Variable Speed Limit Pilot Project in BC

Road Safety Engineering Award Nomination

Project Description and Road Safety Benefits

British Columbia is unique in its challenges. The highways network has more than 46,000 km of roadway and 21 major mountain passes which can be susceptible to rapidly changing road weather conditions. In 2015, the BC highways network has seen 22 million vehicle kilometres travelled. To ensure the safety of the public, BC has been following our BC on the Move, A Ten Year Transportation Plan. One of the key priorities of the plan is to improve highway safety. This plan encourages the use of intelligent transportation technologies to reduce collisions, monitor and manage traffic flows, and provide travellers with timely information. The Ministry recognized that there was a need to develop a system that provided a reliable driving experience during adverse weather conditions to address driver error, distraction and speeding. As part of the commitment to invest in new road safety improvement program, the Ministry designed, constructed and implemented a variable speed limit (VSL) system on 3 corridors in British Columbia that experience rapidly changing weather conditions. These corridors were noted as having severe winter weather conditions, high elevation changes, and a poor road safety performance during winter conditions. The variable speed limit systems were implemented on Highway 5 the Coquihalla, through Snowshed Hill, along Highway 99 between Squamish and Whistler and on Highway 1 from Sicamous to Revelstoke.

Even when adverse weather is detected by drivers, a safe driving speed in not always apparent. The VSL system that the Ministry has developed uses road side collected data on surface conditions, weather, and vehicle speed to make a speed limit recommendation. Variable speed limits were implemented to provide a more reliable driving experience by using real time road condition information to calculate speed limits based on current conditions.

These pilot systems will improve safety in adverse weather by lowering the speed limits based on conditions. The variable speed limit system has been operational since 2016 and ministry staff have had an opportunity to monitor the changing driver behaviors over the course of this first winter season. Based on the data that has been collected, it is observed drivers are reducing their speeds on the variable speed corridors when a lowered speed limit is posted. The data is showing a reduction in driver's 85th percentile speeds, specifically during winter events. Between December 23 and 30, 2016, BC experienced a severe snow event that impacted all 3 corridors as part of the pilot. Analysis of the posted speeds, 85th percentile and precipitation on the corridors showed that drivers responded to the system and lowered their driving speeds. For example, on Highway 1 during the weather event, the signs were displaying a reduced speed of 60km/h. During this time, the 85th percentile speed on the corridor was 59km/h. Drivers were being provided with relevant real time speed limits and compiling to those changes.

Collision statistics for 2016 are not yet available; however, it is anticipated that the implementation of the VSL will increase speed harmonization and decrease speed differentials on the three implementation corridors. This will reduce the risk of collisions and improve the overall safety level of the facility. Robust empirical analysis for similar systems using real-life crash data seems scarce. An evaluation of "controlled motorways", where VSL systems are used in England, showed potential reduction of 10% in injury crashes. A recent study showed that the use of variable speed limit on a section of the I-5 in Washington State showed a drop of 29% in the total number of collisions. The application of VSL on Oregon Route 217 in the Portland area showed a slight increase in the total number of crashes but lower number of severe crashes. Brief safety analysis was undertaken in Texas for three locations where VSL systems were commissioned. It was found that the number of crashes as well as crash rates decreased at two locations and increased at the third location. More detailed analysis showed that the number of crashes with 'adverse' surface conditions (e.g. wet, ice, snow, muddy, etc.) decreased after VSL activation.

This strategy has been successful in Europe and USA but is new to Canada. The Ministry is confident that we will see similar results when there is sufficient data available. In addition, the Ministry has committed to continued monitoring of the system and data to ensure we are achieving the expected safety benefits of the system.

Project Innovation

This project is the first automated variable speed limit system in the BC and it required a dedicated team to overcome the challenges and find innovative solutions. Design of the variable speed limit system took place through 2015 and was activated in June 2016. Overall, there are 47 overhead LED variable speed limits signs with flashers that activate when a reduced speed limit is in place. This system is a new approach to provide drivers real time travel information and recommended speed limits based on weather conditions. To do this, the design team had to determine location and type of sensors that needed to be employed to provide reliable and accurate data to the Ministry's Regional Transportation Management Centre (RTMC) so speed limits can update to match the current roadway conditions. Optical pavement sensors were installed along each corridor which uses infrared technology to measure road surface conditions and microwave vehicle detectors were installed along each corridor to measure vehicle speed, volume, and classification. Previously collected road conditions and operating speeds were used to develop innovative algorithms to calculate variable speed limits. These algorithms were refined and improved as additional data was collected to ensure speed limits remained relevant to the current conditions. This was critical in developing respect of the system by drivers to have a change in driver behaviour during weather events. A displayed speed limit is unique to the data collected within that segment. Novel overhead digital variable speed limit signs, which include a top mounted amber flasher, were designed to indicate to drivers that a variable speed limit has been posted and display the

current speed limit on the corridor. The sign hardware technology was adapted from common technology to maintain reliability and reparability.

