To Separate or Not to Separate?:
The Deerfoot Trail Case Study

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ABSTRACT

Raised barriers are often provided in the median along highways. Providing a barrier can prevent severe cross-median collisions, but can also result in a significant increase in fixed-object crashes. Current guidelines for providing median barriers are based primarily on the median width and traffic volume.

This paper will discuss the classic trade-off between crash frequency and severity, and illustrate it using the example of the Deerfoot Trail in Calgary, where the occurrence of several high-profile fatal crashes raised the question of the need for raised median separation. The case study will review the characteristics of median involved collisions and determine the primary contributing factors of these collisions.

The current relevant standards, experience in various jurisdictions and the expected changes to the standards will be discussed. The need for a barrier will be reviewed at the case study location using both the current standards, the new standards and based on a separate review of the safety performance.

The application of various barrier systems and other median modifications to optimize median operations and safety will be presented. A comparison of the various barrier systems based on the installation cost, maintenance costs, deflection, impact forces and collision performance will be provided. Using the Deerfoot Trail as an example, the multiple considerations in the determination of an appropriate barrier system for a divided highway corridor will be demonstrated.

1.0 INTRODUCTION

Median barriers are commonly installed along divided highways to provide a physical barrier between opposing traffic streams. Median barriers are intended to eliminate cross-median collisions, which have the potential to be severe, by intercepting an errant vehicle prior to crossing into opposing traffic. Although the severity of collisions can be reduced, the introduction of a fixed object at the roadside invariably increases the frequency of collisions.

This paper discusses the classic trade-off between crash frequency and severity, using the example of the Deerfoot Trail in Calgary, where the occurrence of several high-profile fatal crashes raised the question of the need for raised median separation. The case study will review the characteristics of median involved collisions and determine the primary contributing factors of these collisions. The need for a median barrier will be evaluated using several different warrants and by conducting a benefit-cost analysis. The appropriate barrier type will be assessed by reviewing the road, traffic and collision characteristics of the study area.

2.0 MEDIAN BARRIERS: CURRENT PRACTICES AND TYPES

Traffic barriers are protective devices used to deflect errant vehicles away from a potentially dangerous roadside hazard. Traffic barriers are frequently installed in the median to prevent cross-over movements, particularly at locations where the median is narrow and traffic volumes are high. Median barriers are typically implemented at locations where it is anticipated that the risk of colliding with the barrier is less than the risk of colliding with oncoming traffic.

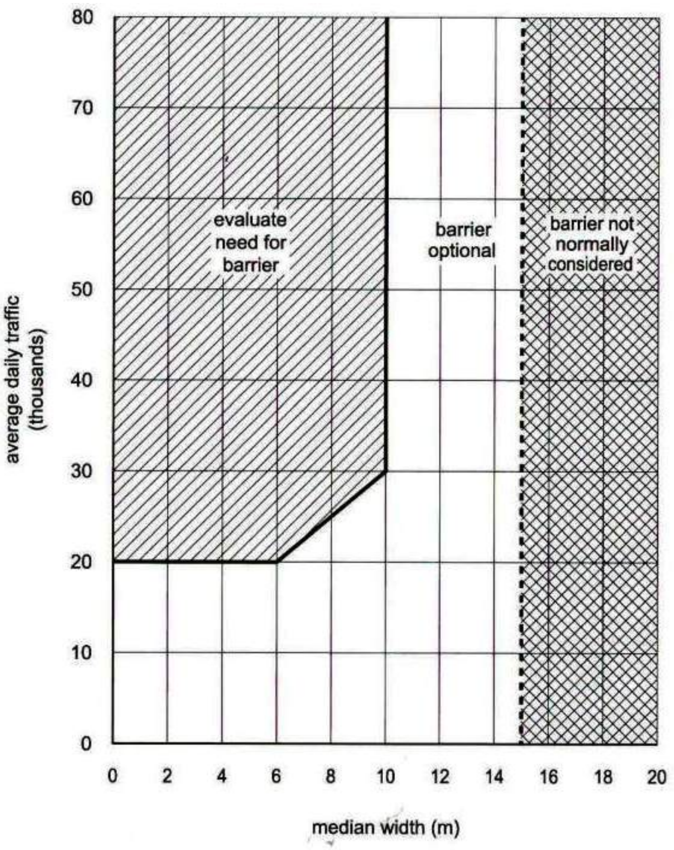
Risk is a function of both collision frequency and collision severity. In the presence of median barriers, the collision frequency typically increases, sometimes significantly. However, the collision severity almost always decreases, because head-on collisions are replaced by fixed-object collisions. The severity of collisions with the barrier is a function of several factors, including the travel speed, the angle of entry and the barrier type.

2.1 Existing Warrants

Road agencies and associations have developed warrants to assist in determining the need for median barriers. The following agencies' median barrier warrants were reviewed as a part of this study:

- Alberta Infrastructure and Transportation (INFTRA) (1)
- Transportation Association of Canada (TAC) (2)
- American Association of State Highway and Transportation Officials (AASHTO) (3)
- British Columbia Ministry of Transportation and Highways (4)
- California Department of Transportation (Caltrans)

The warrants developed by the above agencies are based primarily on traffic volumes and median width, with some provisions made for the consideration of cross-median collisions. All of the warrants make reference to a chart showing median width versus traffic volume, similar to the AASHTO / TAC warrant shown in FIGURE 1. The Caltrans warrant is the only warrant that explicitly considers cross-median collision rates in addition to the traffic volume and median width.



