TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): _WisDOT_____

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)* TPF-5(270)	**Transportation Pooled Fund Program - Report Period:** ☐Quarter 1 (January 1 – March 31) ■Quarter 2 (April 1 – June 30) ☐Quarter 3 (July 1 – September 30) ☐Quarter 4 (October 1 – December 31)

Project Title: Recycled Materials Resources Center- Fourth Generation (RMRC-4G)		
Name of Project Manager(s): Angela Pakes Ahlman and Tuncer B. Edil	**Phone Number:** 608-890-4966	**E-Mail** angela.pakes@wisc.edu
Lead Agency Project ID: TPF-5(352)	**Other Project ID (i.e., contract #):** AAC2312 Admin Contract	**Project Start Date:** January 1, 2017
Original Project End Date: February 28, 2022	**Current Project End Date:** February 28, 2022	**Number of Extensions:** 0

Project schedule status:

■ On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	**Total Cost to Date for Project**	**Percentage of Work Completed to Date**
$382,932	$27,269.46	7.1%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	**Total Amount of Funds Expended This Quarter**	**Total Percentage of Time Used to Date**
$2,482.55; 0.7%	$2,854.93	7.1%

Project Description:

The goal of RMRC-4G is to provide the resources and activities needed to break down barriers and increase utilization of recycled materials and industrial byproducts. This is being done through carefully integrated and orchestrated activities that include applied research in key areas relevant to transportation applications combined with outreach programs that provide the educational and technical resources needed to maximize the rate at which recycled materials and industrial byproducts are used in transportation applications.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

Hosted RMRC Executive Committee meeting 16th June 2018. Presented research ideas and voted on projects moving forward. North Caroline agreed to System-wide Life Cycle Benefits of Recycled Materials.

Completed LCA and LCCA for Sophomore Undergraduate Research Fellowship relating to Polyurethane Injection as a method of ground stabilization, as well as complementary work on LCA and LCCA Cement Slurry Injection and Traditional Tamping and Replacement as methods of ground stabilization for comparison.

Continued updates to the website to add user-friendly features.

Held weekly internal RMRC research administration meetings.

Anticipated work next quarter:

Initiate research on the environmental benefits of alkali activated ash paste versus clinker-based cement.

Initiate System-wide Life Cycle Benefits of Recycled Materials Use in North Carolina.

Contract projects agreed upon with Executive Board members.

Significant Results:

Environmental Benefits of Cold-in-Place Recycling available on TRB Website, soon to be published.

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

NA

Potential Implementation:

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): __ WisDOT_____

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Transportation Pooled Fund Program Project # MSN214029 RMRC 2017	**Transportation Pooled Fund Program - Report Period:** ☐Quarter 1 (January 1 – March 31) ■Quarter 2 (April 1 – June 30) ☐Quarter 3 (July 1 – September 30) ☐Quarter 4 (October 1 – December 31)	
Project Title: USE OF WASTE QUARRY FINES AS A BINDING MATERIAL IN UNPAVED ROADS		
Name of Project Manager(s): Bora Cetin Halil Ceylan Jeramy Ashlock Cassandra Rutherford	**Phone Number:** 515-294-8158	**E-Mail** bcetin@iastate.edu hceylan@iastate.edu jashlock@iastate.edu cassie@iastate.edu
Lead Agency Project ID: 0092-18-16	**Other Project ID (i.e., contract #):**	**Project Start Date:** 04/01/2018
Original Project End Date: 03/31/2019	**Current Project End Date:**	**Number of Extensions:**

Project schedule status:

■n schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
$75,000	$2,250	3%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$2,250/3%	$2,250	3%

Project Description:

In this project, the research team will conduct laboratory and field tests to examine the impact of inclusion of waste quarry fines in granular aggregate materials used in unpaved road designs, using materials collected from various quarries. Based on the laboratory test results, field test sections will be constructed using materials with different quarries. The field performance (abrasion resistance, freeze/thaw resistance, density, material loss, modulus, gradation change) of sections built with different quarry fines will be compared. Then, a comprehensive cost-performance and life cycle cost analyses will be conducted to evaluate the cost effectiveness and sustainability of these unpaved roads to determine whether it is economically advantageous to add waste quarry fines into granular unpaved road materials.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

- Contacted with potential technical advisory committee (TAC) members and possible quarries to donate quarry fines materials.

Anticipated work next quarter:

- Kick-off meeting
- Collection of quarry fines materials
- Starting laboratory tests

Significant Results:

- No significant results were found in this quarter.

