

LIST OF RESEARCH NEED STATEMENTS FY-2015

RNS #	Research Need Statement (RNS) Title	Submitted By	Affiliation
<u>Planning and Environment</u>			
5101	A Study to Determine if the Biofuel Crop Camelina is a Wildlife Attractant	J. Fuller	Aviation Division
5102	Measurement of Locomotive Head End Power Engine Fuel and Emissions	A. Paul	Rail Division
5103	Acquiring Contaminated Properties for Right of Way	C. Parker	Geotechnical Engg.
5104	Cost Analysis on the Reuse of Concrete Residuals	R. Maycock	Roadside Envi.
5105	Flocculent Evaluation	D. Harris	Roadside Envi.
5106	Evaluation of Silt Fence Support System	D. Harris	Roadside Envi.
5107	Performance Standard for Straw Mulch Binding Agents	D. Harris	Roadside Envi.
5201	Reduction in Railroad Right-of-Way Trespassing Incidents	P. Worley	Rail Division
5202	Preventive Maintenance (PM) Criteria	N. Brooks	Asset Management
5203	Commission Contract License Plate Agencies	D. Boone	DMV
<u>Pavement and Maintenance</u>			
5301	Chip Seal Construction Variability and Its Impact on Performance	J. Corley-Lay	Pavement Mgmt
5302	Comparing Performance of Full Depth Asphalt Pavements and Aggregate Base Pavements in NC	J. Corley-Lay	Pavement Mgmt
5303	Improved Data for Mechanistic-Empirical Pavement Design for Concrete Pavements	Surti & Morrison	Construction & PMU
5304	The Effect of Limestone Replacement on the Mechanical Properties, Early-Age Behavior, and Long-Term Durability	N. Surti	Construction
5305	Verifying Low Temperature Performance Grade (PG) Properties of RAP Binders	T. Whittington	Materials & Tests
5306	Superpave Mix Design Software Program for Design of Asphalt Concrete Mixtures	T. Whittington	Materials & Tests
5307	Acceptance of Aggregate Base Course (ABC)	C.K. Su	Materials & Tests
5308	Evaluation of Benefit Weight Factors and Decision Trees for Automated Distress Data Models.	N. Mastin	Pavement Mgmt
<u>Structures and Construction</u>			
5401	Impacts of Utility Excavation on Roadway Integrity in NC Regions	Sykes, Mulla, & Morrison	Utility, Geotech, & Pavement Mgmt.
5402	SPT Hammer Continuous Energy Measure and Calibration	M. Mulla	Geotechnical Engg.
5403	Improvement of Material Criteria for Highway Embankment Construction	K. J. Kim	Geotechnical Engg.
<u>Traffic and Safety</u>			
5501	Performance Evaluation of NCDOT's Cable Guiderail System (Std. 865.01) at Manual for Assessing Safety Hardware (MASH) Test Level 4 (TL-4) Conditions [introduction of a heavy 22,046 lb (10,000 kg) single unit truck].	J. Bennett	Roadway Design
5502	Performance Evaluation of Strong Post Double Faced W-Beam Guardrail and Strong Post Doubled Faced Thrie-Beam Guardrail at Manual for Assessing Safety Hardware (MASH) Test Level 4 (TL-4) and Test Level 5 (TL-5) conditions [TL-4 = introduction of a heavy 22,046 lb (10,000 kg) single unit truck and TL-5 = introduction of a 80,000 lb (36,000 kg) tractor-trailer combination].	J. Bennett	Roadway Design
5503	The Effects of Late Lane Merges on Travel Times	R. King	Mobility & Safety
5504	Safety Assessments for NC Multi-Lane Roundabouts: Roundabouts Crash Prediction Models	M. Al-Ghandour	Program Develop.

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: Jennifer Fuller, P.E. **DATE:** Aug 20, 2013
Branch / Unit: Division of Aviation- Airport Development

TITLE of your Research Idea: A Study to Determine if the Biofuel Crop Camelina is a Wildlife Attractant

Background:

The U.S. Department of Agriculture (USDA) is authorized to protect American agriculture and other resources from damage associated with wildlife. The primary authority for Wildlife Services (WS) is the Act of March 2, 1931 (46 Stat. 1468; 7 U.S.C. 426-426b) as amended, and the Act of December 22, 1987 (101Stat. 1329-331, 7 U.S.C. 426c). Wildlife Services duties are conducted in cooperation with Federal, State, and local agencies; private organizations, and individuals.

The WS program uses an Integrated Wildlife Damage Management (IWDM) approach (sometimes referred to as IPM or "Integrated Pest Management") in which a series of methods may be used or recommended to reduce wildlife damage. IWDM is described in Chapter 1, 1-7 of the Animal Damage Control Program Final Environmental Impact Statement (USDA, 1994).

These methods include the alteration of cultural practices as well as habitat and behavioral modification to prevent damage.

Controlling wildlife damage may require that the offending animal(s) are killed or that the populations of the offending species be reduced.

Wildlife has been shown to be hazardous to air travel (resulting in loss of human life and substantial expense from aircraft damage), most often in the immediate airport environment. USDA Wildlife Services has a long history of involvement with NC Airports, assisting them in identification and management of their most serious wildlife hazards. USDA Wildlife Biologists along with NCSU researchers would be involved with this research.

What is the Specific Problem or Issue?

The purpose of this Cooperative Service Agreement is to fund research to determine if the biofuel crop Camelina (*Camelina sativa* L.) is attractive to wildlife. Research protocols have been developed to determine if airports can generate revenue by planting Camelina without attracting wildlife to the crop.

List Research Objectives and Tasks:

To determine the best methods for researching the production of Camelina (*Camelina sativa* L.) at airports in North Carolina, we agree that the best compromise between cost-efficiency and statistically-sound science would be to do a study in one geographic region of North Carolina. Due to local environmental variations within the region, we will select four candidate airports to establish bird and mammalian surveys. Data collected from these surveys will be analyzed and published following the survey period.

To generate a statistically valid sample of bird usage of Camelina, the study design will consist of four airports with three survey days of bird observations per month at each airport. A survey day is defined as observations at a site conducted during each of the following intervals: morning, midday, and evening. These surveys will be conducted over a 16 month study to observe growth periods and assess the attractant value of Camelina to wildlife in differing growth phases over time.

To estimate mammalian attraction to Camelina, WS has determined that one night-time survey per month will be conducted at each airport using infrared night vision equipment.

What Would be the Product[s] of the Research?

(Note: Progress reports and the Final report are NOT considered a "product," but "deliverables.")

Data that will support NC Airports in this region of the state in cultivating Camelina for the purpose of revenue production and biofuel supply.

How Will You or Others Use the Product[s]?

Airports in this region of NC will be encouraged to begin cultivation of Camelina for the purpose of revenue production and biofuel supply.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

This product will provide report data for use in professional publications and press releases for The Department that will draw positive attention to The Department's support of both NC Airports and the production of cleaner fuels and of course the mission to protect the safety of the traveling public.

Other Comments:

This data will be used by the USDA Wildlife Services and North Carolina State University to increase their understanding of the production of biofuels.

Approval (Division official or Unit Head)

Richard Walls

Aviation

Print Name

Signature

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CALL FOR NEW RESEARCH NEEDS**Your Name:** Allan Paul**DATE:** 8/15/13**Branch / Unit:** NCDOT Rail Division**TITLE of your Research Idea:** Measurement of Locomotive Head End Power Engine Fuel and Emissions**Background:**

The NCDOT Rail Division operates passenger train service between Raleigh and Charlotte. NCDOT has rebuilt six locomotives, including locomotives NC 1755, 1797, 1810, 1859, 869, and 1893. As part of the rebuilds, the head end power (HEP) engine of each locomotive was replaced with a CAT A18 ACERT engine of approximately 900 hp.

What is the Specific Problem or Issue?

NCDOT would like to quantify the emission rates of these HEP engines so that they can be compared to the emission limits of applicable nonroad engine regulations from the U.S. Environmental Protection Agency.

List Research Objectives and Tasks:

The primary objectives of this study are to: (1) demonstrate a methodology for using a Portable Emissions Measurement System (PEMS) to obtain emission factors at various loads for the HEP engines; (2) establish baseline performance of the HEP engines that can be used for comparative purposes in future assessments; and (3) provide insight regarding whether the HEP engines are compliant with the applicable emission standard.

