U.S. Department of Transportation
Research and Innovative Technology Administration
University Transportation Center Grant Agreement

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Mountain Plains Consortium, North Dakota State University
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1. ACCOMPLISHMENTS: What was done? What was learned?

a. *What are the major goals of the program?*

The overall objectives are to: (1) conduct basic and applied research, the products of which are judged by peers or other experts in the field of transportation to advance the body of knowledge in transportation; (2) offer an education program relating to transportation that includes multidisciplinary course work and participation in research; (3) conduct workforce development activities and programs to expand the workforce of transportation professionals; and (4) provide an ongoing program of technology transfer that makes transportation research results available to potential users in a form that can be implemented, utilized, or otherwise applied. Other programmatic goals are to: (1) select projects and conduct activities that address the Secretary's five strategic goals, (2) select and conduct projects utilizing peer review principles and procedures and client input, and (3) select projects that leverage UTC funds with matching funds from state and local governments and private industry. The chief operational goals are to make important contributions to research and technology transfer in key areas related to the Secretary's goals of State of Good Repair, Safety, and Economic Competiveness, while addressing critical issues of the region and stakeholder groups.

b. *What was accomplished under these goals?*

i. Project Selection

Over 40 research projects have been selected and initiated through a peer review process that reflects substantial input and matching resources from state departments of transportation and MPOs in the region. Collectively, this set of projects addresses all five of the Secretary's strategic goals and several of USDOT's requested emphasis areas under State of Good Repair—e.g., (1) bridge condition monitoring, (2) locating critical infrastructure defects, (3) identifying tools to prevent and detect corrosion in transportation infrastructure, (4) analytical tools for infrastructure performance management, and (5) methods and criteria to measure performance of new materials and methods. Other research projects are related to Safety, Economic Competiveness, Livable Communities, and Environmental Sustainability.

The projects selected under the grant are listed in Tables 1-5, under the primary strategic goal addressed by the project. Nevertheless, it must be noted that most of the projects address several goals simultaneously. In particular, many projects that address state of good repair have safety and economic competiveness benefits.

Table 1: MPC Research Projects Most Directly Correlated with State of Good Repair

1. Geotechnical Limit to Scour at Spill-through Abutments (Year 2)
2. Seismic Performance of Self-Consolidating Concrete Bridge Columns and Connections
3. Comprehensive Analysis of Long Term Bridge Performance
4. Structural Health Monitoring of Highway Bridges Subjected to Overweight Trucks – Instrumentation Development and Validation

Table 1: MPC Research Projects Most Directly Correlated with State of Good Repair

5. Quantifying the Performance of Constructed Bridges in Cold Regions: Development, Assessment, and Repair
6. Damage Assessment, Characterization, and Modeling for Enhanced Design of Concrete Bridge Decks in Cold Regions
7. Integrated Real-Time Health Monitoring and Impact/Collision Detection System for Bridges in Cold Remote Regions
8. Improved Understanding of Pavement Impacts and Cost-Effective Designs Based on Mechanistic Empirical Methods
9. Seismic Behavior of Steel Bridges with Fatigue-prone Details
10. Seismic Performance of Highway Embankments
11. Assessing Existing Transportation Sustainability Rating Systems
12. MEMS Sensors for Transportation Structures
13. Plastic-Aluminum Composites in Transportation Infrastructure
14. Design and Construction Monitoring of Surcharged Embankment
15. Implementation of Low Temperature Test for Asphalt Mixtures to Improve Longevity of Road Surfaces
16. Evaluation of Spliced Sleeve Connections for Precast Reinforced Concrete Bridge Piers
17. Performance-based Interaction Analysis of Damage on Bridge Expansion Joints and Heavy Traffic
18. Quantifying Uncertainty in Nondestructive Bridge Inspection Methods for use in Performance Based Inspection
19. Accelerated Bridge Construction in South Dakota: Pilot Study for Implementation Strategy
20. Extent, Severity, and Location of Chip Seal Loss on the South Dakota State Road Network
21. Evaluation and Mitigation of Vehicle Impact Hazard for Overpass Bridges in South Dakota
22. Evaluation of Ice Loads on Bridge Piers in South Dakota (Years 2 & 3)