Note: Average daily traffic is based on a 5-year projection.

FIGURE 1 - AASHTO AND TAC MEDIAN BARRIER WARRANT
Source (3)

2.2 Recently Revised Warrants

It has become increasingly recognized that existing warrant guidance is inadequate (including by the National Transportation Safety Board in February 2002) to cover today's higher-speed and higher-volume roadways, the increase in heavy trucks, changes in vehicle performance and other factors affecting the probability of cross-median collisions. These trends have been found to contribute an increase in the cross-median collision risk. At the same time, barrier systems have evolved, providing safer and lower-cost options for highway median barriers.

Several State Department of Transporations have recently changed their warrants based on their accumulated experience. Experience from New Jersey, North Carolina and other jurisdictions suggest that cross-median collisions occurred with similar frequency in each area of the existing AASHTO warrant chart. Therefore, the revised warrants are generally much more conservative, considering the need for a barrier on medians up to 75 feet (23 metres) wide. Some of the states with revised warrants are listed as follows:

North Carolina: Any medians up to 23 metres (75 feet) could warrant barriers, depending on specific crash histories.

Florida: On all divided highways less than 64 feet (19.5 m)

Maryland:

- All medians less than 30 feet
- Medians less than 50 feet (15.2 metres) with volumes greater than 40,000 vpd
- Medians less than 75 feet (22.9 metres) with volumes greater than 80,000 vpd

California: Evaluated for medians up to 75 ft (22.9 metres) and > 20,000 vpd

Washington / New Hampshire:

- Barrier all medians less than or equal to 50 ft (15.2 m) wide
- Do not install barriers for medians wider than 60 ft (18.3 m)
- Consider case-by-case barriering medians in the 50 ft - 60 ft (15.2m-18.3m) range.

A presentation to the AASHTO Subcommittee on Design in June 2005 proposed revisions to the median barrier guidelines in Chapter 6 of the AASHTO Roadside Design Guide. The new warrant recognizes the experience obtained from various states, and provides more conservative guidance for each of the three regions on the warrant chart. The revised warrant recommends barriers where the median width is <10m and the traffic volumes are >20,000 vehicles/day. Barriers are also recommended for median widths <15m; however the road authority is encouraged to conduct a study to determine if the barrier is appropriate. A median barrier is not recommended for widths >15m except under special circumstances.

2.3 Median Barrier Types

There are several options for the selection of median barrier types. The most common barrier types are described as follows and summarized in TABLE 1.

A. Weak-post W-Beam

The weak-post W-beam is a flexible barrier consisting of “W” shaped steel rail mounted on wooden posts. Deflections are typically in the range of 1.5m to 2.5m. The weak-post W-beam is fairly durable and damage is typically isolated to the impact area and not the entire barrier (5). The weak-post W-beam is recommended for use only in areas that are relatively flat.

B. Strong-Post Blocked-Out W-Beam

The strong-post blocked-out W-beam is a semi-rigid barrier similar to the weak-post barrier. However, the posts are stronger and blocks are used to hold the rail away from the posts to prevent vehicles from striking them. Deflections of the strong-post system are small and typically in the range of 0.6m to 1.2m. Therefore, the barrier can be used closer to a roadside hazard. However, due to the limited deflection, the impact incurred by occupants of the colliding vehicle is greater than the weak-post W-beam. As with the weak-post system, the blocked-out W-Beam is recommended for use only in areas that are relatively flat.

C. Thrie-Beam

The thrie-beam guardrail system is similar to that of the W-beam with a slight deviation in the rail design. The thrie-beam has a slightly wider, triple corrugated rail compared to the W-beam, which is double corrugated. The design of the rail is able to accommodate a larger range of vehicles than the W-beam (6). Typical deflections of the thrie-beam barrier are in the range of 0.3m to 0.9m.

D. Cable Barrier

A cable barrier consists of high tension cables (typically three) supported by a series of weak steal posts. Cable barriers provide the greatest amount of deflection in the range of 2.0m to 4.0m. The large deflection reduces the amount of impact incurred by the occupants of the vehicle. However, the large deflection must be considered when placing the barrier near fixed objects or opposing travel lanes. The cable barrier system is effective on moderate slopes.

E. Concrete Median Barrier

Concrete median barriers, either pre-cast or cast in place, are rigid barriers commonly used in narrow medians. Concrete barriers are most often used when there is no room available for deflection. Collisions with a concrete barrier should not result in deflection of the barrier and therefore the impact on occupants can be severe. For this reason, concrete barriers are typically placed near the edge of the travelled lane where the angle of impact is smaller and more likely to deflect an errant vehicle.

Regardless of the type of median barrier, it is essential that the barrier has undergone testing and has been proven effective. In Canada and the United States the standard for crash testing and evaluating traffic barriers is the National Cooperative Highway Research Program (NCHRP) Report 350.