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

Currently, there are no circumstances that affect the project.

Potential Implementation:
The results of this research will be summarized in a technology transfer brief, which will guide engineers and DOTs in how to apply the recommended methods and designs to improve the performance of unpaved roads. The final report will include an implementation section that will describe all methods, advantages and challenges that can be encountered during applications of the results of this research.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): __ WisDOT_____

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project # MSN214029 RMRC 2017	**Transportation Pooled Fund Program - Report Period:** ☐Quarter 1 (January 1 – March 31) ■Quarter 2 (April 1 – June 30) ☐Quarter 3 (July 1 – September 30) ☐Quarter 4 (October 1 – December 31)	
Project Title: USE OF CONCRETE GRINDING RESIDUE AS CONCRETE AND SOIL AMENDMENT		
Name of Project Manager(s): Bora Cetin Halil Ceylan	**Phone Number:** 515-294-8158 515-294-3374	**E-Mail** bcetin@iastate.edu hceylan@iastate.edu
Lead Agency Project ID: 140926	**Other Project ID (i.e., contract #):**	**Project Start Date:** 01/01/2018
Original Project End Date: 06/30/2018	**Current Project End Date:** 08/30/2018	**Number of Extensions:** 1

Project schedule status:

On schedule ■ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
$30,000	$807.88	3%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
18,813/59.71%	$18,005.12	62.71%

Project Description:

Concrete grinding residue (CGR) is a slurry byproduct created by concrete pavement maintenance operations. It is produced during concrete pavement maintenance operations carried out to extend the pavement service life. Typically CGRs possess a high alkaline characteristics with pH > 11 (DeSutter et al. 2010, Townsend et al. 2016). Current maintenance practice involves dumping of fresh CGR on the roadsides that results in some environmental concerns regarding plant and vegetation growth on the roadsides. This becomes more critical issue when disposal of these CGR slurries are nearby sensitive areas such as farmlands, lake, creeks, rivers, and high groundwater table presence. CGR disposal may lead to reduce density of vegetation which may yield to erosion problems in particular at the sensitive areas mentioned previously. However, CGR poses great potential to be used in concrete as an ingredient and as a soil stabilizing agent due to its high alkaline and rich CaO content.

The purpose of the current study is to conduct a detailed literature review and survey within Department of Transportations (DOTs) throughout US to understand the current issues regarding CGR and analyze interests of DOTs to recycle these materials in concrete and soil applications.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

- First draft of the literature review is completed. The summary of the literature review is provided below.
- Survey questionnaire was sent to the interested stake holders including concrete industry and state DOTs. It was sent to additional industry companies as requested by the RMRC board. The summary of the survey results are added below.

Summary of the CGR RMRC Literature Review Results and Findings

Technical Guidance

Based on several studies related to CGR characteristics, the major negative consideration related to slurry waste is contamination to the local environment, especially bodies of water. To prevent such contamination, the International Grooving and Grinding (IGGA) developed the best management practices (BMPs) for proper disposal of slurry by-products. The IGGA BMPs provide three methods to manage CGR. In some cases, CGR can be spread along roadsides in rural areas, while CGR generated in urban area can be hauled and transported to chosen ponds for decanting or to waste treatment facilities for processing. It should be noticed that spreading of CGR in sensitive areas or drainage facilities (e.g., culverts, drain inlets) is prohibited by the BMPs due to its high pH and metal content. In fact, numerous previous tests have verified that CGR is a nonhazardous material. In addition to the recommended proper disposal methods of CGR, the BMPs also proposed that CGR pH values should be monitored and maintained at the ranges of 2 to 12.5

State Management Practices

The review of state practices revealed that in many states CGR disposal methods are flexible and lack detailed guidelines and control actions. Based on survey responses from few DOTs, CGR is regarded as a hazardous waste in Washington, Ohio, and Arkansas. Although some studies did not expressly describe its negative impacts on plant growth, the variable characteristics of CGR may cause environmental issues depending on the materials used during concrete production. In consideration of these concerns, it is recommended that CGR disposal be managed by following the IGGA BMPs in combination with a pH control plan, or, if needed, with other control plans (TSS and Metals) to minimize the risk to the environment.