Table 2: MPC Research Projects Most Directly Correlated with Safety

1. Developing Statistical Models for Crash Severity Comparing Statewide, County and Indian Reservation Roads
2. Effectiveness of Advisory Letter in Preventing At-Risk Teen Driver Crashes: Pilot Project
3. ND Motor Crash Analysis and Rider Assessment for Improved Conspicuity
4. Anticipatory Guidance for Older Drivers
5. Decision Support for Strategic Truck Safety and Weight Enforcement Planning
6. Investigation of Interactions Between Traffic Law Enforcement and Driving Behavior on Rural Highways in Colorado
7. Modeling, Analysis and Evaluation of Urban Arterial Work Zone
8. Modeling and Evaluation of Traffic Signal Preemption near Railroad Crossings in Small Urban Area
9. Improving Rural Emergency Medical Services (EMS) through Transportation System Enhancements

Table 3: MPC Research Projects Most Directly Correlated with Economic Competiveness

1. Small Railroad Capital Investment Needs and Financial Options
2. Educational and Workforce Development: STEM Outreach at Colorado State University
3. A Two-stage Approach for Estimating a Statewide Truck Trip Table
4. Understanding Public Perceptions of Different Revenue Generation Systems for Highway Construction and Maintenance
5. Selection of Discount Rates for Infrastructure Investment
6. Comprehensive GIS-Based Rural Regional Transportation Planning Models
7. Use of Travel Time, Travel Time Reliability, and Winter Condition Index Information for Improved Operation of Rural Interstates
8. Review of Road User Costs (RUC) and Methods

Table4: MPC Research Projects Most Directly Correlated with Livable Communities

1. Building a Framework for Transportation Resiliency and Evaluating the Resiliency Benefits of Light Rail Transit in Denver, Colorado
2. Traffic Modeling of Transit Oriented Development

Table 5: MPC Research Projects Most Directly Correlated with Environmental Sustainability

Do Changing Prices Portend a Shift in Fuel Consumption, Diminished Greenhouse Gas Emissions, and Lower Fuel Tax Revenue?

ii. Programmatic Milestones

The accomplishments to date are summarized in Table 6 by reference to milestones.

Table 6: Program Milestones

Milestone Event	Description	Start Date	End Date
Development of Proposal Guidelines	Proposal guidelines were developed by the director, in consultation with other consortium members, to ensure a consistent solicitation and project selection process that facilitates peer review and links program activities to the Secretary's strategic goals. The research proposals guidelines are shown in Table 7. Similar but different guidelines were developed for education, workforce development, and technology transfer projects, to reflect the differences in tasks and outcomes associated with these projects. The proposal guidelines and related information have been posted on the Center's webpage.	1/1/2012	1/12/2012

Table 6: Program Milestones

Milestone Event	Description	Start Date	End Date
Call for Proposals	The solicitation of proposals occurred on each university campus, using proposal guidelines developed by the director.	1/12/2012	2/15/2012
UTC/CUTC Meeting	The director and administrative staff attended the UTC/CUTC meeting at TRB and received guidance from RITA regarding the forthcoming grant.	1/22/2012	1/22/2012
Execution of Grant Agreement	The grant was received from RITA and executed by NDSU's Sponsored Programs office. All of the necessary internal accounting and financial procedures were established, including subcontract agreements with consortium universities.	2/15/2012	12/31/2013
Peer Review of Proposals	All project proposals were subjected to external and internal peer review.	2/15/2012	4/15/2012
Center Directory	A directory of key center personnel was completed and published on the center's web page.	2/15/2012	5/13/2012
Center Webpage	The MPC webpage was updated and is fully functional for the current grant period	2/15/2012	5/13/2012
Selection of Theme	The MPC theme for the new program period is "Transportation Infrastructure and Operations to Support Sustainable Energy Development and the Safe Movement of People and Goods." The theme reflects the focus on energy development, efficiency, and independence, including emerging alternative fuels, shale oil and natural gas from the Bakken and Rocky Mountain fields, and energy efficient community design and transportation operations. It also encompasses environmental considerations such as saltwater disposal, freshwater supplies, and land use changes. In addition, the theme stresses the traditional MPC focus areas of safety and freight movements	2/15/2012	12/31/2013
Selection of Projects	Projects were selected from the proposals received and awards were made to principal investigators, based on the peer reviews of proposals, stakeholder commitments, and the overall availability of funds.	3/15/2012	6/15/2012
Posting of Projects	The selected projects were posted on the MPC webpage and added to the Research in Progress database.	4/15/2012	7/15/2012

