



## Research Ideas Needed by July 14, 2017

Thanks to active participation from NCDOT staff and our Research Community, the FY2018 Research Program will launch on August 1, 2017. The program includes twenty-four (24) new projects made up of transportation related research ranging from further developing and improving guardrail designs to testing the use of carbon fiber reinforcement in retro-fitting bridges.

R&D is officially soliciting your new ideas for research topics for the FY2019 program. Nearly everything NCDOT does is eligible for research funding. We want and need your ideas to improve NCDOT service to the public and our partners. Whether it is pavement, structures, planning, funding analysis, safety, mobility, transit, environment or hydraulics, your ideas can be turned into research projects that produces real, working solutions. This year, we are also seeking new and exciting tech transfer ideas. Do you have local or national research you want to implement in North Carolina? We can help!

The Research Need Statement is available on the R&D Connect page and is designed to help employees with ideas to clearly define their needs and to provide researchers with the information they need to get started on quality proposals. The connect site also includes a two-page instruction document to help answer questions and guide you through the process. Contact information for the engineers assigned to various research topics is included.

[Click here for the new Research Need Form](#)

[Click here for the form instructions](#)

If you have an idea, but aren't sure how to fully develop it, please contact me or any of the R&D engineers. We will assist you in developing your statement and can help connect you to experienced research need generators.

**The deadline for RNS submission is July 14, 2017.**

**Neil Mastin**

**Research & Development Unit Manager**



**Caption: Charlotte Cityscape**

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# Meet the Engineers

## Steven J. Boylard



Steven Bolyard recently joined the Research & Development Unit in April. He will be serving as one of three Research Engineers dedicated to providing project management skills to a wide array of annual research projects. Steven was born and raised near Tampa, Florida. He attended the University of Central Florida (UCF) in Orlando, Florida. Steven graduated in December of 2008 with a dual degree in Civil and Environmental Engineering. While attending UCF he started working at a local Maintenance Yard for the Florida Department of Transportation (FDOT). Steven continued working for FDOT while he returned to UCF in 2009 to start his Master's in Environmental Engineering. His first tenure with FDOT came to an end in July of 2011 after a series of budget reductions due to the recent Great Recession.

After leaving FDOT, he worked for Valencia College part time as a math tutor in the college's Math Lab, tutoring students in remedial math and college algebra. He left Valencia College the following year to pursue a job at Camber Corporation, assisting with improving training course curriculum, implementation and quantification for the US Veterans Benefits Administration. Steven returned to FDOT the following year to work

in their Central Office location with the Research Office as the Research Performance Coordinator. He worked there for three years to increase the performance and timely compliance of contract completion. In addition to this role, Steven oversaw his office's implementation and quantification program for completed research projects.

Steven left FDOT in October of 2016 after his wife Stephanie completed her Ph.D. in Environmental Engineering at UCF and accepted a position with the Environmental Research and Education Foundation in Raleigh, NC. Their first child, Parker Steven Bolyard was born on November 13, 2016. Steven's main hobbies are watching movies, wine tasting, and traveling. They reside in Knightdale, NC with their three rescue cats; Echo, Beaker, and Spunky.

## Curtis T. Bradley



Dr. Curtis T. Bradley is the newest member of the North Carolina Department of Transportation's Research & Development Unit where he serves as the Research Implementation Manager. In his previous position he served as the Manager of Research and Transportation Program Planner for the Massachu-

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# Meet the Engineers

sets Department of Transportation where he managed several initiatives including:

- Local Technical Assistance Program
- Massachusetts Technical Assistance Program
- Massachusetts Cooperative Research Program
- Boston South Station Expansion Project (Assistant Project Manager)
- Massachusetts State Rail Plan
- Massachusetts State Research Program (State Planning & Research: Part II)

Prior to his time at the Massachusetts Department of Transportation, Curtis was a Graduate Assistant at the University of Massachusetts Lowell as well as an intern at HNTB Corporation where he conducted research on the Boston South Station Expansion Project as well as the Federal Railroad Administration's Northeast Corridor (NEC) Future project. Prior to moving to Massachusetts, Curtis worked as a Site Engineer for M.B. Kahn Construction Inc. in Columbia, South Carolina. In this position he worked on construction projects for the building of LEED buildings, schools and community centers.

