

Risk-Based Methodology Development and Implementation to Identify Critical Sections along the Trans Canada Trail

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Abstract

The Trans Canada Trail (Trail) is a cross-Canada network of greenways, waterways and roadways consisting of more than 29,000 kilometres (km) of multi-use trails, making it the world's longest network of recreational trails. Trans Canada Trail (TCT) is a not-for-profit organization that works with corporate and individual donors, partners, government and volunteers to raise funds to develop this Trail system. TCT aims to enhance the Trail by making it safer and more accessible for its users. The need for a comprehensive and robust network screening exercise of the Trail system was recognized to identify critical locations, particularly sections of the Trail that are shared with the public roadway through a bicycle accessible shoulder.

A risk-based methodology was developed through extensive literature review and primarily incorporates principles described in the Canadian Road Safety Audit Guide (prepared by the Transportation Association of Canada in 2001). This methodology permits a macro level identification of high-risk road segments along the Trail using data available to TCT. The methodology includes the calculation of a relative risk score for each segment based on the probability, exposure and consequence. The input parameters to this methodology includes the provision of bicycle facility type to estimate the probability of occurrence, the Annual Average Daily Traffic (AADT) of the shared roadway to estimate the exposure, and the posted speed limit to estimate the consequence of potential crashes. Adjustment factors based on the shoulder type and intersection density were also incorporated in the calculation of the risk score. Finally, ranges of the risk score were identified to categorize each Trail segment into six risk levels ranging from "Highest Risk" to "Lowest Risk".

The implementation of the risk-based methodology was conducted through coding of the input parameters and equations into a Geographical Information System (GIS) software. A thorough calibration and validation process was conducted to refine the methodology to ensure practical use and to verify if the risk levels identified were reasonable and consistent. A nation-wide ranking of sections of the Trail system was developed allowing TCT to target priority sections for studies, future active transportation and safety development/construction works, and to make informed decisions on funding projects. The resulting risk-based methodology is applicable to provide a Safe System Approach to a system-wide evaluation of the safety performance of cycling facilities.

1. Introduction

The Trans Canada Trail (Trail) is a cross-Canada network of greenways, waterways and roadways consisting of more than 29,000 kilometres (km) of multi-use trails, making it the world's longest network of recreational trails. The Trail is present in every Canadian province and territory as shown in Figure 1-1 below [1].



Figure 1-1: Trans Canada Trail System (in yellow) across Canada [1]

Trans Canada Trail (TCT) is a not-for-profit organization that works with corporate and individual donors, partners, government and volunteers to raise funds to develop this Trail system. The Trail is owned and operated at the local level and TCT provides support to the local groups to plan, build and maintain sections of the Trail.

TCT aims to enhance the safety and accessibility of the Trail, particularly at the sections of the Trail that are shared with public roadways. The following paper describes the results of the collaborative effort between TCT and Hatch in association with G.Ho Engineering Consultants Inc. to complete the following objectives:

- Develop a comprehensive and robust risk-based approach to identify and rank critical roadway sections using a Safe System Approach¹.
- The risk-based approach is to be developed with data available for the Trail sections that fall on the roadway. The data inputs include:
 - Bicycle Facility Type.
 - Shoulder width (metres).
 - Annual Average Daily Traffic (vehicles per day).
 - Speed (kilometres per hour).
 - Shoulder Type (Paved vs Unpaved).
 - Intersection Density (number of intersections per kilometre).
- Implement the risk-based methodology to develop a nation-wide ranking of Trail sections using the Geographical Information System (GIS) software.
- Develop strategies to improve the Trail sections with the highest risk.

¹ The Safe System Approach is an integrated and comprehensive process to improve the safety performance of the transportation system that makes allowance for errors, and eliminates predictable and preventable serious injuries and fatalities. The Safe System Approach recognizes that humans are vulnerable, and aims to prevent crashes resulting from inevitable human errors, and to mitigate the consequences of crashes when they do occur [21].

The main purpose of the risk-based methodology is to proactively identify high-risk locations allowing TCT to focus its resources on reducing the risk for trail user collision along road cycling routes² of the Trail.

