

Quarterly Progress Report #16

To the

National Cooperative Highway Research Program
(NCHRP)

On Project 17-54

CONSIDERATION OF ROADSIDE FEATURES IN THE HIGHWAY SAFETY MANUAL

Limited Use Document

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For period
January 1 through March 31, 2015

From
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Introduction

The objective of this research is to develop quantitative measures that can be incorporated into the HSM to evaluate the effects of roadside designs and features on the frequency and severity of lane departure crashes. This report describes the progress achieved in this project in the previous quarter with respect to the tasks identified in the work plan. The following sections will describe the task-by-task progress identifying work items accomplished and any problems encountered in the research.

A section describing the contractual status of the project (i.e., funding, schedule, etc.) appears at the end of the report and the progress summary tables and plots appear in [Attachment A](#). [Attachment A](#) has been updated to reflect the addition of Phase III. [Attachment B](#) contains responses to panel comments from the last QPR. This quarterly report and attachments as well as all previous QPRs can be found at <http://www.roadsafellc.com/NCHRP17-54/QPR>. In order to comply with NCHRP requirements regarding the Limited Use of project documents, all the attachments are located in a password-protected subdirectory. The password for all the project documents is “HSMROR.”

PHASE I

Task 1. Literature Review

Conduct a literature review of the analysis methods to quantify lane departure crashes including those used in the HSM and RSAP.

The task is complete and documented in the first interim report.

Task 2. Identify CMFs and Data Sources

Identify CMFs and available data sources related to lane departure crashes from completed and ongoing research projects.

The task is complete and documented in the first interim report.

Task 3. Survey of Practice

Survey practitioners, researchers, design consultants and transportation agencies to assess their current model uses and needs as they relate to roadside safety during the planning and design stages. The survey should also solicit input about specific roadside concerns or areas of need regarding additional CMFs.

The task is complete and documented in the first interim report.

Task 4. Compare HSM and RSAP

Document the strengths and weaknesses and differences between the HSM prediction models and RSAP and identify opportunities to provide consistency through updating data sources, base models, or modification factors.

The task is complete and documented in the first interim report.

Task 5. Sample Scenarios

Analyze sample scenarios for comparison between the HSM prediction models and RSAP. These scenarios should consider: rural 2-lane (level, rolling, and mountainous terrain), rural multilane (level, rolling, and mountainous terrain), and urban arterial. Long and short segment lengths as well as planning and design should be considered.

The task is complete and documented in the first interim report.

Task 6. Recommendations for Future Development Efforts

Develop recommendations that as a minimum address: (1) model applicability; (2) appropriateness of continued parallel development of both methods for roadside safety assessment or, if one method should be chosen, for future development efforts; and (3) methods and coding for the possible inclusion of RSAP as a module in the IHSDM.

The task is complete and documented in the first interim report.

Task 7. Prioritized List of Roadside CMFs

Develop a prioritized list of roadside CMFs that should be evaluated for development and possible inclusion in future versions of the HSM.

The task is complete and documented in the first interim report.

Task 8. Interim Report and Meeting

Submit an interim report that includes the findings from Tasks 1 through 7 and an updated work plan for Phase II.

The task is complete and documented in the first interim report.

PHASE II

As part of the development of the Phase II work plan, some of the tasks as presented in the original proposal were re-arranged and re-named to better conform to the work flow decided upon at the Interim Report panel meeting. The following section, therefore, reflects the task numbers, titles and descriptions as shown in the work plan rather than the original proposal.

The research team suggested and the Program Officer agreed that it would be useful to prepare a second interim report for the project that summarized the findings of Phase II (i.e., Tasks 9 and 10) to-date as well as presented a research plan for pursuing Phase III once that funding is awarded. The second interim report was attached to the June 2014

QPR as [Attachment C14](#) and an interim report panel meeting was held November 7, 2014 in Washington, D.C..

Task 9. Develop Roadside SPFs for Rural Areas

Develop objective roadside SPFs using the HSM protocols for the base conditions outlined in Volumes 2 and 3 of the Highway Safety Manual for rural divided and undivided highways.

This task is now complete and was documented in [Attachment C](#) of the September 2014 QPR.

Task 10a-d. Develop CMFs

Develop objective CMFs for use with the roadside SPFs developed in Task 9 using the HSM protocols for the base conditions outlined in Volumes 2 and 3 of the Highway Safety Manual for rural divided and undivided highways.

This task consists of the following four subtasks as described below:

- a) Field Data Collection
- b) CMFs using Crash Data
- c) CMFs using RSAPv3
- d) Apply Inclusion Rule

Task 10a: Field Data Collection

This task has been canceled.

