EXHIBIT A
SCOPE OF SERVICES

DEVELOPMENT AND INTEGRATION OF ADVANCED TIMBER BRIDGE INSPECTION TECHNIQUES FOR NATIONAL BRIDGE INSPECTION STANDARDS PURCHASE EQUIPMENT AND TRAIN USERS

BACKGROUND

Funding has been approved by the Local Road Research Board (LRRB) (2012-2014) to develop and integrate advanced timber bridge inspection techniques into bridge inspections by Minnesota inspectors. This work has successfully completed the following technical tasks:

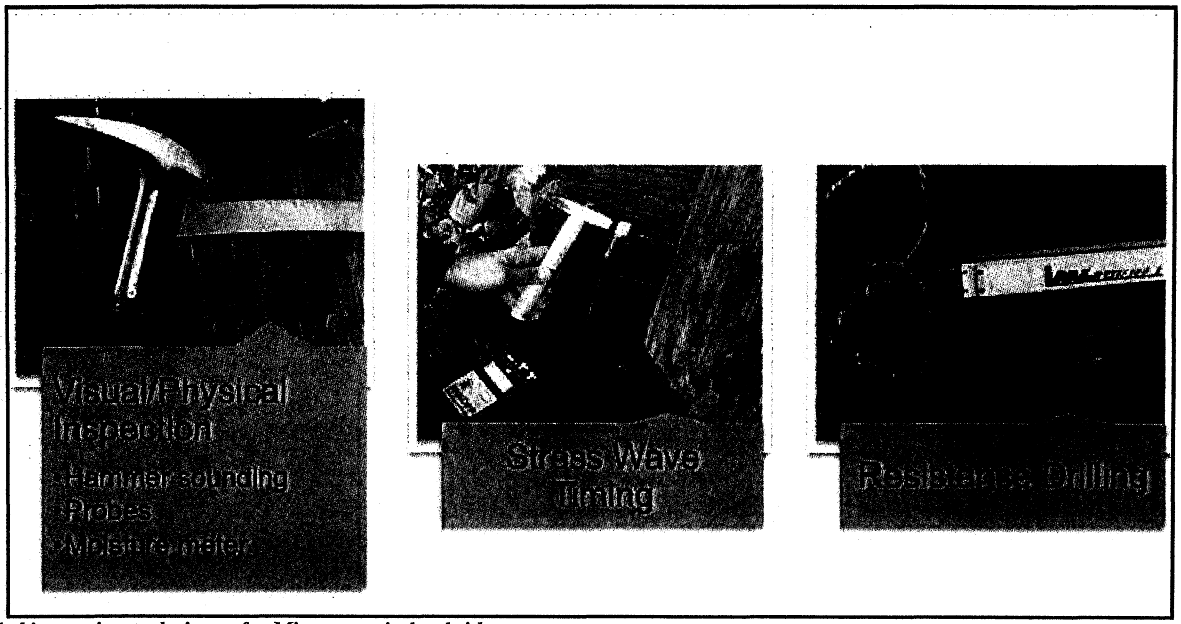
Task 1: Identification of inspection technologies
Task 2: Development of timber bridge inspection protocols
Task 3: Develop condition reporting forms that supplement National Bridge Inspection Standards (NBIS) formats
Task 4: Develop an inspection manual for timber bridges
Task 5: Complete an economic assessment of the inspection protocol
Task 6: Recommend a list of inspection tools/equipment evaluations of bridges
Task 7: Conduct inspection training for MnDOT Districts

This project has set the stage with all necessary protocols and training for improved inspections of timber bridges, especially deteriorated substructure. However, full-scale implementation of this research will require that county and state inspectors have access to the specialized timber bridge inspection equipment that was identified during this project. The project team has worked to develop standard operating procedures, video demonstration and to provide hands-on access during the short courses developed and conducted in this project.

Based on the activities completed, the project team is seeking additional funds to purchase at least three complete sets of inspection equipment and to manage the shared use of this equipment during a 24-month trial period. Further, one final short course will be presented on inspection of timber bridges using this equipment.

OBJECTIVE

During the 2012-2014 project, Development and Implementation of Advanced Timber Bridge Inspection Techniques, new advanced inspection techniques and equipment were identified that were capable of improving the quality of timber bridge inspection by Minnesota county and state inspectors. This equipment includes expanded use of sounding and probing and new incorporation of moisture meters, stress wave timers and resistance microdrills. The following figure provides visual representation of the recommended approach for inspecting timber bridges.