2. Risk-Based Methodology Development

The development of the risk-based methodology involved extensive literature review and was refined through an iterative calibration and validation process. For the purposes of this paper, the literature review to develop the final version of the risk-based methodology is discussed. The calibration process is not included in this paper.

The primary focus of the risk-based methodology is the safety of cyclists. The methodology incorporates the risk assessment principles described in the Canadian Road Safety Audit Guide, permitting a macro level identification of high-risk road segments along the Trail. Collision risk is defined as a function of exposure, probability and consequence in the Canadian Road Safety Audit Guide [2]. A risk score calculator³ shown in Figure 2-1 has been used as a guide to identify level of risk [3].

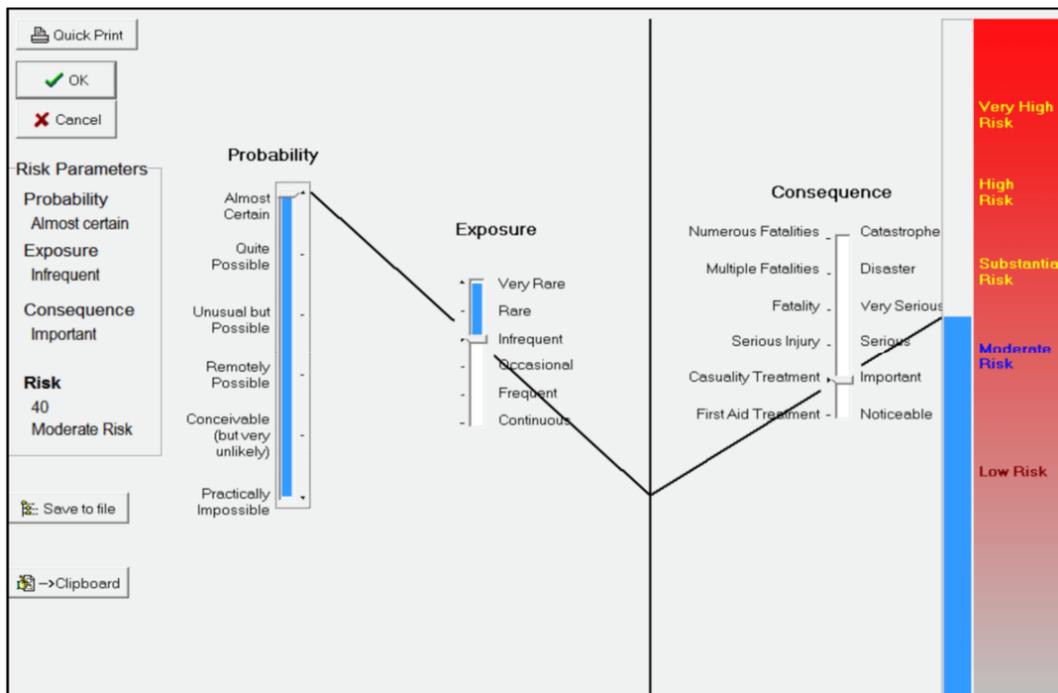


Figure 2-1: Risk Score Calculator Screen Capture [3]

The risk score assigned to each of the risk parameters in the overall risk score used in the calculator is summarized in Table 2-1 below.

² Road cycling routes are defined as “a section of the Trail that is either on a paved or gravel road, where users may be subject to the relevant Highway Traffic Act, motor vehicle code or resource road regulations and/or legislation” [22].

³ The risk score calculator is based on the Occupational Health and Safety (OHS) Risk Assessment AS/NZS 4804:2001 and contained in HB205-2004 OHS Risk Management Handbook [23]. The Ratings used for the Risk Calculation have been adapted from the Journal of Safety Research [24].