This project will include the following tasks: (1) railyard measurement of emission rates on the HEP engines using ultra low sulfur diesel (ULSD) fuel at a wide variety of load settings from idle to 100% load; (2) measurement of some of the HEP engines using a biodiesel blend; (3) evaluation of whether the HEP engines are compliant with applicable standards; and (4) estimation of emission rates typical of previously observed electrical load for passenger car consists.

What Would be the Product[s] of the Research?

*(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")*

At the end of this project, we will have completed emissions measurements of the HEP engines for six locomotives. The data will be reported as average fuel use and emission rates (CO₂, CO, HC, NO, PM) for the engine for each load setting on a mass per gallon, mass per time, and mass per hp-hr basis. The baseline data collected here will be compared to the pre-rebuild data in order to assess the emissions reduction efficacy of the replacement of older HEP engines for NC 1755 and NC 1797.

How Will You or Others Use the Product[s]?

The results of this project will enable the Rail Division to accurately assess the emissions benefits of the locomotive rebuilds. These data will be used to identify priorities for further emission reductions measures, and to quantify the energy and environmental benefits of rail transportation. These data and information will be useful to the Rail Division as the basis for prioritizing future activity pertaining to asset management and community relations.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

The product will benefit the department by providing a methodology and detailed results regarding a relatively low cost method for comparative assessment of locomotive engine emissions that could be promoted and adopted industry-wide as complementary to more expensive and rigorous certification test methods. A key benefit of the PEMS-based approach is that it is flexible, because it is deployable in settings that include an engine dynamometer, railyard stationary test, and over-the-rail testing, thereby enabling comparisons of standardized and real-world operating conditions

Other Comments:

The NCDOT Rail Division will provide significant in-kind support for fuel, personnel, and access to locomotives.

Approval (Division official or Unit Head)

Allan Paul

Print Name

Signature

Deputy Director, NCDOT Rail Division

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CALL FOR NEW RESEARCH IDEA**Your Name:** Cyrus Parker**DATE:** August 8, 2013**Branch / Unit:** Preconstruction/Geotechnical Engineering Unit/ GeoEnvironmental Section**TITLE of your Research Idea:** Acquiring Contaminated Properties for Right of Way**Background:**

Transportation projects often require the acquisition of property known or presumed to be contaminated with hazardous and non-hazardous chemicals. Acquisition of such properties poses a risk of future liability and cost for curing the site.

What is the Specific Problem or Issue?

The appraisal, negotiation, and acquisition of these contaminated properties may not always occur in such a manner as to protect the Department from future liability and cost while preserving the liability of the party responsible for the contamination. Negotiation and acquisition are often delayed due to complications resulting from the contaminated property.

List Research Objectives and Tasks:

The research should review private market comparable sales to determine procedures used in private industry to acquire contaminated property; review current real estate and environmental regulations as they related to the acquisition of contaminated property; review historical right of way acquisitions of contaminated properties; and provide recommendations based on the findings to improve the Department's acquisition procedure for contaminated properties.

What Would be the Product[s] of the Research?

*(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")*

A comparison of private market real estate transactions against the Department's right of way acquisition with consideration for the current real estate and environmental laws.

How Will You or Others Use the Product[s]?

The comparison will be used to update current Department policies for acquiring contaminated properties in an effort to better protect the Department from future liability and streamline the acquisition procedure for contaminated properties.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

The Department will benefit by having better protection against future environmental liability and cost associated with acquiring contaminated properties. The Department will also benefit from a more efficient process to acquire contaminated property.

Other Comments:**Approval (Division official or Unit Head)**

John Pilipchuk

Print Name

State Geotechnical Engineer

Title

Signature

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CALL FOR NEW RESEARCH NEEDS**Your Name:** Robin Maycock**DATE:** 8/8/13**Branch / Unit:** Roadside Environmental Unit**TITLE of your Research Idea:** Cost Analysis on the Reuse of Concrete Residuals**Background:**

NCDOT generates large amounts of concrete residuals from concrete hydrodemolition and diamond grinding and grooving on bridges and overpasses. A Class A Residuals land application permit by DWR and definition of the waste as "inert debris" have provided options for reuse instead of disposal at POTW and MSW landfills, but a cost analysis is needed to investigate potential savings and other potential economic options, such as use as liming amendments on NCDOT right of way, Class B residuals sites and agricultural applications.

What is the Specific Problem or Issue?

NCDOT needs to evaluate the potential cost savings on the different options available to their contractors, in order to utilize the most cost effective option for a given project.

List Research Objectives and Tasks:

Analyze case studies of specific projects to determine cost options and compare different scenarios.

What Would be the Product[s] of the Research?

*(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")*

A cost calculation matrix that contractors could use for a specific project to determine the low cost option.

How Will You or Others Use the Product[s]?

NCDOT will be able to estimate costs prior to project bid process, contractors can estimate waste disposal costs more effectively, and different options can be compared.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

Decrease costs, provide more accurate bids and provide cost comparison on different options.

Other Comments:**Approval (Division official or Unit Head)**

Don Lee

Print Name

Signature

State Roadside Environmental Engineer

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: David Harris

DATE: 8/5/2013

Branch / Unit: Roadside Environmental Unit

TITLE of your Research Idea: Flocculent Evaluation

Background:

NCDOT has researched the value of various flocculants to improve water quality. Many manufacturers and suppliers are marketing flocculants of various formulations and dosage rates. These products are important to improve the efficiency of erosion and sedimentation pollution control devices

What is the Specific Problem or Issue?

NCDOT needs to develop a fair way to evaluate the flocculants and their performance. The goal of the research project is to take the current list of approved flocculants by DWQ and determine which products are viable for NCDOT's use and rank them based on testing in various NC soil conditions.

List Research Objectives and Tasks:

Identify viable flocculants for NCDOT's erosion and sedimentation control use and evaluate them at a test facility using soil from various parts of North Carolina.

What Would be the Product[s] of the Research?

*(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")*

A ranking system for flocculants to determine which ones are the most effective.

How Will You or Others Use the Product[s]?

Contractors and NCDOT inspectors will have the information they need to determine which products are the best for their application and cost.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

NCDOT will improve its use of flocculants and reduce cost by not purchasing products that are inferior.

Other Comments:

Approval (Division official or Unit Head)

Don G Lee

 Print Name

 Signature

State Roadside Environmental Engineer

 Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: David Harris

DATE: 8/5/2013

Branch / Unit: Roadside Environmental Unit

TITLE of your Research Idea: Evaluation of Silt Fence Support System

Background:

NCDOT utilizes metal fence post to support silt fence on construction projects.

What is the Specific Problem or Issue?

NCDOT has been questioned by silt fence post manufactures as to why NCDOT uses the size post that is currently specified in the contract specifications. There is currently no data to support why NCDOT utilizes its current post size.

List Research Objectives and Tasks:

Identify the range of forces that are exerted on a silt fence post and determine the minimal size a post needs to be in order to withstand the loads placed on silt fence. Identify other suitable silt fence post that can be utilized on NCDOT projects and the criteria for which they can be used.

What Would be the Product[s] of the Research?

*(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")*

A specification that would be used to determine what post manufacturers must meet to adequately support silt fence on an NCDOT project.

How Will You or Others Use the Product[s]?

Contractors and NCDOT inspectors will have the information they need to determine which silt fence post are acceptable for the least amount of cost.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

NCDOT will reduce its cost for silt fence while continuing to remain in compliance with the Sedimentation Pollution Control Act.

Other Comments:

Approval (Division official or Unit Head)

Don G Lee

 Print Name

 Signature

State Roadside Environmental Engineer

 Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: David B Harris

DATE: 8/7/2013

Branch / Unit: Roadside Environmental Unit

TITLE of your Research Idea: Performance Standard for Straw Mulch Binding Agents

Background:

NCDOT utilizes emulsified asphalt tack to bind straw mulch for seeding and mulching operations. The private industry has developed other binding products that claim to replace asphalt tack for straw mulch. The contracting industry is utilizing these products but has experienced failures. The contracting industry is being asked to reapply mulch and tack when these failures occur after weather events.