Recommended inspection techniques for Minnesota timber bridges.

Moisture meters can effectively be used in conducting inspections of timber bridge elements. It is well documented that the presence of moisture is required for decay to occur in timber. Typically, moisture contents in timber of less than 20% will not allow decay to occur in wood. However, as the moisture increases above 20%, the potential for decay to occur increases, with the most serious decay occurring when the moisture content exceeds 28%.

Stress wave timing is an effective method for locating and defining areas of decay in timber bridges. Stress wave propagation in wood is a dynamic process that is directly related to the physical and mechanical properties of wood. In general, stress waves travel faster in sound and high quality wood than in deteriorated and low quality wood. By measuring wave transmission time through a timber bridge beam, pile cap or piling in the transverse direction, the internal condition of the structural element can be fairly accurately evaluated. A stress wave is induced by striking the timber member with an impact device instrumented with an accelerometer that emits a start signal to a timer. Alternately, an ultrasonic pulse creates a stress wave in the member. A second accelerometer, held in contact with the other side of the member, senses the leading edge of the propagating stress wave and sends a stop signal to the timer. The elapsed time for the stress wave between the accelerometers is displayed on the timer. This measured time, when converted to a transmission time on a per length basis (or wave propagation speed), can be used as a predictor of the physical conditions inside the timber bridge member.

Another drilling technique that has been commercially developed is the resistance drill system. Developed in the late 1980s, this system was originally developed for use by arborists and tree care professionals to assess tree rings, evaluate the condition of urban trees and locate voids and decay. This technology is now being utilized to identify and quantify decay, voids, and termite galleries in wood beams, columns, poles, and piles. This technique is now the preferred drilling and coring technique for timber elements.

This equipment and technologies were introduced into routine bridge inspections through the development of standard inspection protocols, integration of the results into bridge data management software, development of a customized inspection manual, outreach training for MnDOT districts and state counties, recommendation of equipment purchases, and completion of an economic assessment on the use of advanced inspection techniques.

Implementation of these inspection techniques will support the long-term service life of Minnesota's timber bridges and will improve the safety and reliability of Minnesota's bridges. The major outputs of this project were the development of an inspection manual, Advanced Timber Bridge Inspection: Field Manual for inspection of Minnesota Timber Bridges and an accompanying short course attended by over 150 inspectors and engineers. However, the key implementation of specific equipment recommendations and requires purchase and use strategies to allow access to this equipment by county and state inspectors in the future.

SCOPE

Based on the activities completed in Task 6 of the 2012-2014 project, Development and Integration of Advanced Timber Bridge Inspection Techniques for NBIS, the research team is seeking LRRB/Research Implementation Committee (RIC) funds to manage the shared use of this equipment during a 24-month trial period. Upon purchase of this equipment by MnDOT, this equipment would be located at the University of Minnesota Duluth Natural Resources Research Institute (UMD NRRI) and be available to counties, cities or MnDOT districts. It would be preassembled into ruggedized shipping containers for protection and rapid deployment to Minnesota's timber bridge owners. The UMD NRRI and the project team will be available during the project period to provide technical assistance and hands-on support as appropriate. During the 24-month period, UMD NRRI will work with the current Technical Advisory Panel (TAP) and others to assess the transfer of management of these shared tools to MnDOT's Bridge Office.

Equipment Recommendation:

A comprehensive list of inspection equipment for timber bridges has been compiled and reviewed by the TAP. Based on this list, a prioritized set of equipment was identified. Specific advanced inspection technologies as recommended are shown in Table 1. MnDOT's Bridge Office has agreed to purchase this equipment. Three sets of equipment be purchased initially for shared use. Each kit would contain a stress wave timer and moisture meter, and one of the following resistance microdrills (IML F-Series, IML PD Series and RINNtech microdrill). This equipment would be purchased and used to generate additional feedback and recommendations on ease of use, durability and other considerations from field use by County inspectors.