Table 2-1: Risk Score by Risk Parameter

Probability		Exposure		Consequence	
Almost Certain	50	Very Rare	1	Numerous Fatalities	10
Quite Possible	22.5	Rare	1.8	Multiple Fatalities	3.98
Unusual but Possible	10	Infrequent	3.2	Fatality	1.58
Remotely Possible	4.5	Occasional	6	Serious Injury	0.63
Conceivable	2	Frequent	10.8	Casualty Treatment	0.25
Practically Impossible	1	Continuous	20	First Aid Treatment	0.1

The overall risk score is calculated by multiplying the risk score of each of the risk parameter (probability, exposure and consequence). Collision Modification Factors (CMFs) were applied to the risk function in a multiplicative manner⁴ to account for the effect of intersection density, shoulder type and road use. The risk score is calculated by the following formula:

$$\text{Risk Score} = \text{Probability} * \text{Exposure} * \text{Consequence} * RF_S * RF_{ID} * RF_r$$

where,

RF_S = Risk Factor for Shoulder Type,

RF_{ID} = Risk Factor for Intersection Density, and

RF_r = Risk Factor for Road Use

The risk score ranges from “Low Risk” to “Very High Risk” in the risk calculator (see Figure 2-1). Following a calibration exercise, the nomenclature to describe the risk was adjusted to further differentiate locations with very high risk. A Risk Level category was incorporated using roman numerals with ‘I’ representing locations with the lowest risk and ‘VI’ representing locations with the highest risk. The risk ranges associated with each category of risk score is summarized in Table 2-2 below.

Table 2-2: Risk Level by Risk Score

Overall Risk Score	Risk Calculator Definition (see Figure 2-1)	TCT Ranking Priorities	Risk Level
Less than 10	Low Risk	Lowest Risk	I
10 to 49	Moderate Risk	Slight Risk	II
50 to 199	Substantial Risk	Moderate Risk	III
200 to 399	High Risk	Substantial Risk	IV
400 to 999	Very High Risk	Considerable Risk	V
Equals to or Greater than 1,000		Highest Risk	VI

The safety performance measures to determine each of the risk parameters are discussed in the sections below.

⁴ Applying CMFs to the risk function in a multiplicative manner is consistent with the Highway Safety Manual [25].

2.1 Probability

The safety performance measure to evaluate the probability of a motor vehicle-bicycle collision is the available shoulder width (in metres) of the bicycle facility. The probability of a motor vehicle-bicycle collision is inversely proportional to the separation between the bicycle facility and the adjacent traffic lane. The encroachment-distance relationship is illustrated in Figure 2-2 below [4].

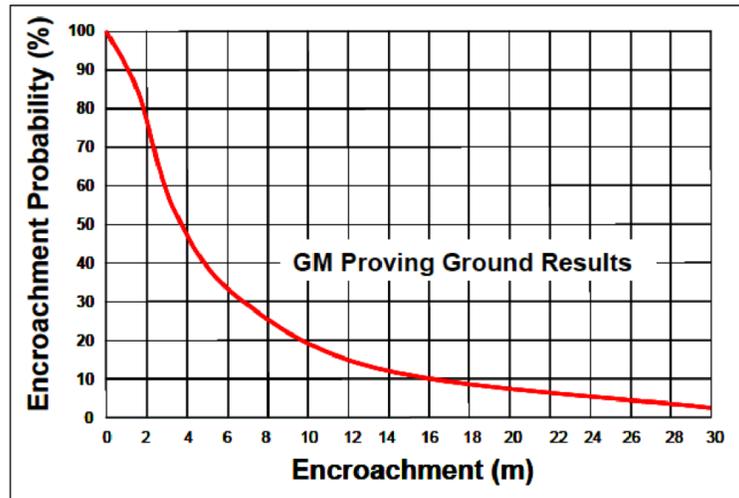


Figure 2-2: Motor Vehicle Encroachment – Distance Relationship [4]

To incorporate into the risk-based methodology, the shoulder widths were divided into various risk parameters for the “Probability” measure as summarized in Table 2-3 below. The shoulder widths were initially chosen based on a literature review and were finalized following calibration of results.

Table 2-3: Probability of Collision by Shoulder Width

Probability	Shoulder Width	Risk Score Assigned
Almost Certain	0.0 m	50
Quite Possible	0.1 m – 0.9 m	22.5
Unusual but Possible	1.0 m – 1.4 m	10
Remotely Possible	1.5 m – 1.9 m	4.5
Conceivable	Greater than or equal to 2.0 m	2
Practically Impossible	Multi-Use Path / Bicycle Path	1

Several types of facilities are used to accommodate bicycles on and off the road. In order to incorporate the bicycle facility type, shoulder widths were assigned for each bicycle facility. The rationale for assigning the shoulder width was based on definitions in the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads for various types of bicycle facilities [5]. Example figures and the shoulder width assigned for each bicycle facility type are shown in Table 2-4 below.