What is the Specific Problem or Issue?

NCDOT does not have valid data that can show the performance of existing straw mulch binding agents and how they perform under various weather conditions when compared to emulsified asphalt.

List Research Objectives and Tasks:

Determine the performance of emulsified asphalt as a binding agent for straw. Compare the same performance of other straw binding agents to asphalt to determine if they can provide the same performance.

What Would be the Product[s] of the Research?

*(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")*

A performance test that can be used to test new binding agents as they become available and a document that provides performance rankings of the currently available binding agents.

How Will You or Others Use the Product[s]?

Engineers will know if the weather conditions that resulted in the failure of the binding agent were a result of natural conditions or poor installation.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

The Department will resolve the issue of when should contractors be compensated to repair a failed area and when it is their responsibility due to their installation.

Other Comments:

Approval (Division official or Unit Head)

Don G Lee

 Print Name

 Signature

State Roadside Environmental Engineer

 Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Name: Paul Worley Date: August 15, 2013 Branch/Unit: Rail Division

Title of Research Idea: Reduction in Railroad Right-of-Way Trespassing Incidents

Background: Since January 2010, there have been 90 confirmed trespassing incidents along railroad rights-of-way in North Carolina. In almost two-thirds of these incidents, fatalities (53) have resulted, and in over one-third (37) there were injuries. On June 20, 2013, the NCDOT Secretary Tony Tata convened a Rail Safety Summit involving law enforcement agencies to identify the most pressing safety issues, and the reduction of trespassing was determined a sufficiently high priority issue, so much so that Secretary Tata requested that an Safety Action Plan be developed to begin to combat and reduce trespassing.

Specific Problem: The completed Safety Action Plan calls for both a better identification of trespass-prone locations to facilitate enforcement actions, and an effective public awareness campaign. Because the act of trespassing involves both walking along railroad tracks and crossing tracks as short-cuts (not usually in the vicinity of public road crossings), observation of non-incident-related trespass acts is rare. Since the number of incident-related trespassing acts is related to the general public's misconception that trespassing is not dangerous, the full extent of trespassing needs to be determined. Only then can the effectiveness of the Safety Action Plan in discouraging and reducing trespass acts be accurately measured.

Research Objectives and Tasks: (1) The first objective of the research project is to provide the Rail Division with a comprehensive assessment of trespassing along the heavily-traveled Charlotte-to-Raleigh Piedmont Passenger and Freight Rail Corridor in terms of locations and frequency of acts. The associated tasks will be (a) to use GIS land use, population, and transportation information layers to identify potential locations, (b) interview local law enforcement agencies for apprehensions and anecdotal evidence of trespass acts, and (c) make site visits to observe conditions and pedestrian patterns at sites where incidents have occurred. (2) The second objective is to develop and recommend alternative methods for remotely observing trespass acts and communicating such information in a timely manner to local law enforcement, State Highway Patrol, rail engineers, and/or railroad police such that injury and fatal incidents can be prevented. Associated tasks could include (a) meeting with railroad and law enforcement representatives to develop alternative methods, (b) implementing one for demonstration purposes, and (3) collecting and analyzing data.

The Products of the Research: The products would be (1) a report describing (and map showing) the location and frequency of reported and unreported trespass acts, (2) a report describing possible alternative methods for observing trespass acts with a recommended method to be demonstrated; (3) a demonstration project design, and (4) the implementation of the demonstration project, its results and conclusions.

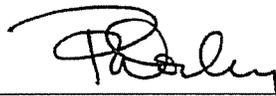
Use of the Products: The products would be of use to the Rail Division in implementing the Safety Action Plan and to local law enforcement agencies, State Highway Patrol and railroad police in developing more effective enforcement programs.

Benefits to the Department: The safety of persons riding on passenger trains, freight train crews, pedestrians and road users in general is an important goal of the NCDOT, and a reduction in trespass acts will contribute towards the achievement of this goal. In addition, the costs incurred by delays to passenger trains (including the passengers) and freight trains involved in trespass-related incidents will be reduced.

Other Comments: This is anticipated to be a two-year project. Approximate cost, including the demonstration project, is \$150,000. The project can be broken up into two phases for cash flow purposes: 1) report and 2) demonstration.

Approval

Paul Worley



Director, Rail Division

Name

Signature

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: Newell Brooks

DATE: 09/03/2013

Branch / Unit: Fleet Material and Management Unit (FMMU)

TITLE of your Research Idea: Preventive Maintenance (PM) Criteria

Background:

FMMU is responsible for proper operation associated with equipment. We have a canned PM schedule that is based off petroleum based applications and consider all applications of use are same. Need to review the optimum delivery time to application of a PM program based on other contributing factors.

What is the Specific Problem or Issue?

What is the correct interval and cost/benefit for an effective PM program. We presently only use time/mileage as decision based. Need to take from "or" statements in program to possibly "and/or" statements.

List Research Objectives and Tasks:

Need to evaluate various PM parameters to meet optimum cost to benefit of a proactive repair program.

What Would be the Product[s] of the Research?

*(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")*

A defined structure of evaluate schedules for various functional types of equipment.

How Will You or Others Use the Product[s]?

Use as an opening criteria for setting up maintenance calls and adequate plans based on multiple factors that may be used instead of time/mileage criteria.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

Would maximize the expenditure of time and dollars as corrects the intervals associated with proactive maintenance.

Other Comments:

Approval (Division official or Unit Head)

Scott Capps

 Print Name

 Signature

State Maintenance and Equipment Engineer

 Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CALL FOR NEW RESEARCH NEEDS**Your Name:** Donna Boone**DATE:** August 6, 2013**Branch / Unit:** Division of Motor Vehicles – Vehicle Registration Section**TITLE of your Research Idea:** Commission Contract License Plate Agencies**Background:**

NCGS § 20 -63 North Carolinians have been registering motor vehicles since 1909 and titling vehicles since 1923. Over time, the General Assembly has transferred responsibility for vehicle registration and titling from the Secretary of State to the Department of Revenue to the Division of Motor Vehicles (DMV). Beginning in 1961, the General Assembly mandated that all registration plates, registration certificates, and certificates of title—outside of those issued by DMV's Charlotte and Raleigh offices—be issued—insofar as practicable and possible through contracts with persons, firms, corporations, or governmental subdivisions of the State, and that DMV provide—proper supervision to the contract agents

What is the Specific Problem or Issue?

Providing cost effective timely and efficient customer service to NC citizens.

Are Contractors the most cost-efficient way for the State to provide vehicle registration and titling services?

Lack of providing performance measures for customer satisfaction, customer complaints and transaction error rates.

List Research Objectives and Tasks:

Determining best technology and best practices to implement to improve customer service such as:

- One Stop Shop – Combine vehicle registration offices with driver license office for streamlined customer service
- Kiosk- Located in retail or other locations for services that do not require face to face assistance
- Commission Contracts or other method of delivering vehicle registration services

What Would be the Product[s] of the Research?

*(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")*

Defined list of practices, procedures or technology that could be implemented to serve customers better.

Defined matrix for accountability

Set of standards that must be met by each LPA

How Will You or Others Use the Product[s]?

Requesting legislation and or implementing new policies and procedures to serve customers best.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

Increase efficiency in serving customers and decrease associated cost with providing services to customers.

Other Comments:

Session Laws 2008-107, S. 25.3

Session Laws 2011-382

Approval (Division official or Unit Head)

Michael Bryant

Print Name

Signature

Director, Vehicle Services

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CALL FOR NEW RESEARCH NEEDS**Your Name:** Judith Corley-Lay**DATE:** August 7, 2012**Branch / Unit:** Operations/Pavement Management Unit**TITLE of your Research Idea:** Chip Seal Construction Variability and Its Impact on Performance**Background:**

NCDOT has undertaken a broad range of research projects on our maintenance/preservation surface treatments. Several of these projects have involved construction of test sections and efforts were made to control variability during construction of the sites. Despite these efforts, application rates for emulsions were found to be highly variable, even when the distributor had been calibrated at the beginning of the day. Chip spreaders also may result in construction variability. This project is to identify the sources and magnitudes of construction variability in surface treatments. It will also determine the impact of the variability (for example, low emulsion rate with high chip spreader rate versus high emulsion rate with low chip spreader rate) on the performance. It is hoped that the project will result in methods to reduce construction variability.

