

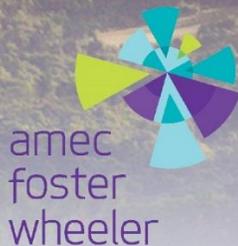


TRB Committees on Resource Conservation and Recovery and Geo-Environmental Processes

2016 Summer Workshop | July 26-29

Asheville, North Carolina

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TRB 2016 Summer Workshop

Sponsored by TRB Committees
ADC60 Resource Conservation and Recovery
AFP40 Geo-Environmental Processes

Hosted by
North Carolina Department of Transportation

Program & Abstracts

July 26 - 29, 2016
Asheville, North Carolina

Edited by
Shunyi Chris Chen, PhD, PE, NCDOT
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Emily Jones & Billy Barrier, NCDOT

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TRB 2016 Summer Workshop

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TRB 2016 Summer Workshop

Main Topics

- Recycle, Reuse, Repurpose, Regenerate
- Waste Management
- Contaminated Site Assessment
- Environmental Liability Management
- Environmental Management Systems
- Transportation Infrastructure, Facilities, and Right of Ways as Sustainable Resources
- Stormwater Management
- Resource Efficiency
- Sustainability
- Recovery and Resiliency
- Renewable Energy
- Climate Adaptation
- Green Infrastructure
- Sustainable Accounting Standards

Workshop Planning Committee

Name	Affiliation
Cyrus Parker, Chair	North Carolina Department of Transportation
Andrew Graettinger	University of Alabama
Andy Alden	Virginia Tech Transportation Institute
Angela Pakes Ahlman	University of Wisconsin
Angelo Elmi	NYC Transit
Antoinette Quagliata	USDOT Federal Transit
Art Hirsch	TerraLogic
Burak Tanyu	George Mason University
Carson Poe	US DOT Volpe Center
S. Chris Chen	North Carolina Department of Transportation
Cris Liban	LA Metro
David Wilson	Virginia Department of Transportation
Denise Ferguson	Law Office of Denise R. Ferguson, LLC
Dennis Li	North Carolina Department of Transportation
Diane Anderson	APEX Companies
Gordon Box	North Carolina Department of Transportation
Helen Corley	Amec Foster Wheeler
Jennie Armstrong	Formerly Oregon Department of Transportation
Jim Heeren	Dewberry
Joshua Proudfoot	Good Company
Joyce Rebar	Maryland Transportation Authority
Kenneth Thronton	Dewberry
Mark Warren	NYC Transit
Robin Maycock	North Carolina Department of Transportation
S. Babusukumar (Babu)	Weston
Steve Eget	Dewberry
Steve Gobelman	Andrews Engineering
Tom Lewis	Louis Berger
Xianming Shi	Washington State University

TRB ADC60 Resource Conservation and Recovery Committee

Name	Affiliation
Jennie Armstrong, Chair	Formerly Oregon Department of Transportation
Cyrus Parker, Vice-Chair	North Carolina Department of Transportation
Andrew Graettinger	University of Alabama
Andrew Alden	Virginia Tech Transportation Institute
Angela Pakes Ahlman	Wisconsin Highway Research Program
Angelo Elmi	Metropolitan Transportation Authority of NYC
Antoinette Quagliata	Federal Transit Administration
Art Hirsch	TerraLogic, LLC
Brendon Bailey	Center for Toxicology and Environmental Health
Carson Poe	Volpe National Transportation Research Center
David Wilson	Virginia Department of Transportation
Denise Ferguson	Law Office of Denise R. Ferguson, LLC
Emmanuel (Cris) Liban	Los Angeles County Metropolitan Transportation Authority
Eric Schmidley	Leidos, Inc.
John Schert	University of Florida
Joshua Proudfoot	Good Company
Joyce Rebar	Maryland Department of Transportation
Kenneth Thornton	Dewberry
Mark Warren	MTA New York City Transit
Nicole Villamizar	U.S. Environmental Protection Agency
Sinnadurai Babusukumar	Weston Solutions, Inc.
Steven Gobelman	Andrews Engineering, Inc.
Thomas Lewis	Louis Berger

TRB AFP40 Geo-Environmental Processes Committee

Name	Affiliation
Burak Tanyu, Chair	George Mason University
Lin Li, Vice-Chair	Jackson State University
Bora Cetin	Iowa State University
Ali Soleimanbeigi	University of Wisconsin, Madison
Angelica Palomino	University of Tennessee, Knoxville
Brina Montoya	North Carolina State University
Cyrus Parker	North Carolina Department of Transportation
D. Stephen Lane	Virginia Transportation Research Council
Eric Dougherty	Maryland State Highway Administration
Guney Olgun	Virginia Tech Transportation Institute
Guoping Zhang	University of Massachusetts, Amherst
Kolawole Osinubi	Ahmadu Bello University
Ming Xiao	Pennsylvania State University
Ming Zhu	GeoSyntec Consultants
Sionel Arocho Meaux	University of Puerto Rico, Mayaguez
Stephen Farrington	Transcend Engineering
Takeshi Katsumi	Kyoto University
Vincent Ogunro	University of North Carolina, Charlotte
Xianming Shi	Washington State University
Yucel Guney	Anadolu University
Zhen Liu	Michigan Technological University



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Updated July 18, 2016

Tuesday, July 26, 2016

08:30 am – 01:15 pm **Field Trip – Biltmore Sustainability Tour**
Biltmore Estate, Asheville, NC
Limited to 48 people
(Bus Departs the Hotel Lobby at 8:00am)

