

**EXHIBIT A  
SCOPE OF SERVICES**

**INVESTIGATING THE NECESSITY AND PRIORITIZING PAVEMENT MARKINGS ON LOW VOLUME ROADS**

**BACKGROUND**

Just as in other states, many miles of Minnesota's low volume roads have been enhanced with pavement markings (e.g. yellow centerline and/or white edge lines). The installation and maintenance of these markings represents a significant financial investment for the local agencies that maintain those markings. In light of this, there is a need to better understand the value and cost of typical and enhanced (e.g. wider) pavement markings along low volume roadways (this can encompass much of the local [county and city] roadway system) and to develop improved guidance that will assist local agency decision-making and understanding of pavement marking installation and maintenance decisions within the constraints of their limited budgets. The objectives of this project are to review the existing research on typical and enhanced pavement marking benefits (e.g. reduced crashes); document the characteristics of pavement marking installation and maintenance current practices along local agency roads; and, to develop an approach and tool based on this collective information to assist local agencies in Minnesota with their pavement marking installation and maintenance decision-making. The approach developed will be designed to aid local agencies that work within a constrained budget, and incorporate and/or propose how it might fit within the prioritization process and recommendations of the County Road Safety Plans (CRSPs) pavement marking strategies. The end result of this research will be a decision-making tool for local agencies (namely counties) to use in determining which routes should receive markings during a given year based on factors such as available budget, age of existing markings, etc.

**OBJECTIVE**

The development of an approach to assist local agencies with installation and maintenance of pavement markings is expected to benefit taxpayers in a number of ways. Foremost is a more efficient use of financial resources through the development of an approach and guidance that focuses on typical and enhanced pavement markings decision-making along local roadways. Scarce resources would be better utilized or conserved by using pavement markings where they will produce the greatest benefit or have the most expected impact via such an approach. Secondly, potential savings could be produced through material and labor savings. These prospective benefits for the taxpayer would be established by comparing the benefits and costs of pavement marking application case studies before and after the proposed approach. Implementation of the research results would be accomplished through distribution of the decision-making tool developed (likely a spreadsheet), final report and related presentation materials (e.g. an overview of the process and how it could be applied from the final project meeting) to local agencies (e.g. counties and cities).

**SCOPE**

The proposed research plan will utilize the results of previous research, as well as the approach and methods used in developing Minnesota's CRSPs, to develop an approach to guide decisions regarding pavement marking along low volume roads. This will be accomplished through the series of tasks and approaches, outlined below:

- Conduct a review of existing research on typical and enhanced pavement markings, with a focus on the benefits they produce (crash reduction, improved lane-keeping, etc.), current maintenance practices and similar aspects.
- Perform a survey of Minnesota counties to learn their current practices and management approaches for pavement markings and other information of interest.
- Review the existing CRSP methodology to understand the data and research used to rank at-risk routes and identify improvement strategies to address issues, specifically the use of different types of pavement markings being recommended. Also, recommend how the approach developed might be incorporated into the strategies/recommendations made within the CRSPs.
- Develop a decision-making assistance approach and tool to guide pavement marking use and management based on the information identified, collected, and reviewed in the prior tasks.
- Produce a draft and final report describing the results of the project tasks. Also, develop a short brochure or technical brief explaining the approach and tool and their implementation.

**ASSISTANCE**

To gain the most from this project, the Technical Advisory Panel (TAP) is expected to provide support for Task 2, the survey of counties and cities, specifically the provision of contact information for local agencies. Assistance is also necessary during Task 3, CRSP considerations, in the form of providing any relevant documents that may assist in documenting and understanding the overall process and examples of plans that they wish to have taken into consideration.

Additionally, the TAP is expected to participate in all scheduled conference calls or web-based presentations, provide input and feedback on the prioritization approach and tool as they are developed, review the task deliverables and final report, and provide comments in a timely manner, and clearly communicate their expectations to the University's Principal Investigator (PI) in the early stage of the project.

## **WORK PLAN**

### **Task Descriptions**

#### **Task 1: Review of Existing Research**

Under this task, the University will review past research about the value and effectiveness of traditional and enhanced pavement markings and current pavement marking maintenance practices. The University will specifically focus on research and results related to local agency roads, but will also consider the broader range of available materials that are available on markings. It will also identify and summarize work, to the extent it exists, that has determined where markings have produced no measurable benefits in order to identify potential cases where the elimination of markings could be an option. The work benefit and build upon work that the research team has completed in Iowa that has examined aspects of pavement marking use along low volume roads. From that work, the University identified a variety of past results of interest to the current project. For example, aside from the work in Virginia, which indicated a minimal safety impact from centerline or edge line pavement markings, other research has produced findings that can also contribute to the development of a prioritization program. Related work on local roads and pavement markings includes that of Louisiana, Kentucky, Pennsylvania and Texas. This work is also discussed in more detail in the literature search section of this proposal. Through the review of relevant literature, this task will draw from the Virginia and other study findings/hypotheses regarding the use of pavement markings. In addition to the impacts and effectiveness of pavement markings, the University will also review and summarize current information related to marking maintenance procedures and processes. Finally, the University will also summarize the Manual on Uniform Traffic Control Devices (MUTCD) proposed rule on minimum retroreflectivity for markings and what the consequences and impacts of this rule would be on marking prioritization, if adopted. Collectively, the University will incorporate this information into the development of the decision-making approach.