What is the Specific Problem or Issue?

Surface treatments have good performance when the correct balance between emulsion rate and chip application rate is achieved. When this balance is not achieved, bleeding can occur (along with surface friction issues), or excessive aggregate can be lost under traffic, increasing tort claim risk. The first step in controlling construction variability is identifying its causes and its impacts. From this, potential solutions can be identified.

List Research Objectives and Tasks:

Identify the sources of construction variability and materials variability. Determine the range of the variability and the impact over the range on performance of the surface treatment. Identify methods that can reduce the variability.

Specific tasks could include the following:

1. Literature review
2. Using the literature review and a panel of surface treatment experts, identify sources of variability in surface treatment construction.
3. Test impact of varying each source of variability over a range of values.
4. Identify those variables having the most significant impact on performance.
5. Identify methods to reduce the variability of these key variables and test performance impact.
6. Final report

What Would be the Product[s] of the Research?

(Note: Progress reports and the Final report are NOT considered a "product," but "deliverables.")

This project will result in a list of the top 2 to 4 variables in construction of a surface treatment, the impact of each one on the performance of a surface treatment and possible methods of controlling the variability.

How Will You or Others Use the Product[s]?

The product will allow our road oil crews or contracted companies to focus on key factors that impact performance of chip seals. Hopefully the report will assist crews in implementing methods to control variability.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

Reducing the variability in construction of surface treatments will result in a more uniform service life for the treatment, and a reduction in corrective actions to recently treated roadways.

Other Comments:**Approval (Division official or Unit Head)**

Judith Corley-Lay

Print Name

Signature

State Pavement Management Engineer

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: Judith Corley-Lay

DATE: 8/19/2013

Branch / Unit: Asset Management/Pavement Management

TITLE of your Research Idea: Comparing Performance of Full Depth Asphalt Pavements and Aggregate Base Pavements in North Carolina

Background:

NCDOT has a long history of building aggregate base pavements and has built full depth asphalt pavements more frequently in recent years. We have used the assumption of equal service lives and rehabilitation treatments for both types. This project will use pavement management system data to test the validity of these assumptions.

In addition, the research team should clearly identify sections of pavement with both types that they recommend as calibration section for pavement design.

What is the Specific Problem or Issue?

Do pavements with aggregate base perform similar to pavement with asphalt stabilized base when placed under similar loadings and climatic conditions? If not, what is the time to first treatment for each type and under what conditions is the time to treatment valid?

List Research Objectives and Tasks:

This research will provide important performance information regarding asphalt base and aggregate base pavements that could be used to update our life cycle cost procedure. In addition, the identified sections may be used in recalibrating the Pavement ME-Design software to North Carolina conditions.

The tasks in this research should include the following as a minimum:

1. Literature review on performance of both flexible pavement types.
2. Identification of data elements desired from the Pavement Management System.
3. Compilation of data.
4. Analysis of time to treatment and perhaps treatment type by climatic zone, traffic levels, etc.
5. Identification of test sections for possible future recalibration of Pavement ME-Design.
6. Prepare final report outlining findings and process.

What Would be the Product[s] of the Research?

*(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")*

The product of the research will be typical times to treatment for both base types for various climate and traffic loadings. The performance of the two base types will be compared to test the existing LCCA assumptions.

A second product will be a selection of test sections for which data is sufficient or nearly sufficient to allow their use in recalibration of Pavement ME-Design. Recalibration is required whenever models in the software are added or changed, so this product will improve the efficiency of the recalibration process.

How Will You or Others Use the Product[s]?

The results on time to treatment and performance comparisons for the two base types will be used in updating the life cycle cost procedure of NCDOT and to validate or disprove assumptions used up to this time. The test section identification will allow pavement designers to more easily select sections for future calibration and recalibration.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

Pavement type selection and bid adjustments are based on life cycle cost procedures. This research will provide data to support and improve our procedure.

Approval (Division official or Unit Head)

Judith Corley-Lay

State Pavement Management Engineer

 Print Name

 Signature

 Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: Nilesh Surti and Clark Morrison

DATE: August 2, 2013

Branch / Unit: Div. of Highways / Construction Unit and Pavement Management Unit

TITLE of your Research Idea: Improved Data for Mechanistic-Empirical Pavement Design for Concrete Pavements

Background:

NCDOT is utilizing the AASHTOWare Pavement ME Design software. Many inputs for HMA pavements were determined through testing supporting FHWA's "Local Calibration of the MEPDG Using Pavement Management Systems" (FHWA Report No. HIF-11-026, 2010). MEPDG calibration for rigid pavements using local materials has not yet been performed, although some Pavement ME inputs for concrete pavements can be reasonably assumed using information from past projects and other resources. Thermal inputs for concrete pavements in Pavement ME Design include Coefficient of Thermal Expansion (CTE), heat capacity, and thermal conductivity. It has been shown that CTE values of concrete are very influential in the performance of concrete pavements, with higher values of concrete CTE linked to early age cracking, higher curling stresses, and premature joint deterioration.

What is the Specific Problem or Issue?

Thermal characteristics of concrete, in particular CTE, are key inputs to the Pavement ME Software. These thermal characteristics will be influenced by the materials used in the concrete mixture. It has been shown that since aggregates comprise the bulk of concrete, the CTE is greatly influenced by the type of aggregate used. Currently, a catalog of thermal characteristic inputs for concrete pavement mixtures utilizing local materials is not available.

List Research Objectives and Tasks:

Obtain representative aggregates from across the State used in concrete mixtures for pavements in North Carolina. Develop and implement a laboratory study to batch concrete mixtures utilizing these local materials. Perform testing to determine the Pavement ME Design thermal inputs (CTE, heat capacity, and thermal conductivity), and other material properties as appropriate.

What Would be the Product[s] of the Research?

*(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")*

This work will result in a documented catalog of concrete characteristics for concrete mixtures that contain materials used in North Carolina pavements.

How Will You or Others Use the Product[s]?

The products of this research will be directly implementable by pavement designers, allowing greater confidence in the predicted performance of concrete pavements designed using Pavement ME. Inputs could be utilized immediately by NCDOT pavement designers and others.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

This project will allow NCDOT to have more confidence in design and analysis of pavements using the Pavement ME Design software.

Other Comments:

Approval (Division official or Unit Head)

Ron Hancock, P.E.

Print Name

Signature

State Construction Engineer

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: Nilesh Surti

DATE: 8/30/2013

Branch / Unit: Highways

Construction Unit / Materials & Tests Unit

TITLE of your Research Idea:

The Effect of Limestone Replacement on the Mechanical Properties, Early-Age Behavior, and Long-Term Durability

Background:

There is a growing interest among infrastructure owners and operators to use more sustainable and lower carbon footprint materials for infrastructure. In response to this interest, cement industry has been developing more sustainable cementitious materials including portland-limestone cements. Portland-limestone cements with limestone replacements up to 5% have been used in the US. Portland cements with higher replacements, as much as 15%, are being used in Canada and Europe. These portland-limestone cements have shown satisfactory mechanical properties and long-term durability performance in Canada and Europe. There is a growing interest in using portland-limestone cements with limestone replacements up to 15% in the US. These portland-limestone cements are becoming commercially available and can potentially result in lower environmental emission implications.

What is the Specific Problem or Issue?

While portland-limestone cements with up to 15% replacement are being produced and can potentially be environmentally beneficial, replacing cement with limestone is expected to change the mechanical properties, long-term performance, and early-age properties of concrete. There is a lack of sufficient data on the use of portland-limestone cement with higher than 5% limestone replacements. Therefore, a need exists for research in evaluating the overall performance of these cementitious materials.

