

Submission for 2013 TAC Road Safety Engineering Award

Route 1 Gateway Project

Introduction:

The Route 1 Gateway Project (R1GP) was a \$580 million Private Public Partnership (P3) between Dexter Developer General Partnership (DDGP) and the Province of New Brunswick, with financial assistance from the Federal Government. The Project Agreement was signed in March 2010 and the work was completed in December 2012, seven months ahead of schedule. Included in the project was an Operation Maintenance and Rehabilitation (OMR) agreement that requires the Operator to accept full OMR responsibility of Route 1 to 2040.

Route 1 is an Arterial highway in NB taking passengers and cargo between Atlantic Canada and the New England states. It extends from the US border at St. Stephen thru Saint John to Route 2 at Riverglade. The Project included the construction of 55 km of new 120km/h design speed 4-lane highway and selected upgrades to 180 km of existing sections of 4-lane highway.

This report will focus on the safety enhancements to reach a 120km/h design speed to the 180 km of existing 4-lane highway. Since not all of the safety enhancements could be completed, details will be provided regarding how certain ones were selected. Also the benefits of the enhancements will be discussed along with the usefulness of the process to other jurisdictions.

Scope Determination:

The Design/Build portion of R1GP initially focused on the new construction of 55km of highway consisting of twinning and constructing new 4-lane sections, and the rehabilitation of app. 60km of 4-lane highway. The remaining 120km portion of the Route 1 divided highway was not, initially, to form part of the work. However after reexamination this 120km was added.

The thought process behind the addition of this 120km of 4-lane highway built during the past 20 years or more was to maintain consistency and maximize safety. Although it was determined that the existing alignment was adequate for a 120km/h design speed, there were certain safety enhancements that were best implemented at the same time the remaining sections of Route 1 were being addressed. This would address safety issues and allow for seamless transitions between the new 55 km section and adjacent existing sections of Route 1.

It was also recognized that completing these improvements at the same time as the main P3 construction work resulted in savings. P3's offer significant cost benefits given their order of magnitude advantage over traditional contracts. As a result the decision was made to incorporate as many of the safety enhancements as financially possible and practicable, with the P3 work. In addition there are risk advantages also. The Developer/Operator accepted the existing sections as they were, and also the prescribed enhancements, and will respond to safety issues/concerns for all of Route 1 should they occur over the operations period extending to 2040.

30km Existing 4-Lane Section:

One particular section of the existing 4-lane divided Route 1, being the oldest and dating back to the 1950s, had noticeable vertical and horizontal geometric restrictions along with some other concerns including roadside hazards and narrow shoulders. This section of highway is 30km long with an overall AADT of app. 7,000, and extended from the Lepreau area to Route 7 interchange.

Speed limits in this section were reduced to 100km/h for an approximate 5 km section due to vertical and horizontal restrictions. Prevailing speeds were relatively high and were not being lowered thru the reduced speed zone. The collision review indicated rates per million vehicle kilometres (MVK) were slightly above that typically experienced in recent years by a 4-lane divided highway, and that historically, were as much as 50% higher. Upon review, it was determined a full safety evaluation for this area was warranted.

Opus International Consultants (Canada) were retained to complete this safety review. The purpose was to determine what improvements should be carried out to bring this section of road, to the greatest extent possible, to a 120km/h design speed and the related cost. The review consisted of several steps including an analysis of:

- collisions
- geometry (including ball bank testing)
- roadside features
- structures
- surface

Collisions were examined for the period 2002-2007. The collision rate per MVK was 0.6. Although this compared to some other 4-lane sections within NB it was on the high side, and substantially higher than sections on Route 2, the Trans Canada Highway. No area in particular within the 30km was observed to have a high collision rate although records did indicate an apparently high number of animal collisions suggesting perhaps wildlife fencing might be warranted. However, these areas were later determined to not meet the DTI policy criteria for wildlife fencing.

The horizontal and vertical geometry was analyzed based upon Transportation Association of Canada (TAC) Geometric Design Guidelines for Canadian Roads. The analysis indicated that 19 curves had a radius below the minimum radius for a 120km/h design speed and that of these, nine had a radius that did not meet a 110km/h design speed.

Further it was found five crest curves did not meet a 120 design speed, and of these five, two did not meet a 110km/h design speed. Three sag vertical curves had a K value below the minimum for a 120km/h design speed, and of these three, one had a K value below the minimum for a 110km/h design speed.

