EXHIBIT A
SCOPE OF SERVICES

EVALUATION OF RECYCLED AGGREGATES TEST SECTION PERFORMANCE

BACKGROUND

Sustainability practices dictate that, whenever possible, materials should be recycled and reused. In fact, the American Society of Civil Engineers Code of Ethics Canon 1 requires civil engineers to consider sustainability in any design. In addition, studies indicate that the natural aggregate resources in the Twin Cities area are being rapidly depleted or built upon, and thus should be conserved by using alternative materials when possible. MnDOT is quite progressive in this regard and allows the use of recycled concrete, asphalt, glass, and brick in various applications. There are a number of pavements in the Minnesota network as well as some cells in the MnROAD test facility which contain recycled concrete aggregate (RCA) as a primary aggregate. However, the long-term performance of such sections has not been formally evaluated against the performance of similar conventional concrete pavements. The variables of interest include such things as mean times between repairs or maintenance, rate of friction degradation, ride quality loss, amount of freeze-thaw degradation, alkali-aggregate reaction, and other distresses.

In addition, an important aspect of the project is to evaluate the material properties of recycled concrete aggregate and those of new concrete made with recycled aggregates. In addition to material properties, the feasibility of constructing concrete pavements with RCA and the ability of the contractor to control the mix and deliver quality materials and workmanship will be evaluated in this project. While a reduction in initial cost may be realized by using RCA, there is the possibility that long-term costs, that is lifecycle costs, may be higher for the RCA pavements. If the lifecycle costs of RCA pavements are found to be lower than those for conventional pavements, this could lead to an increased use of RCA in pavement construction.

WORK PLAN

This section presents an overview of the plan proposed for this project. The MSU's project team will work closely with the Technical Advisory Panel to achieve results that will meet the needs of the Office of Materials. The project will involve some field evaluation of previously constructed concrete pavements with RCA, as well as the development of guidelines for materials and construction of new RCA pavements. It will also involve review of historical data and the analysis of performance curves or service life predictions.

A study of historical data available for RCA pavements will be made via the MnDOT pavement management database. This data is expected to include surface rating, ride quality index, present serviceability rating, record of maintenance and rehabilitation, skid resistance, and layer thicknesses. Similar data will be reviewed for other states as well.

Performance curves and service life predictions will be evaluated. A set of guidelines related to material properties and handling, as well as construction practices will be developed to assist pavement design engineers, materials engineers, and construction personnel in the proper use and constructability of RCA pavements.

IMPLEMENTATION

This research project is expected to be beneficial to pavement design engineers, materials engineers, and to construction personnel and contractors. The practices of other states will provide a starting point for developing guidelines for the use of RCA in concrete pavements. The guidelines developed under this project will assist in the selection of recycled aggregate materials, their appropriate use in concrete, and other construction aspects to ensure that pavements constructed with this type of aggregate perform as expected and are cost-effective to build. The use of RCA promotes sustainable development by recycling a material instead of dumping it to a landfill as well as conserving natural resources.

OBJECTIVES

The primary objective of this project is to develop a set of guidelines for the use of recycled concrete aggregates in concrete pavements. Other objectives include the evaluation of current practices in other states, the performance of RCA pavements in locations in Minnesota, and some basic materials testing to assist in the evaluations and predictions of performance.

MnDOT ASSISTANCE

The project staff will anticipate assistance from MnDOT for the following items:

- Facilitate field evaluations and coring operations assistance.
- Although a private contractor has been selected for coring, it has been assumed that MnDOT will provide the traffic control.
- Provide assistance as needed for accessing historical performance data.

SCOPE OF WORK

Task Descriptions

Task 1: Survey of other States' experience with RCA

MSU will conduct a survey of other states' practices and experiences with RCA. This survey will focus on RCA selection and use in new concrete pavement construction, materials and construction specifications, and long-term performance of concrete pavements constructed with RCA. Much of this work will be subcontracted to CTC and Associates of Wisconsin.