List Research Objectives and Tasks:

The objectives of the proposed research are:

1. To perform a comprehensive literature review on the use of portland-limestone cement with replacements up to 15%.
2. To evaluate the effect of limestone replacements (5% to 15%) on the mechanical properties of concrete mixtures.
3. To evaluate the early age properties of concrete mixtures made with portland-limestone cement with limestone replacements up to 15% including but not limited to strength development, shrinkage, shrinkage cracking, and heat of hydration.
4. To evaluate the long-term performance and durability of concrete mixtures made with portland-limestone cement with limestone replacements up to 15%.
5. To provide recommendations on the use of portland-limestone cement in North Carolina including but not limited to recommendations on the necessary adjustments to the mixture proportioning of the currently approved NCDOT concrete mixtures so that these new portland-limestone concrete mixtures would meet the mechanical, early-age properties, and durability requirements by NCDOT.
6. To perform a comparative cost-benefit analysis on the developed portland-limestone concrete mixtures as compared to standard portland cement concrete mixtures currently used by NCDOT

What Would be the Product[s] of the Research?

(Note: Progress reports and the Final report are NOT considered a "product," but "deliverables.")

1. Experimental data and analyses of the time dependent mechanical properties, early age properties, and long-term performance and durability of concrete mixtures made with portland-limestone cements with replacements higher than 5% and up to 15%
2. Results of comparative cost-benefit analysis on the use of portland-limestone cement concrete mixtures in North Carolina
3. A recommendation on the use of concrete materials made with portland-limestone cements with replacements up to 15% in North Carolina and recommendations on the necessary adjustment to currently approved mixture designed by NCDOT so that portland-limestone cements can be utilized without compromising the mechanical and long-term performance requirements by NCDOT

How Will You or Others Use the Product[s]?

The products of this research will allow NCDOT to perform a rapid assessment on whether portland-limestone cement with replacement levels higher than 5% and up to 15% are a suitable alternative to portland cement. The products of this research will help NCDOT to make informed decisions on the use of portland-limestone concrete with the benefit of reducing carbon footprint.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

The product of this research will help NCDOT to more rapidly assess the mechanical properties, early-age properties, and durability of portland-limestone cement concretes to be used in North Carolina. This can potentially lead to cost savings for NCDOT, and can help in reducing the environmental impact of concrete infrastructure.

Approval (Division official or Unit Head)

Ron Hancock, P.E.

Print Name

Signature

State Construction Engineer

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CALL FOR NEW RESEARCH IDEA**Your Name:** Todd Whittington**DATE:** 08/26/2013**Affiliation:** Materials and Tests Unit**TITLE of your Research Idea:** Verifying Low Temperature Performance Grade (PG) Properties of RAP Binders**Background:**

Use of Recycled Asphalt Pavement (RAP) in asphalt pavement construction is increasing significantly, considering cost savings and sustainability. The binder properties of asphalt mixture containing RAP are a function of the virgin binder grade as well as the properties of the binder contributed by RAP. The resulting high temperature PG grade of the blended binder affects the rutting and fatigue cracking resistance of the pavement, whereas the low temperature properties contribute to its thermal cracking resistance.

What is the Specific Problem or Issue?

The objective of the ongoing research projects RP 2012-04 and RP 2013-06 is to place limits on percentage binder contributed by RAP, instead of percentage by weight of total mixture replaced. In addition, the effect of variation in recycled binder stiffness from different RAP sources is being investigated in project RP 2014-05. The focus of these research projects is to evaluate stiffness of the blended binder at intermediate and high temperatures so that fatigue cracking and rutting can be minimized, respectively. Literature from similar studies shows that the low temperature PG grade of blended binder is not significantly different from that of the virgin binder for lower percentages of RAP. However, with results from the ongoing studies showing increased allowance for recycled binder, it is important to verify the effect of this increased recycled binder percentage on the low temperature PG grade. This can be accomplished by extending the testing procedure adopted for RP 2014-05 to low temperature testing using Bending Beam Rheometer (BBR).

List Research Objectives and Tasks:

- Extract binder from three different RAP sources and three locations within each of these sources that are found to exhibit significant variability from the findings of research project RP 2014-05
- Perform binder testing on the recycled binder, and blends containing different percentages of recycled binder using BBR device. Virgin binder grades used for preparing blends are PG 58-28 and PG 64-22 as specified by NCDOT for surface mixtures
- Identify and statistically quantify difference between low temperature PG grades of virgin and blended binders
- Develop blending charts to determine the maximum allowable recycled binder based on the blended binder properties for different RAP materials and virgin binder grade combinations
- Extend specifications, if required, to limit recycled binder content such that low temperature properties are acceptable

What Would be the Product[s] of the Research?

- Knowledge for design engineers of the appropriate amount of RAP to be used based on percentage recycled binder for different RAP sources such that the RAP mixture performs well at both high and low temperatures

How Will You or Others Use the Product[s]?

Engineers will use these products to better determine virgin binder grades for use with higher contributed recycled binder percentages based on properties of the RAP binder. Recycled binder percentage limits will be determined for different RAP sources which allow better characterization of the blended binder.

How Will the Product Benefit the Department?

- Performance with respect to both high and low temperature distresses will be ensured while selecting RAP content
- Reduce costs of hot mix asphalt by allowing higher recycled binder contents in HMA.
- Increase the environmental stewardship of the Department by diverting recycled asphalt pavement material to become a beneficial product in new pavement construction.

Other Comments:**Approval (Division official or Unit Head)**

Chris Peoples, P.E.

Print Name-----
Signature

State Materials Engineer

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CALL FOR NEW RESEARCH IDEA**Your Name:** Todd Whittington**DATE:** 08/26/2013**Affiliation:** Materials and Tests Unit**TITLE of your Research Idea:** Superpave Mix Design Software Program for Design of Asphalt Concrete Mixtures**Background:**

Superpave mix design of asphalt concrete mixtures involves computation of several volumetric properties during the aggregate blend and asphalt content selection phases. Traditionally, these calculations are performed by many highway agencies with the help of spreadsheet software, predominantly Microsoft Excel. The design process is first divided into tasks and data obtained during each task is systematically recorded into a database for the purpose of selecting the final design variables (aggregate blend ratio and design asphalt content) and preparation of required reports for submittal.

What is the Specific Problem or Issue?

Analysis of Superpave mix design data is currently being performed with the use of spreadsheet software, which is designed specifically to meet NCDOT requirements for submission of mix designs. In the case of a streamlined design procedure such as Superpave mix design, it would be highly beneficial to develop software that could provide contractor users and the design engineer with a highly user-friendly interface, sequential computational capabilities, automatic graph generation, report printing features and most importantly, integration of data with a central database that can be accessed by the user even remotely. The proposed research aims at developing a software program comprising different modules, where each module is designed independently or by importing data from other modules or projects, and then perform analysis of Superpave mix design data.

List Research Objectives and Tasks:

- Consult asphalt mix design engineers at NCDOT and thoroughly understand the requirements of Superpave mix design and job mix formula submission according to the current software standards for data acquisition and reporting.
- Prepare a client specification checklist of additional requirements for the software program such as database integration, security level required to use software and access or edit data, etc.
- Division of software development activity into subtasks based on module description - aggregate blending, selection of design aggregate structure, determining optimum asphalt content, other material tests (such as tensile strength ratio, etc.), and submittal report printing.
- The design of the software package should allow for future editing of specification ranges, design parameters, reporting capabilities, and addition of database fields based on future changes in Superpave mix requirements.
- Demonstration of final product and development of a highly detailed user guide with examples.

What Would be the Product[s] of the Research?

- The final product of this research is a Superpave mix design software program that is easy to use, efficient, robust, customizable, and can be easily implemented.

How Will You or Others Use the Product[s]?

Contractor users and design engineers can use this product to design asphalt concrete mixtures using the Superpave method and prepare job mix formula submission reports.

How Will the Product Benefit the Department?

- Users would be able to more efficiently document, compute, and report data pertaining to Superpave mix design as compared to the current practice.
- The product would be fully customized to incorporate current and future NCDOT Superpave mix design practices and requirements.

Other Comments:**Approval (Division official or Unit Head)**

Chris Peoples, P.E.

