

Evaluation and Advancement of VTrans Bridge Deterioration Model

MONTHLY REPORT

A. PROJECT NUMBER (EA Number): TAMP001-001

B. PRINCIPLE INVESTIGATOR(s): Dr. Eric Hernandez

C. START AND END DATE (per grant assignment): April 17, 2014 – December 31, 2014

D. ANTICIPATED COMPLETION DATE: October 17, 2014

E. PROJECT OBJECTIVES: The primary goal of this project is to evaluate and advance the VTrans' Bridge Deterioration Model (BDM). The objective of the BDM is to estimate when a bridge will fall into the "structurally deficient" category based on previous inspection results for nearly 2,600 bridges documented in the VTrans' Bridge Inventory System (BIS).

F. REPORT PERIOD: June 17th through July 17th, 2014

G. ACCOMPLISHMENTS THIS PERIOD:

- Stopped gathering data on extreme events at the request of VTrans
- Finished gathering data on major repairs and maintenance of bridges for inclusion in the model
- Finished reviewing the BIS inspection data for quality and effectiveness, and developing statistical summaries which point to strengths and weaknesses in the historical data set; the data currently lacks identification of the inspector performing each inspection, which is a critical field for deterioration modeling

H. PROBLEMS ENCOUNTERED (if any): The timeline in the proposal assumed a notice-to-proceed date of March 1, 2014. Since the NTP was not received until April 17, 2014, the timeline is revised as follows:

- Draft Final Report: A draft of the final report will be delivered to VTrans on September 24, 2014. VTrans will be given 15 working days to review and comment on the final product. The final product delivery date for the report, with VTrans comments incorporated, is October 17, 2014.
- Preliminary BDM: The preliminary enhanced BDM, including all supporting electronic files, spreadsheets, databases, & macros, along with all computer codes or languages necessary to run the model, will be delivered by August 29, 2014. With the preliminary BDM, UVM will provide a description (1-2 pages) of the process necessary to perform analyses using the enhanced BDM.

- Final Presentation: UVM shall coordinate a presentation to VTrans to present findings and recommendations at a date that is convenient to VTrans staff near or following delivery of the Final Report.

I. TECHNOLOGY TRANSFER ACTIVITIES:

J. PERCENT COMPLETION OF TOTAL PROJECT: 50%

K. ACTIVITIES PLANNED FOR NEXT REPORTING PERIOD:

- Continue the development of the bridge deterioration model, using a Markov Chain process with either a Regression Method (like Florida) or a Weibull Method (like New York)
- Begin writing the draft-final project report

Progress report prepared by: Jim Sullivan

Date Prepared: July 16, 2014

Improvement and Operation of the Vermont Travel Model

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE: 0001051

SPR: 302

B. PRINCIPLE INVESTIGATOR(s): Jim Sullivan

C. START AND END DATE (per grant assignment): October 1, 2013 –
September 30, 2014

D. ANTICIPATED COMPLETION DATE: September 30, 2014

E. PROJECT OBJECTIVES:

The overall objectives of this project are to:

1. Continue to move the Vermont Travel Model to being a comprehensive predictor of travel behaviors of Vermonters
2. Respond to requests from VTrans staff and its contractors to query or run the model for specific applications

F. REPORT PERIOD: April 1st through July 1st, 2014

G. ACCOMPLISHMENTS THIS PERIOD:

- Improvement of the Model:
 - Completed transferring the Model platform to TransCAD
 - Continued the re-assessment of all centroid connectors locations and resolution of TAZs
 - Completed breaking up HBO and NHB trips in the Model with sub-categories (personal-discretionary, personal non-discretionary, and business) and distance classes (long and short - 50 mile cut-off) as data supports in accordance with NCHRP guidance
 - Continued testing the validity of leaving the trip matrices asymmetrical, particularly for NHB travel, since NHB trips do not necessarily return to their origin daily

H. PROBLEMS ENCOUNTERED (If any):

I. TECHNOLOGY TRANSFER ACTIVITIES:

J. PERCENT COMPLETION OF TOTAL PROJECT: 75%

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- Improvement of the Model:
 - Complete the re-assessment of all centroid connectors locations and resolution of TAZs
 - Complete testing the validity of leaving the trip matrices asymmetrical, particularly for NHB travel, since NHB trips do not necessarily return to their origin daily
 - Begin writing the final-draft report for Year 6 of the project

Progress report prepared by: Jim Sullivan

Date Prepared: July 16, 2014

Vermont Idling Research Project

QUARTERLY REPORT

- A. PROJECT NUMBER AND TITLE:** 0001049
SPR: 307
- B. PRINCIPLE INVESTIGATOR(s):** Lisa Aultman-Hall
- C. START AND END DATE (per grant assignment):** Jan 2011 – Dec 2013
- D. ANTICIPATED COMPLETION DATE:** May 1, 2014
- E. PROJECT OBJECTIVES:** The objectives of current phase:
1. What are the most common locations and who are the most likely perpetrators of long discretionary-idling events? This will provide targets for future programs for idling limitations, education and enforcement.
 2. What is a more accurate estimate of state-wide passenger vehicle GHG emissions and fuel-use resulting from discretionary idling? This understanding will help policymakers understand the urgency of the problem as well as the GHG benefits that will accrue to program success.
 3. What are the temporal patterns of discretionary idling including the impact of outdoor temperature that will help develop targeted strategies to reduce or eliminate this behavior?
- F. REPORT PERIOD:** April 1, 2014 through June 30, 2014
- G. ACCOMPLISHMENTS THIS PERIOD:**
- The final technical report was completed and forwarded to VTrans for review
- H. PROBLEMS ENCOUNTERED (if any):**
- I. TECHNOLOGY TRANSFER ACTIVITIES:**
- J. PERCENT COMPLETION OF TOTAL PROJECT:** 100%
- K. ACTIVITIES PLANNED FOR NEXT QUARTER:**
- Make changes to report after VTrans review

Progress report prepared by: Lisa Aultman-Hall **Date Prepared:** July 2014

Evaluation of Experimental Features

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 352 Evaluation of Experimental Features

B. PRINCIPLE INVESTIGATOR(s):

Wendy Ellis
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C. START AND END DATE (per grant assignment):

Ongoing

D. ANTICIPATED COMPLETION DATE: *If different from the END DATE in paragraph C., the reason must be given.*

E. PROJECT OBJECTIVES: To evaluate experimental features and products on VTrans projects and installations. This includes installation or application, field monitoring and data collection, testing, photographic analysis and preparation of interim and final reports on the methods chosen. Publication or transmittal of experimental results will be sent to interested Agency units.

F. REPORT PERIOD: 4-1-14 to 6-30-14

G. ACCOMPLISHMENTS THIS PERIOD:

- JA MacDonald milled and paved the section of I 89 SB in Hartford where Uretek performed a soil injection in accordance with WP 2012-R-4. Uretek developed a deep injection method used to stabilize the underlying subsurface. The process utilizes an expansive polymer that is hydro-insensitive, ensuring that it will be unaffected by any water or wet soil that may lie under the surface pavement. The injection was completed at the Hartford subsidence site, along I 89 SB in late October/early December 2013. Prior to and immediately after cold planing and paving, the area was surveyed and FWD testing was conducted. All installation information will be available in an Initial Update after the paving, final 3D survey is completed, and FWD testing is conducted.
- Annual and seasonal visits to the following projects:
 - WP 2007-R-1: Reclaimed Stabilized Base with Cement
 - WP 2011-R-4 - 9.5 mm Highly Polymer Modified Thin Hot Mix Asphalt (HMA) Overlay

- WP 2013-S-1 – Assessment of Fiber Reinforced Polymer (FRP) Strips for Bridge Rehabilitation
- Quarterly pavement marking data collection and site observations were completed in St. Albans.
- Report and Update drafts completed:
 - WP 2009-R-03: Glomarc 90 Polyurea Pavement Markings (Initial, Interim, Final)
 - WP 2005-R-1: Fine Graded 75 Gyration Superpave Mix (Initial and 2 Updates)
- Reports published:
 - None.

H. PROBLEMS ENCOUNTERED (If any): None

I. TECHNOLOGY TRANSFER ACTIVITIES: Email notifications. Reports and updates are available electronically through the following link:
http://vtransengineering.vermont.gov/sections/materials_and_research/research/projects/completed

J. PERCENT COMPLETION OF TOTAL PROJECT: N/A

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- Annual and seasonal visits to the following projects:
 - WP 2005-R-1: Fine Graded 75 Gyration Superpave Mix
 - WP 2005-R-2: 50 Gyration Superpave Mix
 - WP 2008-R-2 - Assessment of TechCrete, a Concrete Repair Material and Joint Sealant
 - WP 2011-R-1 - Assessment of Super-Slab, a Precast Concrete Slab in a Bridge Approach Application
 - WP 2011-R-2 - Wavetronix[®] SmartSensor Matrix[™] Radar Stop Bar Detection
 - WP 2011-R-3 - Pedestrian Hybrid Beacon Crosswalk System (PHB) or High-Intensity Activated Crosswalk (HAWK)
 - WP 2011-R-5 - Assessment of Jahn Permeable Mortar System In a Historic Bridge Abutment Application
 - WP 2011-R-6 - Assessment of the Sterling Lloyd Eliminator Waterproofing Membrane System
 - WP 2012-R-1 - Assessment of the Bridge Preservation LLC's BDM Waterproofing Membrane System
 - WP 2012-R-2 - Poly-Carb Flexogrid Bridge Deck Overlay System

- Quarterly pavement marking data collection and site observations will be completed in Lyndon and St. Albans.
- Updates and reports for the following will be completed:
 - Experimental and control crackfill along VT Route 25 (Initial)
 - WP 2011-R-1: Assessment of Super-Slab, a Precast Concrete Slab in a Bridge Approach Application (Initial)
 - WP 2011-R-5: Assessment of Jahn Permeable Mortar System In a Historic Bridge Abutment Application (Initial)
 - WP 2011-R-6: Assessment of the Sterling Lloyd Eliminator Waterproofing Membrane System (Initial)