Curtis received a Bachelor of Science degree in Architecture and Environmental Design from Morgan State University and a Master of Science Degree in Transportation Planning from South Carolina State University. In 2016 he was awarded the doctorate in Civil Engineering: Transportation Engineering from the University of Massachusetts Lowell where his dissertation was *Modeling Short-Haul Intercity Travel Impacts and Behaviors* under the direction of Dr. Yuanchang Xie. Curtis's research interests are transportation financing, multi-modal initiatives, high-speed rail planning and feasibility studies as well as statistics and econometrics.

Curtis is married to Tyachenna Bradley, and they have three children Isaiah (7) Alyssah (5), and Elijah (6-months-old). In his leisure time Curtis likes to spend time with his family doing arts and crafts and playing board games. In his personal time Curtis enjoys playing golf, cooking as well as serving his local community.

## Recently Completed Research Projects

### RP 2014-04 [Characterization of Different RAP Sources](#)

Recycling of asphalt pavements is crucial to alleviating the growing demand for paving materials including both asphalt binder and aggregates. For this reason many states have adopted specifications for the use of reclaimed asphalt pavement (RAP) in hot mix asphalt (HMA).



**Caption:** Example material in a RAP stockpile

These specifications, however, are based on the percentage weight of RAP in the total mix. Because, RAP binder is usually much stiffer than virgin binders and contributes to the increased stiffness of the recycled mixture, placing emphasis on the recycled binder content would be a more efficient way to optimize use of RAP. North Carolina Department of

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## Recently Completed Research Projects

Transportation (NCDOT) research projects RP 2012-04 and RP 2013-06 studied recycled materials with the objective of placing limits on percentage of binder contributed by RAP, instead of percentage by weight of mix replaced. As part of the research, one RAP material was selected and tested with different virgin binders and limits were derived. Since recycled binders from different RAP sources exhibit different properties, the limits determined for binder from a single RAP source are not directly applicable to all RAP sources.

RAP is the material that gets removed and processed from an existing deteriorated asphalt pavement during resurfacing, rehabilitation, or reconstruction operations. Different pavements age to various degrees during their service life depending on aging factors such as geographic location, service life, pavement structure, virgin binders and aggregates used to construct the initial pavement. RAP from different parts of the state age to varying degrees and differ in their properties. Therefore, the need exists to investigate the variability in properties of recycled binder from different sources and design a framework factoring for this variability while recommending a set of specifications for designing recycled mixtures.

This research aimed to evaluate the effect of variability in the RAP binders on the recycled binder limits by extensively examining the rheological properties of recycled binders from different RAP sources. RAP stockpiles from different geographical regions were selected and the recycled binder extracted from RAP was characterized using the Dynamic Shear Rheometer and binder limits determined to identify differences among the stockpiles. Statistical inferences were derived from the rheological properties of the different RAP binders. The binder limits obtained for different stockpiles were used to develop draft specifications to

select the optimum amount of recycled materials based on the variability between and within stockpiles.

### [RP2015-20 Research to Support Design and Siting of Deposition Areas for Dredged Material from the Rodanthe Emergency Channel](#)

The Ferry Division's Stumpy Point - Rodanthe ferry route is designated as an emergency service which provides an alternate means of connecting the north end of Hatteras Island to the mainland. NCDOT's Ferry Division must maintain open channels for ferry passage which may require dredging material from ferry channels. Currently only one inland facility, an hour's drive, is available for disposal of the dredged material. This study explored alternate disposal methods for dredged materials which minimize environmental damage and maximize environmental benefits.

The project involved mapping the ecological, geologi-



**Caption:** USACE Dredging Operations

cal, physical and maritime heritage attributes of the area inland of the Rodanthe Channel; designing dredge material deposition plans, designing an education campaign to inform local residents about the benefits of channel dredging, depositing material back

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## Recently Completed Research Projects (continued)

into the area; and ultimately developing a dredged material deposition site selection matrix.

Results from this project provide the Ferry Division with an improved understanding of the geological, ecological and anthropological factors affecting disposal of dredge material in shallow coastal waters.

Furthermore, disposal options for dredged materials will reduce manpower hours in eliminating transport to the inland disposal facility and reduce disposal facility costs.

### **RP2015-14** [A Study to Determine if the Biofuel Crop Camelina is a Wildlife Attractant](#)

North Carolina has 74 publicly-owned airports with state and federal grant funding available through NCDOT's Division of Aviation for planning, land acquisition and construction of runways, taxiways and aprons. Airport managers have significant annual operating costs tied to maintaining green space that can often exceed hundreds of acres. Turf grass mowing operations generate recurring costs including labor, fuel and capital expenditures. This study examined the option of modifying the land use around airports to support the production of oilseeds and other biomass crops for the potential use as a fuel resource. In addition, the possibility of bird strikes and other animals entering the runway space was assessed.