Table 2-4: Assigned Shoulder Width based on Facility Type.

Type of Bicycle Facility	Example Figure	Urban Shoulder Width Assigned	Rural Shoulder Width Assigned
No Bicycle Facility	-	0.0 m	0.1 m – 0.9 m
Shared Roadway		0.0 m	0.1 m – 0.9 m
Bicycle Boulevard		0.1 m – 0.9 m	
Advisory Bike Lane		0.1 m – 0.9 m	
Shared Lane		0.1 m – 0.9 m	
Bicycle Accessible Shoulder		Measured Shoulder Width	
Bicycle Lane		Measured Bicycle Lane Width	

Type of Bicycle Facility	Example Figure	Urban Shoulder Width Assigned	Rural Shoulder Width Assigned
Protected Bicycle Lane		Measured Protected Bicycle Lane Width (If a roadside barrier is present, a Risk Factor of 0.5 is to be applied)	
Bicycle Path / Multi-Use Path		Refer to Table 2-3 (If a roadside barrier is present, a Risk Factor of 0.5 is to be applied)	
Gravel Road		0.1 m – 0.9 m	

The differing shoulder widths assigned for rural and urban areas for roadway segments with no bicycle facility and for shared roadways were determined following extensive literature review as shown in Table 2-5 below. In general, typical shoulder widths for a local rural road with a gravel surface road was found to allow for some available width for bicycles to share the road with vehicles. Hence, a shoulder width of at least 0.1 m – 0.9 m was assigned for all rural roads.

Table 2-5: Available Shoulder Width for Rural Roads based on road agency

Agency	Available Shoulder Width
Transportation Association of Canada (TAC) Geometric Design Guide [5]	1.0 m
American Association of State Highway and Transportation Officials (AASHTO) [6]	0.6 m
British Columbia (BC) Ministry of Transportation and Transit [7]	0.5 m
Saskatchewan Highways and Transportation [8]	0.3 m – 0.5 m
Manitoba Department of Highways and Transportation [9]	0.3 m
Nova Scotia Transportation and Infrastructure Renewal [10]	0.3 m – 1.2 m
New Brunswick Department of Transportation and Infrastructure [11]	1.3 m

2.2 Exposure

The safety performance measure to evaluate the exposure is the Annual Average Daily Traffic (AADT) of the road. The ranges of traffic volume in vehicles per day for the various risk “Exposure” categories were determined from the following rationale:

- A “Very Low Volume Road” is typically defined as a road with AADT of less than 400 vehicles per day in the TAC Geometric Design Guide [5].
- A “Low Volume Road” is defined as a road with an AADT or less than 1,000 vehicles per day in the TAC Geometric Design Guide [5].
- Shared bicycle facilities are typically designed for roads with AADTs of up to 2,500 vehicles per day.
- Segregated bike lanes are typically used for roads with AADTs of between 2,500 and 4,000 vehicles per day.
- Arterial roads typically accommodate AADTs of greater than 10,000 vehicles per day.

The ranges of traffic volume (AADT) in vehicles per day for the various risk “Exposure” categories are summarized in Table 2-6 below.

Table 2-6: Exposure by Traffic Volume (AADT)

Exposure	AADT (vehicles/day)	Risk Score Assigned
Very Rare	Less than 400	1
Rare	400 to 999	1.8
Infrequent	1,000 to 2,499	3.2
Occasional	2,500 to 3,999	6
Frequent	4,000 to 9,999	10.8
Continuous	Greater than or equal to 10,000	20

2.3 Consequence

The safety performance measure to evaluate the consequence is the Speed Limit (km/h) of the road. The fatality risk of vulnerable road users is directly proportional to the impact speed as shown in Figure 2-3 [12]. The graph shows that the fatality risk is below 10 percent with an impact speed below 50 km/h. The fatality risk rises to approximately 20 percent at 60 km/h, and increases significantly to approximately 40 percent with an impact speed at 70 km/h.