Progress report prepared by: Wendy Ellis

Date Prepared: 7-3-14

Porous Pavement Performance Evaluation in a Cold Weather Climate – Randolph Park and Ride

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 705 Porous Pavement Performance Evaluation in a Cold Weather Climate – Randolph Park and Ride

B. PRINCIPLE INVESTIGATOR(s):

Jason P. Tremblay, P.E.
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C. START AND END DATE (per grant assignment):

2008-2013

D. ANTICIPATED COMPLETION DATE: *If different from the END DATE in paragraph C., the reason must be given.*

E. PROJECT OBJECTIVES: The objective of this research initiative is to examine the overall performance and pollutant removal efficiency of an experimental pervious Park and Ride located in the town of Randolph. This will be accomplished by documenting site characteristics such as soil permeability and frost susceptibility with reference to the water table, construction practices with special emphasis placed on grading, compaction and concrete placement, and the occurrence of any surface distresses including cracking and spalling. Infiltration efficiency will be monitored over time with respect to the pervious wearing course and underlying soils with consideration to winter maintenance practices and pressure washing activities. Pollutant removal will be assessed at varying depths within the basin as well as the incidence of bacterial growth at the interface of the basin and underlying soils.

F. REPORT PERIOD: April 1st, 2014 through June 30th, 2014

G. ACCOMPLISHMENTS THIS PERIOD: Porous concrete replacement designs were drafted using Stormcrete replaceable panels along with cast in place porous concrete, porous asphalt, Flexi-pave, and conventional asphalt. Final water sampling for water quality analysis was completed on three upstream and three downstream wells as well as the pond and SP1. Samples were delivered to the State DEC laboratory for analysis.

H. PROBLEMS ENCOUNTERED (If any):

I. TECHNOLOGY TRANSFER ACTIVITIES: None

J. PERCENT COMPLETION OF TOTAL PROJECT: 90%

K. ACTIVITIES PLANNED FOR NEXT QUARTER: Final infiltration testing, chain drag and overall assessment will be conducted, all prior to any construction with regards to the re-design. Once all data is collected and compiled, data analysis and report writing will commence.

Progress report prepared by: Jason P. Tremblay

Date Prepared: August 8, 2014

Evaluation of Concrete Bridge Mix Designs for Control of Cracking QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 710 Evaluation of Concrete Bridge Mix Designs for Control of Cracking

B. PRINCIPLE INVESTIGATOR(s):

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C. START AND END DATE (per grant assignment):

2009 - 2012

D. ANTICIPATED COMPLETION DATE: *If different from the END DATE in paragraph C., the reason must be given.*

E. PROJECT OBJECTIVES: Phase I: The objective of this research initiative is to examine a series of differing concrete mix designs in order to begin the process of selecting an optimum design for VTrans bare concrete bridge deck projects as well as other bridge projects. The desire is to lower the amount of cracking that is present on the bridge decks, possibly by using shrinkage control agents and/or by reducing the amount of cementitious material which would result in a reduction of needed mix water, based on the current water/cementitious ratios. Laboratory testing of this type is needed in order to provide a basis for support for using shrinkage reducing admixtures and/or adjusting current mix designs.

Mixes will fall within three groups. The first group will be the control group, consisting of batches of normal high performance concrete (HPC), classes A and B. The second group will make use of two different methods of shrinkage control within the control mixes, a shrinkage reducing admixture and a shrinkage compensating cementitious admixture. The third group will make use of an optimized gradation of aggregate and other various alterations.

Phase II: The objective of this second phase of the research initiative is to examine a select few of the top performing mixes tested in the previous study, alter a few key variables in their design, and zero in on the ideal design for the Agency's needs. The first component to evaluate will be the amount of cement required. One mix will be chosen from the initial study and the cement content varied at four different values, 400, 475, 550, and 610 per cubic yard. Four batches of each of these will be produced and tested.

As part of the process it is desired to mix the concrete in larger test batches than during the first study, where mixes were batched in house in approximately 1.5 cubic foot quantities. As part of this phase, mixes will be batched in a three cubic yard quantity; a standard quantity known to replicate the consistency of full scale pours well, and be done by a local concrete producer.

F. REPORT PERIOD: April 1st, 2014 through June 30th, 2014

G. ACCOMPLISHMENTS THIS PERIOD: A decision has been reached as to which new concrete mixer will be purchased for performing phase II; a purchase order will be put through. The draft report has been reviewed, with additions and corrections to be made identified.

H. PROBLEMS ENCOUNTERED (If any):

I. TECHNOLOGY TRANSFER ACTIVITIES:

J. PERCENT COMPLETION OF TOTAL PROJECT: 98% (phase I), all production, testing, data compilations, and basic analysis has been completed, along with a partial draft report.

K. ACTIVITIES PLANNED FOR NEXT QUARTER: The new concrete mixer will be ordered and put into production. The phase I final report will be finalized and published. Equipment and supplies will be purchased for phase II and test batch preparation began.

Progress report prepared by: Jason Tremblay

Date Prepared: August 8, 2014

Correlating M-E PDG with Vermont Conditions – Phase II

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 711 Correlating M-E PDG with Vermont Conditions – Phase II

B. PRINCIPLE INVESTIGATOR(s):

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C. START AND END DATE (per grant assignment):

2010-2012

D. ANTICIPATED COMPLETION DATE: The funding has been extended into FFY '14, and it is anticipated the project will be complete by December 31, 2014.

E. PROJECT OBJECTIVES: Using the information gathered and work completed in Phase I, the first objective of this Phase is to determine the necessary beta-factors for calibration of the M-E PDG software by comparing in-situ pavement distresses with the software output. Both rutting and IRI will be compared at their present day values, along with their quantities over time. Using statistical methods along with NCHRP Report 1-40B *Local Calibration Guide*, a calibration and validation process will be developed and carried out to ascertain the adjustment factors to be used for pavement design in Vermont.

Continuing with the progress of the overall project, the second objective of this phase will be verification of the model. Using additional sites from the 2004 Layer Coefficient Study, in-situ values will be compared with predicted to insure the model is working correctly.

F. REPORT PERIOD: April 1, 2014—June 30, 2014

G. ACCOMPLISHMENTS THIS PERIOD:

The Addison model was evaluated with updated traffic data. The traffic data is currently being verified with Traffic Research before we proceed further. IRI and rutting results from this update are proving site specific data to be of value.

H. PROBLEMS ENCOUNTERED (If any): None

I. TECHNOLOGY TRANSFER ACTIVITIES: N/A

J. PERCENT COMPLETION OF TOTAL PROJECT:

85%

K. ACTIVITIES PLANNED FOR NEXT QUARTER: We plan on verifying all input data for the Addison model to ensure the data is accurate and up to date. Once that model is checked, we will update traffic information from the other sites and compare the results of the modeling to field measure distress data.

Progress report prepared by: Marcy Meyers

Date Prepared: 8-4-2014

Life-Cycle Determination of Preventative Maintenance Treatments QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 713 Life-Cycle Determination of Preventative Maintenance Treatments

B. PRINCIPLE INVESTIGATOR(s):

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C. START AND END DATE (per grant assignment):

2009-2017

D. ANTICIPATED COMPLETION DATE: *If different from the END DATE in paragraph C., the reason must be given.*

E. PROJECT OBJECTIVES: Preventative maintenance treatments, intended to arrest minor deterioration, retard progressive failures, and reduce the need for corrective maintenance, has the potential to both improve quality and reduce expenditures. The life cycle and associated cost-effectiveness of these treatments may vary significantly based upon the selected treatment, functional classification, traffic demand, condition of the roadway prior to application, constructability, and environmental conditions.

The primary intent of this research initiative is to determine the life expectancy and associated costs of preventative maintenance treatments currently used in the State of Vermont. This will be completed by evaluating the constructability, performance and cost effectiveness of all treatments encompassed within the study. The treatments will include paver placed surface treatments, micro-surfacing (Type I and II), chip seal, hot-in-place recycling, and standard mill and fill treatments.

F. REPORT PERIOD: 4-1-14 to 6-30-14

G. ACCOMPLISHMENTS THIS PERIOD:

- Dorset-Danby annual site visit
- Conducted 3 preconstruction visits for Moretown-Duxbury, Morgan-Brighton, and Berlin-Barre City. These projects will not be officially added to the project because it is outside of the scope however the projects were added to SPR 921-

Pavement Life and a short description of the projects may be included in the final report for this project.

H. PROBLEMS ENCOUNTERED (If any): None

I. TECHNOLOGY TRANSFER ACTIVITIES: None.

J. PERCENT COMPLETION OF TOTAL PROJECT: 65%

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- Work on reporting requirements.
- Complete annual site visits.

Progress report prepared by: Wendy Ellis

Date Prepared: 7-3-14

Evaluation of Effectiveness of Centerline Rumble Stripes on Rural Roads

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 714 Evaluation of Effectiveness of Centerline Rumble Stripes on Rural Roads

B. PRINCIPLE INVESTIGATOR(s):

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C. START AND END DATE (per grant assignment):

2009-2014

D. ANTICIPATED COMPLETION DATE: *If different from the END DATE in paragraph C., the reason must be given.*

E. PROJECT OBJECTIVES: The primary objective of this research directly aimed at increasing the safety of the traveling public, one of the Agency's four primary goals, through the use and implementation of centerline rumble stripes. The evaluation will include an assessment of the overall durability and resistance to wear characteristics of the centerline rumble stripes in terms of preexisting pavement and climatic conditions as well as winter maintenance practices. Ease of installation will also be documented along with the design of the rumble stripes in conjunction with the adjacent pavement markings. The stripes will be installed on two projects in summer of 2009. One location will be on preexisting pavement on US 4 in Mendon-Killington and another on new pavement on VT 105 in Sheldon-Enosburg.