State Materials Engineer

Print Name-----
Signature-----
Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: C. K. Su

DATE: August 14, 2013

Branch / Unit: Materials and Tests

TITLE of your Research Idea: Acceptance of Aggregate Base Course (ABC)

Background:

The current specifications for acceptance of ABC materials dated back about a half century ago with few minor adjustments through the years. It is a type of "recipe" specification which is employed by a majority of the DOTs around the country. The specifications dictate the percentages of individual particle that shall be blended in an aggregate product, based on the assumption that the product will achieve the desired engineering performance as long as it meets required gradations and placed properly in the field. However, the biggest disadvantage of the "recipe" specifications is that it cannot quantify the mechanical behavior of the aggregates under the expected traffic conditions. With the rising concerns of environmental and sustainable issues, more by-products and recycled materials are mixed into the virgin materials. Additionally, the concept of mechanical properties of pavement materials is introduced into both design and construction fields, such as mechanistic-empirical pavement design and intelligent compaction, in recent years. Additionally, a split sample based Quality Assurance/Quality Control QA/QC Program has been used as part of the acceptance process, where the producer samples material at a certain frequency and the Department samples at a lesser frequency to verify the producer tests. For ABC, additional roadway assurance samples are taken from the project.

What is the Specific Problem or Issue?

The primary means for accepting ABC is with field density and laboratory gradation and Atteberg limits testing using roadway assurance samples and a split sample based QA/QC program. Various other technologies and methods exist for characterizing this type of material (Resilient Modulus, Dynamic Cone Penetration, etc.). Split sample validation with producer controlled sampling is no longer an acceptable method of accepting project materials. The Department is piloting random and independent Department controlled sampling and exploring a statistically based method to increase the confidence in producer test results. With a reduction in available resources and with other available technologies, we feel that we could utilize statistical methods and a better characterization of the materials to reduce the frequency of sampling required on the project.

List Research Objectives and Tasks:

A new approach to evaluate, approve and accept aggregate base course material. It shall consider not only the appropriate ratios of blending, but also the material properties that affect mechanical properties and the performance of the final product during the service life.

What Would be the Product[s] of the Research?

(Note: Progress reports and the Final report are NOT considered a "product," but "deliverables.")

- Aggregate base course acceptance criteria/specification allowing for reduced frequency of roadway sampling
- The results obtained from acceptance testing should be linkable to pavement design/performance parameters such as resilient modulus, permeability and the soil-water characteristic curve. This link may take the form of correlation equations.
- List of associated required tests
- Training/User's manual for any testing protocols unfamiliar to the Department

How Will You or Others Use the Product[s]?

The product will be included in the future edition of NCDOT Standard Specifications. The design team can use it as inputs for design and the construction offices and Materials and Tests Unit will use it as guidelines to evaluate and determine the acceptance of base course materials.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

With the new specifications, the pavement system can be designed more accurately according to the anticipated traffic loads and other factors and the performance shall be easier to be evaluated, which means the maintenance cost can be predicted and controlled. Plus, the new development can also provide a new perspective in evaluating base course materials, which could encourage construction material industry to further innovate in new generation of materials that can fulfill the engineering functions and satisfy the needs of sustainability.

Approval (Division official or Unit Head)

Chris Peoples, P.E.

State Materials Engineer

Print Name

Signature

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: Neil Mastin

DATE: 8/15/13

Branch / Unit: Asset Management/Pavement Management

TITLE of your Research Idea: Evaluation of Benefit Weight Factors and Decision Trees for Automated Distress Data Models.

Background:

Two years ago, NCDOT began using automated data collection for primary (Interstate, US and NC) routes. New pavement deterioration models specific to the automated data are being developed to allow the Pavement Management System to take advantage of the increased data quality and detail. These new performance models have an impact on the benefit values of applying various preventive treatments to pavement families during pavement optimization. This produces a need to update existing benefit weight factors. New distress models will also change the rates of distress indices reaching certain thresholds or result in the creation of whole new indices. Trigger points on new and existing decision trees will need to be evaluated to assure optimal treatment selection.

What is the Specific Problem or Issue?

New pavement models are currently being developed to take advantage of advances in data collection. This has resulted in the need for updates to benefit weight factors and decision tree trigger points.

List Research Objectives and Tasks:

1. Evaluate new and existing decision trees for optimal pavement treatment trigger points
2. Determine optimal weight factors to apply to treatment selections to assure the most cost and performance effective treatment selection

What Would be the Product[s] of the Research?

*(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")*

1. Weight factors that can be applied to each family of highways to calculate maximum benefit. These will be entered into the PMS for use during optimization analysis
2. Updated Decision Trees and Decision Tree trigger points

How Will You or Others Use the Product[s]?

These work products will be incorporated directly into the PMS module of the Asset Management System and will be available to any user performing pavement analysis activities or consuming the output products of pavement analyses.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

The updated weight factors and decision trees will aid PMU and field personnel by increasing the quality and accuracy of pavement analyses and work plans derived from these analyses. The end results should mean more optimal project selection (time and location) and better performance for dollars spent on pavement treatments such as resurfacing, chip seal and rehabilitation.

Other Comments:

This project would continue a series of improvements to the Pavement Management System analysis capability.

Approval (Division official or Unit Head)

Chris Peoples, P.E.

State Materials Engineer

 Print Name

 Signature

 Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CALL FOR NEW RESEARCH NEEDS**Your Name:** Dewayne Sykes, Mohammed Mulla, Clark Morrison**DATE:** 8/12/2013**Branch / Unit:** Utility Unit, Geotechnical Engineering Unit, and Pavement Management**TITLE of your Research Idea:** Impacts of Utility Excavation on Roadway Integrity in NC Regions**Background:**

Public and private utility companies/agencies excavate in and adjacent to roads using non-positive shoring such as trench boxes to keep the cost low. Unfortunately this kind of shoring can cause subsurface damages to our road system and created additional maintenance costs. Soil excavation can result in soil movement which can cause roadway damages. NCDOT currently requires only positive shoring system for most utilities excavation. Positive shoring is defined as continuous contact of the shoring system to the retained soil (sheet piles, soldier piles with panels etc.) are needed for utility installation and/or repair, replacement of water and sewer lines. Utility excavation in roadways using non positive shoring systems have been observed to be one of the most significant causes of premature pavement deterioration, particularly in urban roads, in North Carolina. The premature damage to pavements results in high maintenance/rehabilitation costs and causes significant loss of pavement life and creates possible dangerous driving conditions. However, with proper soil investigations, trench boxes may be utilized for a specific duration, depth and soil type. This research should determine the specific conditions of when to allow the utilization of the trench box without positive shoring that results in minimum damage to our pavement system. Additionally, the research should predict the zone of influence to be repaired during construction.

What is the Specific Problem or Issue?

Damaging road-pavement caused by utility excavation and installation.

List Research Objectives and Tasks:

The main goal of this research is to determine:

1. The impacts of the damage zone caused by utility cuts using trench boxes (non-positive shoring) to urban roads in NC.
2. The depth, the dimensions, and the duration of the cut section with minimum damage to our pavement
3. The type of the excavated soil that will produce minimum damage to our pavement
4. Construction methods to limit/mitigate the causes of pavement damage
5. Field testing methods to determine the type and strength of soil and acceptability of using trench box or not.
6. Predict the roadway area to be repaired during construction.

What Would be the Product[s] of the Research?

(Note: Progress reports and the Final report are NOT considered a "product," but "deliverables.")

Guidelines of when to allow trench box excavation and prediction of the roadway area to be repaired.

How Will You or Others Use the Product[s]?

1. To help evaluate the most appropriate and cost effective construction method for utility excavation.
2. The guideline will minimize the risk for pavement damage-premature detrition.
3. Will alert the utility contractors and our district engineers with the potential damage form trench box excavations.
4. It will help us establish state wide utility excavation policy.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)
Will decrease costs, enhance safety for both short and long term. The following organizations will benefit from this research.

NCDOT Utilities Unit, NCDOT Asset Management, NCDOT Pavement Management, NCDOT divisions and NCDOT Geotechnical Engineering Unit.

