

**ROAD SAFETY STUDY FOR ROADWAY FUNCTIONAL AND  
PRELIMINARY DESIGNS REHABILITATION OF BELIZE'S NORTHERN  
HIGHWAY BETWEEN MILES 9.5 -24.5**

***Ongoing study. Anticipated Completion December 2017.***

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## **1. INTRODUCTION**

The Government of Belize is a leader in road safety among Caribbean countries. Its vision is that Belize will have the safest roads in the Latin America and Caribbean countries and will work toward the ultimate goal of zero traffic fatalities and zero serious injuries. Since the introduction of the Belize Road Safety Project, there has been some improvement in the death rate from 21 per 100,000 population in 2012 down to a projected death rate of 8.36 per 100,000 population by the end of 2015.

The Climate Resilient Infrastructure Project (CRIP), funded by the World Bank - International Bank for Reconstruction (IBRD), aims at enhancing the resilience of road infrastructure against flood risk and impacts of climate change and at improving Belize's capacity to respond promptly and effectively in an Eligible Crisis or Emergency, as required. As part of this project, a portion of the Philip Goldson Highway (formerly the Northern Highway) was identified for rehabilitation.

In 2013, The **Korea's Knowledge Sharing Program (KSP)** established by the Korean Ministry of Strategy and Finance (MOSF) and the Korea Development Institute (KDI) partnered with Belize with the aim of exchanging socio-economic development experience of the two countries for improving Belize's policy making capacity and achieving socio-economic development. Under the signed MOU a joint research project was born to support the development of a Belizean made Transportation Master Plan (BTMP), based on Korea's experience in devising its own National Transportation Master Plan.

The comprehensive BTMP established a feasible and detailed national transportation master plan for Belize that contains a systematic way to attract investment in transportation infrastructure. This plan was to play a pivotal role in not only improving transportation conditions but also boosting economic development. The BTMP prioritized projects essential to raising the efficiency and advancement of transportation infrastructure in the country. Important synergies and forecasting data resulted from the BTMP have been borrowed to this study for a wide range of purposes including socio-economic modelling, travel demand forecasting, safety risk and societal cost evaluation, national road network priorities and timelines, and multimodal considerations.

## **2. AIM**

Following the success of a highway demonstration corridor project on the Western Highway, the Goldson Highway rehabilitation project included the identification of safety improvements to address current issues affecting the safety of all modes.

Explicit safety reviews were conducted to identify both corridor-wide and location-specific issues that were affecting the existing safety performance of the highway, and options to mitigate these issues through the redesign of the roadway, and to review the design plans during the design stage to identify opportunities to further optimize safety performance.

The PGHW is a two-lane, 92 mile highway originally built in the early 1980s to upgrade the old Northern Highway. The roadway's pavement has deteriorated significantly due to: (i) insufficient/poor drainage; (ii) the sharp increase in truck and bus traffic transporting workers and commerce in and out of Belize City, and to a lesser extent, the agriculture and tourism sectors; and (iii) limited maintenance. The pavement's poor conditions together with the absence of paved shoulders, unsafe road alignments, lack of pedestrian facilities in urban areas, and limited marking and signing add to Belize's high incidence of road fatalities.

### **3. METHODS**

In support of the road safety project, an in-service review (ISR) to address existing issues and a road safety audit (RSA) of preliminary designs were conducted.

#### **3.1 In-Service Safety Review**

Our approach to the ISR component provided a thorough examination of issues, context, root causes, and countermeasures. Quantitative and qualitative methods including expert's insights and user interviews, roadway design and traffic operations reviews, collision data and societal cost analysis, and human factor assessment were used. Specific objectives and associated methods including:

##### **3.1.1 Issues Identification and Understanding Causes**

Understanding the 'What and Why' entails a combined approach that includes various field observations, data analysis and modelling, design reviews, and experiential input from facility users.

**3.1.1.1 Site Investigation:** the four distinctive segments of the corridor were walked and driven as many times as necessary, doing so over multiple times during weekdays, weekends and at night time. The main purpose was to gain first-hand observation of the physical or operational conditions from all user points of views. Besides traditional photography records and checklists, additional tools and technology were used, including Dashboard GPS-enabled cameras, aerial video/photography equipment (i.e. action cameras and 28-foot camera tripods) for real-time traffic monitoring and post-processing, and speed radars as needed.

Our site investigation also included an inventory of all traffic control devices including signals, signs, and pavement markings as well as visibility issues, sight obstructions, lighting issues, access issues and any unusual road geometry. Evidence of frequent evasive actions or unreported crashes (e.g., skid marks, marks on longitudinal barriers, scars on roadside trees or poles, etc.)

Observation of traffic patterns, congestion or queuing issues, transit stops, and routes, active modes including pedestrian and cycle connections and operation.

**3.1.1.2 Collision Analysis:** Analysis of collision data highlighted hot spots on the corridor where improvement efforts were focused, in support of the four emphasis areas. Our collision analysis included a combination of the following:

- Interview local experts, community road safety leaders, government officials and enforcement
- Reviewed available 5-year raw collision data
- Benchmark (when possible) evaluation of crash rates, number-rate, equivalent property damage only (EPDO) rates, and rate quality control (if available).