01:00 pm – 05:30 pm **Registration Open**

01:00 pm – 09:00 pm **Sponsor Exhibits Set Up** (Grand Ballroom A and B)

03:00 pm – 05:00 pm **ADC 60 Committee Business Meeting, Open to Members and Non-Members**
(The Collider)
1 Haywood Street, Suite 401, Asheville www.thecollider.org

06:00 pm – 08:00 pm **Ice Breaker Reception** (Renaissance Ballroom & Patio)
Hors d'oeuvres provided

Wednesday, July 27, 2016

07:00 am – 08:00 am **Registration and Breakfast**

08:00 am – 10:00 am Session 1 – Welcome and Keynotes (Grand Ballroom C)

- Moderator: Jennie Armstrong, Chair, TRB ADC60
- 1-1 **Welcome**
Cyrus Parker, North Carolina Department of Transportation
Jennie Armstrong, Chair, TRB ADC60
 - 1-2 **Opening Remarks**
Michael Culp, FHWA Sustainable Transport and Climate Change Team Leader
 - 1-3 **Implications for Big Data at NOAA's National Centers for Environmental Information**
Tim Owen, NOAA
 - 1-4 **The Implications of the Internet of Things for Public Infrastructure**
Peter Williams, IBM
 - 1-5 **BMW Sustainability & Waste to Energy Initiative**
Cleveland Beaufort, BMW

10:00 am – 10:30 am **Refreshment Break – Exhibit Area**



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Wednesday, July 27, 2016

10:30 am – 12:00 pm Session 2A – Site Investigation and Waste Management (Grand Ballroom C)

- Moderator: Helen Corley, Amec Foster Wheeler
- 2A-1 **QED UVF Forensics for Petroleum Hydrocarbons**
Felecia Owen, RED LAB
 - 2A-2 **Managing Contaminated Right of Way During New Road Construction**
Ben Ashba, Catlin Engineers and Scientists
 - 2A-3 **Applications of Geophysical Methods in Transportation Related Projects**
Scott Carney, GEL Geophysics
 - 2A-4 **Balancing Data Needs in Conceptual Site Models**
Beau Hodge, Geosyntec Consultants of NC, PC

10:30 am – 12:00 pm Session 2B – Technological Approach to Resource Conservation (Windsor Ballroom)

- Moderator: Joyce Rebar, Maryland Transportation Authority
- 2B-1 **PENNDOT Strategic Recycling Program: A Journey through the Years**
Winnie Okello, Pennsylvania Department of Transportation
 - 2B-2 **North Carolina Department of Environmental Quality, Division of Waste Management GIS Data Resources and Applications**
Dean Grantham, Jr., North Carolina Department of Environmental Quality
 - 2B-3 **Leveraging Cross-Sector Investment towards a Sustainable Resiliency Portfolio**
Niek Veraart, Louis Berger Group
 - 2B-4 **Life Cycle Benefits of Using Recycled Materials in Transportation Infrastructure**
Angela Pakes Ahlman, Recycled Materials Resource Center (RMRC)

12:00 pm – 01:00 pm Lunch – Provided

01:00 pm – 02:30 pm Session 3A – Recycled Concrete Materials (Windsor Ballroom)

- Moderator: Angela Pakes Ahlman, University of Wisconsin - Madison
- 3A-1 **Characterization of High pH Leachate Produced from Recycled Concrete Aggregate**
Jiannan (Nick) Chen, University of Wisconsin - Madison
 - 3A-2 **Contribution of Fine and Coarse Fractions of Recycled Concrete Aggregate to Tufa Precipitate Formation**
Aiyoub Abbaspour, George Mason University
 - 3A-3 **Cost Factors Influencing Recycling and Reuse of Concrete Residuals in North Carolina**
Nicholas Tymvios, University of North Carolina Charlotte
 - 3A-4 **Characterization and Land Application of Hydrodemolition and Diamond Grinding Slurries in NC**
Dan Line, North Carolina State University



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01:00 pm – 02:30 pm Session 3B – Remediation and Exposure Management (Grand Ballroom C)

- Moderator: John Stewart, ECS Carolinas
- 3B-1 **Initial Exposure Determinations for Airborne Contaminants during Rehabilitation of the Portsmouth Downtown Tunnels**
Chad Smith, EEE Consulting, Inc.
 - 3B-2 **Assessment and Clean-Up of Lead Contamination at DOT Equipment Yard**
Michael Branson, Solutions-IES, Inc.
 - 3B-3 **Assessing Remediation Effectiveness and Sustainability of a 20-Year Remediation System: Circuit Boards to Shopping Mall**
Sheri Knox, Amec Foster Wheeler
 - 3B-4 **Generation of In Situ Biodegradation-Sorption Barriers for Munitions Constituents**
Bilgen Yuncu, Solutions-IES, Inc.

