Questions & Answers: High Tension Cable Barrier

This document is in two parts:

Part 1 has questions and a very brief answer (without supporting information).
Part 2 has the same question with a full answer

Part 1: Simplified Q&A

Question	Answer
Why is the high tension cable barrier (HTCB) placed near the shoulder rather than in the center of the median?	HTCBs have been tested in specific conditions, such as angle that the vehicle strikes the cable, slope of the ground under the HTCB, amount of clear space behind the HTCB, etc. Where the middle of the median meets these conditions, that's where HTCB is put to provide the best protection for both directions of traffic. If HTCB cannot be put in the middle of the median, installation just outside one shoulder is usually the next best location.
Why does it matter that the sideslope is?	HTCBs work better on flatter sideslopes, where the vehicle will hit it moving essentially sideways (very little vertical motion). On steeper sideslopes and narrow median the vehicle's downward movement may be enough to make it push through underneath the cables.
How long does it take to re-tension/repair the barrier system?	It only takes a few hours to remove a series of bent posts and replace with new. Experience on Deerfoot Trail is that usually 3 – 5 posts must be replaced. This work is scheduled to be completed within 10 days if the cables are still able to stop another vehicle. This timeframe is similar to other jurisdictions that use HTCB.
How does the HTCB system remain functional after being hit?	The vertical posts hold the cables at a standard height above the ground. Cables that are broken away from the post by a previous collision are still able to stop another vehicle. There is often enough tension in the cable that even when posts are broken away, the cables stay close to the standard height.
What are the effects on HTCB on the shoulder when vehicles hit built-up snow?	Packed snow at the bottom of HTCB posts on the shoulder could launch vehicles over the cables. Normal snow removal maintenance is required to remove this packed snow. Experience on Deerfoot Trail has shown that this maintenance can be included in routine winter maintenance.
What is the Post-Construction Performance Study?	EBA have been hired to study the performance of the HTCB along the QE II. EBA had previously completed a study of the performance of the HTCB along Deerfoot Trail. That study found that the HTCB worked well as designed and built.

Part 2: Q&A with supporting information

Q1: Why is the high tension cable barrier (HTCB) placed near the shoulder rather than in the center of the median?

A1: The barrier system have been placed where they are in the median or next to the shoulder because the barrier system has been crash tested successfully based on established testing criteria's. The effectiveness of a cable barrier system is influenced by its placement on the slope and from the directions from which it can be hit. Since cable median barriers can be hit from either side, both sides of the median must be considered as approached slopes. Details of the placement guidelines can be found under relevant facts.

In terms of safety and performance, the barrier placement was reviewed based on the approved test requirements, the manufacturer's specifications/experience and engineering judgement where there was some latitude due to the existing site specific constraints.

The ditch may also be subject to existing drainage structures (culverts, catch basins, riprap, etc), utilities, periodic flooding and/or wet soil conditions.

Q2: Why does it matter that the sideslope is? (Slopes of 6H:1V and flatter versus slopes of 4H:1V)

A2: Slopes of 6H:1V and flatter provides greater flexibility than slopes of 4H:1V and steeper where cable barriers can be placed in the median. On slopes of 4H:1V, the barrier system should be place closer to the shoulder of the road to reduce the likelihood of an errant vehicle overriding the barrier system from the near side.

If the barrier system is placed at the bottom of the median of a steep and narrow V-ditch median section, an errant vehicle's suspension compresses more due to the abruptness of the terrain therefore increasing the likelihood of a vehicle to under-ride the barrier system. To optimize the barrier performance, the barrier system has been installed in close proximity to the shoulder where these site specific conditions are applicable.

Q3: If hit by an errant vehicle, how long does it take to re-tension/repair the barrier system?

A3: Our maintenance contractor is required to complete the repair in 10 days. This is similar to the amount of time allowed to replace posts in other jurisdictions. Priority is normally given to snow and ice control on the highway

network. Time is needed for snow removal in the median to access the site and or to perform lane closures. Response time to complete the repair in the summer will likely be less than 10 days.

It should be also noted that the barrier system can be typically be repaired and re-tension in a matter of several hours. Damaged or missing posts are replaced by inserting the post back into its socket/sleeve footing and the cable run re-tensioned.

Q4: How does the HTCB system remain functional after being hit?

A4: The HTCB system often continues to provide protection even after impact and prior to repairs. Upon being hit by an errant vehicle, the barrier system deflects such that damage may be limited to several posts in the immediate vicinity only. Since the barrier system remains in tension, the remainder of the cable run will continue to be functional. The tension often keeps the cable near the design height even when the posts are damaged, missing, and or have broken off.