These experimental rumble stripes are intended to alert drivers that they have crossed into the path of oncoming traffic. However, there are several concerns that have not yet been adequately studied according to a recent report from the National Cooperative Highway Research Program (NCHRP) including roadside noise complaints, pavement condition, drivers reacting to the left, striping visibility, increased wear from winter maintenance practices, limited after data, lack of widely accepted guidelines, and affect of water, snow, and ice accumulation. This study seeks to address these concerns and draw associated future implementation recommendations for the State of Vermont as well as perform a cost benefit analysis.

F. REPORT PERIOD: 4-1-14 to 6-30-14

G. ACCOMPLISHMENTS THIS PERIOD

- Worked on reformatting the report and inputting data tables and associated summaries.

H. PROBLEMS ENCOUNTERED (If any): None.

I. TECHNOLOGY TRANSFER ACTIVITIES: None.

J. PERCENT COMPLETION OF TOTAL PROJECT: 90%

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- Complete rough draft of the final report.

Progress report prepared by: Wendy Ellis

Date Prepared: 7-3-14

Evaluation of Skid Resistance of Bare Concrete Bridge Decks

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 715 Evaluation of Skid Resistance of Bare Concrete Bridge Decks

B. PRINCIPLE INVESTIGATOR(s):

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C. START AND END DATE (per grant assignment):

2010-2012

D. ANTICIPATED COMPLETION DATE: *If different from the END DATE in paragraph C., the reason must be given.*

E. PROJECT OBJECTIVES: The objective of this research initiative is to examine different concrete surface finishing techniques currently in place on bare bridge decks in order to determine which methodologies lead to the greatest skid resistance. Two differing methods of skid resistance testing will be performed, including the use of a British Pendulum Tester as well as a locked wheel skid test. The Structures Section has comprised a list of fifteen bridges that will be tested around the state, 32 years or younger, with five or more different surface finishing techniques used among them. Analysis of the skid resistance data will help lead to the selection of an optimal concrete surface finish thereby increasing the overall safety of the traveling public.

The analysis of these finishing techniques will also include other factors, such as cost, long term durability, quality assurance, construction feasibility and probability of success.

F. REPORT PERIOD: April 1st, 2014 through June 30th, 2014

G. ACCOMPLISHMENTS THIS PERIOD: None; draft report has been reviewed in house and sent to Wayne Symonds for Structures review, as they were the originators of the solicitation. Awaiting comments for finalization.

H. PROBLEMS ENCOUNTERED (If any):

I. TECHNOLOGY TRANSFER ACTIVITIES:

J. PERCENT COMPLETION OF TOTAL PROJECT: 95%, all data collected; data analysis and draft report finished.

K. ACTIVITIES PLANNED FOR NEXT QUARTER: Final report will be finalized and published.

Progress report prepared by: Jason Tremblay

Date Prepared: August 8, 2014

**Assessment of Design Parameters and Construction
Requirements for Full Depth Reclamation Projects with
Cement
QUARTERLY REPORT**

A. PROJECT NUMBER AND TITLE:

SPR: 718 Assessment of Design Parameters and Construction Requirements for Full Depth Reclamation Projects with Cement

B. PRINCIPLE INVESTIGATOR(s):

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C. START AND END DATE (per grant assignment): January 12, 2011 – July 12, 2012

D. ANTICIPATED COMPLETION DATE: *If different from the END DATE in paragraph C., the reason must be given.*

E. PROJECT OBJECTIVES: The objectives of this research initiative include examining alternative means and methods for assessing performance characteristics of the reclaimed stabilized base material; this data would then be used to develop acceptance criteria and to validate design assumptions with an overall objective of optimizing VTrans' RSB pavement design model.

F. REPORT PERIOD: 4-1-14 to 6-30-14

G. ACCOMPLISHMENTS THIS PERIOD:

- Report is in review.
- 2014 testing plan was completed.

H. PROBLEMS ENCOUNTERED (If any): None

I. TECHNOLOGY TRANSFER ACTIVITIES: None

J. PERCENT COMPLETION OF TOTAL PROJECT: 95%

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- The final report will be distributed to TAC members for their review.
- The final report will be published.
- 2014 field testing will be completed.
 - Elmore-Morristown:
 - 2 – 1000' test sections will be constructed. One lane will examine 3 different mixing speeds (40 fpm, 60 fpm, and 80 fpm) and the other lane will look at different number of microcracking cycles (passes)
 - Within each lane moisture readings will be taken and soil samples will be collected for use in pH testing to determine the presence of cement.
 - All reclaim projects (Elmore-Morristown, Bolton-Waterbury, Wardsboro-Jamaica, and Stockbridge-Bethel)
 - CIST vs Core testing will be conducted. An effort to test using the CIST on Day 1 at each core location will be made to expand the research data in this area.

Progress report prepared by: Wendy Ellis

Date Prepared: 7-3-14

Project Title

QUARTERLY REPORT

- A. **PROJECT NUMBER AND TITLE:** Use of Piles in Slope Stabilization
SPR: RSCH014-719 (Old EA Number)
- B. **PRINCIPAL INVESTIGATOR(s):** Callie Ewald, Chris Benda and Mandar Dewoolkar
- C. **START AND END DATE (per grant assignment):** February 1, 2011 through March 31, 2012. Extended through September, 2014
- D. **ANTICIPATED COMPLETION DATE:** September 2014
- E. **PROJECT OBJECTIVES:** The primary objective of this research is to provide the Agency with design guidance for reinforcing unstable slopes with steel H-Piles and to gap design software omissions. The primary design tool used by the Agency does not consider every aspect of failure in the piles and does not account for soil stiffness. A second objective of the research is to evaluate the suitability of using the Borehole shear Test (BST) apparatus as an aid in establishing soil parameters for analysis. The BST is a test that is performed in the field which determines effective shear strength parameters of the in-situ soil. Due to the high expense and length of time required for laboratory testing, this device could be of significant benefit in slide mitigation activity. A site in Cornwall, VT has been identified to conduct a field investigation and testing program.
- F. **REPORT PERIOD:** April 15, 2014 through July 14, 2014
- G. **ACCOMPLISHMENTS THIS PERIOD:** Continued monitoring of the inclinometers installed during Phase II boring investigation. Updated cross section for Cornwall with new inclinometer data. Began to develop figures of laboratory testing data for report. Made adjustments to the current outline for the report and began working on the first draft, specifically on the section entitled "Cornwall as a Case Study".
- H. **PROBLEMS ENCOUNTERED (If any): Challenge:** The inclinometers were read this spring. Movement is shown at depths greater than expected, meaning the slide area is much greater than anticipated.
- I. **TECHNOLOGY TRANSFER ACTIVITIES:** None
- J. **PERCENT COMPLETION OF TOTAL PROJECT:** 80%
- K. **ACTIVITIES PLANNED FOR NEXT QUARTER:** Develop a remediation for the slide in Cornwall to provide to the District. This may be more involved than originally thought with the discovery of the critical slip surface much deeper and wider than first thought. Complete first draft of report for review.

Progress report prepared by: Callie Ewald
Date Prepared: August 5th, 2014

Verification of Abutment and Retaining Wall Design Assumptions

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 720 Verification of Abutment and Retaining Wall Design Assumptions

B. PRINCIPAL INVESTIGATOR(s):

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C. START AND END DATE (per grant assignment): October 1, 2013 – December 31, 2013.

D. ANTICIPATED COMPLETION DATE: May 30, 2014

E. PROJECT OBJECTIVES: The primary objective of this research is to verify that the backfill and drainage details currently used on cast-in-place concrete cantilevered retaining walls and bridge abutments on VTrans projects perform as expected, i.e. will provide zero pressure head differential on both faces of the wall, and that the backfill has the engineering properties assumed in the design. A second objective is to find the most cost effective backfill details. Included in this objective is developing selection guidelines, soil parameters, drainage details and construction specifications that will allow the use of backfill materials with greater fines content than that currently specified.

F. REPORT PERIOD: 2014 Q3

G. ACCOMPLISHMENTS THIS PERIOD:

- a. 1st Month (April 2014) – Worked on the final report.
- b. 2nd Month (May 2014) – Worked on the final report.
- c. 3rd Month (June 2014) – Acquired new field data from VTrans and incorporated that into the final report.

H. PROBLEMS ENCOUNTERED (If any): No significant problems to report.

I. TECHNOLOGY TRANSFER ACTIVITIES: A manuscript based on this research has been tentatively accepted by the journal of Transportation Research Record.

J. PERCENT COMPLETION OF TOTAL PROJECT: 99.5%

K. ACTIVITIES PLANNED FOR NEXT QUARTER: Finish the final report.

L. ESTIMATED BUDGET AMOUNT SPENT NEXT QUARTER (Q4, July-September)

None.

Progress report prepared by: Mandar Dewoolkar

Date Prepared: August 8, 2014

Evaluation of Load Characteristics of I-89 Bridges 58 N&S, Richmond – Phase II QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 721 Evaluation of Load Characteristics of I-89 Bridges 58 N&S, Richmond

B. PRINCIPLE INVESTIGATOR(s):

Jason P. Tremblay, MS, EI
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Eric M. Hernandez, Ph.D.
Assistant Professor
College of Engineering and Mathematical Sciences
School of Engineering
University of Vermont
301 Votey Hall, 33 Colchester Ave.
Burlington, VT, 05405

C. START AND END DATE (per grant assignment): June 1, 2011 – December 31, 2012

D. ANTICIPATED COMPLETION DATE: *August 2013. This extension was approved by VTrans as a no-cost extension.*

E. PROJECT OBJECTIVES:

The objective of this research initiative is to instrument bridge number 58 (north) on Interstate 89 in the town of Richmond, in an effort to determine its load bearing capabilities. Currently AASHTO distribution factors are used to determine load ratings on the bridges, which lead to possibly conservative estimates, thus restricting some overweight load passage. Accurate determination of the load bearing characteristics would allow for as-tested values to be used in lieu of the AASHTO distribution factors and therefore lead to a more accurate load rating. In addition, due to questions pertaining to the original design plans it is currently unknown what grade of steel was used in the stringers; a separate concurrent project will be undertaken to determine this accurately.