3.1.1.3 Safety Input to Concept Design: As part of the project, the road will be raised and realigned at some locations, which presents the opportunity to redesign various other roadway elements - including cross-sections – and to incorporate safety features into the design to minimize the risk of injuries and fatalities. A geometric concept design (prepared by others) was reviewed to confirm adherence to municipal, provincial and national design standards for safe roads. This high-level review included: Horizontal alignment, vertical alignment, cross-section elements, design consistency, sight distance, auxiliary lanes, transit facilities, pedestrian facilities, bike facilities, and access management considerations.

3.1.1.4 Aerial Intersection Video Footage – Aerial video footage was collected for all main intersection for observational analysis, traffic data counts and micro simulation model calibration. The aerial video footage enabled us to revisit issues at a later date should discrepancies arise in subsequent analysis. An aerial-style perspective to our data collection is accomplished by the combination of professional aerial photography equipment, and action cameras with wireless connectivity. A large geographic area is captured from a single viewpoint (all intersections approaches at once).

3.1.1.5 Operational Analysis: to identify the operational factors and concerns contributing to the safety issues. Synchro/SimTraffic analysis will be typically (next phase) used in conformance with the North America Highway Capacity Manual methods.

3.1.1.6 Human Factors Analysis: A human factor investigation was conducted as part of the on-site review. The analysis typically focuses on the driving task, but depending on the circumstances it may also focus on vulnerable road users navigation tasks. The driving task could be further examined at three levels:

- Control (the driver's interaction with the vehicle);
- Navigation (planning and executing a trip); and
- Positive Guidance (maintaining a safe path and speed).

## **3.2 Road Safety Audit (RSA)**

As applied in North America, a Road Safety Audit (RSA) is a proactive rather than a reactive safety tool that formally examines a future roadway plan (design) to identify highway elements with the potential to contribute to crashes and injury ('hazard identification').

The design team recommended design criteria standards for the Ministry of Works and Transport (MOWT) to approve. Design criteria were largely based on the American Association of State Highway and Transportation Officials (AASHTO) standards and the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roadways.

On that basis, the RSA accepted the fundamentals of the given design, investigate the safety consequences of it, and recommend appropriate mitigation measures. In this particular case, the recommended RSA focused on details related to the Functional Planning (Feasibility) stages of

the roadway project plan (design criteria, design consistency, route choice, access management, adjacent land uses, continuity with existing networks, design speed, volume and traffic composition, intersection layout and traffic controls, tie-ins to existing networks). Issues were identified and subsequently reviewed by the design team.

The recommended RSA scope and methodology was based on the Canadian and US audit model as set forth in the Transportation Association of Canada's (TAC) Canadian Road Safety Guide (2001) and US Federal Highway Administration's (FHWA) Road Safety Audit Guidelines (2006), respectively.

## **4. RESULTS**

### **4.1 Issues and Risk Assessment**

Our presentation provides examples of the identified issues and improvements. Safety issues and mitigation measures on the corridor as identified. The risk associated with each issue is assessed on a scale of A (Low Risk) to F (Extreme Risk). The presentation includes photos of the issues and the recommendations (including photos from the demonstration corridor to illustrate what the improvement might look like once implemented in the study corridor). Lessons learned both from the process and best practices will be shared.

### **4.2 Develop and Evaluate Remediation Action**

As the study evolves and one or more patterns of crashes is identified, a list of potential mitigation measures can be generated. Potential countermeasures may be identified through:

- Detailed investigations of crashes to identify causal factors,
- Reviews of site plans and condition diagrams, site inspections, other traffic studies, and
- Best practices and local know-how
- Risk migration should also be assessed and addressed. Preferred countermeasure should be assessed for operational and geometric compliance with applicable standards.

### **4.2 Priorities for Implementation**

Safety countermeasures were prioritized as those having the highest potential for improvement, effectively reducing fatalities and serious injuries. When appropriate, potential mitigation measures focused on vulnerable road users and/or reduction of the severity of relevant crash types. Order-of magnitude estimated cost and implementation horizon for (short, medium, and long-term) were reviewed.

## **5. CONCLUSION**

The main focus of our presentation will be describing the process (incl. the risk assessment), and how it was applied to that context, as well as the presentation of a few examples of the kinds of issues and solutions recommended and incorporated into the design.

In roughly one decade, Belize has advanced to the forefront of Road Safety leadership in the Central America and Caribbean region. This project is a testament of their commitment, and a continuation of a country wide effort to bring national road infrastructure to international standards and to apply world-class best practices in roadways planning and design, road safety evaluation and injury prevention.

Knowledge sharing has been pivotal to get to this point, as is one of the key determinants of a country's level of socioeconomic development. Research and consultancy work in collaboration with international agencies, governments, and international industry experts has been instrumental to leverage local knowledge and expertise for the betterment of national roadways and their safety performance.

Challenges still remain particular in terms of availability of high quality data, traceability, and institutional capacity to sustain a national road safety data system. A more holistic and systemic approach to road safety assessment, evaluation, and monitoring is needed, especially in support of priority infrastructure projects that are currently funded and are being implemented.