- Example - Deerfoot Trail, an average of 3 to 5 post replaced per collision

Q5: What are the effects on HTCB on the shoulder when vehicles hit built-up snow?

A5: Packed snow at the bottom of HTCB posts on the shoulder could launch vehicles over the cables. To control snow buildups, snowplow operations will be removing as much snow as possible at these locations without taking out and/or damaging the post. We don't expect small snow buildups to have enough of an impact on the barrier performance.

Q6: What is the Post- Construction Performance Study?

A6: EBA has been retained to undertake a post-construction study over the next year to monitor the overall performance of the barrier design for possible future changes, improvements and or adjustments if required. The study will also include collision data collection, analysis of collisions with emphasis on those locations involving serious injuries or penetration of the barrier system, collision severities, tracking the actual maintenance cost and cost/benefit analysis, and any other issues that may come up during the study. etc.

EBA had previously completed a study of the performance of the HTCB along Deerfoot Trail. That study found that the HTCB worked well as designed and built.

Other Information

RELEVANT FACTS	• All cable barriers must meet the crash test requirements of NCHRP Report 350 or MASH09 (AASHTO, Manual for Assessing Safety Hardware 2009). The HTCB system installed on Highway 2 meets the requirements of NCHRP 350, Test Level 3. • Since cable median barriers can be hit from either side, both sides of the median must be considered as approached slopes. The following are the preferred locations for cable barrier in the median. • For depressed medians with slopes of 6H:1V or flatter, the most desirable placement of barrier is down the centre of the median. However to reduce the probability of vehicles under-riding the system HTCB typically should not be placed between 300 mm to 2400 mm from the toe of the slope. • For depressed medians with slopes steeper than 6H:1V but flatter than 4H:1V, cable barrier typically should be placed within 1200 mm from the edge of the shoulder breakpoint but greater than 2400 mm away from the toe of slope. • Median cable barrier placement relative to the toe of slope is also a factor in reducing the potential of penetrating the barrier system. When cable barrier is placed on the slope near ditch bottoms, compressed suspensions may increase the likelihood of vehicles to under ride the barrier system. • FHWA does not recommend installing cable barriers on slopes steeper than 4H:1V. Currently there no cable barrier system has been approved for placement on theses slope. • Cable deflection are designed and installed to prevent intrusion of opposing vehicles into the travel lane caused by the impact to the cable system on the back-side after crossing the median. The offset from the travel lane on Highway 2 is generally about 3 m. The design deflection is approximately 2.4m. Therefore there should be no encroachment into oncoming traffic under normal design conditions. • The ditch may also be subject to existing drainage structures (culverts, catch basins, rip rap, etc), utilities, periodic flooding and/or wet soil conditions. • A HTCB supplier's (Gibraltar) representative has stated that, based on their experience, installations on the shoulder are highly effective. In general, the chance of an errant vehicle hitting the barrier at a more obtuse angle increases with the offset from the travel lane.

	• We have had good experience with the barrier system on the shoulder of the Deerfoot Trail. • The design was reviewed based on the approved test requirements, the manufacturer's specifications/experience and engineering judgement where there was some latitude due to the existing site specific constraints. A post construction performance study of the cable system will be conducted.
Timeframe to Re-Tension / Repair HTCB System	HTCB generally has many advantages over other types of barrier systems. Besides being the most forgiving barrier system when compared to concrete and steel systems (i.e. F-Shape, single slope concrete, W-beam, strong post, modified thrie beam, etc), HTCB systems often: • continues to provide protection even after impact and prior to repairs. The tension keeps the cable near the design height even when the posts are damaged, missing, and or have broken off. • From correspondence with Central Region's Operations Manager, the maintenance contractor is required to complete the repair in 10 days. This allows the contractor time to manage their resources and respond in the most efficient manner. In the winter, there will issues with contractor's prioritizing their resources for snow and ice control on the highway network. Additional time is anticipated for snow removal in the median to access the site and or to perform lane closures will also be required. Response time in the summer will likely be less than 10 days.
Collision History on the QE II	• There have been approximately 100 hits to the barrier systems (June to November 2010) and five occurrences where the barrier has been breached: three under/through and 2 overrides. We currently have some details of three of the five collisions. From details of three of the collisions, it appears that the vehicles were travelling at excessive speeds (150km/h or more) and hit the barrier at an acute angle of entry. • It is important to note that under the conditions in which the barriers were breached are beyond (and cannot be accounted for) in the crash test level (TL-3) criteria's of the barrier system.