#### **Task 2: Survey of Minnesota Counties**

Under this task, the University will survey Minnesota counties in order to document what their current practices are regarding different aspects of pavement marking use, maintenance and management. The survey will specifically focus on the extent that markings are used, the surfaces they are being applied to (for example, asphalt, concrete, chipseals, etc.), whether aspects such as functional classification are considered, the frequency that maintenance (mainly repainting) is performed, the budget that is available for pavement markings, if (and how) markings are managed and other information determined to be of interest. The University will use the data collected through the survey in developing the decision-making approach during Task 4.

#### **Task 3: County Road Safety Plan Considerations**

Under this task, the University will review the methodology employed in the CRSP process to better understand how pavement marking recommendations and prioritization are being completed and how the results of this project might be incorporated. At present, the CRSPs use star rankings to assign levels of risk to roadway segments based on five factors. Segments ranked with the most stars are riskiest. Crash Reduction Factors (CRFs), which provide a percentage crash reduction that might be expected after implementing a treatment, are not incorporated into CRSPs at present. As a result, while pavement markings might be a countermeasure recommended by the plans for certain locations, their potential impact on crashes is not taken into account. Consequently, the University will examine the extent that marking strategies are recommended and used, as well as how the absence of CRF consideration in the CRSPs can be addressed, particularly within the prioritization process to be developed. The approach or methodology developed in Task 4 will take into account the overall findings and conclusions of this task.

#### **Task 4: Develop Decision-Making Assistance Process and Tool**

Under this task, the University will develop the decision-making assistance process and tool for local agencies to use in managing pavement markings. The process will be guided by the findings of the prior research tasks and TAP feedback, but its end result will be a mechanism (likely a spreadsheet tool) which takes input information and prioritizes which markings should be replaced for a given time period (e.g. annually). Input information and factors may include available budget, age of current markings, pavement age or condition (surrogate for marking condition), location (rural, suburban, urban), expected crash reduction/prevention, etc. The input factors would be applied to the consideration of both typical pavement markings and the enhanced pavement markings.

The exact prioritization process and output will emerge as the work processes, but, for example markings in a suburban/urban setting might be prioritized (depending on research results and survey feedback) as needing to be repainted bi-annually rather than annually. It is anticipated that the TAP will be consulted with at various points during this task for discussion, input and feedback to ensure that the approach is incorporating the needs of local agencies.

**Task 5: Compile Report, Technical Advisory Panel Review and Revisions**

The University will prepare a draft report, following MnDOT’s publication guidelines, to document project activities, findings, the program/process/tool developed, and implementation recommendations. This report will need to be reviewed by the TAP, updated by the University’s PI to incorporate technical comments, and then approved by the Technical Liaison before this task is considered complete. It is also anticipated that a TAP meeting will be held as part of this task to discuss the draft report and review comments. TAP members will also be consulted for clarification or discussion of comments, as needed.

**Task 6: Editorial Review and Publication of Final Report**

During this task, the Approved Report will be processed by MnDOT’s Contract Editors. The editors will review the document to ensure that it meets the publication standard. This task must be completed within the contract time in order for the editors to provide editorial comments and request information from the PI.

**Task Deliverables**

Task:	Deliverable(s):
1:	Summary Report, describing the review of existing research
2:	Summary Report, describing Minnesota’s county practices
3:	Summary Report, describing CRSP considerations to incorporate into the decision-making approach
4:	Summary Report, describing the approach an tool that are developed
5:	Draft Report and Final Report, approved for publication
6:	Final Published Report

**PROJECT SCHEDULE**

**Task Completion Dates**

Task:	Draft Deliverable Due Date:	Final Task Approval Date:
1:	October 31, 2016	December 31, 2016
2:	October 31, 2016	December 31, 2016
3:	December 31, 2016	February 28, 2017
4:	May 31, 2017	July 31, 2017
5:	August 31, 2017	October 31, 2017
6:		December 31, 2017

**Task Durations**

Months:	2016						2017												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Task 1	X	X	X	X	X	X													
Task 2	X	X	X	X	X	X													
Task 3			X	X	X	X	X	X											
Task 4			X	X	X	X	X	X	X	X	X	X	X						
Task 5												X	X	X	X	X			
Task 6																	X	X	

**Key Milestones**

<b>Milestone</b>	<b>Target Date</b>	<b>Description</b>
Kick-Off Teleconference	July 1, 2015	Review and discuss key milestones, make additional work plan modifications, if necessary; review project tasks and goals, and discuss the plan for the initial tasks
TAP Teleconferences	As Needed	Teleconferences throughout the project to discuss current activities, seek feedback, etc.
Draft Final Report	August 31, 2017	Delivery of draft final report to the TAP for review and comment
Presentation of Final Results to TAP	October 31, 2017	Review of overall project, task results and final report to TAP
Final Report Publication	December 31, 2017	Publication of final report document

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