Determination of the load bearing characteristics of this bridge will be done through the use a series of remain-in-place strain and/or displacement gauges installed on three of the bridges stringers; one near and abutment, one near a pier, and one in a negative moment region. The system will be capable of recording continuous load data, thus displaying characteristics over a wide range of traffic types and streams. Instrumentation plans specifics, as well as all work, will be done through a consultant, selected through a request for proposal (RFP) process. Special attention will be paid to the data when a known heavyweight vehicle or load will be traversing the bridge and in conjunction with nearby weigh in motion (WIM) stations. Information will be used in an effort to determine whether or not special care need be taken when overweight loads cross the bridge, and to possibly revise bridge load ratings.

F. REPORT PERIOD: April 01, 2014 to June 30, 2014

G. ACCOMPLISHMENTS THIS PERIOD:

- All field activities and computational work related to this project have been completed.

H. PROBLEMS ENCOUNTERED (If any):

I. TECHNOLOGY TRANSFER ACTIVITIES:

J. PERCENT COMPLETION OF TOTAL PROJECT: 99%

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- Submit final report.

Progress report prepared by: Eric M. Hernandez, Ph.D.

Date Prepared: August 6th 2014

Statistical Analysis of Weigh-in-Motion Data to Validate Use of HL-93 AASHTO Vehicle Live Load for Bridge Design in Vermont

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 729 Statistical Analysis of Weigh-in-Motion Data to Validate Use of HL-93 AASHTO Vehicle Live Load for Bridge Design in Vermont

B. PRINCIPLE INVESTIGATOR(s):

Eric M. Hernandez, Ph.D.
Assistant Professor
College of Engineering and Mathematical Sciences
School of Engineering
University of Vermont
301 Votey Hall, 33 Colchester Ave.
Burlington, VT, 05405

C. START AND END DATE (per grant assignment): March 1, 2012 – February 28, 2013

D. ANTICIPATED COMPLETION DATE: *Sept 30th, 2014.* This was a no cost extension approved by VTrans.

E. PROJECT OBJECTIVES:

The objective of the proposed research is to investigate the adequacy of the AASHTO HL-93 design vehicular live load for Vermont. Since the LRFD is a probabilistic based design code, that is, each load combination is intended to provide a uniform and very low probability of exceedance in terms of structural demands, the adequacy of the HL-93 must be investigated in probabilistic terms.

The main objective of the proposed research can be divided into three sequential aspects:

1. Collect/Transfer/Classify data from WIM stations
2. Perform statistical analysis of WIM truck data recorded at all the operating stations in Vermont
3. Perform stochastic structural analysis simulations under various conditions of number and length of spans. The main objective is to compare the lane bending moments and shears of the actual/measured truck data with those provided by the LRFD vehicular design live load. This will enable us to

compute the expected probability of exceedance with respect to the LRFD HL-93 vehicular loading and compare AASHTO LRFD design target.

F. REPORT PERIOD: April 01, 2014 to June 30, 2014

G. ACCOMPLISHMENTS THIS PERIOD:

Up to this date, the following goals have been accomplished:

- We have completed the analysis all available WIM data from VTrans corresponding to years 2000-2011 and 2012.
- We have simulated stochastic structural analysis models for the effect (lane shear and bending moment) of vehicular loads on various types of single spans (< 60 m). We have determined the probability of failure for every year/station. These computed probabilities of failure will be compared with target probability of failure induced from AASHTO LRFD design criteria.
- We performed extreme value statistical analysis of the lane demands (shear and bending moment). We have found that statistical non-stationarity plays a significant role in the probability of failure.
- We submitted a paper for the Journal of Structural Safety on the research carried out in this grant.
- Final report has been submitted.

H. PROBLEMS ENCOUNTERED (If any): We are missing data from one station near Montpellier (W088). We are waiting on VTrans to provide this data.

I. TECHNOLOGY TRANSFER ACTIVITIES:

J. PERCENT COMPLETION OF TOTAL PROJECT: 100%

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

Progress report prepared by: Eric M. Hernandez, Ph.D.
Date Prepared: August 6th, 2014

**Designing Porous Concrete to Resist Damage from
Deicing Salts and Freeze-Thaw
QUARTERLY REPORT**

A. PROJECT NUMBER AND TITLE:

SPR: 730 Designing Porous Concrete to Resist Damage from Deicing Salts and Freeze-Thaw

B. PRINCIPAL INVESTIGATOR(s):

Dr. Mandar Dewoolkar
Associate Professor
School of Engineering - University of Vermont
(802)656-1942

Dr. Edwin R. Schmeckpeper, Associate Professor
Dr. Adam F. Sevi, Assistant Professor
Civil and Environmental Engineering
Norwich University

C. START AND END DATE (per grant assignment): June 1, 2012 – December 31, 2014.

D. ANTICIPATED COMPLETION DATE: December 31, 2014

E. PROJECT OBJECTIVES: The scope of this research is to: (1) evaluate in the laboratory porous concrete mixes for their resistance to deicing chemicals; (2) quantify the effects of sand addition on the resistance to deicing salts; (3) quantify the effects of fly ash replacement on resistance to deicing salts; (4) evaluate various chemical admixtures to determine if they improve resistance of porous concrete to deicing salts; and (5) determine how curing time affects resistance to deicing salts.

F. REPORT PERIOD: 2014 Q3

G. ACCOMPLISHMENTS THIS PERIOD:

- (a) 1st Month (April 2014): The testing program is progressing. The samples are continued to be tested for hydraulic conductivity, void content, compressive strength and Freeze-Thaw cycles at UVM and Norwich.
- (b) 2nd Month (May 2014): The testing program is progressing. The samples are continued to be tested for hydraulic conductivity, void content, compressive strength and Freeze-Thaw cycles at UVM and Norwich.
- (c) 3rd Month (June 2014): The testing program is progressing. The samples are continued to be tested for hydraulic conductivity, void content, compressive

strength and Freeze-Thaw cycles at UVM and Norwich. Data from both Universities were combined and analyzed.

H. PROBLEMS ENCOUNTERED (If any): Some data were of suspect. Those tests will be repeated.

I. TECHNOLOGY TRANSFER ACTIVITIES: N/A

J. PERCENT COMPLETION OF TOTAL PROJECT: 92%

K. ACTIVITIES PLANNED FOR NEXT QUARTER: Freeze-Thaw testing at UVM and Norwich will continue. Some new specimens will be made, cured and tested.

L. ESTIMATED BUDGET AMOUNT SPENT NEXT QUARTER (Q4, July-September)

About \$3,000

Progress report prepared by: Mandar Dewoolkar

Date Prepared: August 8, 2014

Prediction and Mitigation of Scour for Vermont Bridges QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 731 Prediction and Mitigation of Scour for Vermont Bridges

B. PRINCIPAL INVESTIGATOR(s):

Mandar Dewoolkar, Ph.D., P.E.
Associate Professor
School of Engineering - University of Vermont

C. START AND END DATE (per grant assignment): June 1, 2012 – May 31, 2015.

D. ANTICIPATED COMPLETION DATE: August 31, 2015

E. PROJECT OBJECTIVES: Successfully mitigating scour related problems associated with bridges is dependent on engineers' ability to reliably estimate scour potential, design effective scour prevention and countermeasures, design safe and economical foundation elements accounting for scour potential, and design reliable and economically feasible monitoring systems. The specific objectives of this research are to: (1) conduct an extensive literature review on methods to estimate scour potential, methods of monitoring, design methodologies, and countermeasures, and summarize the results in a summary document and make recommendations on specific methodologies that would be adaptable for Vermont; (2) develop a methodology for semi-empirically linking rapid geomorphic assessments (RGA) to observed bridge scour as a predictive tool; and (3) instrument select test sites with relatively low-cost passive sensors that will actively yet remotely communicate excessive scour.

F. REPORT PERIOD: 2014 Q3: April 2014 to June 2014

G. ACCOMPLISHMENTS THIS PERIOD:

- a. 1st Month (April 2014): Gave a presentation at the ASCE Structures Congress on April 3, 2014 in Boston. Presentation focused on the analysis of the bridge inspection rating system and the outcome of Tropical Storm Irene. Analysis continued to determine the effectiveness of bridge scour rating, and which factors could be included to improve it.
- b. 2nd Month (May 2014): Expanded the comprehensive bridge database to include photos of damage from the VTrans Digital Print Room, descriptions of the damage based on these photos, and details from the as-built plans. This data has been included in the analysis of scour damage.

- c. 3rd Month (June 2014): Initial HEC-RAS modeling has been conducted on Irene damaged bridges, and will be expanded to a wider number for analysis in the future. The analysis models the as-built bridge, and seeks to compare the estimated scour to the field observations.

H. PROBLEMS ENCOUNTERED (If any):

I. TECHNOLOGY TRANSFER ACTIVITIES: N/A

J. PERCENT COMPLETION OF TOTAL PROJECT: 50%

K. ACTIVITIES PLANNED FOR NEXT QUARTER: The literature review will continue. A review of bridge records and scour design procedures will continue. Scour probe prototype testing will continue, with further development underway. Investigations into countermeasures and design alternatives will be analyzed in HEC-RAS and in laboratory prototype testing.