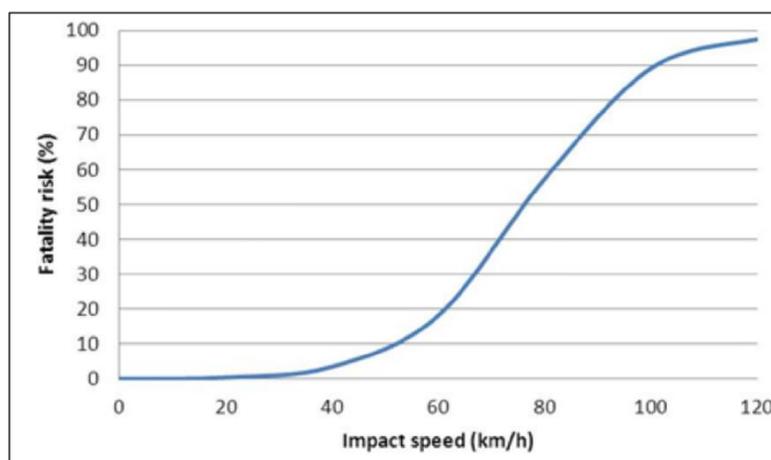


Figure 2-3: Relationship between Impact Speed and Fatality Risk [12]

For the purpose of this risk-based methodology, the “Consequence” parameters for fatal collisions shown in Table 2-1 is replaced as follows:

- Numerous Fatalities = Greater than 40 percent fatality,
- Multiple Fatalities = 40 percent fatality, and
- Fatality = 20 percent fatality

The speed limits were divided into various risk parameters for the “Consequence” measure as summarized in Table 2-7 below.

Table 2-7: Consequence by Posted Speed Limit (km/h)

Consequence	Posted Speed Limit (km/h)	Risk Score Assigned
Greater than 40 Percent Fatality	Greater than 70 km/h	10
40 Percent Fatality	70 km/h	3.98
20 Percent Fatality	60 km/h	1.58
Serious Injury	50 km/h	0.63
Casualty Treatment	30 to 40 km/h	0.25
First Aid Treatment	Less than 30 km/h	0.1

2.4 Collision Modification Factors

Collision Modification Factors (CMF) is a multiplicative factor that indicates the proportion of collisions expected after implementing a countermeasure/design change. A CMF of less than 1.0 indicates that a treatment has potential to reduce crashes while a CMF of greater than 1.0 indicates an expected increase in collisions. The CMF value indicates the safety effectiveness of a particular treatment or design element [13]. For the purposes of the risk-based methodology, Risk Factors (RF) which is the reciprocal of the CMF were applied based on the shoulder type, intersection density and road use as discussed in the sections below.

CMF for Shoulder Type (RF_s)

The effect of shoulder type can be applied using a CMF. A review of literature for two lane and multi-lane roads in both urban and rural environments indicated that the conversion of an unpaved shoulder to a paved shoulder has a CMF ranging from 0.24 to 0.97 with an average of approximately 0.85 [14] [15] [16] [17]. The reciprocal of this CMF value (equal to 1.2) is used to represent the increased risk factor for an unpaved shoulder as shown in Table 2-8.

For the purposes of the risk-based methodology, the Risk Factor for Shoulder Type was not applied to gravel roads since initial testing of the methodology showed high risk scores for trail sections that fall on gravel roads and for trail sections in rural areas. Gravel roads are generally found in rural regions where cost of paving and maintaining a paved road is not economically feasible. Since gravel roads is established as a subset of low-volume roads [18], the risk factor of 1.2 is not applied to trail sections on these types of roads.

Table 2-8: Risk Factor for Shoulder Type

Shoulder Type	Risk Factor (RF _s)
Paved Shoulder	1.0
Unpaved Shoulder	1.2

Note: Unpaved Shoulder excludes Gravel Road

CMF for Intersection Density (RF_{ID})

Intersection density on the safety performance of cycling facilities is dependent on several factors including the traffic control type and lane configuration. A review of literature for two-lane and multi-lane roads in both urban and rural environments indicates that risk increases as the density of driveway increases for two-lane roads. However, research indicates that the density of driveways does not affect safety risk for four-lane rural roads [19] [20]. For the purpose of the risk-based methodology, the increased risk factor based on intersection density for two-lane roads is shown in Table 2-9.

