



Research Ideas Needed by July 15, 2016

Thanks to active participation from NCDOT staff and our Research Community, the FY2017 Research Program will launch on August 1, 2016. The program includes twenty-seven (27) new projects of transportation related research ranging from automated Personal Rapid Transit technologies to supporting North Carolina agriculture by planting roadside pollinator crops as part of the wildflower program to improving our ability to test in situ pavements.

R&D is now soliciting your new ideas for research topics for the FY2017 program. Nearly every aspect of the Department’s business is eligible for research funding. Whether it is pavement, structures, planning, funding analysis, safety, mobility, transit, environment or hydraulics, your ideas can be turned into a research project. We are looking for projects that can become working solutions for NCDOT.

The Research Need Statement is available on the R&D Connect page and is designed to help employees with an idea 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 all of 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 don’t know how to get it down on paper, 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 15, 2016.**

Neil Mastin
Research & Development Unit Manager



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# Ecology of *Corynorhinus townsendii virginianus* in North Carolina

[Research Project No. 2013-33](#) Researcher: Joy O'Keefe, Assistant Professor, Department of Biology Director, Center for Bat Research, Outreach, and Conservation Indiana State University

John W. Kirby



**Picture:** Virginia Big Eared Bat roost, installing radio transmitters and collecting roost data by ISU graduate student Joey Weber

## Background:

The North Carolina Department of Transportation (NCDOT) has several State Transportation Improvement Projects (STIP) scheduled in Avery, Caldwell and Watauga counties. At the intersection of these three counties is the primary winter roost site of an endangered bat species, the Virginia big-eared bat (VABEB), *Corynorhinus townsendii virginianus*. The species has a very limited range in the eastern U.S., and very little was known about it. Only 12,000 to 20,000 Virginia big-eared bats remain in NC., TN., WV, VA and KY. These docile animals provide a valuable service by eating many harmful insects on their nightly excursions. The major causes of the species' decline are loss of habitat, vandalism, and increased human visitation to maternity roosts and hibernacula. Virginia big-eared bats are extremely sensitive to human disturbance. Even slight disturbances can cause

adults to abandon caves, abandon young, and force bats to use valuable energy reserves needed to survive hibernation. As a result, anticipating whether the effects of NCDOT highway and bridge projects by the presence of this species were impossible. STIP projects are proposed in the three counties within ten miles of known VABEB occurrences, a distance that bats can easily fly in one night. The most notable of the STIP projects occurring near the VABEB roost is STIP R-2566, the proposed widening of N.C. 105 in Watauga county.

## Specific Research Objective:

Virginia big-eared bats are extremely difficult to capture with nets. Although the bats were known to be in the vicinity of STIP R-2566, two summers of mist-netting survey work by NCDOT staff had not produced any data about the species. U.S. Fish and Wildlife Service staff

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# Ecology of *Corynorhinus townsendii virginianus* in North Carolina

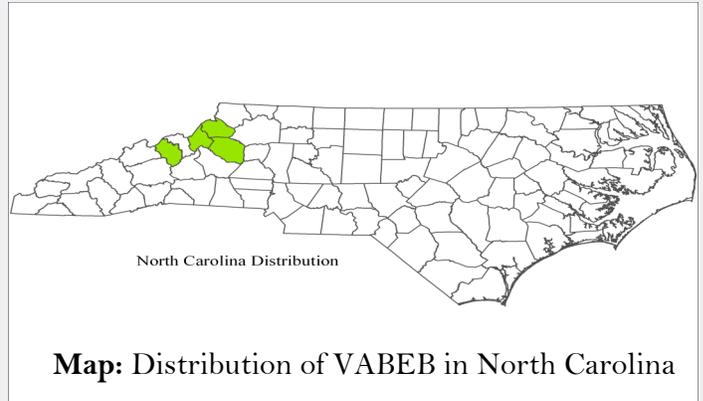
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stated that more information must be collected on the VABEB before formal consultation under the Endangered Species Act could occur. *The project could not proceed until more information was obtained.*

## What research work was done?

NCDOT contracted with researchers at Indiana State University's Center for Bat Outreach, Research and Conservation. Graduate student Joey Weber and other researchers used advanced radio telemetry techniques to discover more about the migration routes and foraging areas used by these bats. Cave entrances were monitored with acoustics and night time emergence counts were recorded. Contact was established with approximately 20 private property owners to gain property access to bat roosts and foraging telemetry stations. Telemetry towers with data loggers were installed near North Carolina's Grandfather Mountain, including 5 points along N.C. 105. Tiny radio transmitters were attached to the backs of captured bats. Weber captured 42 bats in caves on Grandfather Mountain and other springtime roosts, attaching tiny radio transmitters to their backs. Researchers tracked the bats to caves at the base of Beech Mountain, North Carolina, eight miles away and to 31 additional roosts. This is the first time maternity roosts have been found in North Carolina. One transmitter was found in scat after the bat ran afoul of an owl and another was tracked to the basement of an unfinished house in a nearby golf course community. In addition, the researchers developed conservation outreach materials for the general public and private land owners affected by the VABEB.