Researchers at N.C. State University partnered with the U.S. Department of Agriculture (USDA) to assess the potential of growing biofuel crops at local airports and the wildlife intrusion implications of modifying airport land use.

Camelina (a short seasoned, fast growing plant with oily seeds) was grown at three regional airports: Person County, Johnston County and Kinston airports. Camelina varieties were identified that were best suited

for our climate and the study aided in determining best growing practices. The USDA performed bird and mammalian surveys at all three airports to observe the attractant value of camelina to wildlife in differing growth phases over time.

Results from this study will allow airport managers and the Division of Aviation to make informed decisions about their facility's resources and optimize activities to reduce operational costs while ensuring airport runway safety. A second phase of the project is set to begin in August, 2017 to further optimize biofuel growth and production parameters and increase knowledge of possible wildlife attractant values to assure the safety of aircraft.



**Caption:** Camelina at Person County Airport

### **RP 2016-07** [The Use of Fiber Reinforcement in Latex Modified Concrete Overlay](#)

Due to the requirement of rapid reopening and resuming traffic in highways, concrete materials produced with rapid-setting cement are often used by state Departments of Transportation (DOTs) for patching or overlaying bridge decks. Very often, micronized latex polymer is added to reduce the ingress of moisture and deicing salts, potentially increasing the service life of the bridge deck. The use of such rapid-setting materials in some instances has been noted by various DOTs to exhibit cracking soon after opening the road to traffic.

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## Recently Completed Research Projects (continued)

However, the early-age behavior of this material has not been well studied in the laboratory or construction environments, and the causation of some of the observed cracking is not well understood. It has been suggested by the North Carolina Department of Transportation (NCDOT) and others that the use of non-metallic fiber reinforcement could mitigate cracking in plastic or hardened states.

This project investigated potential reasons for cracking in deck overlays, and further studied whether non-metallic fiber reinforcement can be used to reduce crack width in rapid-set latex modified concrete overlays. A state-of-the-art literature review was provided, current construction practices were evaluated, and an extensive experimental program was executed. In the experimental program, tests were conducted to evaluate plastic shrinkage cracking, restrained shrinkage cracking, cement hydration kinetics, effects of curing conditions, and the behavior of large-scale restrained shrinkage slabs.



**Caption:** Latex Modified Concrete Overlay during the casting.

states. These construction processes included i) uncontrolled spraying of water on unfinished and finished concrete, ii) ad-hoc addition of water at the volumetric mixer, iii) placing (and finishing) of fresh concrete over a wetted and finished surface, and iv) excessive vibration of the bridge deck due to traffic.

Results from the experimental program indicate that, due to the expansive nature of rapid setting cement used in this research, restrained shrinkage cracking is not the primary cause of cracking in rapid-setting latex modified concrete overlays. Experimental investigations also confirmed that plastic shrinkage cracking is not a contributing factor to cracking of the material since, when proper mixture proportioning and placement processes is used, a meniscus does not form at the surface.

Potential sources of cracking were concluded to result from i) over-finishing in the plastic state, ii) using non-saturated or non-rewetted burlap during curing, iii) temperature effects in large geometries due to the high heat of hydration, iv) settlement cracking during rapid hardening, v) other uncontrolled construction procedures, and vi) excessive vibration of the bridge deck during or shortly after placement. Since plastic and restrained shrinkage cracking did not occur in the materials, the use of fiber reinforcement was deemed unnecessary and is not required. However, the use of fiber reinforcement to mitigate cracking due to settlement, improper finishing and curing procedures, and temperature effects may be effective but requires further investigation.

While evaluating current construction practices, some undesirable field processes were observed that may increase the potential for cracking in plastic and hardened

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## Recently Completed Research Projects (conclusion)

### RP2013-16 [Vegetation Management Practices and Cost Effectiveness on North Carolina Roadsides](#)

The Roadside Environmental Unit is tasked with implementing NCDOT's integrated vegetation management (IVM) program to ensure public safety and provide aesthetically pleasing views to the traveling public. This study was conducted to evaluate current and proposed vegetation management techniques



**Caption:** Vegetation Management under desirable pine trees



**Caption:** Baccharis treated with herbicides

to improve IVM practices on NC roadsides.

