Memo

To: USDOT/RITA research team members

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Re: DSS Update – 4th Quarter

The 4th Quarter Report summary describes the current three-tiered design that the Bridge Condition Assessment using Remote Sensors Decision Support System (BCARS DSS), which is:

1. Providing a field data interface to allow DOT users to access existing bridge condition information and to enter bridge condition data while out in the field.
2. The ability to display already-processed remote sensing data from previous collects in an intelligent, easy-to-use format and DSS tool interface.
3. The ability to integrate, analyze, and display remote sensing data for bridge condition indicators collected "live" in the field.

As stated previously, DSS design efforts in quarters 3 and 4 have focused on the first two tiers, which are within the scope and timeline of this two-year project. The third tier, integrating remote sensing data "live" into a DSS, is a logical next step for DSS development.

Tier 1 is a near-term goal of the DSS because many state departments of transportation, such as Michigan's (MDOT), already have web-based information tools that provide access to a database of bridge condition information. MDOT's Michigan Bridge Reference System (MBRS) provides a web-based interface to the data collected during previous bridge inspections, and is used by inspectors to plan for upcoming inspections and to prioritize repair work assignments after collection of field data. The Michigan Bridge Information System (MBIS) provides a web-based interface to enter (and retrieve) bridge inspection data in a format that looks very similar to the printed bridge inspection reports that

are currently taken out into the field. Providing access to these sorts of databases while out in the field, with the ability to navigate to the next bridge of interest, is our recommended first step in building an effective and useful DSS.

The current project work to design and test remote sensing technology demonstrations and practical field data collection methods will provide the example data needed to design and code the new software part of the DSS, which is our second and newly started tier. For example, we plan to integrate data from the current radar, 3-D optics, thermal IR, and digital image correlation lab work into the DSS. The data will be represented in the DSS as having been already collected for bridges of interest and translated into useful indicators of bridge condition for the inspectors and state-level planners to use in their bridge repair and Asset Management efforts. For example, using 3-D optics, a three-dimensional surface of a bridge could be analyzed and interpreted into a surface roughness per unit area value, which could be translated into a indicator of condition similar to the National Bridge Inventory rating system. We anticipate that a similar rating could be derived for the number of spalls per unit area for the deck bottom surface. Such quantities might be visualized as a color-coded overlay on a photograph of the bridge surface. A radar-based sensing of delamination presence or crack width could be displayed on a digital photo of that part of the bridge and integrated into a larger NBI-style indicator of condition.

A key point to remember when doing this translation of data into decision-supporting information is that the strengths of remote sensing are in being able to gain a wide spatial and temporal coverage while not necessarily obtaining the same resolution as manual, close-up methods. The benefits of this approach are realized when assessing the condition of bridges at the scale of a region or state through a geographic information system (GIS) that codes bridge condition and recent changes for a large number of bridges in a given region. The ability to integrate large amounts of data and then monitor change over time is another traditional strength of remote sensing-based technologies that this project and the DSS need to take advantage of. Taking the remote sensing data and creating indicators of relatively good, medium, relatively poor condition is another key goal. Presenting those overall ratings to the bridge condition community through the DSS to help make economically-efficient decisions on which bridges to focus on in a budget-limited repair environment is part of that goal. Highlighting changes in those conditions so that users represented by our Technical Advisory Committee can have the “red light / green light” indicators of problem bridges that they requested is another part of that goal. Figure A below shows an example of displaying bridge condition information (from Michigan’s Transportation Management System) this is also available through the MBIS) with a green-to-red (relatively good to relatively bad) condition state for the bridge deck, with a highlight on those the “Fair” (NBI rating of 5 or 6) condition that are typically the focus of MDOT repair efforts. This could easily represent a

highlighting of those bridges where the condition has recently changed based on traditional inspections combined with new remote sensing-based data.