Approval (Division official or Unit Head)

Print Name

Signature

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CALL FOR NEW RESEARCH IDEA

Your Name: Mohammed A. Mulla

DATE: 8/12/13

Branch / Unit: Geotechnical Engineering Unit

TITLE of your Research Idea: SPT Hammer Continuous Energy Measure and Calibration**Background:**

The Standard Penetration Test (SPT) is widely used in geotechnical investigation to estimate soil strength. An SPT hammer drives a split barrel sampler at the bottom of a drive rod and recovers soil samples. The number of blows required to drive the last one foot is the "N value", and indicates soil strength. Based on our experience the SPT hammer energies can vary greatly even among the type of hammers. The hammer performance will influence the N value and the variations in this value can be traced to the hammer the hammer transfer energy. The ratio between the measured energy transferred to the rod and the theoretical potential energy of the hammer are vary widely. This ratio will compensate for the wide variability of the estimates obtained from the SPT test.

What is the Specific Problem or Issue?

1. The hummer energy is very hard to estimate without testing.
2. The N value is not reliable due to the variety of the SPT hammer efficiency.
3. It is not practical to assume that the correction factor for all hammers is the same.

List Research Objectives and Tasks:

1. Collect data for automatic SPT hammer energy and provide a summary of the deficiency of the energy and the reasons.
2. Develop a system including software that can be used during the SPT operation to determine the hammer energy and to measure the energy transferred by the Standard Penetration Test (SPT) hammer to the SPT rod and record the blow counts (N).
3. The system shall be reusable and shall not exceed \$4000

What Would be the Product[s] of the Research?

(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")

1. A device that will be hooked or can be wireless to the SPT W rod and
2. Software to evaluate the results form the SPT reading that can generate a report for efficiencies and the blow counts and how to be corrected when used for design.

How Will You or Others Use the Product[s]?

Any drill rig used for NCDOT work will benefit from this research. The in house and our consultant's rigs will use this device to estimate the actual efficiency of the hammer which results in a better design.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

It will assist the Geotechnical Engineering Unit implementing the LRFD more accurately and more efficiently. Instead of checking the efficiency in each hammer once a year this system will measure it continuously and that will limit our assumption from over or under estimating the N value.

Other Comments:**Approval (Division official or Unit Head)**

John Pilipchuk

Print Name

State Geotechnical Engineer

Title

Signature

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CALL FOR NEW RESEARCH NEEDS

Your Name: K. J. Kim

DATE: 8-6-2013

Branch / Unit: Geotechnical Engineering Unit

TITLE of your Research Idea: Improvement of Material Criteria for Highway Embankment Construction**Background:**

A combination of unclassified excavation material and borrow material is used for highway embankment construction. Currently, the NCDOT Standard Specification Section 1018 specifies borrow material criteria, which are solely based on the soil's plasticity index (PI). There are other material properties than PI that may affect the performance of the borrow material. On the other hand, there are no specific criteria that govern the soil from unclassified excavation that is used for embankment construction. Since unclassified excavation and/or borrow excavation are a major contract item in many projects, the criteria governing these materials are a very important element of highway design and construction. It is urgent to examine the current borrow material criteria and develop more rational and optimum criteria for both borrow material and unclassified excavation material in terms of economy and constructability.

What is the Specific Problem or Issue?

1. It is not known how the current borrow material criteria were developed or how rational they are. The current borrow criteria solely based on PI seem to be insufficient to be used effectively in all highway projects.
2. There are no specific criteria for the soils from unclassified excavation that are used for embankment construction.
3. The borrow material meeting the current borrow criteria and the unclassified excavation material sometimes cause problems during construction such as difficulty of compaction, subgrade instability, or slope failure.
4. Insufficient criteria for both borrow material and unclassified excavation material resulted in construction delays, disputes, claims, cost overruns, or waste of good materials in many projects.
5. It is becoming more difficult to secure borrow material sources within an economical distance from project sites, which necessitates development of more rational and optimum criteria for borrow material and unclassified excavation material.

List Research Objectives and Tasks:

1. Review the NCDOT's current criteria for borrow material and unclassified excavation material and the practice of highway embankment construction.
2. Survey and review the construction problems associated with borrow and unclassified excavation material.
3. Perform both laboratory and in-site testing of selected soil samples representing different geologic regions of NC.
4. Perform engineering analysis of different criteria options.
5. Develop rational and economical criteria for borrow and unclassified excavation material for different geologic regions of NC.

What Would be the Product[s] of the Research?

(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")

Rational and economical criteria for borrow and unclassified excavation material for different geologic regions of NC.

How Will You or Others Use the Product[s]?

1. The products will be used to improve the criteria for borrow and unclassified excavation material used for highway embankment construction.
2. Geotechnical Engineering Unit will use the products in the subsurface investigation and design recommendations for highway earthworks (embankments and excavations).
3. Division offices and Construction Unit will use the products for highway earthworks.

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

1. More rational and economical design of highway earthworks (short and long term benefits).
2. Better quality construction of highway embankments (short and long term benefits).
3. Reduce construction disputes, claims, delays, cost overruns, or waste of good materials (short and long term benefits).
4. Reduce long-term maintenance cost of highways (long term benefit).

Approval (Division official or Unit Head)

John Pilipchuk

Print Name

Signature

State Geotechnical Engineer

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: Jay A. Bennett, PE

DATE: August 23, 2013

Branch / Unit: Roadway Design Unit

TITLE of your Research Idea: Performance Evaluation of NCDOT's Cable Guiderail System (Std. 865.01) at Manual for Assessing Safety Hardware (MASH) Test Level 4 (TL-4) Conditions [introduction of a heavy 22,046 lb (10,000 kg) single unit truck].

Background:

A goal for a highway safety feature is to provide a forgiving roadway and a roadside that reduces the risk of a serious crash when a motorist leaves the roadway. The safety goal is met when the feature either contains and redirects the vehicle away from a roadside obstacle, decelerates the vehicle to a safe stop, allows controlled penetration, without causing serious injuries to vehicle occupants or to other motorists.

The performance of North Carolina's low tension cable guiderail system has not been tested and evaluated for impacts by a 22,046 lb (10,000 kg) single unit truck at 56 mph and 15 degree impact. The performance of our cable system at Test Level 4 conditions remains unknown.

What is the Specific Problem or Issue?

Questions often arise about the Department's design decisions and how various safety hardware systems function under different conditions. The low tension cable guiderail system is used in North Carolina as a low cost design for the prevention of median crossover crashes that minimizes property damage to the vehicle and occupancy injury risk when struck. The performance of the system has not been fully determined under MASH Test Level 4 conditions. The functionality of the cable, cable hook bolt, the cable guiderail post and the soil parameters around the posts as well as the deflection distances should be evaluated to understand the functionality of the system at these test level conditions. Currently, the use of the system only requires compliance with Test Level-3 conditions.

List Research Objectives and Tasks:

Evaluation of the performance of the current NCDOT cable guiderail system (Std. 865.01) under MASH Test Level 4 conditions on a flat surface installed at locations with traditional soil properties and at locations with strengthened soil properties. Evaluation of the performance of the current system with upgraded hardware.

What Would be the Product[s] of the Research?

The proposed research will provide a summary of effectiveness of the current NCDOT cable guiderail system at Test Level 4 conditions. It will provide the Department some insight for system performance when impacted by a single unit truck. This includes any redirection characteristics and amount of system deflection.

How Will You or Others Use the Product[s]?

NCDOT engineers and officials will use this research to make informed design and installation decisions for cable median guiderail placement and use. The Department will use this research to convey system performance expectations when this type of system is impacted by a single unit truck.

How Will the Product Benefit the Department?

The research results will help the Department in its ability to evaluate and communicate their efforts to enhance safety as it relates to the prevention of cross median crashes. The results can be used to evaluate the effectiveness of providing higher standards than those recommended by the FHWA Office of Safety.

Other Comments:

None.

Approval (Division official or Unit Head)

Jay A. Bennett

Print Name

Signature

State Roadway Design Engineer

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: Jay A. Bennett, PE

DATE: August 23, 2013

Branch / Unit: Roadway Design Unit

TITLE of your Research Idea: Performance Evaluation of Strong Post Double Faced W-Beam Guardrail and Strong Post Doubled Faced Thrie-Beam Guardrail at Manual for Assessing Safety Hardware (MASH) Test Level 4 (TL-4) and Test Level 5 (TL-5) conditions [TL-4 = introduction of a heavy 22,046 lb (10,000 kg) single unit truck and TL-5 = introduction of a 80,000 lb (36,000 kg) tractor-trailer combination].