Anticipated Start Date: Upon Notice to Proceed
Scheduled Date to submit draft deliverable: October 30, 2014
Scheduled date for final task approval: January 31, 2015
Duration: 6 months including the TAP review and comment period
Deliverable: Transportation Research Synthesis Report

Task 2: Evaluation of long-term performance of RCA pavements

MSU will review historical pavement management data for both Minnesota and out-of-state RCA pavement sites. Performance curves will be fitted to the historical data. Average service life of RCA pavements will be investigated and evaluated to see if they are statistically different from conventional concrete. Other factors which might impact the service life of the specific pavements will also be considered. These factors could include differences in materials or construction practices that are detrimental or beneficial to concrete pavements with RCA.

Anticipated Start Date: September 1, 2014
Scheduled Date to submit draft deliverable: February 28, 2015
Scheduled date for final task approval: April 30, 2015
Duration: 8 months including the TAP review and comment period
Deliverable: Summary Report

Task 3: Evaluation of material properties and constructability of RCA pavements

One important aspect of the project is to evaluate the material properties of recycled concrete aggregate and those of new concrete made with recycled aggregates. In addition to material properties, the feasibility of constructing concrete pavements with RCA and the ability of the contractor to control the mix and deliver quality materials and workmanship will be evaluated. Of primary concern is the interaction of the mix proportioning and porosity of the RCA, and the probability of obtaining appropriate water-cementitious materials ratio consistently throughout a construction project. Specifically, one question that will be addressed is the level of precision with which the w/cm can be produced, replicated, and measured on the job site for purposes of applying an incentive or disincentive based on w/cm. The subcontract to Braun Intertec is included entirely within this task, and will include coring services as well as petrographic analysis to estimate porosity, w-cm ratio, and other properties of the in-place concrete that was constructed with recycled concrete aggregate.

Anticipated Start Date: October 1, 2014
Scheduled Date to submit draft deliverable: March 28, 2015
Scheduled date for final task approval: May 30, 2015
Duration: 8 months including the TAP review and comment period
Deliverable: Summary Report

Task 4: Evaluation of the economics of using RCA
MSU will investigate the cost effectiveness of using RCA from the perspective of pavement performance and expected service life. This evaluation will include pavement design, construction, and performance practices and data from previous projects. It will also include predicted improvements to performance using best construction practices that will become part of the guidelines in Task 5.

Anticipated Start Date: April 1, 2015
Scheduled Date to submit draft deliverable: July 30, 2015
Scheduled date for final task approval: September 30, 2015
Duration: 6 months including the TAP review and comment period
Deliverable: Summary Report

Task 5: Development of guidelines for the use of RCA in new construction
MSU will develop a set of draft guidelines for the use of RCA in concrete pavement construction. The guidelines will include information such as recommended gradations, mechanical properties, material handling, mixing and construction practices, and reasonable expectations of concrete pavements constructed with RCA. The document will also discuss possible cost savings by using RCA and potential future maintenance and rehabilitation issues that may arise due to their use. The guidelines will also draw on the experience of DOT personnel at other states and paving contractors.

Anticipated Start Date: August 1, 2015
Scheduled Date to submit draft deliverable: January 31, 2016
Scheduled date for final task approval: March 28, 2016
Duration: 8 months including the TAP review and comment period
Deliverable: Summary Report

Task 6: Compile Report, Technical Advisory Panel Review and Revisions
MSU will prepare a draft report, following MnDOT publication guidelines, to document project activities, findings and recommendations. This report will need to be reviewed by the Technical Advisory Panel (TAP), updated by the 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.

Anticipated Start Date: January 1, 2016
Scheduled Date to Submit Draft Report: February 28, 2016
Schedule Date for Final Report Approval: April 30, 2016
Duration: 4 months
Deliverables: A Draft Report and Final Report Approved for Publication

Task 7: 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 Principal Investigator.

Scheduled Start Date: May 1, 2016
Scheduled End Date: June 30, 2016
Duration: 2 months (required)
Deliverables: Final Published Report

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