02:30 pm – 03:00 pm Refreshment Break – Exhibit Area

03:00 pm – 05:00 pm Session 4A – Implementation of Sustainability in Transportation Infrastructure (Windsor Ballroom)

- Moderator: Bora Cetin, Iowa State University and Vincent Ogunro, University of North Carolina-Charlotte
- 4A-1 **Beneficial Reuse of Coal Ash in North Carolina**
John L. Daniels, University of North Carolina Charlotte
Ellen Lorscheider, North Carolina Department of Environmental Quality
 - 4A-2 **The Future for Coal Combustion Products**
Thomas Adams, American Coal Ash Association
 - 4A-3 **Stabilization of Expansive Subgrade Soil with Chemical Additives**
Bora Cetin, Iowa State University
 - 4A-4 **Use of Reclaimed Asphalt Pavement (RAP) in Unbound Base Aggregate for Sustainable Road Construction**
Saad Ullah, George Mason University
 - 4A-5 **Sustainable Use of Quarry By Products and Fine Materials**
Kevin Vaughan, Vulcan Materials Company
 - 4A-6 **Mining Byproducts and Recycled Materials for Better Roads and Road Repairs**
Lawrence Zanko and Sara Post, University of Minnesota Duluth
 - 4A-7 **Nanosopic Phase Contrast and Mechanistic Properties of Waste Automobile Tires Modified Asphalts**
Zahid Hossain, Arkansas State University



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03:00 pm – 05:00 pm Session 4B – Environmental Management Systems (Grand Ballroom C)

- Moderator: Xianming Shi, Washington State University
- 4B-1 **Implementing the new ISO 14001:2015 Standard for Transportation Agencies**
Peter Hall, Amec Foster Wheeler
 - 4B-2 **Using Management System Concepts to Achieve Adaptation**
Elizabeth Delaney, First Environment, Inc.
 - 4B-3 **Water Efficiency Management Program Guidebook**
James Jolley, The Cadmus Group, Inc.
 - 4B-4 **Measuring Sustainability at Mother Clara Hale Bus Depot**
Steven Eget, Dewberry
 - 4B-5 **Building a Strong and Award Worthy Environmental Management System**
Carissa Agnese, Skanska

Wednesday, July 27, 2016 Banquet Dinner

06:00 pm – 09:00 pm **Banquet Dinner at New Belgium Brewery Brownfield Site**
New Belgium Brewery, Asheville, NC
(Shuttles Begin Departing Hotel Lobby at 5:45 pm)

Presentation: Redevelopment of an Underutilized Warehouse District into a LEED Certified, State of the Art Brewery
Susanne Hackett, New Belgium Brewery

Thursday, July 28, 2016

07:30 am – 08:30 am **Breakfast**

08:30 am – 10:00 am Session 5A – Beneficial Uses of Transportation Corridors (Windsor Ballroom)

- Moderator: Andy Alden, Virginia Tech Transportation Institute
- 5A-1 **Retention and Infiltration: Balancing Plant Growth and Function using Alternative Media for Bio-Retention Systems**
Debbie Stringer, Carolina Stalite Company
 - 5A-2 **Hybrid Energy Harvesting and Sensing System For The Next Generation Smart Transportation Infrastructures**
Samer Dessouky, University of Texas at San Antonio
 - 5A-3 **Pollinator Habitats and Highways**
David Harris, North Carolina Department of Transportation
 - 5A-4 **The City of Asheville's Edible Mile**
Amber Weaver, City of Asheville



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Thursday, July 28, 2016

08:30 am – 10:00 am Session 5B –Panel Discussion (Grand Ballroom C) Reuse of Contaminated Media

- Moderator: David Wilson, Virginia Department of Transportation
- 5B-1 **Risk-based methodology as it applies to petroleum contaminated sites, the ESPCSR program and the various disposal and remediation options available for petroleum contaminated soil in the State of North Carolina**
Jeremy Poplawski, North Carolina Department of Environmental Quality
- 5B-2 **Discussion of the Virginia Department of Environmental Quality Management and Reuse of Contaminated Media State-wide Variance Guidance**
Justin Williams, Virginia Department of Environmental Quality
- 5B-3 **Using a multiple-lines-of-evidence approach and the Virginia Department of Environmental Quality Management and Reuse of Contaminated Media Variance Guidance to evaluate the Reuse of TPH and Cadmium Soil in a Proposed Roadway Improvement Corridor**
Chris Lalli, EEE Consulting, Inc.
- 5B-4 **Panel Discussion**
Virginia Department of Environmental Quality and NC Department of Environmental Quality
Jeremy Poplawski, Justin Williams, Chris Lalli

10:00 am – 10:30 am Refreshment Break – Exhibit Area

10:30 am – 12:00 pm Session 6A – Sustainable North Carolina (Grand Ballroom C)

- Moderator: Benjamin Johnson, North Carolina Department of Transportation
- 6A-1 **Making North Carolina Department of Transportation More Sustainable Through Opportunities for Innovative Products and Technologies**
Natalie Roskam, North Carolina Department of Transportation
- 6A-2 **Sustainable Approach to Groundwater Remediation at Asphalt Testing Sites**
Thomas "Chris" Niver, North Carolina Department of Transportation
Matt Bramblett, Hart & Hickman
- 6A-3 **Bioremediation of an Asphalt Manufacturing Site**
Michael Jordan, Terracon
- 6A-4 **Sustainability at Biltmore**
Chuck Pickering, Biltmore

10:30 am – 12:00 pm Session 6B – Innovative Technologies and Strategies for Stormwater Management (Windsor Ballroom)

- Moderator: Matt Lauffer, North Carolina Department of Transportation
- 6B-1 **Roadside Retrofits for Bacteria Reduction**
Hunter Freeman, WithersRavenel
- 6B-2 **Route 9 Drainage Improvements – Pervious Asphalt**
Michael Sears, HNTB



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- 6B-3 **Research to Optimize the Nutrient Removal Performance of Storm water BMPs Within the Right-of-Way**
Brian Lipscomb, North Carolina Department of Transportation
- 6B-4 **Evaluation of the Effect of Highway and Bridge Facilities on Sediment Quality**
Chris Moody, The Intelligence Group