In addition to infrastructure design, the Ministry needed to develop proprietary software for system operation which went through extensive scrutiny in design to meet the demands of the corridor, data collection and storage requirements, and a reliable regulatory system. All metrics of the system operation are stored indefinitely to be used for future system refinement and development. All collected data is sent into the RTMC where it is used to calculate the new variable speed limit. Operators within the RTMC review the system and proposed speed limits before they are sent to the signs installed on a corridor. Speed limits can change as often as every fifteen minutes; ensuring speed limits are accurate based on current conditions. The Ministry has developed and updated operating procedures to ensure speed limits remain as relevant as possible to rapidly changing road conditions. This has been the biggest challenge of the system. This procedure required considerable consultation with the district operations team, RTMC, and engineering staff to ensure that the most appropriate speed limits were being uploaded to signs. Additional policy had to be developed for the manual override which permits the posting of speed limits by designated individuals if the collected data is not leading to a reasonable speed limit. This operation is limited in use and is reserved for extreme events or planned activity where the VSL system can be used to supplement roadside traffic control devices.

This project included work that went beyond design and installation challenges. The team had to develop and update regulations in the Motor Vehicle Act to ensure that the posted speed limits were regulatory and could be enforced by law enforcement. The team also developed an educational campaign for the corridors to address driver behaviours. Public acceptance and understanding of the system is crucial to its success. Drivers must be able to understand why the speed limit is being reduced and that the reason is legitimate. Whether the new speed limit is advisory or mandatory must also be clearly understood by all drivers. The education campaign utilized the overhead dynamic message signs and was developed to be executed in stages. The first stage educated drivers to the new VSL system during its implementation. Once the system was fully operational, a second stage was initiated to provide confirmation to drivers that they were entering a VSL corridor and speed limits can change depending on the road conditions. Finally, the third stage can be utilized to inform drivers when there is a weather event that is causing a reduction in speed limits on the corridor. This is the first time an education campaign has been implemented on the overhead dynamic message signs for an ITS project in BC.

Application in other Communities

While BC is unique in its geographic challenges, the variable speed limit system can be applied anywhere that has rapidly changing or severe weather conditions and poor safety performance. In addition, this technology can be adapted to provide real time information to drivers to address other safety challenges. For example, the Ministry is adapting this system to be employed on a congested corridor in a mild climate to improve safety. The process for collecting data and installation of signs will be similar; however, the number of sensors, algorithms, and analysis will be updated to provide drivers a more reasonable speed when they are approaching congestion. This is an example of how the Ministry is leveraging technology and innovation to meet the strategic objectives of the Road Safety Strategy.

In addition to providing up to date speed limits during weather conditions, the VSL system has secondary value as a traffic control tool for planned events, including construction and maintenance activities. This improves highway safety and operation during summer months when severe weather is less likely.

Legislation and legal challenges in other communities may restrict the implementation of similar systems; however, BC has already undertaken the first step in Canada to have legislation updated to ensure that variable speed limits are legal and enforceable. These changes provide a framework for other provinces and territories that are interested in employing this innovative technology.

The Ministry has proved that variable speed limit systems in a rural, Canadian, mountainous environment are possible and practical. The Ministry has taken a lead in the country to develop and implement this type of road safety device. There have been many lessons learned that we are sharing with the transportation community at conferences and though other communication channels. We are hopeful that others pick up on the effectiveness of this technology and use it to the best of their advantage in locations where severe weather is not being appropriately responded to by drivers. It is our responsibility to provide a reliable driving experience to keep highways safe and operational during all conditions, not just ideal ones.