Background:

A goal for a highway safety feature is to provide a forgiving roadway and a roadside that reduces the risk of a serious crash when a motorist leaves the roadway. The safety goal is met when the feature either contains and redirects the vehicle away from a roadside obstacle, decelerates the vehicle to a safe stop, allows controlled penetration, without causing serious injuries to vehicle occupants or to other motorists.

The performance of double faced strong post W-Beam guardrail and double faced strong post Thrie-Beam guardrail has not been tested and evaluated for impacts by a 22,046 lb (10,000 kg) single unit truck at 56 mph and 15 degree impact and 80,000 lb (36,000 kg) tractor-trailer combination at 50 mph and 15 degree impact . The performance of the two doubled faced systems at Test Level 4 and Test Level 5 conditions remains unknown.

What is the Specific Problem or Issue?

Questions often arise about the Department's design decisions and how various safety hardware systems function under different conditions. The double faced guardrail treatments in highway medians are being used based on the lower initial installation costs. The performance of the system has not been fully determined under MASH Test Level 4 and Test Level 5 conditions. The functionality of the W-Beam, Thrie-Beam, offset blocks and guardrail posts should be evaluated to understand the functionality of the system at these higher test level conditions. Currently, the use of the system only requires compliance with Test Level-3 conditions.

List Research Objectives and Tasks:

Evaluation of the performance of the current doubled faced strong post W-Beam guardrail installation (Std. 862.02) and strong post double faced Thrie-Beam installation under MASH Test Level 4 and Test Level 5 conditions on a 10:1 or flatter surface.

What Would be the Product[s] of the Research?

The proposed research will provide a summary of effectiveness of the current strong post double faced W-Beam and the strong post double faced Thrie-Beam installation within highway medians at Test Level 4 and Test Level 5 conditions. It will provide the Department insight for system performance when impacted by a single unit truck and tractor-trailer combination. This includes any redirection characteristics and amount of system deflection.

How Will You or Others Use the Product[s]?

NCDOT engineers and officials will use this research to make informed design and installation decisions for doubled faced W-Beam and Thrie-Beam median guardrail placement and use. The Department will use this research to convey system performance expectations when this type of system is impacted by a single unit truck and/or tractor-trailer combination.

How Will the Product Benefit the Department?

The research results will help the Department in its ability to evaluate and communicate their efforts to enhance safety as it relates to the prevention of cross median crashes. The results can be used to evaluate the effectiveness of providing higher standards than those currently recommended by the FHWA Office of Safety.

Other Comments:

None.

Approval (Division official or Unit Head)

Jay A. Bennett

Print Name

Signature

State Roadway Design Engineer

Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: Ron King

DATE: August 28, 2013

Branch / Unit: Signing and Delineation Unit

TITLE of your Research Idea: The Effects of Late Lane Merges on Travel Times

Background:

We have seen a significant increase in travel times at a certain location by removing a merge area.

What is the Specific Problem or Issue?

Improving travel times at major interchanges

List Research Objectives and Tasks:

Determine if improvements in travel times are obtained by reducing/eliminating late merge movements

What Would be the Product[s] of the Research?

*(Note: Progress reports and the Final report are **NOT** considered a "product," but "deliverables.")*

Signing and marking practices at major interchanges

How Will You or Others Use the Product[s]?

Case by case

How Will the Product Benefit the Department?

(e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

Improved travel times

Other Comments:

Approval (Division official or Unit Head)

Kevin Lacy

 Print Name

 Signature

State Traffic Engineer

 Title

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH NEEDS

Your Name: Dr. Majed Al-Ghandour, PE

DATE: 08/26/13

Branch / Unit: Program Development Branch

TITLE of your Research Idea: Safety Assessments for NC Multi-Lane Roundabouts: Roundabouts Crash Prediction Models

Background:

In the 1950s, several Department Of Transportation (DOT) agencies and local officials began designing and building roundabouts on state roads in urban and rural areas. A roundabout is a one-way, yield-controlled circular intersection, whose configuration can vary in number of approaches and circulating lanes, in which traffic flows counterclockwise around a central island. In recent years, roundabouts have become progressively more popular as an innovative operational and safety key for both low- and high-volume travel demands. For example, recently City of Raleigh installed 3 roundabouts at Hillsborough Street and several in Cary Town of Chatham Street, etc. Roundabouts must be designed to meet the needs of all road users, including vehicle drivers, pedestrians (including those with disabilities such as visual impairment), and bicyclists. Research indicates that well designed roundabouts can be safer and more efficient than traditional intersections because they present fewer conflict points and thus reduce the likelihood and severity of collisions. The potential for risky conflicts, such as right-angle and left-turn head-on crashes, is reduced with roundabout use. Also, research indicates that single-lane roundabouts are safer than multilane because they present less potential for conflicts between road users, and because pedestrian crossing distances are shorter. Studies by the Insurance Institute for Highway Safety (IIHS) indicate that a modern roundabout approach to traffic management can reduce injury accidents by 75 percent, pedestrian crashes by 30-40 percent, bicycle crashes by 10 percent, and fatal crashes by as much as 90 percent. *Highway Safety Manual* (HSM) is still in development to support a better quantify changes in safety performance and safety prediction methods.

The goals from this research idea are to undertake a safety assessment for Multi-Lane Roundabouts for the North Carolina Department of Transportation (NCDOT). The main objective is to develop models that predict the future number of crashes on multi-lane roundabouts at North Carolina. Different configurations for roundabouts need different type of predicated crash models.

What is the Specific Problem or Issue?

The NCDOT is continuously seeking improvements to its traffic operation and safety for several signalized intersections and un-signalized intersections. The NCDOT moves in direction to build more roundabouts in the future. To day, the NCDOT constructed about more than fifteen roundabouts statewide. NCDOT has no crash prediction model(s) for roundabouts. It needs to develop models that predict the future number of reported crashes on roundabouts with different configurations (single-lane roundabout, multi-lane roundabout, interchange roundabout, Slip lane roundabout, Dog Bone/Turbo roundabout, and Teardrop roundabout). The models will be critical in terms of the major types of roadway connected to roundabout using average daily traffic and other simple inputs typically available during long-range transportation planning. Planners, traffic engineers can then use these models to help prioritize future roadway improvement projects.

The main goal of this proposal research idea is to address the question: How NCDOT transportation planners, traffic engineers and decision-makers efficiently can predict the safety assessment and the performance of multi-lane roundabouts. There is a need to develop models that predict the future number of crashes on roundabouts at North Carolina. Different configurations for roundabout will have different type of crash models too. Are other state's crash models transferable and transperance to North Carolina Roundabouts? Does path overlap on a multilane roundabout entry influence crash frequency?

List Research Objectives and Tasks:

Models, framework, tools, and applications for NCDOT related to signalized intersections and crashed models for some pilot projects that NCDOT needs to assist in constructing roundabouts. Tools will also address visualization and simulation models too for the predicted crash models using VISSIM/ VISTRO (PTV) and SSAM tools (FHWA). These tools that can better quantify in safety performance of NC multi-lane roundabouts.

What Would be the Product[s] of the Research?

Improve NCDOT and local efficiency through simulation technologies and models for Roundabouts.

- Use Visualized models to help transportation engineers and policy makers that can be used more quantify Roundabouts.
- Evaluate Performance Measure (delay time) using Visualized simulation Models for NCDOT signalized intersections.

How Will You or Others Use the Product[s]?

- In developing guidelines and procedures to identify project type (a Design Build or a Traditional Construction)
- Support, aid, and allow transportation engineers and policy makers to quantify benefit of selecting project types,
- Identify problems, risks, and failure for not selecting other types.

How Will the Product Benefit the Department?

Roundabouts present several safety benefits: substantial reduction of crash rates and crash severity, and improved pedestrian safety. Roundabouts reduce speeds of conflicting flows, reduce serious crossing conflicts and simplify driver decision-making with clear indication of drivers' right of way.

- Improve NCDOT efficiency through using those predicted crash models for evaluation before construction.
- Improve Accountability on those NCDOT Roundabouts Projects for the public and decision-makers.

Approval (Division official or Unit Head)

Calvin Leggett, PE

Print Name

Signature

Branch Manager

Title