Thursday, July 28, 2016

12:00 pm – 01:30 pm **Lunch – Provided**

01:30 pm – 03:00 pm **Session 7A – Emerging Sustainable Concepts (Grand Ballroom C)**

- Moderator: Steven Eget, Dewberry
- 7A-1 **North Carolina Department of Transportation Resource Conservation: Where We Were, Where We Are, and Where We're Going**
Alyson Tamer, North Carolina Department of Transportation
 - 7A-2 **Utilization of Intrinsic Vehicle Sensors to Enhance Winter Maintenance Operations**
Cristian Druta, Virginia Tech Transp. Institute
 - 7A-3 **Related Global Trends: Smart/Resilient Mega-Cities, Sustainability and Big Data**
Thomas Lewis, Louis Berger Group
 - 7A-4 **Evaluation of Waste Concrete Road Materials for Use in Oyster Aquaculture**
Dong Hee Kang, Morgan State University

01:30 pm – 03:00 pm **Session 7B – Improving Your Stormwater Program's Triple Bottom Line (Windsor Ballroom)**

- Moderator: Andy McDaniel, North Carolina Department of Transportation
- 7B-1 **Reducing Storm water Infrastructure Costs through Better Soil Management**
Gary Gittere, North Carolina Composting Council
 - 7B-2 **Prioritizing BMP Maintenance by Utilizing a Ranking System**
Kathleen Cabe, EEE Consulting
 - 7B-3 **Using Research to Enhance North Carolina Department of Transportation's Highway Storm Water Program: An Overview**
Ryan Mullins, North Carolina Department of Transportation
Karthik Narayanaswamy, AECOM
 - 7B-4 **Maryland's Critical Area Program: Challenges and Opportunities of Implementing a Watershed Management Program, A State DOT's Perspective**
Ariene Metzbower, Maryland Department of Transportation

03:00 pm – 03:30 pm **Refreshment Break – Exhibit Area**



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Thursday, July 28, 2016

03:30 pm – 05:00 pm Session 8A – Improving Project Sustainability (Grand Ballroom C)

- Moderator: Diane Anderson, APEX Companies
- 8A-1 **Recycled Material Web Map: Connecting Consumers and Producers**
Brittany Shake, The University of Alabama
 - 8A-2 **Mobile to Real-Time Environmental Management Systems**
Frances Curtis, Apex Companies, LLC
 - 8A-3 **Green Bond Financing Opportunities for Transportation Projects**
Phillip Ludvigsen, First Environment, Inc.
 - 8A-4 **Forecasting Demand for Electric Bicycles and Their Sustainability Impacts: Case Study for a University Campus**
Michael Maness, Oak Ridge National Laboratories

03:30 pm – 05:00 pm Session 8B – Environmental Risk Management (Windsor Ballroom)

- Moderator: Robin Maycock, North Carolina Department of Transportation
- 8B-1 **Environmental Liability and Right of Way/Easement Acquisition – Martin Luther King Expressway Extension, Portsmouth, Virginia**
Douglas Fraser, EEE Consulting, Inc.
 - 8B-2 **A Practical Approach to Environmental Risk Prioritization**
Daniel Smith, Apex Companies, LLC
 - 8B-3 **North Carolina DEQ's Implementation of Risk-based Remediation**
Janet Macdonald, North Carolina Department of Environmental Quality
 - 8B-4 **Statistical Evaluation to Determine Background Metal Soil Concentrations**
Matt Jenny, Geosyntec; Gordon Box, North Carolina Department of Transportation

Thursday, July 28, 2016 Poster Session

07:30 am – 08:30 am **Breakfast**

08:30 am – 10:00 am Poster Session

- Moderator: Gordon Box, North Carolina Department of Transportation
- P-1 **Synergistic Approach to Processing Aggregate Fines and Coal Fly Ash for Beneficial Re-use**
Robert Mensah-Biney, North Carolina State Minerals Research Laboratory
 - P-2 **Environmentally Friendly Pervious Concrete with Fly ash as Sole Binder**
Gang Xu and Xianming Shi, Washington State University
 - P-3 **Blending Use – An Innovative Way to Fully Utilization of Nontraditional Materials or Byproducts**
George Wang, East Carolina University



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- P-4 **Compliance Analysis of CAFE and GHG Standards from Market Acceptance's Prospective**
Fei Xie, Oak Ridge National Laboratories
- P-5 **Modeling of Oxyanion Speciations Released from Geopolymer Using PHREEQC**
Sanusi et al., University of North Carolina Charlotte
- P-6 **A Dynamic Contact Angle Measurement Technique for Water Repellent Coal Fly Ash**
Jenberu Feyyisa and John Daniels, University of North Carolina Charlotte
- P-7 **Water Retention Characteristics of Compacted Coal Combustion Residuals from SE US Power Plants**
Livingstone Dumenu, Mehrab Moid, Carlos Rodriguez, Miguel A. Pando, Vincent Ogunro, and John Daniels, University of North Carolina Charlotte
- P-8 **Bio-based Renewable Additives for Anti-icing Applications**
Mehdi Honarvarnazari and Xianming Shi, Washington State University
- P-9 **Water Absorptivity and Permeability of High Volume Fly Ash Mortars with Various Chemical Admixtures**
Sen Du and Xianming Shi, Washington State University
Yong Ge, Harbin Institute of Technology

Friday, July 29, 2016

- 08:00 am – 02:00 pm **Field Trip – BMW Vehicle Manufacturing Sustainability Tour (Free)**
BMW Group, Greer, SC
Limited to 30 people
(Bus Departs Hotel Lobby at 8:00 am)