TABLE 1 - MEDIAN BARRIER SYSTEM COMPARISON

BARRIER TYPE	FLEXIBILITY	DEFLECTION (m)	IMPACT FORCES	INSTALLATION COST (per km)	ANNUAL MAINTENANCE COST (per km)
Weak-Post W-Beam	Flexible	1.5 - 2.5	Low	$125,000(1)	$200(2)
Strong-Post Blocked-Out W-Beam	Semi-Rigid	0.6 – 1.2	Medium	Slightly higher than weak-post	Slightly lower than weak-post
Thrie-Beam	Semi-Rigid	0.3 – 0.9	Medium	Slightly higher than W-beam	Similar to W-beam
Cable Barrier	Flexible	2.0 – 4.0	Low	$70,000(1) $150,000+(3)	$1,400(2)
Concrete Median Barrier	Rigid	0	High	$210,000(1)	$32(2)

(1) Source (7) – converted to Canadian dollars and per kilometre

(2) Annual Maintenance costs include periodic inspection, adjustment, and repair estimated by reviewing actual maintenance costs for repairs to systems in Washington State (7)

(3) Alberta Infrastructure and Transportation was quoted a price of approximately $150,000 per kilometre for cable barrier materials (installation would be extra)

One of the most important characteristics to consider in the barrier selection process is the amount of deflection that may occur during a collision. If the barrier is located close to the roadside hazard or the opposing travel lanes, only a minimal deflection can be tolerated. However, if the median is wider, then a greater deflection is more desirable due to the decrease in the impact incurred by the occupants of the vehicle striking the barrier.

The performance of various median barriers was tested by NCHRP and the results are summarized in TABLE 2.

TABLE 2 - COLLISION PERFORMANCE OF MEDIAN BARRIERS

	MEDIAN BARRIER TYPE*			
	Weak-Post	Strong-Post	Concrete	Other
Injury or Fatality (%)	8.8	17.5	16.2	11.5
Redirect (%)	82	88	91	78
Snag (%)	12	5	0	7
Penetrate (%)	3	5	5	15

* Cable Barriers were not covered in this evaluation

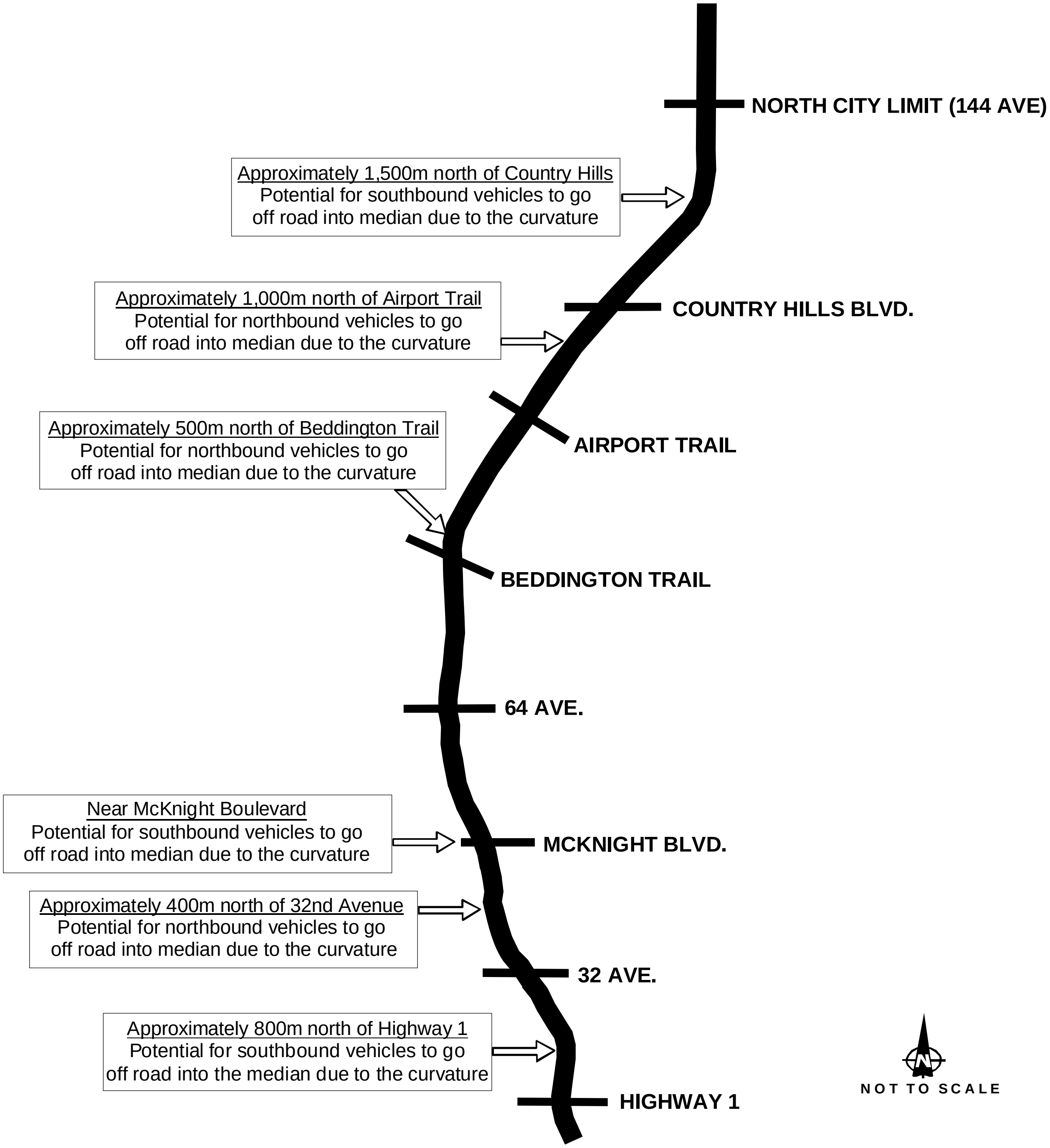
Source (8)

3.0 DEERFOOT TRAIL CASE STUDY

The following case study is provided to illustrate the processes involved in selecting an appropriate median barrier. The case study reviews the road, traffic and collision characteristics of the study area and correlates these characteristics with the need for a median barrier and the appropriate barrier type.