L. ESTIMATED BUDGET AMOUNT SPENT NEXT QUARTER (Q4, July-September):

- a. About \$54,000

Progress report prepared by: Mandar Dewoolkar

Date Prepared: July 18, 2014

Pavement Marking Comparison Study

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 732 Pavement Marking Comparison Study

B. PRINCIPLE INVESTIGATOR(s):

Wendy Ellis
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Vermont Agency of Transportation
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C. START AND END DATE (per grant assignment): January 1, 2013 – September 30, 2018

D. ANTICIPATED COMPLETION DATE: *If different from the END DATE in paragraph C., the reason must be given.*

E. PROJECT OBJECTIVES: The objectives of this research initiative include examining and evaluating the reflective and durable characteristics of recessed and surface applied pavement markings in both wet and dry conditions and to classify durable tapes into performance categories based on their durability and adhesion capabilities.

F. REPORT PERIOD: 4-1-14 to 6-30-14

G. ACCOMPLISHMENTS THIS PERIOD:

- Attended preconstruction meeting for Brookfield-Montpelier which will house the paint test deck.
- Experimental feature work plan for WP 2013-R-3 was revised to meet project and specification expectations which was incorporated into a change order (Agency driven) to ensure ideal marking conditions and applications.
- Worked on database.
- Finalized draft sole source justification documents to purchase the adhesion tester and purchase the equipment.

H. PROBLEMS ENCOUNTERED (If any): None

I. TECHNOLOGY TRANSFER ACTIVITIES: None

J. PERCENT COMPLETION OF TOTAL PROJECT: 15%

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- Observe pavement marking installation along I89 SB.
- Set-up 2 – 400' test sites per marking package, totaling 36 total test sites.
- Collect retroreflectivity readings.

Progress report prepared by: Wendy Ellis

Date Prepared: 7-3-14

Long-Term & Short-Term Measures of Roadway Snow & Ice Control Performance

QUARTERLY REPORT

- A. PROJECT NUMBER AND TITLE:** RSCH016
SPR: 733
- B. PRINCIPLE INVESTIGATOR(s):** Jim Sullivan
- C. START AND END DATE (per grant assignment):** April 1, 2013 – March 31, 2015
- D. ANTICIPATED COMPLETION DATE:** March 31, 2015
- E. PROJECT OBJECTIVES:** The objectives of this project are to improve the performance of RSIC activities by the VTrans fleet by developing a plan for implementation of new performance measures. Long-term, seasonal measures will be developed which implement a time-to-normal approach. A short-term measure will be pilot-tested, utilizing real-time thermal image processing.
- F. REPORT PERIOD:** April 1st through July 1st, 2014
- G. ACCOMPLISHMENTS THIS PERIOD:**
- None. Project is on hold until October 1, 2014.
- H. PROBLEMS ENCOUNTERED (if any):**
- Speed data collection at RWIS stations was not possible due to malfunctioning field equipment and malfunctioning data-servers
 - Testing, troubleshooting and field inspection for installation of thermal infrared camera equipment was not completed in time to collect thermal video imagery in a winter storm. A new end date of 3/31/2015 for the project has been established at no additional cost. No effort will be incurred from April 1, 2014 to October 1, 2014. The remaining budget will be used between October 1, 2014 and March 31, 2015 to accomplish the originally defined scope.
- I. TECHNOLOGY TRANSFER ACTIVITIES:**
- J. PERCENT COMPLETION OF TOTAL PROJECT:** 60%
- K. ACTIVITIES PLANNED FOR NEXT QUARTER:**
- None. Project is on hold until October 1, 2014.

Progress report prepared by: Jim Sullivan

Date Prepared: July 16, 2014

Development of GIS Tools to Optimize Identification of Road Segments Prone to Flood Damage

QUARTERLY REPORT

- A. PROJECT NUMBER AND TITLE:** RSCH016
SPR: 734
- B. PRINCIPLE INVESTIGATOR(s):** Jim Sullivan
- C. START AND END DATE (per grant assignment):** April 1, 2013 – September 30, 2014
- D. ANTICIPATED COMPLETION DATE:** September 30, 2014
- E. PROJECT OBJECTIVES:** The objectives of this project are to
- Identify road segments in Vermont with highest probability of flood damage
 - Validate methodology against damage from Tropical Storm Irene and re-calibrate if necessary
 - Develop an exportable ArcGIS model
- F. REPORT PERIOD:** April 1st through July 1st, 2014
- G. ACCOMPLISHMENTS THIS PERIOD:**
- Completed the multi-scale spatial regression of selected watershed parameters and peak flows
 - Began spatial identification of bridge and culvert capacities, and/or height differences between road surface
- H. PROBLEMS ENCOUNTERED (if any):**
- I. TECHNOLOGY TRANSFER ACTIVITIES:**
- J. PERCENT COMPLETION OF TOTAL PROJECT:** 75%
- K. ACTIVITIES PLANNED FOR NEXT QUARTER:**
- Complete spatial identification of bridge and culvert capacities, and/or height differences between road surface
 - Validate the model and develop an exportable ArcGIS model
 - Write the draft-final project report

Progress report prepared by: Jim Sullivan

Date Prepared: July 16, 2014

Strategic Location of Satellite Salt Storage for Roadway Snow and Ice Control in Vermont

FINAL QUARTERLY REPORT

- A. PROJECT NUMBER AND TITLE:** RSCH016
SPR: 735
- B. PRINCIPLE INVESTIGATOR(s):** Jim Sullivan
- C. START AND END DATE (per grant assignment):** April 1, 2013 – May 31st, 2014
- D. ANTICIPATED COMPLETION DATE:** May 31st, 2014
- E. PROJECT OBJECTIVES:** The objective of this project was to improve the effectiveness of winter RSIC activities by optimizing the storage locations of RSIC materials throughout the state.
- F. REPORT PERIOD:** April 1st through July 1st, 2014
- G. ACCOMPLISHMENTS THIS PERIOD:**
- Completed simulation analysis to develop optimal satellite salt storage locations
 - Completed and submitted the draft-final project report
- H. PROBLEMS ENCOUNTERED (if any):**
- I. TECHNOLOGY TRANSFER ACTIVITIES:**
- J. PERCENT COMPLETION OF TOTAL PROJECT:** 100%
- K. ACTIVITIES PLANNED FOR NEXT QUARTER:**
- None

Progress report prepared by: Jim Sullivan

Date Prepared: July 16, 2014

Statewide Analysis of Guardrails, Curves and Crashes

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 736

B. PRINCIPLE INVESTIGATOR(s): Brian H. Y. Lee

C. START AND END DATE (per grant assignment): 1 Mar 2013 – 30 Sep 2014

D. ANTICIPATED COMPLETION DATE: 30 Sep 2014

E. PROJECT OBJECTIVES:

This research project focuses on the placement of guardrails and the location of curves, both with respect to crash incidents. Since guardrails and curves are often co-located (i.e., many guardrails are placed along curves and many curves have guardrails), it is highly likely that these two road features are correlated in space and confound each other's relationship with crashes. Both guardrails and curves may vary in their attributes by location (e.g., guardrails in size, material, offset; curves in radii, length, pavement material) and can relate to crashes in positive and negative ways. In this project, both guardrails and curves are considered together in a single, holistic statewide study, while maintaining the ability to discuss each of these issues separately.

There are two project objectives:

Objective 1: Develop guidelines that will inform road engineers about contexts in which the use of guardrails to help prevent crashes is appropriate. This would include taking into account of the site conditions, the users, and the types of facilities and guardrails.

Objective 2: Determine curve characteristics that are highly correlated with crashes to help identify locations where safety interventions may be warranted. Similar to Objective 1, this would include taking into account of the site conditions, the users, the types of facilities, and the presence of different interventions.

F. REPORT PERIOD: 1 Apr through 30 Jun 2014

G. ACCOMPLISHMENTS THIS PERIOD:

- Provided VTrans with assessment of Fugro data issues
- Revised methods for assigning curve and guardrail feature data to crash points
- Assigned horizontal curvature values to crash points
- Assigned vertical curvature values to crash points
- Assigned guardrail values to crash points
- Assigned sign values to horizontal curves
- Assigned traffic volume data to horizontal curves
- Integrated horizontal curvature and vertical curvature into one dataset containing both horizontal and vertical curvature
- Further developed spatial statistical models for analysis on crash data
- Continued draft report

H. PROBLEMS ENCOUNTERED (If any):

- Discovered issues in VTrans ARAN Grade dataset where duplicate, overlapped segments have inconsistent grade values

I. TECHNOLOGY TRANSFER ACTIVITIES:

N/A

J. PERCENT COMPLETION OF TOTAL PROJECT: 60%

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- Refine process of combining horizontal and vertical data into one dataset to improve accuracy and better eliminate errors
- Complete assignment of roadway feature data to crash points
- Complete QA/QC on roadway feature data assignment methods and results
- Finalize development of spatial statistical models
- Complete spatial statistical modelling
- Perform QA/QC of spatial statistical modelling
- Complete draft report
- Submit draft report to TAC for review

Progress report prepared by: Sean Neely

Date Prepared: 14 July 2014

Quantifying the Vulnerability of Vermont Bridges to Seismic Loading QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 737 Quantifying the Vulnerability of Vermont Bridges to Seismic Loading

B. PRINCIPAL INVESTIGATOR(s):

Mandar Dewoolkar, Ph.D., P.E.
Associate Professor
School of Engineering - University of Vermont
(802) 656 1942

Eric Hernandez, Ph.D.
Assistant Professor
School of Engineering - University of Vermont
(802) 656-3331

C. START AND END DATE (per grant assignment): May 15, 2013 – May 31, 2016.

D. ANTICIPATED COMPLETION DATE: May 31, 2016

E. PROJECT OBJECTIVES: The overarching objective of this research is to assist the Agency in establishing a methodology for the seismic assessment of their inventory of bridges; that is, to provide a rational basis for ranking their bridges according to their seismic vulnerability in consideration of variations in seismicity, foundation, terrain, and geologic conditions, and structure type, age and importance. The specific objectives are to: (1) review and update Agency's bridge inventory; (2) conduct a thorough literature review on seismic vulnerability ranking of bridges; (3) develop an appropriate seismic vulnerability ranking system for Vermont bridges and slopes associated with bridges; (4) assign and validate the rankings by conducting thorough seismic analysis of select bridge sites; and (5) prepare training materials and final report to assist Agency personnel in the upkeep of the inventory and rating system for retrofitted and new bridges.

