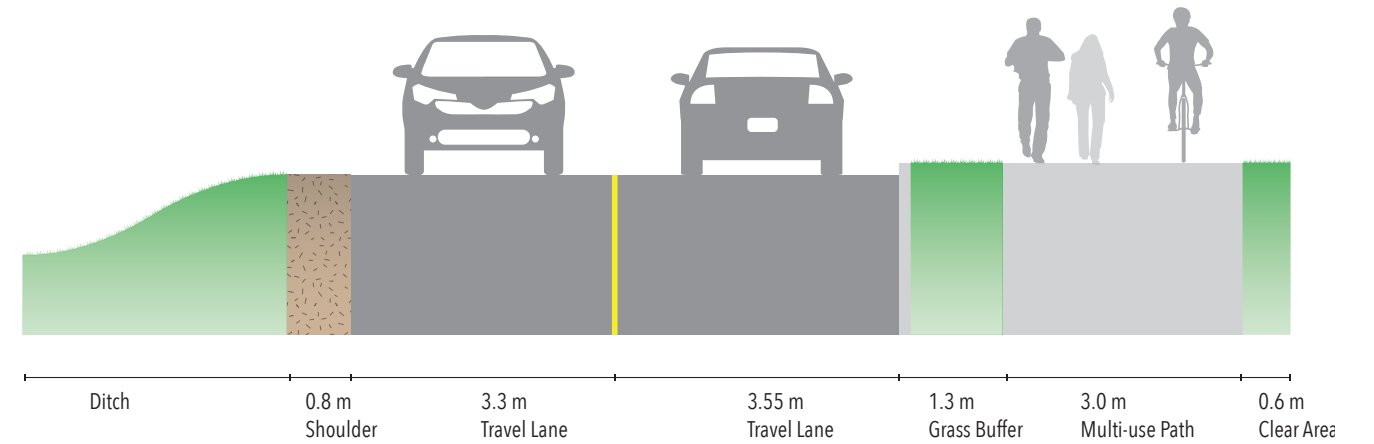
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- Multi-use Path
- Grass Buffer
- Existing Curb
- Property Line

Section A

Clearway St: Existing

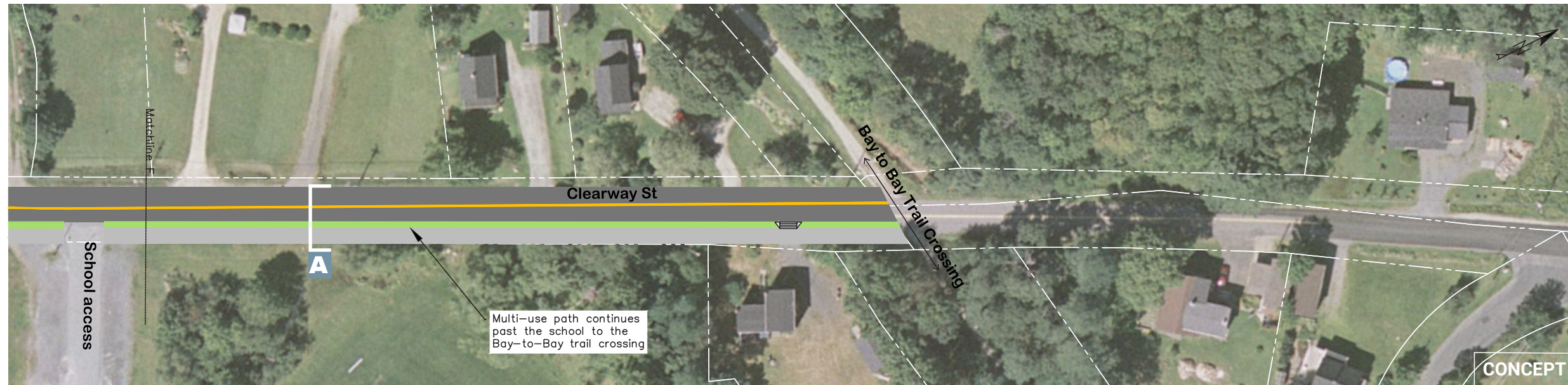


Clearway St: Proposed



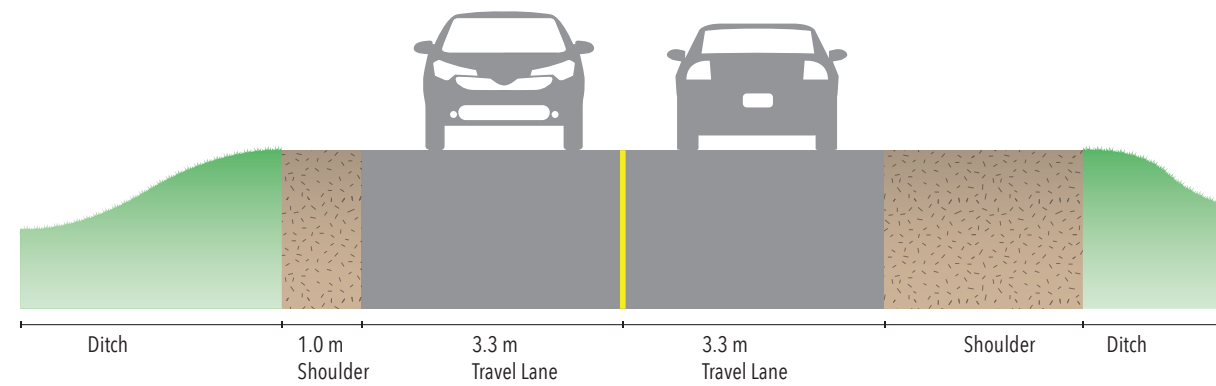
BIKEWAY DESIGN CONCEPT: Cycling Route to School and Bay to Bay Trail Connection

Tile #8: Clearway St.



Section A

Clearway St: Existing



Clearway St: Proposed