The case study was conducted by Hamilton-Finn Road Safety Consultants for Alberta Infrastructure and Transportation, along a section of the Deerfoot Trail in the City of Calgary. In 2004 and 2005, there were three fatal collisions resulting from vehicle manoeuvres across the median. The purpose of this study is to assess the existing median conditions and determine what improvements may be considered to reduce the overall risk of collisions, including the evaluation of the need for a median barrier.

The section of the Deerfoot Trail Corridor that was reviewed extends from Highway 1 to the northern Calgary city limit. Deerfoot Trail, also known as Highway 2, is the major north-south freeway through the City of Calgary. The study section is approximately 14.5 km long and is illustrated in FIGURE 2.



Approximately 1,500m north of Country Hills
Potential for southbound vehicles to go
off road into median due to the curvature

Approximately 1,000m north of Airport Trail
Potential for northbound vehicles to go
off road into median due to the curvature

Approximately 500m north of Beddington Trail
Potential for northbound vehicles to go
off road into median due to the curvature

Near McKnight Boulevard
Potential for southbound vehicles to go
off road into median due to the curvature

Approximately 400m north of 32nd Avenue
Potential for northbound vehicles to go
off road into median due to the curvature

Approximately 800m north of Highway 1
Potential for southbound vehicles to go
off road into the median due to the curvature

FIGURE 2 - DEERFOOT TRAIL HORIZONTAL ALIGNMENT

3.1 Median Characteristics

Within the study section, the median varies in width from 17m to 31m (including shoulders). No traffic barriers are provided in the median with the exception of guardrails that protect bridge piers and select overhead sign installations. The median is relatively free of fixed objects, with the exception of a few signs, bridge piers and electrical (or other) transformer boxes.

For the purpose of analyzing and illustrating the study section characteristics, the study corridor was divided into seven sub-sections, separated by the overpass locations. The physical characteristics for each sub-section are summarized in TABLE 3.

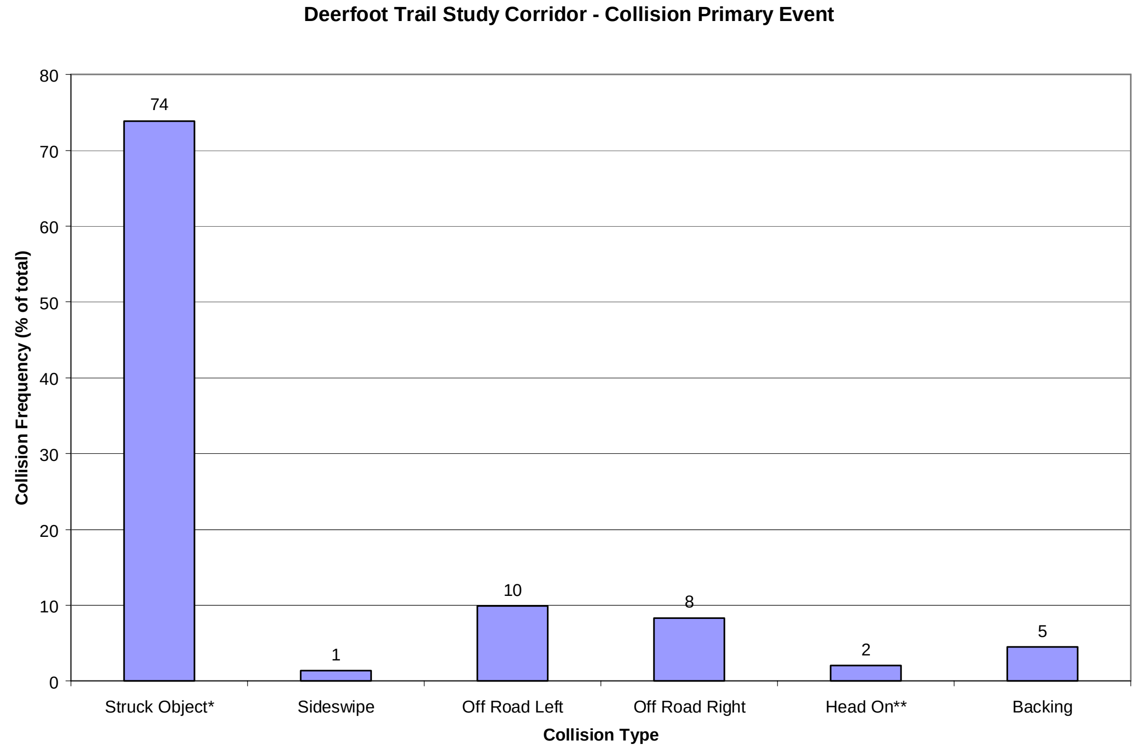
TABLE 3 - SUB-SECTION CHARACTERISTICS

SECTION		DISTANCE (km)	MEDIAN WIDTH (m)	NUMBER OF HORIZONTAL CURVES
1	Highway 1 to 32nd Avenue	1.75	17	1
2	32nd Avenue to McKnight Blvd.	1.65	17	2
3	McKnight Blvd. to 64th Avenue	1.65	17	1
4	64th Avenue to Beddington Trail	1.75	17 - 29	0
5	Beddington Trail to Airport Trail	2.0	29 - 31	1
6	Airport Trail to Country Hills Blvd.	1.75	31	1
7	Country Hills Blvd. to North City Limit	3.7	31	1

The median characteristics adjacent to the study section were documented for comparative purposes. South of Highway 1 a median barrier is provided along Deerfoot Trail. The median barrier is a W-beam for approximately 3km, where it continues as a concrete barrier several kilometres further south. The median width of the section provided with W-beam median barrier is approximately 17m, and comparable to the median along the study section. North of the City limit, Deerfoot Trail maintains the 31m grassy median. Median barriers are not provided north of the city limits.