## Impact, or Potential Impact, of Implementing Research Results :

The research provided NCDOT with essential data for writing Biological Assessments as mandated under the Endangered Species Act to determine the effects on STIP R-2566 and other STIP projects, and developed potential conservation measures for VABEBs. In addition, it provided the US Fish and Wildlife Service with the necessary data to produce Biological Opinions necessary to allow STIP projects to proceed.

## Benefits of Research Results :

The data collected eliminated uncertainties about the STIP projects in Watauga, Avery and portions of Caldwell counties, allowing the project to proceed on schedule and in a timely manner. It also allowed NCDOT to anticipate what mitigation measures may be needed for upcoming projects. The location of maternity roosts for the population of VABEBs hibernating on Grandfather Mountain was unknown at the start of project. This research provided this information and allowed for protection of these important natural resources through state, federal and private conservation partnerships.

# In-Situ Determination of Emulsion Application Rate for Tack Coats and Surface Treatments

Research Project No. 2014-03 Researcher: Cassie A. Castorena, Assistant Professor, Department of Civil, Construction, and Environmental Engineering, North Carolina State University

Mustan Kadibhai

AASHTO High Value Research Award Winner

## Background:

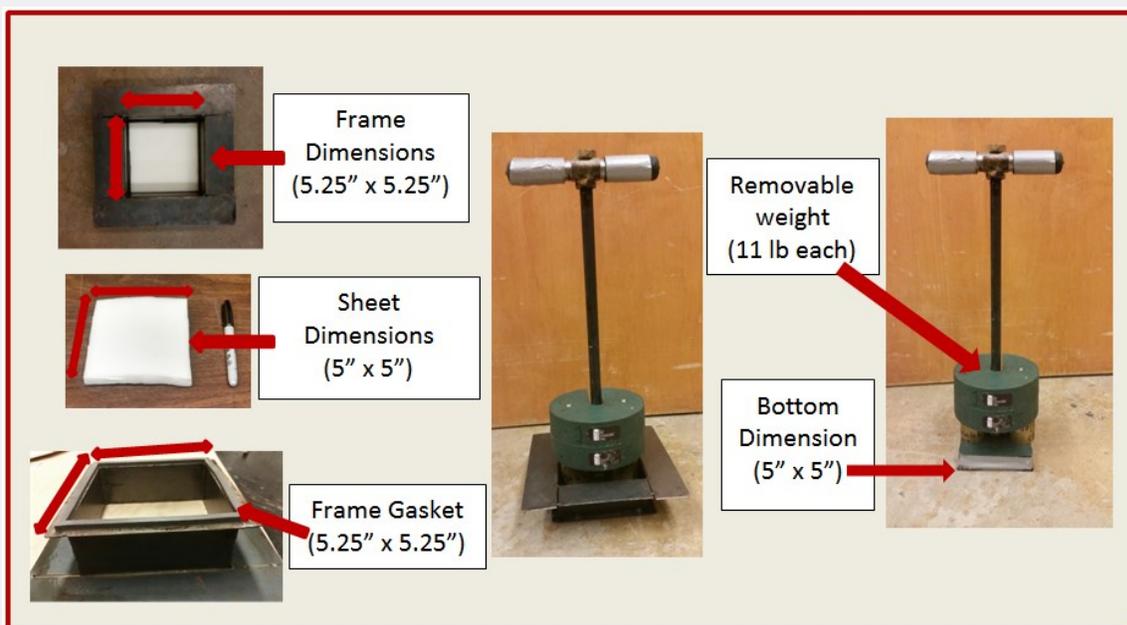
Emulsions are used as tack coats to bond asphalt concrete layers and as a bonding agent for aggregates in chip seals. The rate of emulsion application is critical to the performance of both tack coats and chip seals. It has been demonstrated that field emulsion application rates (EARs) can be highly variable. Emulsion application can vary transversely across a pavement due to variability in emulsion output and fan patterns among distributor nozzles. Emulsion application can also vary longitudinally along the length of paving as a result of fluctuations in distributor speed and flow rates. In addition, the existing paving surface will absorb a fraction of emulsion applied which will be unavailable to act as a bonding agent for

aggregate or asphalt concrete placed on top of the emulsion.