Table 1 – Recommended list of inspection equipment for Minnesota's timber bridges

Technology	Manufacturer	Product Description	Quantity	Est. Cost (US $) – based on October 2014
Carrying Case	Pelican	Durable cases for equipment	6	$1,300.00
Basic Inspection	Vaughan	Inspection Hammer	3	$111.60
	Stanley	Scratch awl	3	$28.83
	Johnson	Plumb bob	3	$23.94
	CH Hanson	Utility string	3	$71.88
	Johnson	Protractor angle finder (magnetic)	3	$56.67
	Markal	White and blue railroad chalk	1 pack each	$107.35
Moisture Meter	Delmhorst J-2000 Wood	Digital meter with hammer slide and spare pins	3 sets and spare pins	$2,167.00
Stress Wave Timers	Fakopp	Microsecond Timer		$6,780.00 – 3 units
Micro Drilling	IML, Inc.	Resistodrill MD 300 and supplies	1 and supplies	$1,080.00
	IML, Inc.	Resistograph F400S	1 and supplies	$5,935.50
	IML, Inc.	Resistograph F300 Refurb	1 and supplies	$2,402.50
	IML, Inc.	Resistograph PD 400 mm, software, supplies		$12,338.00
	RINNtech	Resistograph 440 mm	1 and supplies	New model, currently in production (available 2015) ~$12,000

Use Recommendations:

It has also been recommended by the current project TAP and the Minnesota County Engineering Association Bridge Committee that the inspection equipment sets be purchased by MnDOT and their use coordinated by UMD NRRI during a 24-month trial period. UMD NRRI would coordinate shipping of the equipment, additional consultation on use as necessary and be responsible for ensuring that preventative maintenance, repair and needed supplies are managed appropriately. The UMD NRRI is uniquely capable of managing this process, as they are a non-teaching research arm of the University system that has over 15 years of experience with the use and management of the recommended equipment. It is envisioned that counties will request this equipment for use during routine timber bridge inspections or for use in completing supplemental inspections based on findings during regular inspections. During the trial period, the project team would help develop a long-term implementation plan for MnDOT's Bridge Office to manage the tools and to help identify sources of funding for additional equipment purchase and management. Additional training opportunities will be available annually through the Minnesota Local Technical Assistance Program (LTAP).

ASSISTANCE

MnDOT has agreed to purchase the equipment specified in Table 1. MnDOT's Bridge Office has agreed to continue support and engagement of this research implementation. This includes Dave Conkel, State aid Bridge Engineer.

WORK PLAN

Task Descriptions

Task 1: Manage Shared Timber Bridge Equipment Use (Year 1)
The University will manage shared usage and provide technical assistance, preventative maintenance and coordinate repairs, as needed. This includes setting up a request process, coordinating shipping of equipment, providing consultation via telephone or web meeting, preventative maintenance, and collecting feedback from all users.

Task 2: Manage Shared Timber Bridge Equipment Use (Year 2)
The University will manage shared usage and provide technical assistance, preventative maintenance and coordinate repairs as needed. This includes setting up a request process, coordinating shipping of equipment, providing consultation via telephone or web meeting, preventative maintenance, and collecting feedback from all users.

Task 3: Determine Future Direction for NDE Equipment Usage
The University will review the success and determine the validity of recommending additional equipment sets and who the coordinating entity should be after the 24-month trial period. This will include review of Task 1 activities and feedback, consultation with MnDOT's Bridge and Regional Offices and other feedback from county engineers.

Task 4: Compile Report, TAP Review and Revisions
The University will prepare a draft report, following MnDOT's publication guidelines, to document project activities, findings and recommendations. This report will need to be reviewed by the TAP, updated by the University's Principal Investigator to incorporate technical comments, and then approved by Technical Liaison before this task is considered complete. Holding a TAP meeting to discuss the draft report and review comments is strongly encouraged. TAP members may be consulted for clarification or discussion of comments.

Task 5: 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 it meets the publication standard. This task must be completed within the Contract time because the editors will provide editorial comments and request information from the University's Principal Investigator.

Task Deliverables

Task:	Deliverable(s):
1:	A Written Report, detailing usage, end-user survey results, and recommendations
2:	A Written Report, detailing usage, end-user survey results, and recommendations
3:	A Written Report
4:	A Draft Report and Final Report Approved for Publication
5:	A Final Published Report

PROJECT SCHEDULE

Task Completion Dates

Task:	Draft Deliverable Due Date:	Final Task Approval Date:
1:	October 31, 2015	December 31, 2015
2:	October 31, 2015	December 31, 2015
3:	September 30, 2016	November 30, 2016
4:	September 30, 2016	November 30, 2016
5:		December 31, 2016

Task Durations

	2015												2016											
Months:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Task 1	X	X	X	X	X	X	X	X	X	X	X	X												
Task 2													X	X	X	X	X	X	X	X	X	X	X	X
Task 3																X	X	X	X	X	X	X	X	
Task 4																						X	X	
Task 5																							X	X

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