Reuse of CGR

The literature shows that while concrete fines may be a useful waste product for many applications. The solid phase of CGR can be utilized in similar applications due to its composition. However, applications of the CGR

recycling may be restricted by a number of factors such as time, cost, existing environmental conditions, and local regulations. Thus, there is a need to enlarge the range of application areas of CGR. Soil stabilization is a common practice related to the application of additives (e.g. cement, lime, fly ash) to improve engineering properties of subgrade soil for supporting pavement structures. The reuse of waste materials such as CGR in soil stabilization contributes to reduction in hazardous environmental impact and strengthening the engineering properties of soil which can ultimately reduce the cost of construction and increase the service life of the pavement structure built on the stabilized soil.

Anticipated work next quarter:

- Final report will be submitted

Significant Results:

- Draft literature review showed that CGR application on the roadsides is the most common technique. Studies showed that there is no adverse impact on vegetation.
- There are not studies thoroughly studied the reuse of CGR in soil and concrete. Preliminary tests conducted by ISU team showed that addition of CGR in two different fine-grained soils resulted in increases in UC strength of these soils.
- Based on the current survey results, it is evident that CGR is a common challenge for all state DOTs. In addition, there is an interest to investigate the reuse of CGR in soils as an amendment to understand whether this material can improve the engineering properties of soils without an adverse impact to the environment.

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

Currently, there are no circumstances that affect the project.

Potential Implementation:
Tech transfer will be prepared based on the results of this study to summarize the potential environmental impacts of CGR, the state of practice, and its physicochemical and geo-engineering properties.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Wisconsin Department of Transportation

INSTRUCTIONS:

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Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)*	**Transportation Pooled Fund Program - Report Period:** ☐Quarter 1 (January 1 – March 31) ☑Quarter 2 (April 1 – June 30) ☐Quarter 3 (July 1 – September 30) ☐Quarter 4 (October 1 – December 31)	
Project Title: Recycled Material Web Map: Connecting Consumers and Producers		
Name of Project Manager(s): Andrew J. Graettinger, Ph. D.	**Phone Number:** (205) 348-1707	**E-Mail** andrewg@eng.ua.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:** January 1, 2018
Original Project End Date: December 31, 2018	**Current Project End Date:** December 31, 2018	**Number of Extensions:** 0

Project schedule status:

☐ On schedule ☑ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
$49,518	$7,428	30%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$6,935	$6,935	50%

Project Description:

An on-line Geographic Information System (GIS) web application that connects producers and consumers of recyclable material was developed to assist engineers and contractors in the beneficial reuse of nonhazardous recycled materials in transportation projects. The Recycled Material Network (RMN) is comprised of four core layers: providers, stockpiles, specifications, and case studies. Providers of recycled material can locate their facility and enter contact information. The stockpile layer, connected to the provider layer, allows facility managers to add or update information about their recycled material stockpiles including material type(s), application(s), availability, and cost information. Multiple stockpiles can be associated with each provider. The specification layer includes both Department of Transportation (DOT) specifications and environmental regulations pertaining to the beneficial reuse of recycled material based on specific location, material type, and application. The case study layer locates projects that successfully utilized recycled materials and includes information regarding the material type, application, volume data, and any additional documentation. The web map utilizes search capabilities to locate nearby stockpiles to minimize transportation costs that typically dictate the use of large volumes of materials. The RMN provides key information that engineers and contractors need to successfully utilize recycled materials, thereby preserving limited natural resources and benefiting the project and society as a whole.

The RMN is hosted at the Center for Advanced Public Safety (CAPS) at The University of Alabama and was funded through a pooled fund supporting the Recycled Materials Resource Center (RMRC) at the University of Wisconsin – Madison. During the first phase of this work, the RMN was designed, developed, and tested with preliminary data. A beta version of the web application has been demonstrated to be a useful tool, but there are several areas of the application that need to be addressed for widespread use of this web tool. To address these areas, The University of Alabama is partnering with the University of Wisconsin – Madison and proposing a second phase of the project.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

This quarter, the project team worked on Tasks 1-3. For Task 1, data was collected for new case studies and facilities. New producers were found for Wisconsin, Virginia, North Carolina, Iowa, Pennsylvania, Illinois, Georgia, Alabama, Colorado, and Minnesota. All existing specification/regulations were checked for broken hyperlinks, and regulations and specifications were added for Iowa. For Task 2, information about existing approved recycled products was collected for Illinois, North Carolina, Minnesota, Iowa, Colorado, and Alabama. The project team has reached out to producers of recycled products to collect additional information on state approval of these products. On May 29, the project team met with the Center for Advanced Public Safety (CAPS) to discuss the early stages of creating the 'Approved Products' tab on the site. In this meeting, the project team also discussed updating the site to fix any outdated coding within the RMWM. For Task 3, the project team worked toward creating a check system. After repairing broken Reg/Spec links, screen shots of each web page were captured. These screen shots were compiled and sorted by state and regulating body for later use with the Link-Check Tool. This Link-Check Tool will use these screen shots to verify the functionality of each link in the Reg/Spec tab. On May 29, the project team discussed the implementation of this Link-Check Tool with CAPS.