3.2 Characteristics of Median Collisions

The Transportation Safety Services Division of INFTRA provided collision data for the review. Collision summaries were provided for all collisions occurring along the Deerfoot Trail Corridor within the city limits between 1999 and 2003. During that time a total of 487 reported collisions occurred in the Deerfoot Trail study section. A summary of the collision types is provided in FIGURE 3.



* Struck object includes rear-ends and collisions with fixed objects and objects on the roadway.
** Head on collisions include collisions with opposing traffic and vehicles travelling in the same direction (i.e. one vehicle turned 180 degrees)

FIGURE 3 - DISTRIBUTION BY COLLISION TYPE

Of the 487 collisions reported, 36 involved at least one vehicle entering the Deerfoot Trail median at a location where no barrier was provided. An additional 31 collisions occurred at locations with a protective guardrail, such as bridge piers and overhead sign posts.

A. Median Collision Frequency and Severity

Examining the median collision rates revealed that they were higher along sections where the median is narrower. The lower collision rate observed at wider medians is likely the result of the larger recovery zone available to errant vehicles. The collision rates are summarized in FIGURE 4.

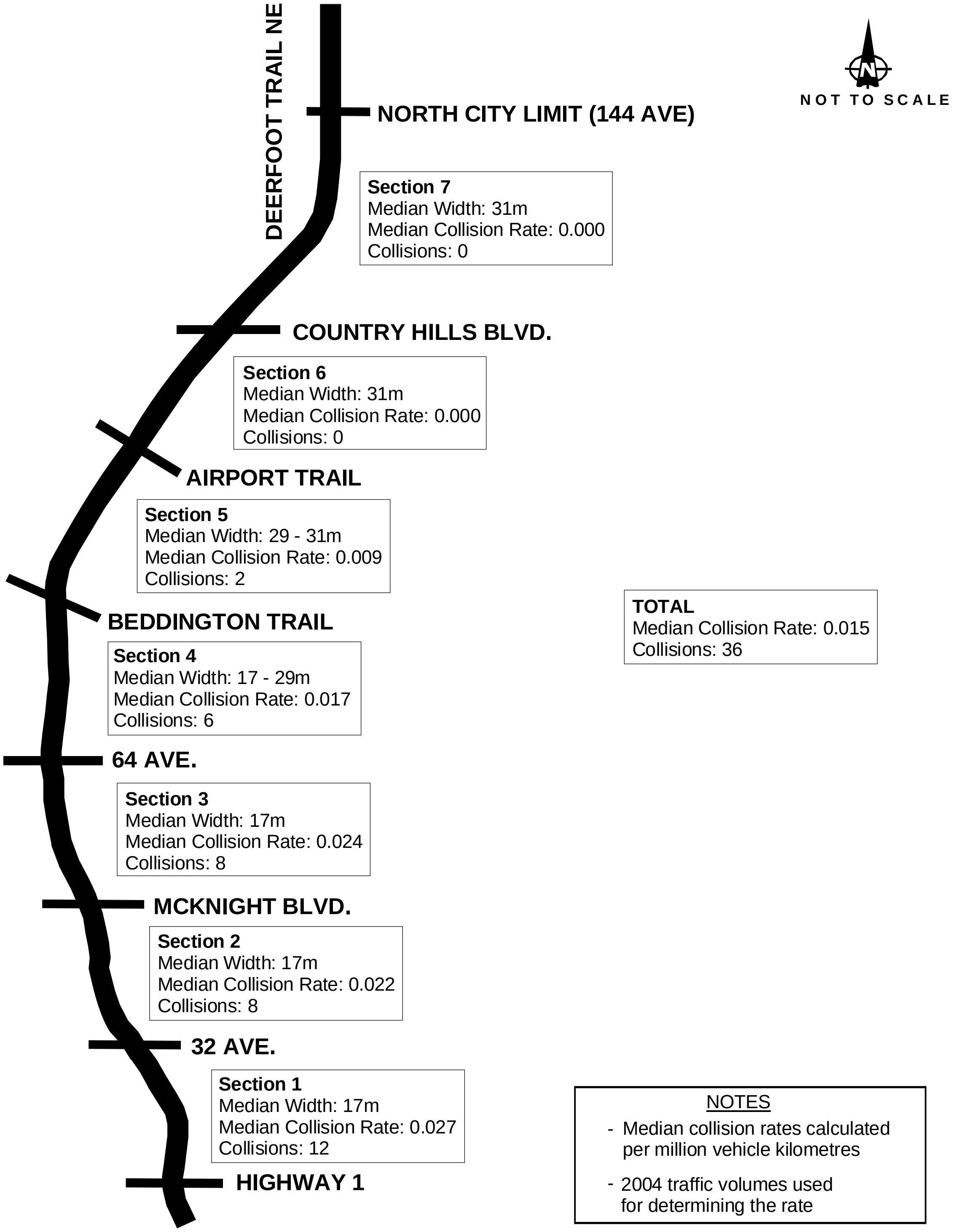
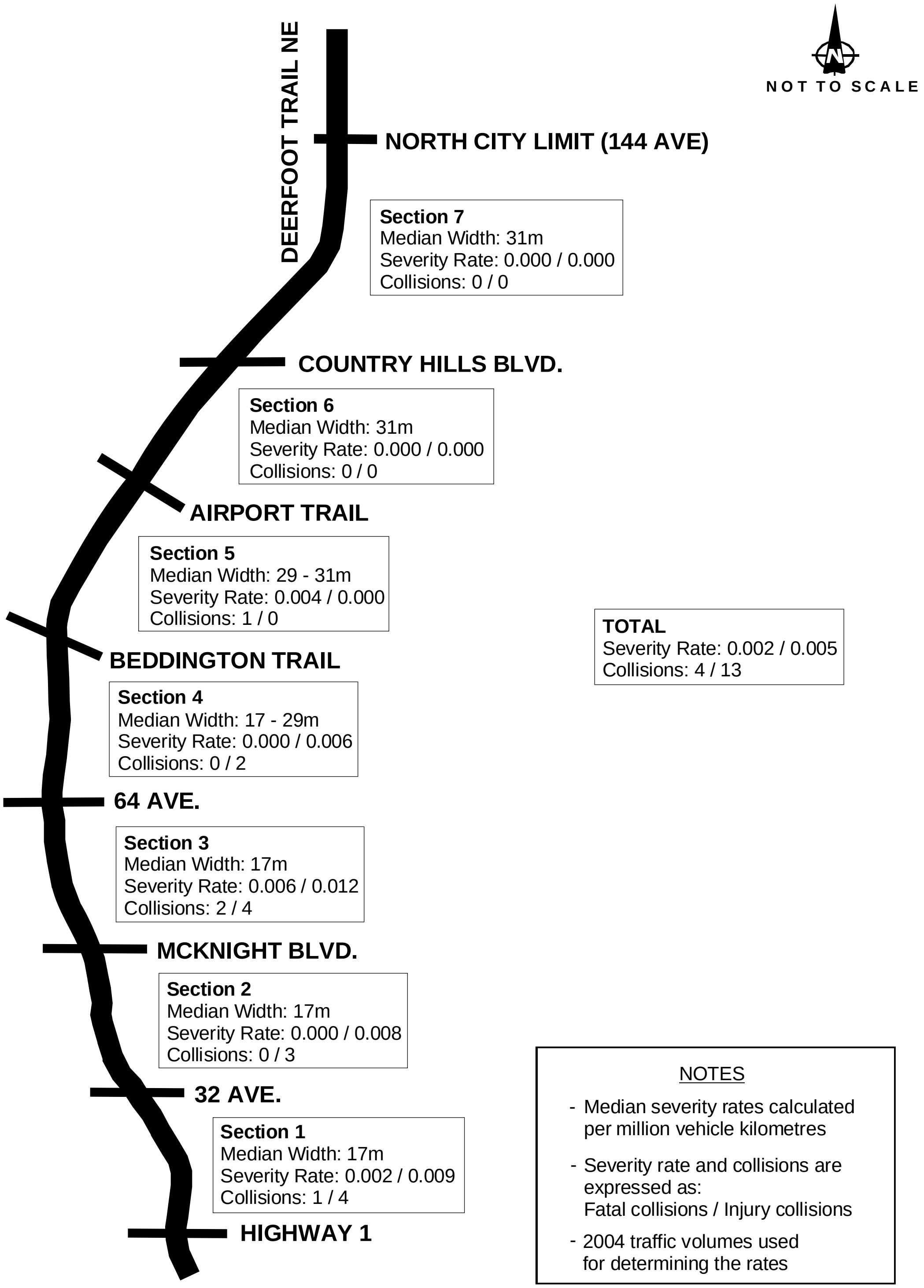


FIGURE 4 - MEDIAN COLLISION RATE

A review of the median collision severity revealed that median collisions also become more severe as the median narrows. The fatal and injury collisions occurred at a higher rate within sections where the median is narrower. The collision severity rates are summarized in FIGURE 5.



NOTES

- Median severity rates calculated per million vehicle kilometres
- Severity rate and collisions are expressed as:
  Fatal collisions / Injury collisions
- 2004 traffic volumes used for determining the rates

FIGURE 5 - MEDIAN COLLISION SEVERITY

B. Median Collision Contributing Factors

Collision descriptions were reviewed to determine the primary factors contributing to the 36 median collisions between 1999 and 2003. The median collisions were divided into fixed object collisions, cross-median collisions and other collisions in the median. TABLE 4 identifies the primary contributing factors associated with the collisions for each of these consequences. Although it is likely that most of the collisions resulted from a combination of factors, the study team made an effort to determine the primary contributing factor in order to reveal patterns.