Ontario Ministry of Transportation (MTO)

Restoring Fish Passage to a Tributary of the Saugeen River

2017 Transportation Association of Canada

Environmental Achievement Award Nomination Submission

APPENDICES

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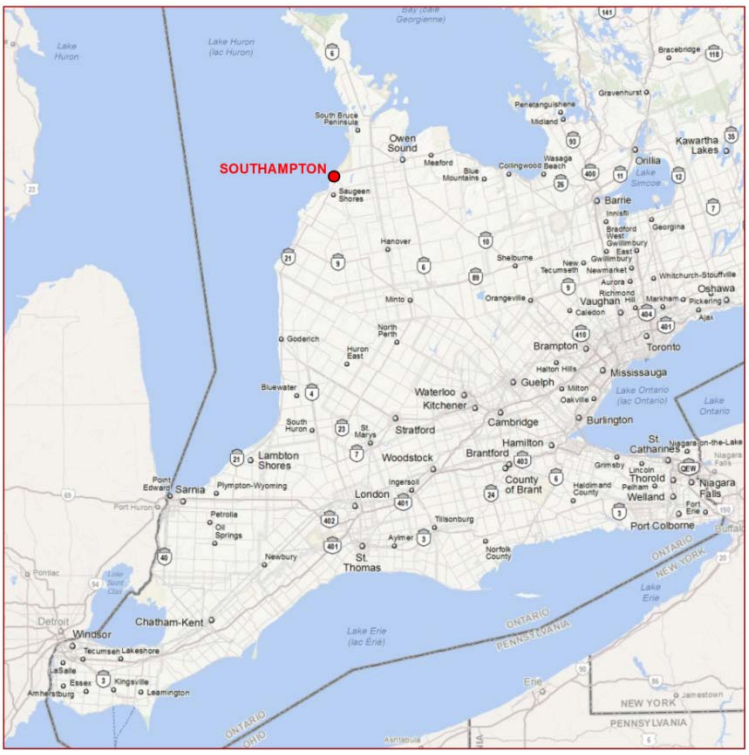
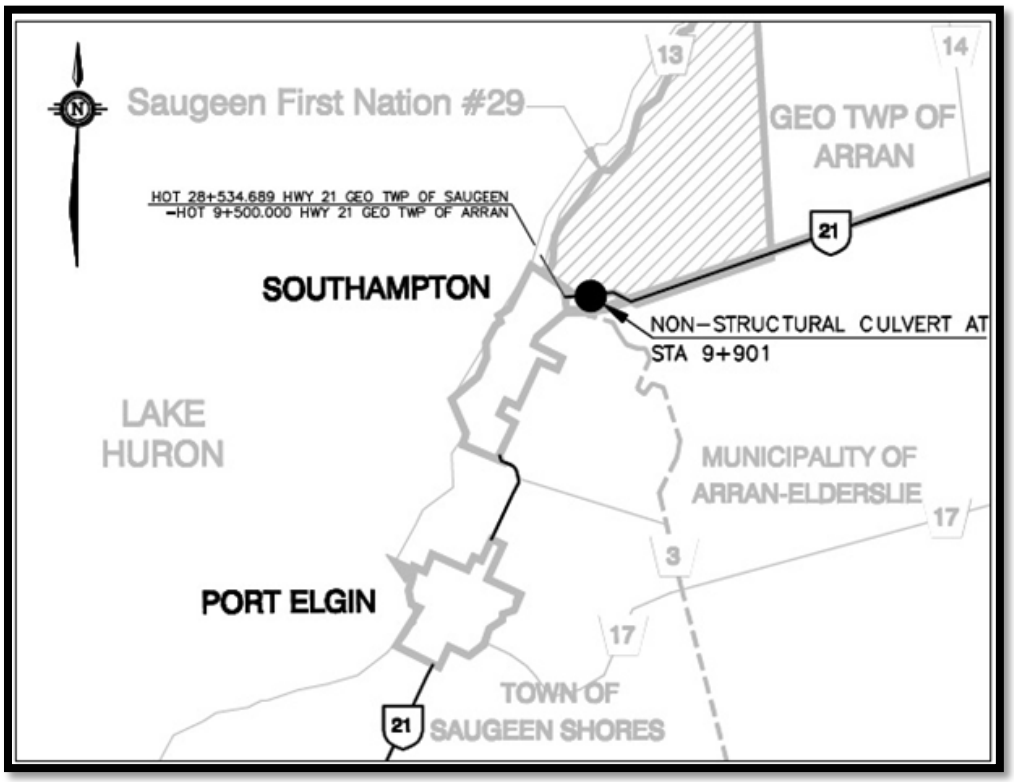
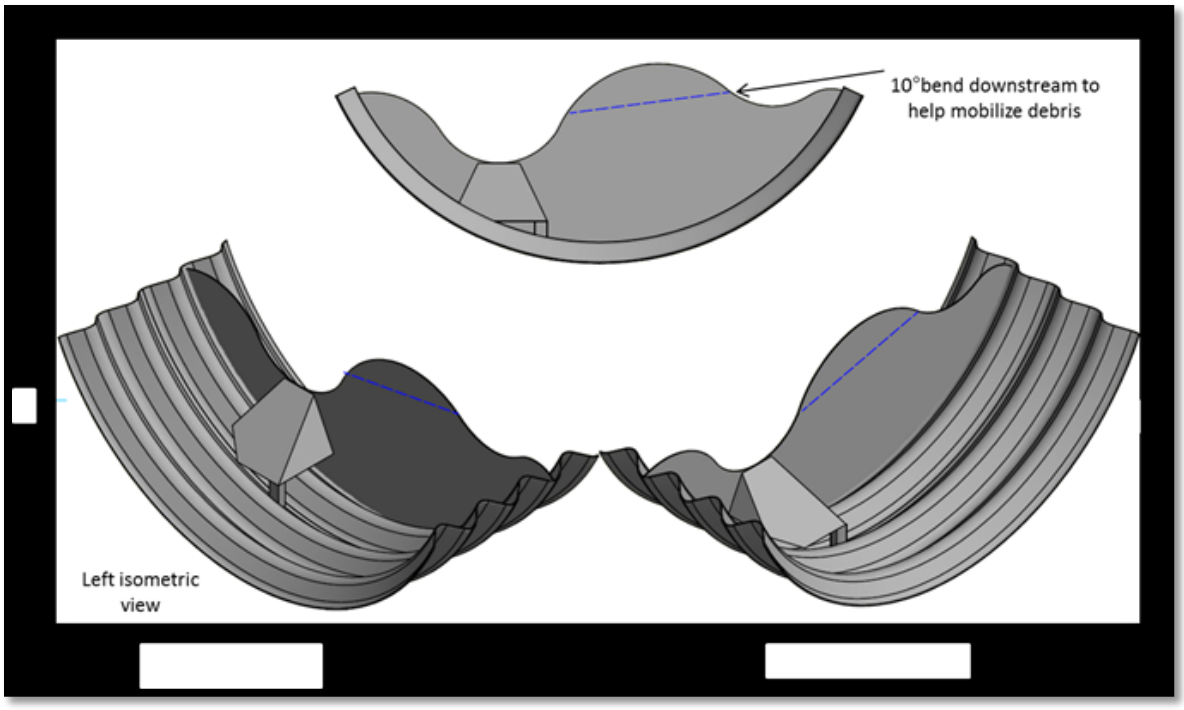
APPENDIX A – Location of the Highway 21 Craig St. Culvert