Table 6: Program Milestones

Milestone Event	Description	Start Date	End Date
Development of Implementation Plan	An implementation plan was developed and submitted to RITA. It is applicable through the end of the program period.	5/21/2012	12/31/2013
Site Visit	A site visit was held in Fargo that included several UTC program administrators from RITA, key NDSU officials, and representatives from the other consortium universities.	5/30/2012	5/30/2012
UTC/CUTC Summer Meeting	The center director and other key staff attended the 2012 summer UTC/CUTC meeting in Michigan.	6/20/2012	6/23/2012

Table 7: MPC Research Proposal Guidelines for Faculty

Title	Provide a title that is descriptive of the project and includes key terms that will facilitate internet and library searches for the project.
Universities	If the project is a multi-university proposal, list each university involved.
Principal Investigators	If the project is a multi-university proposal, list a principal investigator from each university, with the university affiliations denoted in parentheses.
Research Needs	Provide a statement of the important issues and problems that give rise to the need for the project, including a brief literature review (if appropriate) that summarizes the state of knowledge in the subject area and identifies the knowledge gaps the project seeks to fill. It must be clear from the description that there are compelling needs for the study and it will address issues of national and regional importance.
Research Objectives	Provide a clear statement of the research objectives, including any hypotheses to be tested. At least some of the objectives must be measurable—i.e., at the conclusion of the project, it must be possible to ascertain whether the stated objectives have been achieved.
Research Methods	Provide a sufficient description so that reviewers can assess the appropriateness of the research approach and methods and the quality and reliability of data, including descriptions of any mathematical, statistical, operations research, and simulation techniques to be used, as well as surveys, lab tests, and field data.
Expected Outcomes	Provide a description of the expected outcomes in terms of potential findings and impacts, including advances in modeling, practices, and procedures; implications for future research; and how the results of the project can be used by practitioners. Describe any tangible products beyond the research report, including prototype software, equipment, guidebooks, or instructional manuals that may emanate from the project.

Table 7: MPC Research Proposal Guidelines for Faculty

Relevance to Strategic Goals	Describe how the proposed project and its expected outcomes are related to one or more of the following goals: State of Good Repair, Safety, Economic Competiveness, Environmental Sustainability, and Livable Communities.
Educational Benefits	If applicable, describe how students will be involved in the project and any expected classroom or instructional uses of procedures, examples, or discoveries derived from the project.
Work Plan	Provide a description of the major tasks or steps in the project, along with an expected timeline. The tasks should be numbered and an expected completion date assigned to each one. Instead of calendar dates, the timeline should be expressed in months from the starting date. Typically, a work plan includes steps such as the completion (and testing) of questionnaires, lab tests, field tests or data collection efforts, input or focus group meetings, and critical steps such as the initial runs and calibrations of models. A draft report and other milestone events should be included, as well as a technology transfer plan that includes a research seminar via the Transportation Learning Network and/or plans to collaborate with an LTAP or TTAP center (if appropriate). If the research is basic in nature, other dissemination methods may be substituted for the TLN, LTAP, or TTAP distribution channels.
Project Cost	List the amount of MPC funds requested, the amount of the expected matching contributions, and the sources of the matching resources, including all agencies expected to contribute funds or in-kind resources to the project. MPC research projects require at least a dollar for dollar match. However, other federal funds (e.g., federal funds other than UTC funds) cannot be used as match, except for state planning and research funds and LTAP funds, which are eligible under exclusionary provisions of the authorizing legislation. The definition of "non-federal funds" is based on the original source of funds.
Potential Peer Reviewers	Provide the complete contact information of at least three persons who are qualified to review and critically assess the proposal, including the person's name, position title and organization, street address, city, state, zip code, and email address. Please keep in mind that peer reviewers cannot have conflicts of interests, such as those that may arise if someone stands to personally or professionally benefit from the proposed project. Peer reviewers may include professionals at federal, state, metropolitan, or local agencies, as well as university and private-sector researchers. Given that at least three completed reviews are required for a proposal to move forward in the assessment process, the submission of more than three names may expedite the time frame for approval, in the event of one or more nonresponsive reviewers.
TRB Keywords	Provide a complete list of applicable TRB keywords
References	List the major references cited in the proposal and other seminal work in the field.