TABLE 4 - CONTRIBUTING FACTORS TO COLLISIONS

PRIMARY CONTRIBUTING FACTOR	CONSEQUENCE									
	Off-Road Collision (collision with median)			Collision With Fixed Object			Cross-median Collision			Total
	P	I	F	P	I	F	P	I	F	
Surface Conditions	4	1	0	5	0	1	0	2	0	13
Excessive Speed	0	1	0	0	0	1	0	2	0	4
Avoiding Collision	3	3	0	0	0	0	0	0	0	6
Vehicle Failure	3	0	0	0	0	0	0	0	0	3
Collision with other vehicle	2	0	0	0	0	0	1	0	0	3
Driver Distraction / Impairment	0	1	0	0	0	0	0	2	1	4
Unknown	1	0	0	0	1	0	0	0	1	3
TOTAL	13	6	0	5	1	2	1	6	2	36

P= Property Damage Only, I = Injury, F = Fatal

The distribution of the primary contributing factors revealed the following trends:

- The off-road collisions are the most common and the least severe. The leading causes of these collisions were adverse surface conditions and collision avoidance manoeuvres.
- The majority of the collisions with fixed objects occurred during adverse road surface conditions, including one of the two fatal collisions.

- Of the cross-median collisions, the primary contributing factors were reported to be excessive speed and driver distraction or impairment, including one of the two fatal collisions.

C. Median Cross-Over Collision Characteristics

Of the four fatal collisions occurring in the median between 1999 and 2003, two were the result of median cross-over movements. The median cross-over collision analysis revealed that the rate of cross-over collisions is likely related to the median width. Cross-median collisions were more frequent in sections having a narrower median width, with eight of the nine collisions occurring within the section with the 17m wide median. Since 2003, there have been an additional three fatal cross-median collisions within the study area.

D. Median Collision Locations

Of the 36 median collisions, 19 occurred along a curved segment. In particular, ten collisions occurred on the curve located 800m north of Highway 1. This is a relatively tight curve and the median is 17m wide. Five of the cross-median collisions also occurred along a curved segment, including four on the curve located 800m north of Highway 1.

There is a greater potential for vehicles to travel off road on the outside edge of a curve, particularly when surface conditions are poor or when a driver is impaired from intoxication, fatigue or as the result of a medical condition.

3.3 Application of Warrants

The INFTRA, AASHTO/TAC and CalTrans warrants were conducted for the study section. The median barrier warrants conducted for the current traffic volumes (2004) are provided in TABLE 5.

The results revealed that, according to the AIT and AASHTO/TAC warrants, median barriers are not required north of Highway 1 because the median width is greater than the 15m stipulated by all three warrants.

However, all three warrants mention that while barriers may not be warranted based on traffic volumes and median width, they might be necessary based on an adverse collision history. The AIT and AASHTO/TAC warrants did not elaborate on how the collision history should be accounted for.

TABLE 5 - MEDIAN BARRIER WARRANT APPLICATION RESULTS

			Barrier Warrant Result		
Section	**Median Width**	**AADT**	**AIT**	**AASHTO / TAC**	**CALTRANS**
1	17m	138,180	AADT exceeds limits of Alberta guidelines. Therefore use AASHTO warrants.	Barrier not normally considered (Median width > 15m)	Barrier Study Warranted
2	17m	119,120			
3	17m	111,380			
4	17m - 29m	108,340			Barrier warranted up to 23m median width. Barrier not warranted based on collision rate
5	29m - 31m	62,200	Median Barrier not Required (Median Width > 15m)		0.1 fatal cross-median collisions per kilometer per year > 0.73. Therefore, further analysis warranted.
6	31m	58,060			Study Not Warranted based on AADT, median width or collisions
7	31m	50,110			

According to the CalTrans warrant a barrier study is warranted for all locations where the median width is less than 23m based on the high traffic volumes. In addition, the warrant suggests that further analysis be conducted to determine the advisability of a barrier between Beddington Trail and Airport Trail (Section 5). This recommendation is based on the fatal cross-median collision rate of 0.1 collisions per kilometre per year (based on one fatal collision), which exceeds the limit of 0.073 stipulated in the Caltrans warrant.

3.4 Benefit Analysis

Estimating the possible benefits of providing a median barrier along the study section was conducted using collision reduction factors from the literature and experience in other jurisdictions. It also considered the historical collision occurrence and collision type along the study section.

Based on the literature and experience in other jurisdictions, anecdotal information regarding the frequency of median encroachments, and the performance of the barrier along the section to the south, the study team made the following estimates and assumptions of the performance with a barrier. Ranges are provided to account for some of the uncertainty in the estimates and the random nature of collision occurrence:

- 100% of cross-median collisions would be eliminated in the presence of a barrier.
- Fixed-object collisions with signposts would be replaced by collisions with the barrier. These would be less severe than the fixed object collisions.
- The increase in off-road collisions (with barrier) could be anywhere between 100% and 300% percent.
- Collisions with the barrier would have the following breakdown:
    - 1% fatal
    - 33% injury
    - 66% property damage only

This breakdown is based on documented experience in various jurisdictions. Applying these assumptions to the Deerfoot Trail Corridor would yield the collision breakdown summarized in TABLE 6.

TABLE 6 - POTENTIAL COLLISION REDUCTION ESTIMATES

COLLISION TYPE	1999-2003 COLLISION FREQUENCY	1999-2003 COLLISION FREQUENCY PLUS FATALITIES SINCE 2003	PREDICTED FIVE-YEAR COLLISION FREQUENCY (LOW ESTIMATE – BASED ON 100% INCREASE)	5 YR FREQ. (HIGH ESTIMATE – INCLUDING FATALITIES SINCE 2003 AND 300% INCREASE)
Fatal Cross-Median Collisions	1	3	0	0
Injury Cross-Median Collisions	6	6	0	0
PDO Cross-Median Collisions	1	1	0	0
Fatal Collisions with Barrier/Median	2	2	0.7*	1.4*
Injury Collisions with Barrier/Median	7	7	22.3*	47.6*
PDO Collisions with Barrier/Median	17	17	45.0*	95*
TOTALS	34	36	68**	144***

*Based on breakdown of 1% fatality, 33% injury, 66% PDO
**Based on 100% increase in total collisions
***Based on 300% increase in total collisions

Based on this projected change in collisions and the societal costs of collision values used by the Province of Alberta and published in the 3R/4R Guidelines of the Highway Geometric Design Guide, the expected collision cost savings are summarized in TABLE 7.