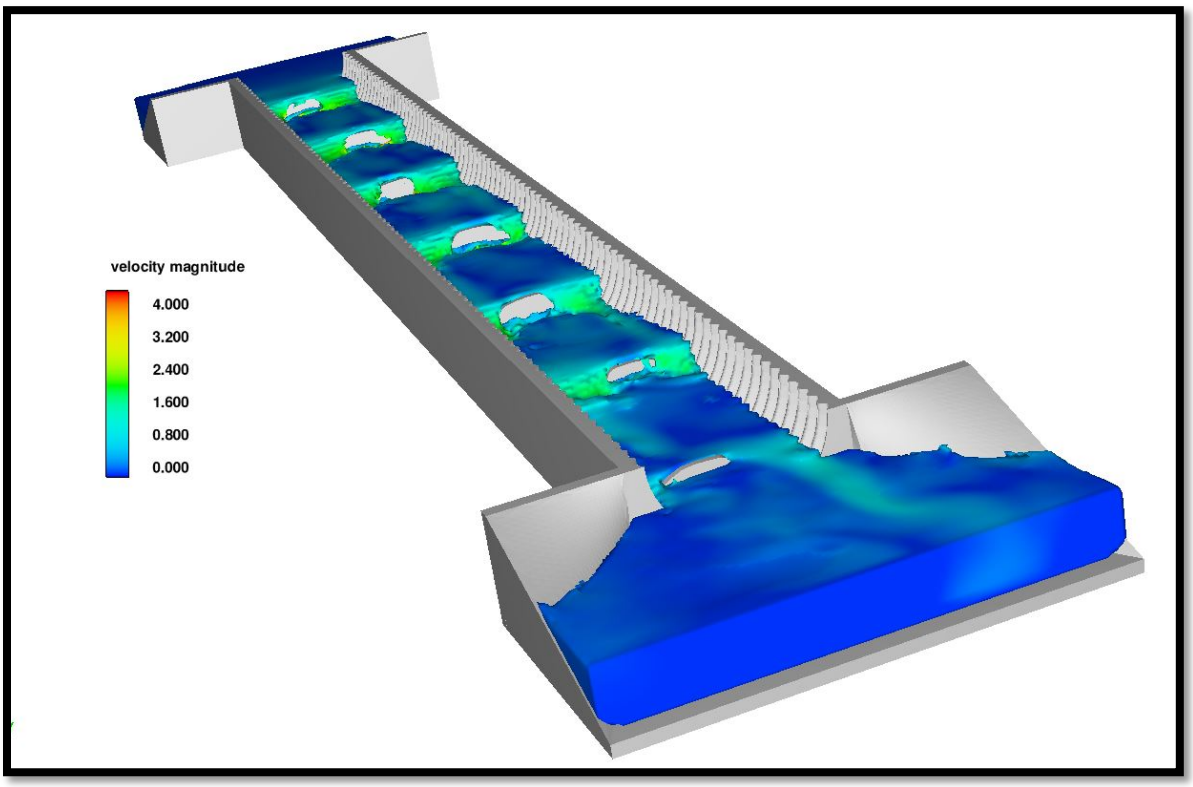




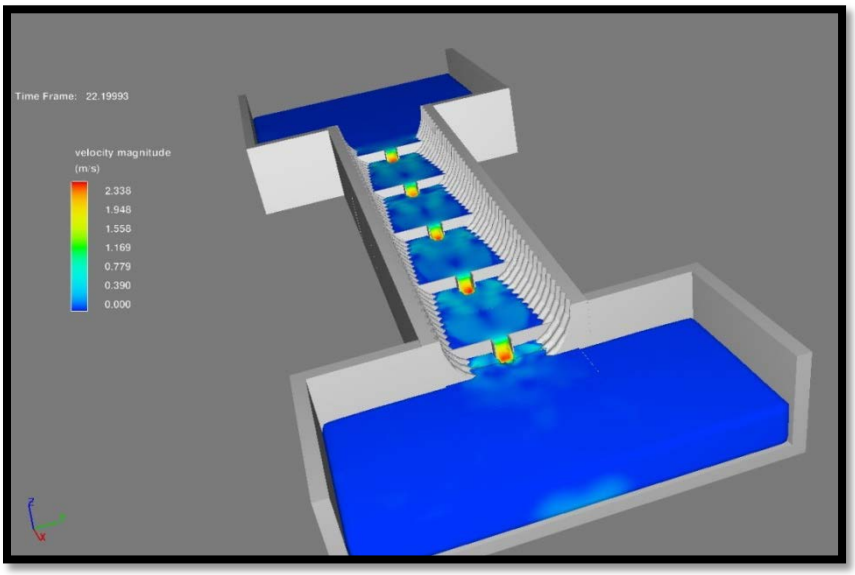
APPENDIX B – Original Culvert

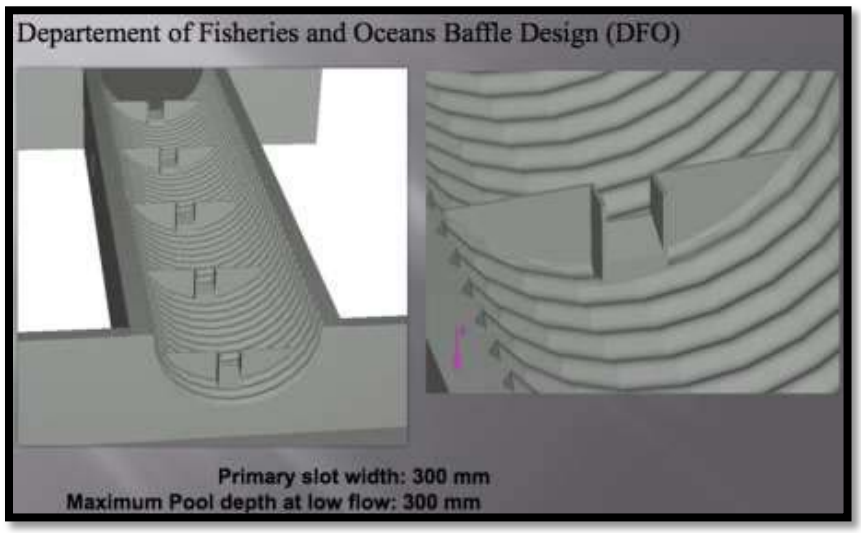
APPENDIX C – Hannaford Baffle Design





APPENDIX D – DFO Fish Baffle Design





APPENDIX E – Construction and Final Results