The researchers evaluated numerous herbicide treatment practices focusing specifically on: 1) vegetation management under desirable pine trees, 2) general



**Caption :** General brush control following cut and mulch



**Caption:** Boomless Nozzle Spray Trial

brush control following cut and mulch operations, 3) Baccharis (a fall flowering shrub), 4) pine control (vegetated areas adjacent to interchanges), and 5) woody defoliation.

Results indicated herbicide treatments under desirable pine trees provide up to 95% control of unwanted vegetation.

Results from this study will be used by the Roadside Environmental Unit to improve IVM programs and reduce roadside vegetation management expenses while providing safe conduits for the motorists traveling on NC roadways. In addition, results indicated it is critical NCDOT divisions utilize IVM programs within specified time frames to maintain effective vegetation management practices on roadsides.



By Lamara Williams-Jones, Research Librarian

## From the Archives



**Caption:** This is a view of early morning congestion on the southbound lane of Downtown Boulevard in Raleigh taken on a weekday morning at 8:15 from a point just south of Fairview Road intersection.

From May-June, 1958 *North Carolina Roadways Magazine*

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## Library Notes

- Come across a resource you need that's not available in our [Online Catalog](#)? I may be able to get the item for you via Interlibrary Loan at minimal or no cost to you.
- Contact the NCDOT Librarian, [Lamara Williams-Jones](#), for assistance: 919-508-1820, Monday through Friday from 8:30 to 4:30. Since there is only one Librarian, customers should call before visiting the Library.

# New Publications from Transportation Research Board

## **Green Stormwater Infrastructure-[Volume 1: Primer & Volume 2: Guidebook: Airport Cooperative Research Program \(ACRP\) Report 174](#)**

This report defines and discusses green stormwater infrastructure (GSI) management strategies, a relatively new approach to regulation compliance. As more airports are proactively incorporating sustainable practices in all aspects of their operations, federal and state regulatory agencies are also promoting GSI strategies to comply with water regulations and requirements. Volume 1: Primer is written for the airport manager, planner, and engineer seeking to understand stormwater management and how GSI can comply with regulatory standards and requirements along with other benefits. Volume 2: Guidebook has assists airport staff with evaluating the applicability of a GSI strategy and how to select an appropriate GSI strategy.

## **[Guide for Integrating Goods and Services Movement by Commercial Vehicles in Smart Growth Environments: National Cooperative Highway Research Program \(NCHRP\) Report 844](#)**

This report describes policy, planning, design, and operations practices considering the coexistence of moving goods and services in smart growth environments at both the design and implementation stages as well as retroactively improving existing conditions. This report will help readers understand common issues and conflicts pertaining to

smart growth, how those issues and conflicts manifest themselves in different environments, and the types of strategies and actions stakeholders can take to better integrate goods and services movement by commercial vehicles in smart growth environments.

## **[Highway Worker Safety: National Cooperative Highway Research Program \(NCHRP\) Synthesis 509](#)**

This synthesis identifies how state departments of transportation (DOTs) implement policies using highway worker safety and health data to reduce injuries and manage risk. The report is a synthesis of current proactive safety practices that will be useful when developing or updating policies, programs, or tools to minimize injuries, fatalities, and risk. The study also identifies gaps in knowledge and future research needs.

**Please note:** The National Academies Press; publisher of TRB publications now requires an email before downloading some publications to view. An account with [My NAP](#) is encouraged.

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Many more publication links can be found on [NCDOT's TRB News Feed](#)

### Calendar of Events 2017

#### June 2017

- NC DOT Board of Transportation Meeting, June 28-29 2017

#### July 2017

- AASHTO Research Advisory Committee Meeting, July 24-27 2017, Louisville, KY

#### August 2017

- NC DOT Board of Transportation Meeting, August 2-3 2017



## NCDOT Research and Development Unit General Information

### How to find us:

We are located at 104 Fayetteville Street, Raleigh, in the Transportation Technology Center (formerly The Raney Building).

The Research & Development [web page](#) contains more information about the Unit and what we do.

The Research Library's [catalog](#) is also available on the web.

### NCDOT RESEARCH AND DEVELOPMENT

The Research & Development Unit oversees transportation-related research that investigates materials, operations, planning, traffic and safety, structures, human environments, natural environments, and more. Please contact one of our engineers listed on this page if you have questions.

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RESEARCH & DEVELOPMENT