TABLE 7 - POTENTIAL COLLISION COST SAVINGS

COLLISION CONSEQUENCE	CHANGE IN 5 YEAR COLLISIONS		COST PER COLLISION	CHANGE IN 5 YEAR COLLISION COST	
	Low Est.	High Est.		Low Est.	High Est.
Fatal Collisions	-3.6	-2.3	$1,345,068	-$4.84M	-$3.09M
Injury Collisions	+9.3	+34.6	$100,000	+$0.90M	+$3.46M
PDO Collisions	+27	+77	$12,000	+$0.32M	+$0.92M
NET CHANGE IN COLLISION COSTS				-$3.62M	$1.29M

The following conclusions were made with respect to the potential benefits of providing a raised median barrier:

- The likelihood of a decrease in the total cost of collisions is much higher than the likelihood of an increase. Overall, a net benefit is expected.
- The median barrier is expected to eliminate the high-profile, tragic crashes that involve cross-overs and head-ons. Given the collision profile that was reviewed for this study, the expected increase in lower-severity crashes with the median is considered an acceptable trade-off.
- The provision of a barrier along the section with the 17 metre median will be consistent with the identified trend of providing a barrier along highway sections with wider medians (for example in California, Florida, North Carolina, Maryland) and with the findings of NCHRP Report 17-14 and the proposed revisions to the AASHTO Roadside Design Guide.
- Given the horizontal curves and likelihood of adverse weather conditions in the study area, the benefits of a median barrier are emphasized.
- It is expected that a concrete barrier is likely to result in higher-severity collisions, while the more flexible guardrail and post-cable systems are expected to result in much lower-severity collisions.

3.5 Cost Estimates

The costs of installing the three main barrier types were estimated for the section between Highway 1 and Beddington Trail where the median is 17m wide. The cost estimate in TABLE 8 is based on the length to tie in to the existing guardrail to the south and to the guardrail that protects the bridge pier at Beddington Trail as shown in FIGURE 6 – a length of approximately 6.8 km.

TABLE 8 - ESTIMATED INSTALLATION AND MAINTENANCE COSTS

BARRIER SYSTEM	INSTALLATION COST*	ANNUAL MAINTENANCE COST*
Cable and Post	$500,000	$10,000
Guardrail	$850,000	$1,500
Concrete	$1,500,000	$250

* Based on Washington State findings (7) (converted to Canadian dollars).

SUGGESTED MEDIAN BARRIER INSTALLATION

FIGURE 6 - SUGGESTED BARRIER INSTALLATION LOCATION

3.6 Benefit-Cost Analysis

Based on the preceding benefit analysis and cost estimates, the benefits and costs associated with each of the systems are summarized in TABLE 9. The values represent the ratio of the estimated benefits to the estimated costs. The service life of a barrier system is variable, but estimates over a period of 5 years and 20 years have been provided. No adjustments to account for inflation or interest were made. For this analysis, the benefit-cost ratios presented are based on the low estimate; this represents the high end of the range of the potential benefit-cost ratio that can be achieved.

TABLE 9 - PROJECTED BENEFIT-COST RATIOS

BARRIER SYSTEM	5-YEAR BENEFIT-COST RATIO*	20 YEAR BENEFIT-COST RATIO*
Cable and Post	6.6	20.1
Guardrail	4.2	16.5
Concrete	2.4	9.6

* Based on the best case scenario (high reduction in collision costs)

Based on this benefit-cost ratio, it is recommended to give strong consideration to installing a cable-and-post median barrier system along the section between Highway 1 and Beddington Trail. A more detailed benefit-cost analysis should be conducted at the preliminary design stage when more concrete installation and maintenance costs are established.

3.7 Conclusion

The case study revealed that the need for a median barrier should go beyond the mere consideration of existing warrants to include a review of the cross-median collision history, other geometric factors such as the presence of curves, and the benefits that can be recognized with modern barrier systems. In the example of the Deerfoot Trail study in Calgary, Alberta, several fatal cross-median collisions occurred at locations where a median barrier was not warranted based on the median width, according to existing warrant systems.

The benefits of providing a median barrier were assessed by determining the potential reduction in collisions. It was estimated that installing a median barrier would reduce the frequency of higher-severity cross-median collisions and increase the frequency of lower-severity fixed object collisions. The benefit-cost analysis revealed that the potential collision cost savings supports the installation of a median barrier. Due to the higher societal costs associated with the higher-severity cross-median collisions, the expected increase in lower-severity crashes with the median was considered an acceptable trade-off.

The review of barrier systems with a range of deflection characteristics indicated that a cable barrier would be the most effective in reducing the severity of collisions with the median barrier. Cable barriers typically result in lower-severity collisions because they result in the greatest deflection and hence the least impact in collision, and are therefore often the most appropriate barrier type for medians of sufficient width.

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