MPC-451 (Year 2)
May 10, 2015

Project Title:
Assessing the Cost-Effectiveness of Wyoming's CMAQ Unpaved Road Dust Suppression Program (Year 2)

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University of Wyoming

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Research Needs:
For a number of years, Wyoming counties have used CMAQ funds to apply dust suppressants to their unpaved roads. These funds are intended to help reduce PM_{10} emissions (particulate matter less than 10 µm in diameter). Particulate matter is one of the U.S. Environmental Protection Agency's six criteria pollutants affecting air quality. PM_{10} is referred to as "inhalable coarse particles," such as those found near roadways. In the past, decisions as to where and how CMAQ funds are applied have been subjectively based on engineering judgment. This study will attempt to quantify the benefits and costs of these dust suppression efforts.

This study will monitor dust suppressant application, surfacing aggregate type, traffic, weather, roadway performance, and fugitive dust emissions to provide a comprehensive assessment of the effectiveness of the dust suppression efforts paid for with CMAQ funds. Due to the performance difference between unpaved roads in drier and wetter climates, the results from this study will be most applicable to the interior western United States and to other drier climates throughout the world. The methodologies developed during this study will be applicable for assessing the effectiveness of any dust control efforts, regardless of differences in precipitation.

Research Objectives:
The objective of this study is to quantify the benefits of the use of congestion mitigation and air quality (CMAQ) funds to provide Wyoming counties with funding to apply dust suppressants to their unpaved roads. There are several benefits from the use of dust suppressants. There is the environmental benefit of reduced fugitive dust emissions from unpaved roads. Maintenance costs are generally reduced on treated roads since maintenance isn't needed as often and gravel isn't lost as quickly so it doesn't need to be replaced as often. Finally, treated roads generally provide the

user with a higher quality road surface with less raveling, loose aggregate and washboards, all of which can contribute to a loss of vehicle control. Both these improvements in road surface quality and the improved visibility that arises from reductions in dust make unpaved roads safer when they are treated. The goal of this project is to determine the value of the reductions in fugitive dust emissions which are realized by using different dust suppressants and application methods in different situations. By determining the benefits realized in different situations, the results of this study will allow for cost-effective allocation of CMAQ funds in the future. On a broader scale, this study will provide information that will allow for more cost-effective use of road dust suppressants in general.

Research Methods:
This study will utilize field data and comprehensive statistical analysis to prove the effectiveness of various dust suppressants.

Expected Outcomes:
This study will provide basic information needed to use dust suppressants and CMAQ funds as efficiently as possible. When combined with knowledge about traffic characteristics and surfacing aggregate types, the most cost-effective use of dust suppressants and CMAQ funds will be established. This will benefit both those deciding how to allocate CMAQ funds and others deciding where they will get the most value out of the money they spend on dust suppression purchases and applications.

Beyond the direct benefits of lowered fugitive dust emissions and lower maintenance costs for agencies using dust suppressants, there are also substantial user cost benefits. Lower vehicle costs will result from improved surface conditions. Finally, by reducing raveling, loose aggregate, washboards, and dust, the safety of treated, unpaved roads' surfaces will be improved. Though it is not a direct objective of this study, it is highly likely that it will save lives by improving the overall safety of unpaved roads' surfaces.

The results of this study will be directly applicable throughout the interior western United States and other drier climates.

Relevance to Strategic Goals:

This project is relevant to the following two MPC strategic goals: State of Good Repair and Safety.

Educational Benefits:
The knowledge learn from this study will be integrated in various transportation courses taught at the University of Wyoming.

Work Plan:
The following task list delineates the process of quantifying dust suppressants' economic impacts and the effectiveness of the CMAQ program. First is the Year 1 data collection, followed by the Year 2 data collection, followed by the third year data analysis and report preparation. The task

lists below apply to the sites established in Year 1, in Year 2 and the analytical tasks. They will temporally overlap somewhat, particularly when monitoring continues for a year after dust suppressants' application.

Year 1 Accomplishments

1. A procedure was established for collecting field data.
2. A correlation between two dust data collection techniques was established.
3. A few sections were tested in 2014.
4. Presentations were given at the WACERS meeting and the Transportation & Safety Congress about the study.
5. Seven Counties agreed to participate in the 2015 data collection.

Year 2 Construction and Data Collection

1. Identify those counties which receive CMAQ funding for dust suppression in Year 2.
2. Obtain planned locations, dust suppressant types and application methods.
3. Determine the surfacing aggregate type for roads scheduled for treatment if this has not already been done or if any changes have been made.
4. Select road sections to be monitored in Year 2.
    a. Determine the roads treated in Year 1 that will also be treated in Year 2. These roads should be monitored in Year 2.
    b. Determine whether and which additional roads should be monitored in Year 2.
5. Perform dust measurements and surface condition evaluations before treatment.
6. Monitor and document dust suppressant application methods.
7. Perform traffic counts on monitored roads.
8. Perform dust monitoring and surface condition evaluations.
9. Test and evaluate surfacing aggregate samples.
10. Obtain weather data from the weeks before dust monitoring.