Thus, it is important to differentiate between total EAR and “effective” EAR available for bonding. The importance of surface absorption is considered in many tack coat and chip seal design methods. However, specified adjustments to EARs to account for surface absorption lack experimental or theoretical basis. Existing methods for quality control (QC) of EAR are very limited. The only standardized test procedure is ASTM D 2995, which targets calibration rather than in-situ measurements and does not allow for capture of the effective EAR.

## Specific Research Objective:

1. To identify issues in determining EARs in the field.
2. To develop a recommended field test for determination of EARs at specific locations along a roadway for QC purposes

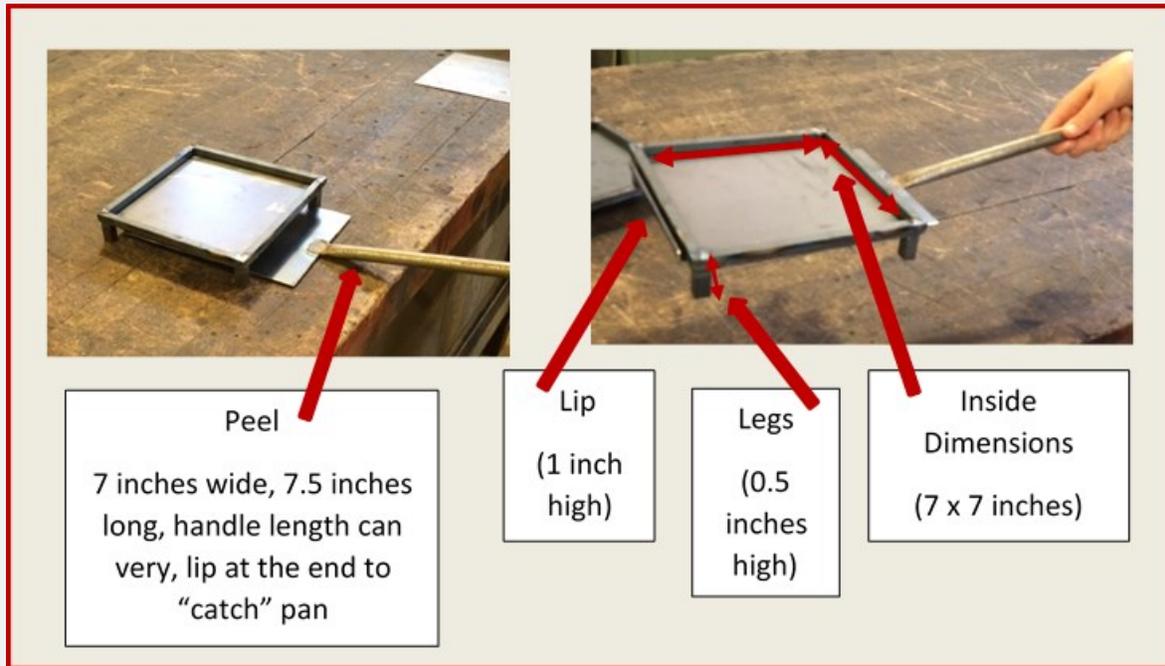


Picture: Tack Lifter components

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## In-Situ Determination of Emulsion Application Rate for Tack Coats and Surface Treatments (continued)

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**Picture:** Elevated plate components

### What research work was done?

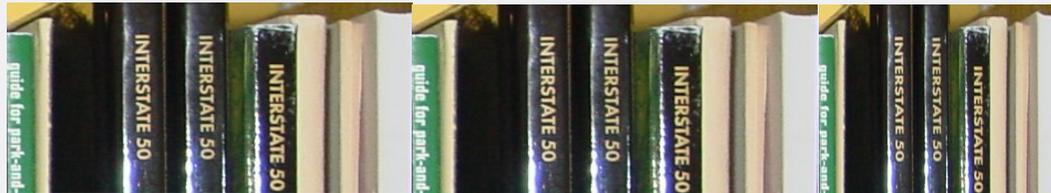
A literature review was conducted to identify existing test methods for QC of EARs, sources of variability in the EAR, and issues in determining EARs in the field. The Tack Lifter was developed as a simple and efficient means for in-situ measurements of applied EAR and effective EAR, neglecting emulsion absorbed by the paving surface to improve QC measures. The Tack Lifter consists of a weight device, frame, and absorbent sheet. Following emulsion application by a distributor, the frame is applied to the surface of interest to seal the test area. The absorbent sheet is inserted into the frame and the weighted device is applied. Emulsion is absorbed into the sheet. The weight of emulsion combined with the sheet area is used to obtain a spot check of EAR. Tests can be applied directly to the paving surface to provide a measure of effective EAR.