F. REPORT PERIOD: 2014 Q2

G. ACCOMPLISHMENTS THIS PERIOD:

- a. 1st Month (April 2014) - Presented a summary of preliminary screening findings in a poster session at the ASCE Structures Congress on April 3, 2014 in Boston. Worked on the vulnerability rating literature review and a summary of review findings.

- b. 2nd Month (May 2014) – Performed a preliminary seismic displacement ductility demand analysis of 5 typical interstate type (dry crossing) bridges. Continued with the literature review and summary. Met with VTrans on May 30 to review use and application of the Vermont NBI database for the vulnerability screening.
- c. 3rd Month (June 2014) – Continued on literature review and summary. Cataloged the inventory of multi-span bridges by type with regard to dry and water crossings, and general structural characteristics (e.g., simple or continuous spans, truss vs. multi-girder, etc.). Continued preliminary seismic displacement ductility demand analyses. Developed draft memo on post-earthquake response inspection plan examples from other states and recommendations for post-earthquake response prioritization.

H. PROBLEMS ENCOUNTERED (If any): None to date.

I. TECHNOLOGY TRANSFER ACTIVITIES: Presented a brief summary of the project to VTrans personnel attending May 13, 2014 training at VTrans entitled AASHTO LRFD Bridge Design Specifications (Zone 1 and 2) given by Dale Manceaux of FHWA.

J. PERCENT COMPLETION OF TOTAL PROJECT: 37%

K. ACTIVITIES PLANNED FOR NEXT QUARTER: Seismic response analyses of representative bridges to support recommendation for a seismic vulnerability rating system to be used by VTrans.

L. ESTIMATED BUDGET AMOUNT SPENT NEXT QUARTER (Q4, July-September)

About \$32,000

Progress report prepared by: Mandar Dewoolkar

Date Prepared: July 18, 2014

High Speed Ground Penetrating Radar (GPR) for Road Pavement and Bridge Structural Inspection and Maintenance

Quarterly Report

A. PROJECT NUMBER AND TITLE:

SPR: RSCH017-738

High Speed Ground Penetrating Radar (GPR) for Road Pavement and Bridge Structural Inspection and Maintenance

B. PRINCIPLE INVESTIGATOR(s):

Tian Xia

Associate Professor

School of Engineering

University of Vermont

C. START AND END DATE (per grant assignment):

05/01/2014-06/30/2016

D. ANTICIPATED COMPLETION DATE:

06/30/2016

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E. PROJECT OBJECTIVES:

The overarching objective of this research is the development of a systematic methodology of employing GPR, including instruments, subsequent data processing and interpretation that can be used regularly as part of a roadway pavement and bridge evaluation program. Test methodologies and procedures that are suitable for Vermont environmental and infrastructural conditions will be explored and evaluated. Moreover we will implement and improve a high speed GPR system that allows driving speed roadway and bridge deck inspection with leveraged inspection resolution. We will investigate the strengths and limitations of GPR to determination the correct implementation both in terms of operation and data assessment, and the range of road conditions for which usage is worthwhile. We will work with VTrans closely to make GPR a suitable tool to facilitate transportation infrastructure survey, maintenance, repair and rehabilitation in Vermont and beyond. To ensure the successful accomplishment of the project, we will fulfill the following research objectives in two phases.

Phase 1 (Year 1):

- **Objective 1:** Review and evaluate current roadway pavement and bridge deck inspection methods employed by VTrans, and gather the available structural as-built plans. Also available GPRs systems and their functionalities will be reviewed.
- **Objective 2:** Develop and improve a high performance high resolution GPR that allows surveying at highway speeds.
- **Objective 3:** Apply GPR for roadway pavement profile inspections.
- **Objective 4:** Apply GPR for bridge deck inspections.

Phase 2 (Year 2):

- **Objective 5:** To inspect seasonal changes and deicing salt effects on pavement and bridge deck condition.
- **Objective 6:** Data registration method will be implemented to facilitate database development and data management. Integration with VTrans Automatic Road Analyzer (ARAN).

- **Objective 7:** Develop systematic GPR inspection flow and procedures applicable for maintenance and rehabilitation decision making.
- **Objective 8:** Identify and recommend areas for further study to improve inspection accuracy and effectiveness.

F. REPORT PERIOD:

05/01/2014 – 07/15/2014

G. ACCOMPLISHMENTS THIS PERIOD (broken down by month):

a. 1st Month (May 2014)

Accomplishment 1: Project kick-off meeting:

On Feb. 19, before the project final approval documents were received, the project kick-off meeting was held at VTrans. VTrans. engineers and UVM investigators attended the meeting, including Reid Kiniry, Jennifer Royer, Chris Benda, George Colgrove, Tian Xia, Dryver Huston, and Dylan Burns. In the meeting, the project objectives and research methods were reviewed and discussed. It is determined that this project should focus on bridge deck and roadway pavement inspections, and investigate the feasibility of using GPR for sinkhole detection.

Accomplishment 2 – Conduct an expanded and comprehensive review of GPR sensing technologies and algorithms

We have started working on the review of published materials and on-going research projects related to GPR bridge and roadway inspection practices. References have been collected through various library/internet searches. In addition, we have received data files from Tim Fillbach of 4 VT bridges. We are reading these files and will use them as reference files for GPR bridge inspection experiments.

b. 2nd Month (June 2014)

Accomplishment 3: Ground penetrating radar system development and configuration

The research group at UVM is leading the development of the ground penetrating radar (GPR) hardware for this research. In the first quarter, UVM group has been focusing on setting up the GPR development platform. There are two major elements for the GPR system: a high-speed data acquisition unit for real-time radar data acquisition and a high-performance computer enabling parallel computing for large value radar data processing. The team has conducted intensive research and comparisons, and has identified and configured the equipment with the following configurations:

- **DELL Alienware Aurora-R4 Workstation:** This workstation is equipped with Intel 3.9 GHz i7-3930K processor containing 6 cores and 128 MB cache, and 8 GB quad-channel DDR3 1600 MHz memory. Such a CPU and memory configuration provides sufficient speed for parallel radar data acquisition, transmission, storage and processing.
- **Agilent Acquris U1065A Digitizer:** This digitizer is a real-time analog-to-digital converter with 8 GSps sampling rate, 10-bit resolution and 128 MB memory. The I/O interface is PCI-E. For this project, the digitizer will be connected to a receiver channel to digitize the reflection signal received by the receiver antenna. Since the data sampling rate is very high, in order to ensure the digitized data can be streamed continuously and smoothly to computer

without jam or data loss, the team will investigate how to configure it in an appropriate operation mode to speed up the data transmission. One possible solution is to program the digitizer in the simultaneous multi-buffer acquisition and readout (SAR) mode to achieve parallel data input and output.

c. 3rd Month (July 2014)

Accomplishment 4: Identifying a commercial GPR system for inspection results validation.

In order to evaluate roadway and bridge deck inspection results with our high speed GPR system, we have been searching for a commercial GPR that can be used as a reference system. By checking functional specifications, the GSSI UtilityScan™ LT is identified as a proper low cost system for this project. GSSI UtilityScan™ LT is a ground coupled GPR whose operating frequency is 400 MHz and penetrating depth is 0 ~ 12 inches. A purchasing order is planned in the 2nd quarter.

H. PROBLEMS ENCOUNTERED (If any):

N/A.

I. TECHNOLOGY TRANSFER ACTIVITIES:

N/A.

J. PERCENT COMPLETION OF TOTAL PROJECT:

Percent completion of total project is estimated to be around 10%. We expect much more accomplishments in the following quarters.

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- We will finish our high speed system development and configuration;
- Field tests will be conducted either on UVM campus or on spots recommended by VTrans.
- Data processing algorithm will be implemented for result analysis.

L. ESTIMATED BUDGET AMOUNT SPENT NEXT QUARTER (Q4, July – September, break down into monthly estimates):

- 07/2014: \$24,000 to cover investigators' and a postdoc's salary, fringe benefits and indirect cost;
- 07/2014: \$5,000 will be used for purchasing a commercial GPR (GSSI UtilityScan™ LT).
- 08/2014: \$1,800 for a postdoc's monthly payment including indirect cost.
- 09/2014: \$1,800 for a postdoc's monthly payment including indirect cost.

Progress report prepared by: **Tian Xia**

Date Prepared: **07/11/2014**

Cost-Effective and Rapid Concrete Repair Techniques

Quarterly Report

A. PROJECT NUMBER AND TITLE:

RSCH017-739

Cost-Effective and Rapid Concrete Repair Techniques

B. PRINCIPLE INVESTIGATOR(S):

Dryver Huston

Professor

School of Engineering

University of Vermont

C. START AND END DATE (per grant assignment):

05/01/2014-06/30/2015

D. ANTICIPATED COMPLETION DATE:

06/30/2015

E. PROJECT OBJECTIVES:

The intent of this project is to identify concrete repair practices that work best for the climate and infrastructure conditions in Vermont. Concrete is a principal component of many transportation structures. While highly durable, a variety of processes degrade and damage concrete. Replacement is expensive. Many cases warrant repair instead of replacement. Since many damage processes are progressive, early and properly timed repairs can reduce costs. Overall lifetime cost of ownership approach to selection and design of repairs has merit, but requires good information about costs and outcomes. There is a possibility that proper timing and application of repairs can be of great benefit to maintenance activities – including lifetime costs and rapid techniques that allow for expedited designs of repairs and minimizing repair times. Realizing the advantages of concrete repair requires effective execution of damage identification, damage assessment, repair design, repair, and post-repair assessment.