ABSTRACTS

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Session 1 – Welcome and Keynotes

- 1-1 **Welcome**
Cyrus Parker, NCDOT
Jennie Armstrong, Chair, TRB ADC60
- 1-2 **Opening Remark**
Michael Culp, FHWA
- 1-3 **Implications for Big Data at NOAA’s National Centers for Environmental Information**
Tim Owen, NOAA
- 1-4 **The Implications of the Internet of Things for Public Infrastructure**
Peter Williams, IBM
- 1-5 **BMW Sustainability & Waste to Energy Initiative**
Cleveland Beaufort, BMW

- 1-1 **Welcome**
Cyrus Parker, NCDOT
Jennie Armstrong, Chair, TRB ADC60



Cyrus Parker



Jennie Armstrong

- 1-2 **Opening Remark**
Michael Culp, FHWA



1-3 **Implications for Big Data at NOAA's National Centers for Environmental Information**
Tim Owen, NOAA



Leveraging environmental data and information to make specific, informed decisions is critical to the Nation's economy, environment, and public safety. The ability to successfully transform past and recent data into environmental intelligence is predicated on the articulation of use-inspired, actionable requirements for product and service development. With the formation of the National Centers for Environmental Information (NCEI), there is a unique opportunity to revolutionize the delivery of information services in support of customer requirements. Such delivery cuts across the disciplines of meteorology, geophysics, and oceanography, as well as regions and sectors for the United States.

At NCEI, information services are based on a two-way dialogue that (i) raises awareness of environmental data products and services and (ii) captures user needs for product and services sustainment and development. To this end, NCEI information services has developed a formal process for collecting user needs and translating them into requirements. This process reflects economically-prevalent and regionally-focused sectors based on Census Bureau classifications.

1-4 **The Implications of the Internet of Things for Public Infrastructure**
Peter Williams, IBM



Much has been written about the Internet of Things (IOT) and government - recently, for example, Gartner identified cities as the fastest growing users of IOT in any sector. The general impact of the IOT in enabling greater levels of control and optimization of infrastructure operations are somewhat understood, but the wider implications (both good and bad), for example, for how the public and businesses will use infrastructure, how once separate systems can now interact, and for privacy and security are often not fully grasped. This presentation will examine those implications.

1-5 **BMW Sustainability & Waste to Energy Initiative**
Cleveland Beaufort, BMW



Discuss BMW's Sustainability Strategy, Goals and Target with an emphasis on a Landfill Gas to Energy project that was developed, designed and installed at the BMW Manufacturing Facility in Greer, South Carolina. This sustainability project has proven to be very successful over a decade and economically advantageous for the company. Participants will be able to gain insights into BMW's Sustainability Strategy as well as the need for sustainable actions.

Session 2A – Site Investigation and Waste Management

- 2A-1 **QED UVF Forensics for Petroleum Hydrocarbons**
Felecia Owen, RED LAB
- 2A-2 **Managing Contaminated Right of Way During New Road Construction**
Ben Ashba, Catlin Engineers and Scientists
- 2A-3 **Applications of Geophysical Methods in Transportation Related Projects**
Scott Carney, GEL Geophysics
- 2A-4 **Balancing Data Needs in Conceptual Site Models**
Beau Hodge, Geosyntec Consultants of NC, PC

- 2A-1 **QED UVF Forensics for Petroleum Hydrocarbons**
Felecia Owen, RED LAB



QED UVF Forensic Petroleum Hydrocarbon Fingerprinting: This UVF method provides rapid determination between fresh releases, historical releases and background organics. **QED UVF Fingerprinting Background:** The QED UVF method enables the distinction between a wide range of petroleum hydrocarbon products and product degradation. Petroleum products have unique fluorescent patterns based on the type of petroleum present and the degree of degradation. The QED enables a visualization of weathered petroleum products as the carbon chains are degraded; this is how it distinguishes between fresh fuel and degraded fuel.

- 2A-2 **Managing Contaminated Right of Way During New Road Construction**
Ben Ashba, Catlin Engineers and Scientists



NCDOT was tasked with an urban widening project partially on new location. The project, identified as the 10th Street Connector, is located between the East Carolina University (ECU) main campus and the Vidant Medical Center/ECU Brody School of Medicine, west of Memorial Drive (NC 11) in Greenville, NC. Previous research conducted by CATLIN and other NCDOT GeoEnvironmental Section contractors identified 39 contaminated parcels in the 1.4 mile new roadway corridor. Contaminants included petroleum and solvent sources from known UST sites, dry cleaning facilities, and unknown sources. Construction activities include a bridge over an active CSX rail, an at grade Norfolk Southern rail crossing and a number of new subsurface utilities including large diameter storm sewer pipes installed through areas of hazardous and non-hazardous groundwater contamination. In order to assist the roadway construction contractor with necessary dewatering activities for utility installation within contaminant plumes, CATLIN and NCDOT obtained an expedited Individual National Pollutant Discharge Elimination System Permit for two 100 gallon per minute mobile groundwater treatment systems and an Administrative Agreement for discharge of untreated groundwater to the Greenville Utility Commission's sanitary sewer. The presentation will discuss soil and groundwater contamination management strategies, lessons learned and possible approaches for future projects.