The Consultant reviewed these geometric features and then considered potential areas for inclusion in the construction project. This resulted in seven locations totaling 7.3 km (i.e. 23% of the study area) being identified for potential improvements.

After examining the remaining areas it was determined there were four locations that involved single horizontal curves that did not meet the TAC guidelines. Ball bank testing was completed for these curves and it was determined that they met the provincial criteria for 110km/h posted speed, with readings <10. These curves therefore were not recommended for inclusion in the construction project even though their radii were less than a 120km/h design speed.

The remaining two areas did not meet the geometric or ball bank guidelines for the 120km/h design speed, due to for example, noticeable combined multiple horizontal (e.g. 1 curve with horizontal radius of 450m) or vertical features not meeting the targeted design speed. Safety enhancement work was therefore recommended for these areas.

A review was also conducted on the five interchanges within this 30km section. Three loop ramps had a radius of 90m which met a design speed of 50km/h, however a 60km/h loop ramp (130m radius) is recommended for a 120km/h design speed. Further four acceleration/deceleration ramp lengths were determined to be lower or near the TAC guidelines established for their lengths. Following a review of these ramps it was decided to address the acceleration/deceleration ramp lengths since the loop ramps were not causing any safety issues and contained sufficient warning signage.

The roadside features of Route 1 for this 30 km section were also reviewed. It was determined that guide rail end treatments (EAGRTs) were warranted to replace buried ends. Length of need was also addressed. In addition, median crossover slopes were recommended to be flattened along with installing grates on the ends of longitudinal median pipes. While there were some rumble strips in this section, it was recommended that additional strips be installed (right side only) to complete the area. In adhering to provincial practices the rumble strips were not placed on the left.

The decision was made to increase the length of need to meet 120km/h design speed for existing hazards vs. protecting roadside hazards not currently protected. This was in part due to the collision history and looking at run off the road type incidents. Some of this section was designed when the policy was to determine the end of the hazard and only extend the guide rail an additional 25m, which is significantly less than the approach length currently used for a 120km/hr design speed. It was recognized not all safety enhancements could be implemented from a financial point of view and that it was better to have the length of need addressed for known existing hazards, and clearly have this safety measure meeting TAC guidelines.

In particular areas of this 30km section some of the medians were narrow with a distance of app. 22m between centerlines of the eastbound and westbound lanes. The medians although having gradual slopes could allow for a vehicle to cross thru and enter into the oncoming lane. Given the collision history not revealing such a problem and the significant cost of installing a median barrier per TAC guidelines it was decided to leave these median areas as they were.

Structures were also examined along this section of Route 1. The review indicated one structure built in 1961 did not meet the shoulder widths for a 120km/h design speed (i.e. 8.6m vs. 12.4m). Due to its age, width concern and bridge condition report, it was recommended

that this structure be replaced. Further it was determined that only one structure did not have at least a PL2 bridge railing. Fortunately this was the same structure as noted above. All vertical clearances were found to be in accordance with provincial minimum legal limits and also none were found to have been damaged from passing vehicles.

The shoulders, some of which were chipseal, along this 30 km highway were found to need improvements. These were largely in the form of paving the right side shoulder, and at one location, it was determined the shoulder was only a third of the standard shoulder width and had to be widened for app. 300m. This was thought to be a good investment as shoulder smoothness is an important feature of providing a recovery as drivers inadvertently drift over the shoulder and hit the rumble strip, while consistent shoulder width is also an important safety feature. Further from an operational and maintenance perspective, chipsealed shoulders pose a concern during winter maintenance activities and therefore were removed and paved.

In summary the review of this existing section of Route 1 indicated that it would cost app. \$28 million to carry out the more urgent safety improvements and app. \$10 million to carry out the remaining more minor ones. This, however, did not include the cost to address all concerns including substandard foreslopes and previously unprotected hazards which would have added significant costs. It is believed that these issues along with other safety enhancements will be addressed by the operator as part of their future Operator rehabilitation projects. Further they could be addressed should problems arise at a certain location.

Aside from the high priority safety concerns, it is ultimately a policy decision to determine what safety features to put in place on an upgrading project. It was recognized that not all of the improvements could be done otherwise the project likely would not have been financially possible. It is important to note however that it was better to address the identified safety concerns, through a controlled and informed manner as determined by the Consultant, and as agreed to by the Department and Route 1 Steering Committee, than to not address any of the safety concerns of the existing 4-lane highway.