Year 3 Data Analysis and Report Preparation

11. Compile database.
    a. Assemble dust data from before and after dust suppressant application.
    b. Assemble road condition data from before and after dust suppressant application.
    c. Assemble traffic data.
    d. Assemble materials data
    e. Assemble application information
        i. Dust suppressant type
        ii. Construction methods
        iii. Terrain and alignment
        iv. Costs
12. Analyze data
    a. Estimate aggregate loss due to dust.
    b. Perform regression analyses for each cell within the experimental matrix (See Table 1).
        i. Cell parameters

        1. Surfacing aggregate types
        2. Dust suppressant types and application methods
    ii. Independent variables
        1. Traffic data
        2. Precipitation in the preceding week
        3. Relative humidity in the preceding week
        4. Terrain
        5. Time since dust suppressant application
        6. Surfacing aggregate properties
    iii. Dependent variables
        1. Dust measurements
        2. Road surface conditions

13. Estimate and assess economic benefits and costs of dust suppression for the various combinations of dust suppressants and application methods with the various surfacing aggregate types. These estimates will be performed using the results of the data analysis and regression equations described above.
14. Prepare final report.
15. Present results.

Table 1. Example Experimental Matrix

	Soil Type			
Dust Suppression Agent and Construction Method	Blow Sand (A-3, SP-SP-SM)	Caliche (A-2-4, A-4, SM, SM-SC, SP-SC, ML)	Alluvial Gravel (A-1, A-2, GM, GP, GW-GM, GW-GC, GP-GM, GP-GC, GM-GC)	Quarried Limestone (A-1, GW, GP, GM, GW-GM)
$MgCl_2$ topical spray				
$CaCl_2$ topical flakes				
$CaCl_2$ blended flakes				
$MgCl_2$/Lignin topical spray				
Lignosulfonate topical spray				
Proprietary topical spray				

9. Milestones, Dates:

The proposed duration of the study is January 1, 2014 through December 31, 2016. Figures 1 and 2 show timelines for years 2 and 3.

	Task & Description*	January-15	February-15	March-15	April-15	May-15	June-15	July-15	August-15	September-15	October-15	November-15	December-15
8	*Perform dust and condition evaluations.*					Year 1	Year 1						
9	Test surfacing aggregate samples.	Year 1											
11	Identify counties receiving CMAQ funds Year 2.	Year 2											
12	Obtain dust suppressant application plans.	Year 2	Year 2	Year 2									
13	*Determine surfacing aggregate types.*			Year 2	Year 2	Year 2							
14	Select road sections to be monitored in Year 2.			Year 2	Year 2	Year 2							
15	*Perform preliminary dust and condition evaluations.*					Year 2	Year 2	Year 2	Year 2				
16	*Monitor and document applications.*					Year 2	Year 2	Year 2	Year 2	Year 2			
17	*Perform traffic counts.*						Year 2	Year 2	Year 2	Year 2	Year 2		
18	*Perform dust and condition evaluations.*							Year 2	Year 2	Year 2	Year 2		
19	Test surfacing aggregate samples.											Year 2	Year 2
20	Obtain weather data											Year 2	Year 2

Year 1 Tasks   Year 2 Tasks

***** Tasks in *italics* will be performed in the field. Other tasks will be performed in the laboratory, the office, or remotely in collaboration with county road and bridge departments.

Figure 1. Intermediate Year Timeline

	Task & Description*	January-16	February-16	March-16	April-16	May-16	June-16	July-16	August-16	September-16	October-16	November-16	December-16
18	*Perform dust and condition evaluations.*					Year 2	Year 2						
19	Test surfacing aggregate samples.	Year 2											
21	Compile database.						Final	Final					
22	Analyze data.							Final	Final				
23	Assess economic benefits and costs.								Final	Final	Final		
24	Prepare final report.									Final	Final	Final	
25	Present results.												Final

Year 2 Tasks   Final Tasks

***** Tasks in *italics* will be performed in the field. Other tasks will be performed in the laboratory, the office, or remotely in collaboration with county road and bridge departments.

Figure 2. Third Year Timeline.

Project Cost:
MPC Funds Requested: $ 41,683
Matching Funds: $42,132
Total Second Year Project Costs: $ 83,815
Source of Matching Funds: LTAP/UW

TRB Keywords:

Dust, CMAQ, unpaved, gravel, unsealed, dust control, air quality.

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