2A-3

Applications of Geophysical Methods in Transportation Related Projects

Scott Carney, GEL Geophysics



In recent years, surface geophysical methods have become extremely valuable tools for many types of transportation related projects. Geophysical methods are capable of quickly scanning large areas and providing detailed information regarding the subsurface. In most cases the information is qualitative and should be combined with probing and sampling to verify interpretation of the results. A powerful combination is to first use geophysical methods to delineate areas of interest, and then focus in-depth investigations in areas of interest. These methods include the use of electromagnetic ground conductivity and magnetic susceptibility, electric resistivity and induced polarization imaging (ERI/IP), and ground penetrating radar systems. This presentation will focus on some of the most frequently used geophysical applications including: delineating buried waste and contamination plumes, detection of voids in the subsurface, non-destructive testing of concrete, mapping geological features and man-made underground infrastructure. Case studies and examples from field investigations will be presented.

2A-4

Balancing Data Needs in Conceptual Site Models

Beau Hodge, Geosyntec Consultants of NC, PC



Finding the right balance for data needs in developing a conceptual site model (CSM) of sufficient quality to drive remedial decisions can be a challenge. Direct sensing, rapid assessment approaches can provide much needed information to refine the understanding of the CSM so that the choice of remedial strategies can be selected with a much higher degree of confidence. This presentation provides a case study of a National Priorities List site in North Carolina where laser induced fluorescence (LIF), specifically turned to coal tar and creosote, has been used to refine the CSM so that a remedy can be selected. This talk presents the collection of the field data, and as equally important, the reduction and analysis of the data to develop a remedy that will have the highest chance for success. Data analysis used advanced gridding, geostatistical analysis and fully 3-dimensional visualization tools to provide a clear understanding of the important technical and regulatory drivers for this site.

Session 2B – Technological Approach to Resource Conservation

- 2B-1 **PENNDOT Strategic Recycling Program: A Journey through the Years**
Winnie Okello, Pennsylvania Department of Transportation
- 2B-2 **North Carolina Department of Environmental Quality, Division of Waste Management GIS Data Resources and Applications**
Dean Grantham, Jr., North Carolina Department of Environmental Quality
- 2B-3 **Leveraging Cross-Sector Investment towards a Sustainable Resiliency Portfolio**
Niek Veraart, Louis Berger Group
- 2B-4 **Life Cycle Benefits of Using Recycled Materials in Transportation Infrastructure**
Angela Pakes Ahlman, Recycled Materials Resource Center (RMRC)

- 2B-1 **PENNDOT Strategic Recycling Program: A Journey through the Years**
Winnie Okello, Pennsylvania Department of Transportation



The Strategic Recycling Program (SRP) was created as a means to systematically identify, evaluate and implement recycling opportunities throughout Pennsylvania (PA), via a memorandum of understanding with the PA Department of Environmental Protection. Nowadays, Recycling –especially within the context of D.O.Ts, as a practice sits in the nexus of water quality, and emerging issues within the transportation sector, and PA continues to strive for better implementation of emerging technologies, innovations and, industry standards.

- 2B-2 **North Carolina Department of Environmental Quality, Division of Waste Management GIS Data Resources and Applications**
Dean Grantham, Jr., North Carolina Department of Environmental Quality



The North Carolina Department of Environmental Quality's Division of Waste Management (DWM) is actively improving and developing new processes for the dissemination of its GIS data inventory that include the Brownfields, Hazardous Waste, Superfund, Underground Storage Tanks, and Solid Waste programs of the Division. All programs regularly produce geographically referenced information that can be used for many types of site assessment and environmental research. As the use of GIS technologies continue to grow, it is the strategy of the DWM to leverage more of its enterprise data through this technology in an effort to provide better, more efficient access to its data inventory. In mid-2016, the Division will deploy the Well Permit Decision Tool, which is a web based application that will leverage some of these datasets to assist local health departments in locating known sources of contamination and what information exists about each source. This is a working example of how these GIS datasets, supported by the Division, can be used to provide valuable insight to aid in the decision making process regarding development and construction activities at these sites.

2B-3 Leveraging Cross-Sector Investment towards a Sustainable Resiliency Portfolio

Niek Veraart, Louis Berger Group



Resiliency crosses jurisdictions, scales and sectors. The challenge in building an integrated resiliency portfolio and financing it is to match short term benefits with long term benefits and investments. Infrastructure investments, which tend to have a longer lifecycle need to be balanced with community investments that require more immediate pay-off to gain sustained support. Similarly, natural systems require longer lifecycles to become effective in creating resilience benefits and ecological benefits. At the same time, geographic areas require addressing resilience at multiple levels of scale in order to create truly integrated resilience, whether it concerns roadways, transit, housing or natural resources that need to be protected. Resiliency mandates of different asset owners or operators may vary, representing a challenge for integrating resilience. Investment mechanisms have the potential to overcome such challenges by creating benefits while at the same time addressing resilience across a range of sectors and providing funding. This concept will be illustrated with examples from projects across the United States, reviewing a diverse set of resilience initiatives, including energy projects, flood management projects, open space and transportation infrastructure projects.