Table 2-9: Risk Factor for Intersection Density

Density (no./km)	Risk Factor for Two-Lane Roads (RF _{ID})	Risk Factor for Multi-Lane Roads (RF _{ID})
11-15	1.2	1.0
6-10	1.1	1.0
1-5	1.0	1.0

Note: For 3-lane roads, use the average of the two risk factors.

CMF for Road Use (RF_R)

The type of road use can have a significant impact on the safety of cyclists on roads. Roads with high volume of commercial/heavy vehicles can increase the severity of collision. For the purposes of the risk-based methodology, a risk factor of 0.7 was recommended on recreational/scenic roads and minor access roads where the present of commercial vehicles is minimal (less than 15 vehicles per day) as shown in Table 2-10. This risk factor was based on engineering judgement due to limited research on increased risk on cyclists resulting from truck exposure.

Table 2-10: Risk Factor for Road Use

Principal Road Use	Risk Factor (RF _r)
Standard Travel	1.0
Access to Parks / Recreational Areas	0.7

2.5 Application

The risk-based methodology can be applied by multiplying the risk score assigned for probability, exposure and consequence shown in Table 2-3, Table 2-6 and Table 2-7 with the Risk Factors determined in Table 2-8, Table 2-9 and Table 2-10 for each trail section. The overall risk score ranges between 1 and 14,400. The Risk Level of the trail section can then be defined using Table 2-2.

3. Risk-Based Methodology Implementation

3.1 National Data Collection

The GIS team approached the project with a structured and scalable methodology, designed to address the complexity of Canada's vast and varied geography. The realignment and data collection work was supported by four key datasets. KOREM's 2018 StreetPro Navigation Premium (1:10,000) connected road network dataset was purchased to provide a singular, primary reference for spatial realignment of all road sections in the Trans Canada Trail network. The dataset was also the source of important variables such as intersection density and average road speed. Provincial and municipal open data sources contributed additional roadway attributes, specifically Annual Average Daily Traffic (AADT) for primary roads, as well as data on on-road cycling facilities and sidewalks. StreetLight Data Inc.'s 2019 AADT product was utilized to supplement average annual daily traffic estimates for low-volume roads, a critical gap in publicly available information. To ensure accuracy, Google StreetView and aerial imagery were employed for ground-truthing cycling facilities, speed attributes, and sidewalk presence.

The technical process began with the realignment of existing on-road trail sections to the KOREM Road Network using ArcGIS Pro software from the Environmental Systems Research Institute (ESRI), enhancing positional accuracy and providing a consistent base for all subsequent analysis. New road variables were collected and systematically integrated into the GIS database, with particular emphasis on verification through imagery where secondary data sources lacked detail. A key computational step involved the development of custom geoprocessing tools to automate the calculation of intersection density and to generate a final Risk Safety Assessment (RSA) score for each road segment, supporting trail management decisions. The initial implementation spanned approximately one year, during which two GIS specialists analyzed and processed close to 10,000 kilometers of trail network.

3.2 First Pass Results

The first technical pass, completed in September 2020, resulted in the realignment and detailed analysis of 9,361 kilometers of on-road trail sections (see Table 3-1 for the summary by on-road cycling facility type). Through this effort, risk safety assessment scores were generated for 4,466 individual road segments, providing a standardized metric for evaluating road suitability across the network. These results laid a critical foundation for future trail improvement projects and informed the development of a more systematic approach to trail assessment and management.

Table 3-1: Total length of on-road trail by on-road cycling facility type across the Trans Canada Trail network as of September 2020.