Phase 1:

This is a proposed one-year single-phase effort. Included in this Phase is Objective 5 which will be to develop a Phase II effort aimed at bringing the best practices into field evaluations.

- **Objective 1:** Assess present practices of concrete repair – The objective is to identify repair practices for concrete transportation infrastructure in Vermont and neighboring states. This will include the processes damage identification, damage assessment, repair design, repair, and post-repair assessment.
- **Objective 2:** Develop flow chart of decision-making and options for repair practice and evaluation – This will create a guide with recommendations for maintenance personnel and engineers, with an emphasis on cost-effective procedures that minimize imposing additional burdens on inspection and maintenance personnel.
- **Objective 3:** Develop procedures for integrating repair options and decisions into asset management – This will aid in reducing lifetime costs of ownership and assist in statewide maintenance planning.
- **Objective 4:** Recommend areas for further study and tech transfer to make cost effective repairs – This will be an effort to identify topics of importance to Vermont and achievable within present resource constraints.

- **Objective 5:** Describe a future Phase II effort that would take the procedures that seem to work the best and apply them in the field – This will result in a test plan for a Phase II effort.

F. REPORT PERIOD:

05/01/2014 – 07/15/2014

G. ACCOMPLISHMENTS THIS PERIOD (broken down by month):

a. 1st Month (May 2014)

The primary activity during this month was to review the technical literature on concrete repair, including information gathered from the American Concrete Institute, including the Concrete Repair Manual and the in development Concrete Repair Code 562.

b. 2nd Month (June 2014)

The primary activity during this month was to participate in a kickoff meeting with VTrans personnel on the project. The topics discussed included the entire project. Some of the key items discussed were:

1. Focus the effort on bridge structures
2. Focus the effort on decks, barriers, integral abutments, wing walls and strengthening.
3. Deemphasize joints, bearings, railings and railings with ASR damage.
4. Develop list of bridges for further study. These include those with bare decks, those with important issues and those undergoing repair.
5. Ultimate goal is a maintenance plan for concrete.

c. 3rd Month (July 2014)

Reviewed documents on the strengthening FRP repair of a bridge near St. Albans. Prepared for site visits.

H. PROBLEMS ENCOUNTERED (If any):

N/A.

I. TECHNOLOGY TRANSFER ACTIVITIES:

N/A.

J. PERCENT COMPLETION OF TOTAL PROJECT:

Percent completion of total project is estimated to be around 10%. It is anticipated that the pace will pick up in the next months.

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- We will finish our high speed system development and configuration;
- Field tests will be conducted either on UVM campus or on spots recommended by VTrans.
- Data processing algorithm will be implemented for result analysis.

L. ESTIMATED BUDGET AMOUNT SPENT NEXT QUARTER (Q4, July – September, break down into monthly estimates):

- 07/2014: \$8,876 to cover salary for the faculty investigator (D. Huston) and postdoc (D. Burns), fringe benefits and indirect cost;
- 07/2014: \$150 to cover mileage charges to visit bridge sites in Vermont
- 08/2014: \$9,400 to cover salary for the faculty investigator (D. Huston), postdoc (D. Burns) and a student (TBD);
- 08/2014: \$150 to cover mileage charges to visit bridge sites in Vermont
- 09/2014: \$1,936 to cover salary for a postdoc (D. Burns) fringe benefits, including indirect cost.
- 09/2014: \$150 to cover mileage charges to visit bridge sites in Vermont

Progress report prepared by: **Dryver Huston**

Date Prepared: **07/14/2014**

Personal Transportation Plan Pilot Program (PTP3), Phase 1

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

RSCH017-741: Personal Transportation Plan Pilot Program (PTP3), Phase 1

B. PRINCIPLE INVESTIGATOR(s): Brian H. Y. Lee

C. START AND END DATE (per grant assignment): 1 Jun 2014 – 30 Sep 2015

D. ANTICIPATED COMPLETION DATE: 30 Sep 2015

E. PROJECT OBJECTIVES:

The Personal Transportation Plan Pilot Program (PTP3) is a collaboration between VAOT, the University of Vermont (UVM), and the Vermont Statewide Independent Living Council (SILC, www.vtsilc.org). The **primary objective** of the entire project is to:

Improve the mobility of Vermonters with disabilities by creating a personal transportation planning tool that would be used by the target population as well as their families, friends, and other caretakers to match existing transportation resources with their travel needs.

The long-term objective of this effort is to create a planning tool that would be used by transportation-disadvantaged Vermonters from across the entire state. There will be online and paper/telephone versions of this tool where users can answer a list of questions concerning the schedules and locations of various activities in their lives and be interactively guided to information about existing transportation resources that could help meet their travel needs.

The PTP3 project will include at least four phases: I) Pre-Program Assessment, II) Pilot Program Development, III) Pilot Program Implementation, and IV) Post-Program Evaluation. The research work in this current project only concerns Phase I of this pilot program. The following are the **Phase I objectives**. Other phases of this pilot program are outside of this proposed scope of work.

1. Phase I: Pre-Program Assessment
 - a. Objective 1: Identify mobility needs
 - b. Objective 2: Measure abilities to meet mobility needs
 - c. Objective 3: Inform the subsequent phases

F. REPORT PERIOD: April 1, 2014 to June 30, 2014

G. ACCOMPLISHMENTS THIS PERIOD:

- Human Subjects Research Protocols submitted to UVM IRB in April/May.
- Contacted public/private stakeholders to better understand their perspective on service systems for both veterans and the physically disabled community.
- Prepared to conduct 4 – 6 focus groups in the month of July to focus on the veteran population and 5 – 7 focus groups to focus on the disabled population in August.
- Wrote the introduction of the report.

H. PROBLEMS ENCOUNTERED (If any): N/A

I. TECHNOLOGY TRANSFER ACTIVITIES: N/A

J. PERCENT COMPLETION OF TOTAL PROJECT: 10%

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- Completing interviews of service organizations and transit services.
- Develop a set of protocols for conducting focus groups and collection of focus group participants.
- Conducting focus group meetings in development of a survey instrument.
- Compile the literature review.
- Write the introduction of report focused on the disabled population.

Progress report prepared by: Samantha L. Tilton

Date Prepared: 14 July 2014

Demonstration and Purchase of PG Binder Testing Equipment QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 905 Demonstration and Purchase of PG Binder Testing Equipment

B. PRINCIPAL INVESTIGATOR(s):

Troy Lawson
Asphalt & Hot Mix Unit
Materials and Research

C. START AND END DATE (per grant assignment): December 15, 2013 – September 30, 2014.

D. ANTICIPATED COMPLETION DATE: September 30, 2014

E. PROJECT OBJECTIVES: Materials and Research initiated an effort to procure the same PG Binder lab equipment that it acquired earlier in a Pooled Fund Project. The Pooled Fund project was a New England wide project where the New England states would use the same testing equipment to unify the testing processes and for comparisons. With the pooled fund project terminating early, this effort was initiated to complete the equipment acquisition.

F. REPORT PERIOD: 2014 Q3

G. ACCOMPLISHMENTS THIS PERIOD:

The equipment has been fully installed and tested. The new equipment has been compared with the existing equipment for consistency. The equipment is currently in full operation. The PG Binder lab has experienced a significant turnaround time improvement with acceptance testing and increase production in the Binder lab.

H. PROBLEMS ENCOUNTERED (If any):

No problems have been encountered in this period.

I. TECHNOLOGY TRANSFER ACTIVITIES: None

J. PERCENT COMPLETION OF TOTAL PROJECT: 95%

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

A Research Update will be produced to summarize the effort in obtaining and installing the new PG Binder.

The wireless communication equipment will be acquired and installed in the HMA lab. This equipment will allow direct connection of the HMA testing equipment to a central data collection point. The connection and data acquisition will be tested. A Research Update will be produced to summarize this work.

Progress report prepared by: Troy Lawson
Date Prepared: Aug 8, 2014

Pavement Performance and Annualized Cost Study

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 921 Pavement Performance and Annualized Cost Study

B. PRINCIPLE INVESTIGATOR(s):

Wendy Ellis
Research Technician V
Vermont Agency of Transportation
2178 Airport Rd., Unit B
Berlin, VT 05641
Telephone: (802) 828-6918
Fax: (802) 828-2792

C. START AND END DATE (per grant assignment):

ongoing

D. ANTICIPATED COMPLETION DATE: *If different from the END DATE in paragraph C., the reason must be given.*

E. PROJECT OBJECTIVES: To collect performance data from a comprehensive array of pavement rehabilitation techniques for the purpose of monitoring effectiveness and costs. The evaluation is centered upon those projects which have rehabilitated existing pavements with reclaimed base stabilization, cold recycled bituminous concrete, milling followed by overlay, and overlays. Projects have been selected from distinct microclimates representing the range of Vermont weather conditions. This project is vital to the ongoing success of our paving program. Findings from this study will be used to determine the most cost effective treatment based upon various factors including daily traffic, underlying soils and pavement profile, and roadway condition prior to any rehabilitation efforts.

F. REPORT PERIOD: 4-1-14 to 6-30-14

G. ACCOMPLISHMENTS THIS PERIOD:

- Pre-construction information and documents for the 8 - 2014 construction projects selected for evaluation was gathered.
- 8 pre-construction site visits were conducted to document existing site conditions and distresses including rutting and various cracking.
- 12 annual site visits were completed.