Alternatively, tests can be applied to pans placed on the paving surface prior to emulsion application to provide a measure of the applied EAR. The difference between applied and effective EARs measured by the Tack Lifter allows for quantifying the rate by which a pavement absorbs applied emulsion. Comprehensive laboratory and field experiments were conducted to develop and evaluate the use of the Tack Lifter for QC of EAR. In addition, ASTM D 2995 was evaluated.

### Impact, or Potential Impact, of Implementing Research Results :

A proposed practice for QC of EARs was developed. The practice includes three test procedures:

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Lamara Williams-Jones, Research Librarian

### Did You Know?

“Fun and interesting fact about Transportation in North Carolina”

The North Carolina Department of Transportation [Wildflower Program](#) began in 1985 as an integral part of highway beautification. Wildflower beds are installed and maintained across the state by Roadside Environmental personnel in each of the fourteen highway divisions.



### 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 (see contact information below).
- 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.

Oak Island Bridge

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### In-Situ Determination...(conclusion)

1. ASTM D 2995 Test Method B for QC of transverse variability in the applied EAR.
2. Tack Lifter tests applied in the wheel path to flat, steel pans and the paving surface on a test pavement section to quantify the rate by which the pavement absorbs emulsion and correspondingly, guide adjustment of the target EAR,
3. Tack Lifter tests conducted on elevated plates following removal from the roadway for QC of longitudinal variability in the applied EAR.

#### Benefits of Research Results

- Application of optimal Tack Coat EAR can save pavement from premature failure that occurs due to a variety of distresses, including slippage cracking, top-down cracking, premature fatigue

cracking, pothole development, and complete delamination. Excessive EARs cause slippage and delamination whereas insufficient EARs can lead to lack of adhesion between layers.

- Application of optimal Chip Seal EAR can save the surface treatment from bleeding and aggregate loss. Excessive emulsion application causes bleeding which diminishes skid resistance. Insufficient emulsion application leads to aggregate loss which often results in windshield damage.
- The research product resulted in improved QC of EAR.
- Improved QC of EARs will lead to prolonged pavement service life, decreased life cycle costs, and enhanced safety.

## New Publications from Transportation Research Board

### [Guidelines for Certification and Management of Flexible Rockfall Protection Systems](#): National Cooperative Highway Research Program (NCHRP) 823

This report provides advice on rockfall fence systems for transportation agencies. It also outlines data that are needed to evaluate the results of rockfall fence systems tested using the procedure recommended for acceptance.

### [Life-Cycle Cost Analysis for Management of Highway Assets](#): National Cooperative Highway Research Program (NCHRP) Synthesis 494

This synthesis documents the state of the practice of life-cycle cost analysis (LCCA) and risk-based analysis into state highway agencies' asset management plans for pavements and bridges on the National Highway System.

### [Practices for High-Tension Cable Barriers](#): National Cooperative Highway Research Program (NCHRP) Synthesis 493

Practices for High-Tension Cable Barriers reports on the current state of the practice for high-tension cable barriers (HTCB) used in the medians of access-controlled roadways in the United States.

### [Protection of Transportation Infrastructure from Cyber Attacks](#): A Primer: Web-Only Document 221

This primer provides transportation organizations with reference materials concerning cybersecurity concepts, guidelines, definitions, and standards. The primer is a joint product of two TRB Cooperative Research Programs and delivers strategic, management, and planning information associated with cybersecurity and its applicability to transit and state DOT operations

### [Transformational Technologies in Transportation: State of the Activities](#) :TRB's Transportation Research E-Circular 208

This Circular explores the status and applications of transportation goods, services, and systems that fall under the umbrella of transformational technology. Key transformational technologies include connected and automated vehicles, including shared use services; unmanned aerial systems (drones); Internet of Things (including smart cities); and cybersecurity.

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

### Calendar of Events 2016

#### June 2016

- NC DOT Board of Transportation Meeting, June 29-30, 2016

#### July 2016

- Deadline to submit ideas for FY2017 Research Program , July 15, 2016

#### August 2016

- NC DOT Board of Transportation Meeting, August 3-4, 2016



## 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