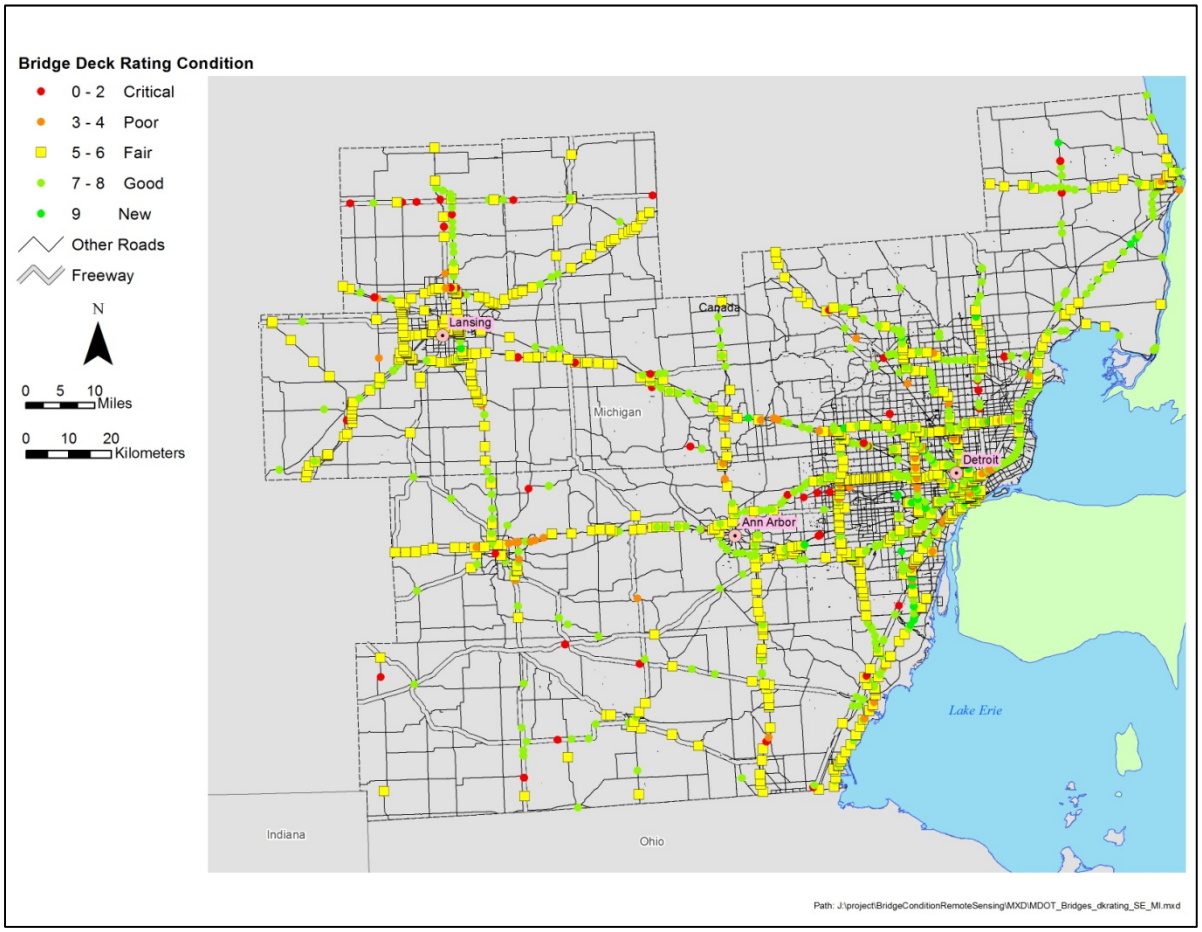

Figure A: A representation of Michigan's bridge condition data for southeast Michigan, using the deck rating as of March 2010, to show one way that remote sensing-based condition data could be presented to DSS users when integrated with traditional inspection data.

As stated in Tech Memo 10, we are now working on the DSS task as having a coincident end with the Field Demonstration (Task 5) so that we can integrate more data into it, enhance the interface and analysis algorithms based on the field demonstration data, and gain more information from ongoing lab work. We propose to deliver an interim report at the original deadline of April 2011 (end of Quarter 5) and a final, revised deliverable with the end of Task 5 (Quarter 7).