On-Road Cycling Facility	Length (km)
Gravel Roads	3,970
Bicycle Accessible Shoulders	3,334
Shared Roadways / No bicycle facilities	1,835
Bicycle Lane (with or without buffer)	167
Shared Lane	26
Bicycle Boulevard	19
Advisory Bike Lanes	9

4. Case Studies

At its base, the tool was used to look at priority assessment of opportunities in the existing trail routing on roadway. The RSA tool was used in several ways since it had been implemented into the TCT database, these included (but not exclusive to):

- Identification of routing realignment
- Supplementary guide for project valuation and approval
- Prioritization guide for Active Transportation development discussions
- Consideration of proposed extensions to the network

Ultimately, the most influential factors in the scoring of the tool were the speed of vehicular traffic, the AADT, and the shoulder width. Naturally, these factors were looked at closely when considering each of the above categories of usage.

As of 2021, approximately one-third of the Trail falls on roadway sections. Each of these sections, whether a short connection between greenways or a longer distance, had been evaluated using the RSA tool. TCT wanted to approach the existing routing on road from a perspective of optimal experience for the user. This meant to consider the access from any given point A to point B from the perspective of ease of use, experience of the user, and points of interest.

Identification of routing realignment

Using an internal ArcGIS Online map view and the assistance of the RSA tool, TCT staff were able to explore each section of road, specifically those with higher RSA prioritization scores, to see if alternative options existed.

The practice was fairly simple, using the routing layer overlay, staff would identify segments of roadway routing and explore the region around the point-to-point section of interest. In some instances, there was an existing trail that would only cause a minor realignment of the routing to access and would essentially serve the same point to point connection. In other instances, there were no evident greenways to realign to, however, there were other roadways that appeared to be less of a direct route for vehicular traffic (more of a local road). Staff would then identify existing factors of the alternate route and assess the overall RSA score of each option. If it was determined to potentially improve the experience of the user, contact would be made with the Trail Partner (trail organization, city, etc.) in order to discuss and agree on a realignment.



Figure 4-1: Photo of the Active Transportation path along the Hillsborough Bridge (Prince Edward Island)

Supplementary guide for project valuation and approval

Among the many services that the TCT provides to trail partners, is that of a project funder. As active transportation and recreation began taking a higher priority among many cities and towns, TCT started to receive many more applications from groups that focused on trail development or multi-use path construction projects.

As no two projects are easily compared, TCT staff used the RSA tool as a supplementary guide towards approving project applications for funding and the amount they may receive. As the scoring system of the RSA highlights Levels 4 to 6 as a higher priority, applications that helped to reduce the number of kilometers of those ratings could be viewed more favorably to receive funding. Many elements factored into the decision-making process including the RSA score, the distance of the trail project, the cost of the project, and the experience of the user.

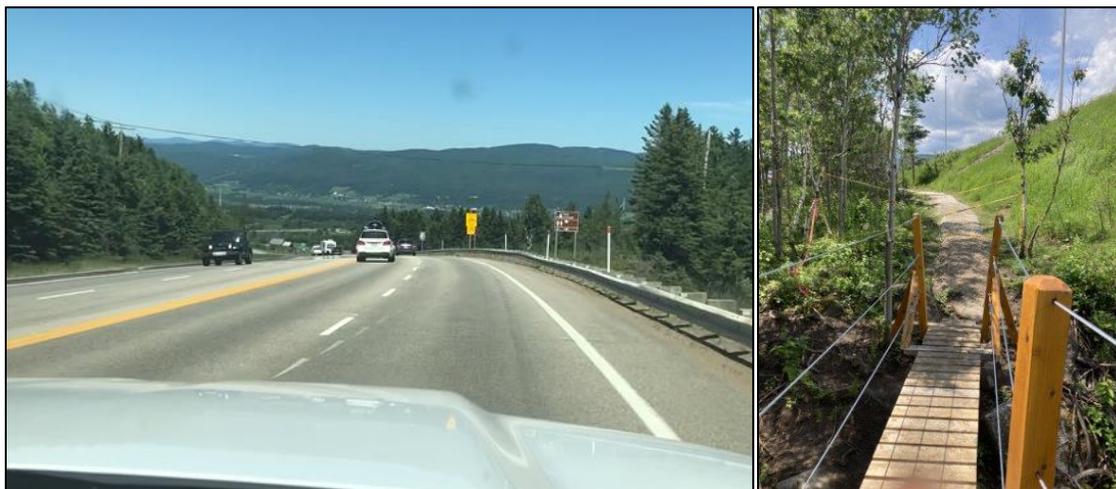


Figure 4-2: Before and after pictures of a project guided by the RSA tool in Baie St. Paul (Quebec)