Project Schedule Status

Task 1: Integrate Additional Data to Website	50%
Task 2: Recycle Material Approved Products and Material Tracking Layer	30%
Task 3: Stockpile/Provider/Hyperlink Accuracy Checking	50%

Tasks 4-5 have not been initiated at this point in the project.

Anticipated work next quarter:

Contact the materials engineer from the participating DOTs for new stockpile data. Collect more data on approved products and case studies for every pooled fund state. Begin entering data into the 'Approved Products' tab on the site. Set-up the automatic email system to notify providers to update stockpile information. Verify the Link-Check Tool and test reliability. Begin creating a marketing strategy for promoting the RMN and expanding the pooled fund to new members for RMRC-4G.

Significant Results:

On May 29, the project team met with CAPS to discuss creating the Link-Check Tool and adding the 'Approved Products' tab to the site.

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

Potential Implementation:

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Lead Agency (FHWA or State DOT): _____WisDOT_____

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Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)*	**Transportation Pooled Fund Program - Report Period:** ☐Quarter 1 (January 1 – March 31) ■Quarter 2 (April 1 – June 30) ☐Quarter 3 (July 1 – September 30) ☐Quarter 4 (October 1 – December 31)
Project Title: Physical and Chemical Factors Controlling pH and Alkalinity of RCA Leachate	

Name of Project Manager(s): Matthew Ginder-Vogel	**Phone Number:** (608) 262-0768	**E-Mail** matt.ginder-vogel@wisc.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:** October 1, 2017
Original Project End Date: April 1, 2019	**Current Project End Date:** April 1, 2019	**Number of Extensions:** 0

Project schedule status:

■ On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	**Total Cost to Date for Project**	**Percentage of Work Completed to Date**
$125,000	$ 18,863.07	15%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	**Total Amount of Funds Expended This Quarter**	**Total Percentage of Time Used to Date**
$ 15,000	$ 15,000	33%

Project Description:

The goal of this project is to develop an understanding of long-term RCA leachate chemistry to enable optimal implementation of the material, thereby maximizing its life cycle benefits and limiting its environmental impacts when stockpiled or utilized in roadbeds. Concurrent geochemical modelling and laboratory studies will connect field measurements of RCA leachate pH to laboratory measurements of leachate pH in order to develop guidelines for RCA implementation.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

Conducted control reactor batch experiments on calcium carbonate and calcium hydroxide (portlandite).

Continued batch reactor experiments of RCA to measure pH, alkalinity, and calcium ion concentration with contact time.

Began geochemical modelling of RCA leachate using Geochemist's Workbench.

Held weekly meetings to coordinate laboratory and modelling components of the work.

Completed laboratory investigation and wrote "Assessing the Impact of Contact Time on Leachate Chemistry from Recycled Concrete Aggregates".

Analyzed laboratory data and wrote "Characterization of Recycled Concrete Aggregate After Eight Years of Field Deployment".

Submitted "Characterization of Recycled Concrete Aggregate After Eight Years of Field Deployment," to *Journal of Materials in Civil Engineering,* ASCE.

Anticipated work next quarter:

Continue batch reactor experiments of RCA to measure pH, alkalinity, and calcium ion concentration with contact time.

Continue geochemical modelling of RCA leachate using Geochemist's Workbench.

Begin column experiments on compacted RCA to simulate field drainage conditions.

Begin to develop methodology and guidelines to advise stockpiling and road base construction using simple, inexpensive techniques.

Submit "Assessing the Impact of Contact Time on Leachate Chemistry from Recycled Concrete Aggregates" to the *Journal of Materials in Civil Engineering,* ASCE.

Submit paper to 2019 TRB Annual Meeting.

Continue holding weekly meetings with research team to review progress.

Significant Results:

Submitted “Characterization of Recycled Concrete Aggregate After Eight Years of Field Deployment,” to *Journal of Materials in Civil Engineering,* ASCE

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

NA

Potential Implementation:

The outcomes of the modelling and laboratory studies will provide scientific guidance for the regulation of leachate from RCA in road construction and detailed information about the changes in leachate chemistry as they relate to pH and alkalinity. Additionally, the research will provide implementation recommendations for consideration by the States.