Task 10b: CMFs using Crash Data

The subtask to develop CMFs from crash data is complete. The technical documentation for these CMFs was presented in Appendix B of the Interim Report ([Attachment C14](#) of the September 2014 QPR).

Task 10c: CMFs using RSAPv3

The research approach original discussed in [Attachment D](#) of the March 2014 QPR (see discussion starting on page D-13) was applied this quarter to develop $CMF_{ROADSIDE}$. $CMF_{ROADSIDE}$ is documented in [Attachment C](#) of this QPR. Companion CMFs will be developed for use with $CMF_{ROADSIDE}$. This effort will include a simulated before/after study using RSAPv3. The characterization of the roadside environments in both Washington and Ohio was the first necessary step in this analysis. This characterization was completed this quarter and is documented in [Attachment D](#) of this QPR. After understanding the characteristics of the roadside environment, the second step was to develop Equivalent Fatal Crash Cost Ratios (EFCCRs) for use in the simulated before/after study. The development of EFCCR is documented in [Attachment E](#) of this QPR. Progress is expected to continue on this task next quarter, resulting in a completed roadside model.

Task 10d: Apply Inclusion Rule

This subtask is now complete.

Task 11. Modifications to RSAPv3 and Coordination with the IHSDM

Depending on the outcome of Phase I, Task 6, prepare recommendations for potential modifications to the RSAP model and coordinate new roadside SPFs and CMFs with the FHWA IHSDM development team.

As discussed at the second interim report meeting, this task will be postponed until the phase II and phase III results can be implemented together at the same time.

PHASE III

A request for continuation funding for a Phase III for this project was forwarded to AASHTO SCOR in the fall of 2013 and approved by SCOR at their spring 2014 meeting. The PI received and signed the Phase III contract modification on 17 March 2015. We expect that NCHRP will execute the Phase III contract modification and provide authorization to proceed very shortly. The 2nd Interim Report submitted with September 2014 QPR ([Attachment C](#)) included a Phase III work plan with the following tasks:

- 13 Develop Roadside SPFs for Urban Roadsides and one-way roads.
- 14 Develop CMFs
- 14a Inventory Roadside Features
- 14b Develop CMF_{ROADWAY}
- 14c Develop CMF_{ROADSIDE}
- 15 RSAPv3 Modifications and Coordination with ISHDM for Urban Roads
- 16 Final Report

Once the Phase III contract modification is complete and authorization to proceed with Phase III has been obtained work will begin on Phase III.

Task 12. Final Report

Submit a final report documenting the entire research project. CMFs developed from this research should be documented in separate appendices that include, as a minimum, data sources, sample size, and analysis methodology

This task has not been initiated pending the results of Tasks 9 through 16.

Contractual

The project was initiated on April 4, 2011. Phase I was completed after the interim report panel meeting on May 8, 2012. The research team received authorization from the NCHRP Program Officer to proceed with the Phase II work plan on July 12, 2012 and Phase II was officially started at that time. The PI requested a 12-month no-cost time extension from the NCHRP Senior Program Officer in May 2013 and the extension was granted on May 24, 2013. The new contract completion date is July 31, 2014. A second contract modification was processed on July 1, 2014 to extend the contract end date to July 31, 2015 to allow time for the Phase III funding modification to be processed.

A continuation request was submitted to AASHTO SCOR in November 2013 in order to add Phase III to the project. The continuation request was approved by SCOR in March 2014 and the PI signed the contract modification for Phase III in March 2015 and authorization to proceed with Phase III is expected shortly from the Program Officer. A summary of the progress and fiscal status of the project is shown in [Attachment A](#). [Attachment A](#) has been revised and updated in anticipation of the approval to begin work on Phase III.

The project team presented the results of the edge proportions analysis and the curve and grade adjustment factors developed as part of this project at the Annual Meeting of the Transportation Research Board in January 2015. The curve and grade adjustment factors were selected for publication in the Transportation Research Report. A finalized copy of that manuscript is attached to this QPR as [Attachment F](#). The team will continue to reach out to the appropriate AASHTO and TRB committees as the research progresses to keep them informed about the status and findings of the project.

Sincerely,



Malcolm H. Ray, P.E., Ph.D.

- Attachment A: [Progress and Fiscal Summary](#)
- Attachment B: [Responses to Panel Comments](#)
- Attachment C: [High Speed Unrestricted CMF_{ROADSIDE}](#)
- Attachment D: [Characterization of the Roadside Environment](#)
- Attachment E: [Development of EFCCRs for Roadside Hazards](#)
- Attachment F: [Proposed Horizontal Curve and Vertical Grade Encroachment Adjustment Factors](#)