Figure 4-2 above demonstrates a project where the TCT routing was initially on approximately 2 km of a 4-lane highway to connect two trailheads. The local group had received the permission to construct trail in the highway right-of-way and had applied for funding from TCT. The proposed new routing was to develop a much more enjoyable and scenic trail for pedestrians and cyclists alike. The project was evaluated and considered as a priority project with the support of the RSA tool. Ultimately, the decision was made to support this project by providing funding to the proponent group.

Prioritization guide for Active Transportation development discussions

Following the realignment of identified sections and many partner driven projects being initiated, there were a few remaining segments of the TCT routing that the RSA tool identified as a priority to consider. Longer stretches of routing with higher RSA were prioritized internally and TCT began outreach with Trail Partners (e.g., municipalities, cities, towns) to identify opportunities for those sections. In some cases, these discussions resulted in learning of the timeline for the Trail Partners plan to begin potential projects, while other discussions identified that it was not in the group's near-term capacity to explore on their own. In some of these cases, TCT began to explore studies that would provide information about potential opportunities and costing that may kickstart planning for these sections of TCT routing. These studies were meant to provide early-stage work that could encourage Trail Partners to take these results and move the project to the next level.

Consideration of proposed extensions to the network

Since 2022, the Trans Canada Trail has begun the process of actively expanding the Trail by 10% over a 5-year period (ending in 2027). Additions to the network are being explored based on two reception mechanisms: a) applications to join from external groups, b) TCT driven explorations of priority regions that are not served currently by TCT. Some of the applications include road cycling networks or extensive on-road portions. TCT has used the RSA tool to explore each section of roadway that may be considered. This has helped to determine if the proposed sections would provide a good experience for the user and should be added to the network. Similar to the assessment of alternative routing options above, an internal evaluation of the roadway factors was completed with support of the RSA Tool.



Figure 4-3: A Trail Section at Véloroute Péninsule Acadienne (New Brunswick)

Figure 4-3 above is a section of the routing for the addition of the Véloroute Péninsule Acadienne in northeastern New Brunswick. Approximately 65 percent of the routing for this cycle tourism network was on the roadway. TCT used the tool to provide scoring for each roadway section as part of the evaluation process for this extension. This was included in the recommendation and eventually registered partially based on the quality cycling conditions identified by the RSA tool.

5. Lessons Learned

Several important technical and operational lessons emerged from the project. One of the primary findings was that national-scale studies of road networks require extremely high-precision, local-level data to achieve meaningful results. Early development of data pipelines was essential to efficiently manage the large volumes of incoming data and to maintain consistency over time. The team also learned the value of beginning with the most difficult cases, particularly rural areas with low population density and limited data availability. This strategy ensured that workflows were robust enough to handle the full range of environments across Canada.

Minimizing manual intervention emerged as another key lesson, as processes like visual assessments of road shoulders from imagery proved inconsistent and time intensive. Wherever possible, the GIS team focused on automation and standardization to reduce the potential for human error and to increase efficiency. Finally, the project highlighted ongoing challenges with the cost and availability of reliable AADT and speed data, particularly for secondary and rural roads, which will continue to require creative solutions in future work.

6. Next Steps

Building on the successes and lessons of the first pass, the GIS team plans several strategic initiatives to further strengthen the Trail's GIS infrastructure. A major priority is the migration of the trail network alignment to that of OpenStreetMap (OSM), which offers improved long-term data maintenance capabilities and includes both roadway and non-roadway trail linework. This transition will also enable a more seamless integration of on-road and off-road trail sections within a unified dataset.

Another focus area will be the enhancement of rural area data completeness, ensuring that the Trail network reflects the realities of all regions in Canada, not just urban centers. To support ongoing data updates, the team will expand the use of Python scripting to automate the extraction of relevant variables from provincial and municipal open data sources on a recurring basis. These next steps will help ensure that the Trans Canada Trail's GIS data remains current, comprehensive, and capable of supporting future trail planning and development.

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