In addition to the work done by the Consultant the R1GP team solicited input from the local transportation district offices. This took into account the districts feedback from their many years of maintaining the highway concerning highway safety or operational issues that could be addressed thru this construction work. This ended up being most useful and their input was reflected in the work to be conducted. As an example their comment regarding a section of highway with a narrow shoulder was incorporated into the work for the 30km section that was studied in depth by the Consultant. As it turned out the narrow shoulder with guide rail and trail behind, turned out to be a safety issue during snow plowing.

Total Upgrades:

The Consultant performed another safety review, although to a lesser degree, for the remaining 120km section of Route 1 divided highway. Being more recently constructed than the 30km section noted above this review was not as detailed and considered volumes, collisions, mainlane geometry and interchanges. Costs of safety enhancements for this work were in the range of \$12 million.

With the addition of the above noted safety features to the existing Route 1 including: guide rail end treatments (235), extension of guiderail to meet the higher design speed (45km), addition of rumble strips (70km) and frangible bases (300 plus), safety benefits are expected regarding the number of collisions and severity.

In addition other safety enhancements included for example: signs relocated outside clear zone, improvement in shoulder conditions, guiderail replaced as required, jersey barrier added, barrier walls upgraded to PL3 levels, interchange ramps lengthened, alignment improvements made and the consolidation and upgrade of emergency crossovers. The result is a roadside that has been enhanced to a high standard including guide rail to a length of need meeting 120km/h design speed, yielding a positive impact regarding collisions. The total upgrading cost for existing Route 1 was app. \$50 million.

Usefulness of Process to Other Jurisdictions

The method used in this report to address safety issues for an existing section of highway should be most useful to other jurisdictions. It offers advantages in costs and risk transfer by completing these safety upgrades thru a P3 contract along with having an agreed upon maintenance period. It also addresses the matter of what safety enhancements to carry out should they not all be possible. A thorough and defensible method is recommended to address this matter. A full in-service road safety audit complete with a benefit/cost analysis could be considered to determine which safety enhancements to complete.

Discussion/Benefits:

Although difficult to quantify the benefits resulting from the above noted enhancements, it can be stated with certainty that collisions rates per MVK should be reduced both in number and severity. It is too soon to evaluate as these enhancement were only completed in December 2012.

A modeling exercise utilizing for example volumes and collision modification factors would be required to quantify the expected benefits. In this example a combination of a comprehensive safety review and engineering judgment was utilized to justify the approximate \$50 million in enhancement costs. Collision rates and severity will be analyzed in future years to gain a better understanding of the benefits gained from the enhancements completed.

The Agreement for the 28 year operating period has specific condition standards and response times that the operator has to meet to address issues on the highway. This will ensure the safety measures put in place for Route 1 highway will be addressed, as required in a priority manner, and therefore sustain safety throughout the 28 year period. With regard to resources, the Operator is obligated to care for the facility as stipulated by the Agreement, and therefore will have to provide sufficient corresponding resources. The operator is subject to regular audits to ensure compliance to the Agreement.

Design consistency is always an important component of highway safety and the consideration of the above noted safety measures to existing Route 1 was thought to adequately provide a seamless highway with the new 55 km section.

On several occasions the issue of TAC guidelines and provincial practices came up. The attempt was made to meet TAC guidelines where possible (e.g. guide rail length of need). In other cases where they could not be met the decision was made to go with provincial practices. (e.g. ball bank tests vs. TAC radius of curve).

Conclusions and Recommendations:

The development of a P3 capital construction project should take into account existing highway safety upgrades, if applicable, given the cost effectiveness to implement at that time. Other advantages exist also including the time savings in conducting the work via P3 model.

There are risk/liability benefits associated with carrying out the enhancements through a P3 model. Given not all of the enhancements could be carried out, and that the Operator is responsible for the highway for another 28 years, benefits result as they will be responsible to address any issue/concern, including safety, arising as a result of the ongoing operation/maintenance of the highway.

With the implementation of the many safety enhancements discussed collision frequency and severity will be reduced. Although this report did not quantify the reduction the safety measures implemented are well accepted and known to provide safety benefits.

The cost for such enhancements also has to be considered and be financially manageable. Having the Consultants safety review completed utilizing accepted engineering practices/judgments, along with Department input, allowed for sufficient enhancements to be completed and still allow for the project to be financially manageable.

Input from provincial District offices is an important part of the process as it reflects years of experiences the District has gone thru including any emergency service issue.

Should all the safety enhancements not be possible to implement, a formal and thorough process should be utilized to determine which enhancements to go with. This process could include a formal in-service road safety audit and possibly a benefit/cost analysis.