iii. Project Milestones

In addition to the programmatic milestones described above, several milestones embedded within individual projects have been achieved. Most of the research projects call for literature reviews. The literature reviews for those projects with the earliest starts are substantially complete. Interim reports are not required after the literature review stage. So, no publications have been produced at this time. Nevertheless, certain milestones have been reached for individual projects based on literature reviews and early results. For example, in MPC-365 (Improved Understanding of Pavement Impacts and Cost-Effective Designs Based on Mechanistic Empirical Methods), the Darwin-ME software has been acquired and used for sensitivity analysis to determine the key parameters to be examined in the design of oilfield roads. Detailed climate data have also been collected for this project. In MPC-364 (Do Changing Prices Portend a Shift in Fuel Consumption, Diminished Greenhouse Gas Emissions, and Lower Fuel Tax Revenue?) a webinar has been conducted for state DOTs and preliminary reports have been issued for internal review. In MPC-375 (Small Railroad Capital Investment Needs and Financial Options) a questionnaire for a small railroad survey has been developed. Furthermore, a draft survey has been designed for financial institutions that provide funding for railroad investments. This project is being fast tracked because of a Congressional study request received by FRA. MPC-393 (Traffic Modeling of Transit Oriented Development) has produced a literature review on traffic modeling of transit oriented development, as well as a written description of design principles for transit oriented developments. At this time, all projects are on schedule to be completed as planned during the program period.

c. How have the results been disseminated?

Because the effective starting dates of most projects were from mid-March to mid-April, no tangible results have been produced at this time. Therefore, we have nothing to report.

d. What do you plan to do during the next reporting period to accomplish the goals/objectives?
No changes are foreseen to the accepted plan and implementation schedule.

2. PRODUCTS: What has the program produced?

a. *Publications, conference papers, presentations?* Nothing to report.

b. *Books or other non-periodical, one-time publications?* Nothing to report.

c. *Website(s) or other internet site(s)?* The MPC website is fully operational at:
http://www.mountain-plains.org/

d. *Technologies or Techniques ?* Nothing to report.

e. *Inventions, patent applications, and/or licenses?* Nothing to report.

f. Other? All of the transportation-related courses listed in the prospectus which were scheduled for spring semester of 2012 were offered and taught. However, commitments had previously been made to offer these courses, with or without the UTC grant—which was executed after the

start of the semester. Therefore, these courses are not listed in the progress report. At this time, we have nothing to report.

3. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS: Who has been involved?

a. *What individuals have worked on the program?*

The principal investigators, faculty, and administrators participating in MPC projects at the **Utah State University** are:

1. Kevin Heaslip, University Program Coordinator and PI (Transportation Engineering)
2. Paul Barr, PI
3. Ryan Bosworth, Co-PI (Applied Economics)
4. Michael Thomas, Investigator (Economics)
5. Rebecca Winstead, TIMELab Administrator

Students participating in MPC research projects at **Utah State University** are:

1. Ali Soltani Sobh, Ph.D. student (Transportation Engineering)
2. Donghyung Yook, Ph.D. Ssudent (Transportation Engineering)
3. Mr. Sarawut Jansuwan, a Ph.D. student from Utah State University, who is investigating the FAF^3 commodity flow database.
4. Ms. Areekamol Tor. Chaisuwan, a visiting Ph.D. student from Burapha University, Thailand, who is currently involved in data collection efforts.
5. Conner Huffaker (Graduate Student)

Others participating in MPC projects at **Utah State University** include Hugh Boyle (a consultant).

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Wyoming** are:

1. Khaled Ksaibati, University Program Coordinator and PI
2. Robert Ettema, PI
3. John Turner, PI
4. Rhonda Young, PI
5. Richard J. Schmidt
6. Robert G. Erikson
7. Hilmar L. Heininger
8. Debbie Shinstine

Students participating in MPC research projects at the **University of Wyoming** include Taylor J. Kasperick.

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Utah** are:

1. Steven Bartlett, Associate Professor (Geotechnical);
2. Evert Lawton (co-PI), Professor (Geotechnical);
3. Chris Pantelides, Professor (Structures);

4. Lawrence Reaveley (co-PI), Professor (Structures);
5. Pedro Romero, Associate Professor (Materials/Pavements); and
6. Xuesong Zhou, Assistant Professor (Transportation)

Graduate and undergraduate students working on MPC research projects at the **University of Utah** include:

1. Zacgary Jones (Masters);
2. Charan Chandika (Masters);
3. Mohammad Ameli (PhD);
4. Joel Parks (Masters);
5. Dylan Brown (undergraduate);
6. Ivana Tasic (PhD); and
7. Milan Zlatkovic (PhD)