2B-4 Life Cycle Benefits of Using Recycled Materials in Transportation Infrastructure

Angela Pakes Ahlman, Recycled Materials Resource Center (RMRC)



The use of recycled materials in highway construction has the potential to achieve significant benefits affecting the triple-bottom line (People, Planet and Prosperity). Such benefits include reducing the need for mining and transportation through in-situ applications of virgin materials, thus reducing environmental impacts and life cycle costs. Although state departments of transportation (DOTs) have been in the forefront of introducing recycled materials, they have not been able to clearly convey the benefits in a quantitative and transparent manner using easily understood metrics. What is lacking is direct information on sustainability assessment characteristics, i.e. greenhouse gas emissions, energy and water consumption and life cycle cost benefits. The main reason for this is the difficulty in tracking the quantities of recycled materials used in state DOT projects. To better define the benefits of using recycled materials, the Recycled Materials Resource Center (RMRC) developed a tool for tracking and reporting the recycled material quantities used in state DOT projects. A suitable method was recommended after studying how RMRC member states currently track their quantities of recycled materials, such as fly ash, reclaimed asphalt pavement (RAP) and recycled concrete aggregate (RCA). Furthermore, a life cycle assessment (LCA) using PaLATE and a life cycle cost analysis (LCCA) were conducted to quantitatively analyze and report the environmental and cost benefits of using recycled materials in highway construction. The LCA of three environmental parameters, energy use, water consumption and carbon dioxide emissions, showed significant environmental benefits when states used recycled industrial byproducts such as fly ash, and recycled materials such as RCA and RAP. The percent savings of environmental impacts due to replacing virgin materials with recycled materials for all the states varied between 80% and 95%.

Session 3A – Recycled Concrete Materials

- 3A-1 **Characterization of High pH Leachate Produced from Recycled Concrete Aggregate**
 Jiannan (Nick) Chen, University of Wisconsin - Madison
- 3A-2 **Contribution of Fine and Coarse Fractions of Recycled Concrete Aggregate to Tufa Precipitate Formation**
 Aiyoub Abbaspour, George Mason University
- 3A-3 **Cost Factors Influencing Recycling and Reuse of Concrete Residuals in North Carolina**
 Nicholas Tymvios, University of North Carolina Charlotte
- 3A-4 **Characterization and Land Application of Hydrodemolition and Diamond Grinding Slurries in NC**
 Dan Line, North Carolina State University

- 3A-1 **Characterization of high pH leachate produced from Recycled Concrete Aggregate**
 Jiannan (Nick) Chen, University of Wisconsin - Madison



Concrete recycling is rapidly becoming a preferred construction practice and supported by State DOT's, FWHA, and others to meet sustainable construction practices. Use of concrete recycled materials reduces the need for mining of virgin aggregate, thereby conserving scarce natural resources and can dramatically decrease transport costs, reduce related emissions and provide a new and ready source of construction aggregates. Due to the solubility of hydroxide-bearing minerals and other chemical reactions, the pH of water that interacts with recycled concrete may become elevated until carbonation of exposed surfaces has taken place. Regulations to limit high pH leachate are being considered in several states. For example, proposed regulations in the State of Washington, requiring a pH below 8.5 at the point of discharge from the recycled concrete aggregate (RCA), may have the unintended consequence of actually prohibiting the use of recycled concrete materials in commonly accepted concrete recycling applications; e.g., as unbound base course or fill material or aggregate in ready-mix concrete. Here we evaluate the neutralization of high pH leachate by subgrade soils and present a forensic examination of RCA and soil from the MnROAD field site to determine the causative mechanisms of the near neutral pH of the leachate at the field site. We expect our research to reconcile the contradictory results of previous studies of leachate pH from fresh and aged RCA.

- 3A-2 **Contribution of Fine and Coarse Fractions of Recycled Concrete Aggregate to Tufa Precipitate Formation**
 Aiyoub Abbaspour, George Mason University



The fine particle fraction of recycled concrete aggregate, RCA, (<4.75mm) has previously been claimed to be responsible for release of elements that are responsible for high tufaceous precipitation potential. In order to mitigate this problem, replacing fine fractions with natural aggregate is recommended. However, this recommendation is of limited practicality and may not be necessary because previous evaluations have not considered the effects of effluent contact time (a factor of water percolation time through the material) and the age of the materials being used. A methodology has been developed to simulate aging of RCA under laboratory conditions and its effects on characteristics of leachate extracted following two different methods (quick and long agitation). Also, relative contributions of the fine and coarse fractions, as compared to that of unfractionated samples, toward constituent release were studied using the quick leachate

extraction method. It was found that leaching of Ca, Mg and S are affected by contact time rather than the particle size, whereas release of Si, Al and Cu release are affected by both particle size and contact time. Except for Mg, all other elements showed fluctuations in released concentration over the first two months of aging and thereafter approached steady state. Mg release showed continuous increase with aging

3A-3

Cost Factors Influencing Recycling and Reuse of Concrete Residuals in North Carolina

Nicholas Tymvios, University of North Carolina Charlotte



Concrete hydrodemolition and diamond grinding/grooving operations performed for the North Carolina Department of Transportation (NCDOT) generate large amounts of concrete residuals. These residuals include waste water, wet sand, chips and chunks of concrete, and slurry water. Currently these residuals are classified by the North Carolina Department of Water Resources (NCDWR) as Class A Residuals and are treated as “inert debris” thus allowing them to be reused instead of being disposed at Publicly Owned Treatment Works (POTW) and Municipal Solid Waste (MSW) sites. Some of these beneficial reuse options include: Land Application, Water Reclamation, Beneficial Fill, Alternative Daily Cover, and Soil Modification within Roadways. In order to encourage contractors to opt for the reuse options, and to allow NCDOT to better estimate costs, a research study was initiated to investigate and identify the cost factors for each different disposal/reuse option. The identification of these cost factors can potentially be used to influence contractor decisions on the disposal/reuse method used, provide cost savings to NCDOT, and environmental benefits through the reuse of these concrete residuals. This paper discusses these cost factors that were identified by contractors performing work in North Carolina, and presents a method that allows contractors to estimate their disposal/reuse costs.