H. PROBLEMS ENCOUNTERED (If any): None

I. TECHNOLOGY TRANSFER ACTIVITIES: None

J. PERCENT COMPLETION OF TOTAL PROJECT: N/A

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- Complete annual site visits for remaining 31 projects.

Progress report prepared by: Wendy Ellis

Date Prepared: 7-3-14

An Assessment of Culvert Replacements Modified for Fish Passage

QUARTERLY REPORT

A. PROJECT NUMBER AND TITLE:

SPR: 969 An Assessment of Culvert Replacements Modified for Fish Passage

B. PRINCIPLE INVESTIGATOR(s):

Wendy Ellis
Research Technician V
Vermont Agency of Transportation
2178 Airport Rd., Unit B
Berlin, VT 05641
Telephone: (802) 828-6918
Fax: (802) 828-2792

C. START AND END DATE (per grant assignment):

2008-2013

D. ANTICIPATED COMPLETION DATE: *If different from the END DATE in paragraph C., the reason must be given.*

E. PROJECT OBJECTIVES: With over 50 modified culverts previously installed throughout the State of Vermont, the objective of this research project is to determine the effectiveness of fish passage restoration. An examination of representative fish passage structures will define the character, durability and stability of the constructed habitats and improved connectivity up and downstream of the culvert. In addition, the research project will evaluate the cost-effectiveness of these types of structures, including the timing of the natural bed load accumulation in the structure.

F. REPORT PERIOD: 4-1-14 to 6-30-14

G. ACCOMPLISHMENTS THIS PERIOD:

- Initial report draft is in review.

H. PROBLEMS ENCOUNTERED (If any): None

I. TECHNOLOGY TRANSFER ACTIVITIES: None

J. PERCENT COMPLETION OF TOTAL PROJECT: 90%

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

- An outline to accomplish reporting requirements will be completed.

Progress report prepared by: Wendy Ellis

Date Prepared: 7-3-14

**PERFORMANCE MONITORING OF JOINTLESS BRIDGES – PHASE III
QUARTERLY REPORT**

A. PROJECT NUMBER AND TITLE: Performance Monitoring of Jointless Bridges – Phase III
SPR: 986

B. PRINCIPLE INVESTIGATOR(s): UMass professors Scott Civjan and Sergio Brena

C. START AND END DATE: **Start:** October 5, 2007 **End:** May 31, 2014

D. ANTICIPATED COMPLETION DATE: May 31, 2014

E. PROJECT OBJECTIVES:

The objectives of this research project are to increase the knowledge base of VTrans' engineers and answer as many design and construction related questions as possible while 1) providing appropriate documentation of the research, 2) outlining current performance issues, and 3) providing recommendations for the design and construction of jointless bridges.

F. REPORT PERIOD: April 1, 2014 to June 30, 2014

G. ACCOMPLISHMENTS THIS PERIOD:

- 1) Routine data downloads.
- 2) Training by UMass to VTrans personnel took place to hand off data download responsibilities to VTrans
- 3) The final report has been published

H. PROBLEMS ENCOUNTERED (If any):

I. TECHNOLOGY TRANSFER ACTIVITIES:

J. PERCENT COMPLETION OF TOTAL PROJECT:

100%

K. ACTIVITIES PLANNED FOR NEXT QUARTER:

Since download activities have transfer to VTrans, personnel will download data quarterly and send to UMass to compile the data and provide analysis on an as-needed basis.

Progress report prepared by: Jason P. Tremblay **Date Prepared:** August 8, 2014

TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Date: 6/30/2014

Lead Agency (FHWA or State DOT): Vermont Agency of Transportation

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>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> TPF-5(222)		Transportation Pooled Fund Program - Report Period: <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 1 – December 31)	
Project Title: New England Transportation Consortium (VI)			
Name of Project Manager(s): Bill Ahearn		Phone Number: 802-828-2561	E-Mail Bill.Ahearn@state.vt.us
Lead Agency Project ID: CA0306		Other Project ID (i.e., contract #): NETC 06-4 NETC 07-1 NETC 09-2 NETC 09-3 NETC 10-3	Project Start Date: 9/16/13 7/1/13 9/1/13 9/1/13 9/16/13
Original Project End Date: NETC 06-4 9/15/15 NETC 07-1 3/31/16 NETC 09-2 2/28/16 NETC 09-3 8/31/15 NETC 10-3 9/15/15		Current Project End Date: 9/15/15 3/31/16 2/28/16 8/31/15 9/15/15	Number of Extensions: 0 0 0 0 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
NETC 06-4 \$242,909	\$0	12%
NETC 07-1 \$198,154	\$48,462.14	20%
NETC 09-2 \$80,000	\$1,083.20	25%
NETC 09-3 \$165,000	\$39,217	60%
NETC 10-3 \$150,158	\$0	22%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter			Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
NETC 06-4	\$0	0%	\$0	39%
NETC 07-1	\$48,462.14	22.8%	\$45,082.11	35%
NETC 09-2	\$1,083.20	0%	\$0	30%
NETC 09-3	\$39,217	0%	\$0	39%
NETC 10-3	\$0	0%	\$0	39%

Project Description:

- 06-4 Preventative Maintenance and Timing of Applications
- 07-1 In-Place Response Mechanisms of Recycled Layers Due to Temperature and Moisture Variations
- 09-2 Effective Establishment of Native Grasses on Roadsides
- 09-3 Advanced Composite Materials: Prototype Development and Demonstration
- 10-3 Low Temperature and Moisture Susceptibility of RAP Mixtures with Warm Mix Technology

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

06-4, UMass Dartmouth received data on CDs from NHDOT and is in the process of reviewing the data to include in the research project. UMass Dartmouth continued work on the literature review and internet survey.

07-1, Accomplishments this period include testing and data collection from the existing Warren Flats and Kancamangus sites in NH and identification and partial instrumentation of two new sites in ME.

09-2, The following activities were implemented during this reporting period:

- John Campanelli was hired for the Graduate Assistant position to work on this project. He conducted the literature search for the appropriate mixture of native seeds to establish demonstration plots.
- April 12 – Cristian Schulthess and John Campanelli collected soil samples from the proposed demonstration sites along Rt. 6
- April 23 Kuzovkina and Schulthess met with Don Woodall from Colonial Seed Co at the road sites to discuss the project
- Colonial Seed Company, CT was consulted during April-May for the protocols suitable for the establishments of demonstration plots.
- CT DOT managers were contacted in order to obtain the permit for the establishment of three demonstration sites along Rt. 6. The meeting with the DOT managers was scheduled for May 9 2014 to inspect the sites to confirm the suitability of obtaining permit. The permit was obtained on May 14, 2014.
- May 20, 2014 all co-PIs, Colonial Seed Co and other consultants on the project met at the proposed demonstration sites along Rt. 6 to confirm the establishment protocols. The seeding protocols include the use of a seed drill, hydroseeding, use of sawdust, and use of a Jacobsen overseeder.
- CT DEEP was contacted to assist with the Truax drill and to provide an operator for the establishment of one demonstration site. Uconn Landscaping was scheduled to conduct the hydroseeding, and Colonial Seed to conduct the overseeding.
- Establishment of the demonstration sites along Rt. 6:
 - May 14, 2014 – all demonstration sites were sprayed with RoundUp non-selective herbicide
 - May 21, 2014 – all demonstration sites were mowed and raked
 - May 27, 2014 – a site with saw-dust application was planted
 - May 28, 2014 – a site was hydroseeded with two levels of mulch
 - May 29, 2014 – a site was planted with the Truax seed drill

- June 3, 2014 – a site was seeded with the Jacobsen overseeder.
- June 11, 2014 – two botanists from the Arnold Arboretum visited the sites to conduct a survey of existing native and introduced vegetation along Rt. 6.
- By-weekly site inspections were conducted throughout June to observe the germination and establishment rates.
- July 8, 2014 Inspection of the demonstration sites with Mark Lavoie from the Colonial Seed Co to assess the early establishment success of plantings and herbicide needs.

09-3, The following activities were implemented during this reporting period:

- Draft specifications have been submitted to committee – Final versions are ready for final submittal
- Reports for task 1, 2 and 3 have been drafted and will be submitted in the next quarter
- Potential demonstration projects have been identified. Follow up is needed to get these projects moving
- Vendor witness plates received for ACO and Kenway.

10-3, UMass Dartmouth conducted additional meetings with the two contractors, (Palmer Paving - MA, & Tilcon - CT) who will produce mixtures for this study. Based on the additional meetings, the production matrix was updated. UMass Dartmouth updated a list of state agencies and contractors that will be targeted to complete the surveys.

Anticipated work next quarter:

06-4, Obtain information on new or planned pavement preservation projects in New England.

07-1, The research team will be continuing analysis on the data collected from the two existing NH sites during the 2014 spring thaw period. The team will also finalize the installation of instrumentation at the two new ME sites, pending construction schedules.

09-2, Continue the literature review, evaluation of the establishment of the demonstration plots and data collection as described in the proposal. Provide maintenance of the demonstration plots. Contact the native plant nurseries in the region for availability of different native species. Continue the discussions with the stakeholders to receive sufficient feedback about the project.

09-3, Submission of reports for task 1, 2 and 3. Determine demonstration bridges. Determine list of bridge projects that can be included for demonstrations. Vendor evaluation checklist to be submitted. Material testing for vendor witness plates for 2 of 3 vendors.

10-3, Complete Literature Review. Determine Critical Information.

Significant Results:

None as of this reporting period.

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).

NETC 09-2 and 09-3 contracts were executed 6 weeks after the start date listed in the contract. This should not cause a significant delay in the project.

Potential Implementation:

The 5 research projects listed above are fairly new. Implementations of the results of those projects are not anticipated in the near future.