The principal investigators, faculty, and administrators participating in MPC projects at **South Dakota State University** are:

1. Nadim Wehbe, University Program Coordinator and PI
2. Allen Jones, PI
3. Xiao Qin, PI
4. Zhiguang Wang, PI
5. Shiling Pei, PI
6. Haifa Samra, PI

Graduate and undergraduate students working on MPC research projects at **South Dakota State University** include:

1. Brittney Ahrenstorff
2. Chase Cutler
3. Todd Pauly (starting August 2012)
4. Melissa McMullen (starting August 2012)
5. SDSU Undergraduate Students:
6. Nicole Campbell (undergraduate)

The principal investigators, faculty, and administrators participating in selected projects from **Colorado State University** are:

1. Rebecca Atadero, University Program Coordinator and PI
2. Paul Heyliger, PI
3. Suren Chen, PI
4. Hussam Mahmoud, Co-PI
5. Mehmet Ozbek, Co-PI
6. Caroline Clevenger, Co-PI

Graduate and undergraduate students working on MPC research projects at **Colorado State University** include:

1. Alex Hesse MS,
2. Paula Miller MS,
3. Greg Yucha MS

North Dakota State University –

The principal investigators, faculty, and administrators participating in selected projects from **North Dakota State University** are:

1. Kimberly Vachal, University Program Coordinator and PI
2. Andrea Huseth , PI
3. Mark Berwick , PI
4. Brenda Lantz , PI
5. Jimmy Kim , PI
6. Frank Yazdani , PI
7. Dr. Mijia Yang, PI
8. Doug Benson, PI
9. EunSu Lee, PI
10. Pan Lu, PI
11. Denver Tolliver, Director and Co-PI

Graduate and undergraduate students working on MPC projects at **North Dakota State University** include:

1. Agrawal, Ankush
2. Campbell, Eileen
3. Dang, Vu
4. DeHaan, Christopher
5. Holt, Luke
6. Itani, Maher
7. Kayabas, Poyraz
8. Kazemi, Yasaman
9. Liu, Qing
10. Mistry, Dilip
11. Park, Ju Dong
12. Shakya, Sumadhur
13. Siriward, Thushara
14. Telste, Michael
15. Zheng, Zijian

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Denver** include Patrick Sherry, University Program Coordinator and PI.

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Colorado Denver** include Wesley Marshall, University Program Coordinator and PI.

b. ***What other organizations have been involved as partners?***

The timing of match funding and the commitments of collaborators vary widely and are still unfolding. At this time, we have the following committed collaborators. However, others will be added later. The participants from many of these organizations will be named at a later date, when their funding and personnel availability becomes more certain.

1. South Dakota LTAP: Ken Skorseth
2. South Dakota DOT: Daris Ormesher, Aaron Breyfogle, Dustin Artz, Megan Steever
3. South Dakota Department of Public Safety: to be identified in September 2012
4. SD Department of Public Health: to be identified in September 2012
5. North Dakota Highway Patrol (key participants to be named later)
6. North Dakota Department of Transportation (key participants to be named later)
7. Utah Department of Transportation (key participants to be named later)
8. New York State Department of Transportation (key participants to be named later)
9. Texas Department of Transportation (key participants to be named later)
10. Utah Transit Authority (key participants to be named later)
11. Hanson Structural Precast (key participants to be named later)
12. NIST (key participants to be named later)
13. Tegracore (key participants to be named later)
14. Wind River Indian Reservation (key participants to be named later)
15. Washington Department of Transportation (key participants to be named later)

c. ***Have other collaborators or contacts been involved?*** Additional collaborators are being added this summer, as projects and match funding come on line, including more individuals from the private sector. The list presented is this report is preliminary and is expected to increase, with more details available in subsequent progress reports.

4. IMPACT: At this time, the impact of the projects and overall program cannot be judged. Therefore, we have nothing to report.

5. CHANGES/PROBLEMS: No changes are foreseen at this time.

5a. ADDITIONAL INFORMATION REGARDING PRODUCTS AND IMPACTS:
Nothing to report at this time.

PROGRAM OUTPUTS: Nothing to report at this time.

PROGRAM OUTCOMES: Nothing to report at this time.

PROGRAM IMPACTS: Nothing to report at this time.

6. SPECIAL REPORTING REQUIREMENTS: None