3A-4

Characterization and Land Application of Hydrodemolition and Diamond Grinding Slurries in NC

Dan Line, North Carolina State University



Dan Line

Hydrodemolition and grinding of highway surfaces creates large volumes of a water and concrete slurry that must be safely disposed of or reused. This project evaluated the effect of applying the slurry as a liming agent to vegetated areas. Results of two controlled greenhouse studies documented that the incorporation of concrete slurry at up to twice the recommended rate to correct low soil pH had no detrimental effect on the soils or the germination and establishment of fescue and bahiagrass. Further, surface application of concrete slurry to small field plots at rates recommended to correct low soil pH resulted in no detrimental effect on soils or vegetation including bermudagrass. In addition, the water quality of rainfall runoff from the plots with concrete slurry application was not different than runoff from a plot with no slurry application. Hence, these results show that the application of concrete slurry at rates to correct soil pH should have no detrimental effect on soils, vegetation, or surface runoff.

Session 3B – Remediation and Exposure Management

3B-1 **Initial Exposure Determinations for Airborne Contaminants during Rehabilitation of the Portsmouth Downtown Tunnels**

Chad Smith, EEE Consulting, Inc.

3B-2 **Assessment and Clean-Up of Lead Contamination at DOT Equipment Yard**

Michael Branson, Solutions-IES, Inc.

3B-3 **Assessing Remediation Effectiveness and Sustainability of a 20-Year Remediation System: Circuit Boards to Shopping Mall**

Sheri Knox, Amec Foster Wheeler

3B-4 **Generation of In Situ Biodegradation-Sorption Barriers for Munitions Constituents**

Bilgen Yuncu, Solutions-IES, Inc.

3B-1 **Initial Exposure Determinations for Airborne Contaminants during Rehabilitation of the Portsmouth Downtown Tunnels**

Chad Smith, EEE Consulting, Inc.



After decades of service, aging tunnels need major rehabilitation/refurbishment to maintain their level of service, prevent costly repairs, and maintain safety. Under Virginia's Public Private Transportation Act, the Virginia Department of Transportation (VDOT) entered into an agreement with Elizabeth River Crossings, LLC (ERC) for rehabilitation and operation of the Portsmouth Downtown Tunnels for a 58-year concession period. Safety upgrades and tunnel repairs were dictated by Federal Highway Administration (FHWA) and VDOT requirements to meet current safety standards. Rehabilitation of the Portsmouth Downtown Tunnels consisted of structural, fire, life and safety improvements including: repairing cracks, spalling, and delaminated concrete; removing old lighting and electrical conduit; and installing fire proofing panels and new jet fans on tunnel ceilings, and electrical conduit on walls. Drilling and saw cutting activities employed during the tunnel rehabilitation presented potential hazardous exposures to airborne particulates for the construction workers performing these activities, as well as other trades working inside the tunnel structures. Exposure to airborne lead and silica particulate during concrete repair and safety systems installation posed an exposure hazard due to high concentrations of concrete dust generated during drilling and saw cutting operations. Construction worker exposure assessments were conducted upon commencement of the drilling, saw cutting, and lighting fixture removal/replacement activities to determine the exposure levels and establish employee protective measures for the duration of the rehab work for compliance with the OSHA Safety and Health Regulations for Construction (29 CFR 1926).

3B-2 **Assessment and Clean-Up of Lead Contamination at DOT Equipment Yard**

Michael Branson, Solutions-IES, Inc.



Many Responsible Parties are required to remediate sites resulting from pre-1976 uncontrolled discharges to the environment. For example, a common disposition of lead-based paint was to pour unused paint into the storm sewer. After the paint dried, it remained relatively stable until it flaked off the sewer pipes. This allowed the lead-based paint flakes to flush to nearby outfalls and onto the receiving properties. A contractor jet-cleaned a sewer on NCDOT property. Flaking remained significant, after cleaning and they recommended replacing the entire storm sewer system. A camera survey showed most of the paint was intact and a second jet-wash was conducted to remove residual flakes.

Despite these efforts, after a subsequent storm event, paint flakes again appeared in the outfall requiring NCDOT to identify the source of the problem. NCDOT traced the paint flakes in the outfall to old, painted bridge beams stored on an adjacent lot. Subsequent soil testing determined that lead concentrations were above action levels. The hazardous soils were excavated and treated on-site to reduce lead to non-hazardous concentrations so the soil could be safely disposed off-site at far reduced cost. The end result was that only a small portion of the sewer line was replaced and the site was kept off the Superfund list. This approach saved the NCDOT over \$250,000.

3B-3 **Assessing Remediation Effectiveness and Sustainability of a 20-Year Remediation System: Circuit Boards to Shopping Mall**

Sheri Knox, Amec Foster Wheeler



Background/Objectives. The Site, currently developed as a shopping mall, was previously used for the manufacture of circuit boards. In 1986, chlorinated volatile organic compounds (CVOCs) were identified in groundwater and in 1991, the USEPA required the installation/operation of a groundwater treatment system (GWTS). Although mass was effectively removed from the aquifer (45%) by the GWTS in the 90's, by 2003, mass removal was reduced to less than 5% even with improved pumping at 1.5 MG/month. The stagnated-low removal rate, nowhere near treatment goals, combined with an annual electricity usage by the GWTS equivalent to that required to power an electric car for 7 years convinced the USEPA to consider a more effective and sustainable approach. **Approach/Activities.** To evaluate the current remedial efforts and potentially, a more effective solution: 1) The GWTS was temporarily "shut down" to evaluate mass flux and natural attenuation (MNA), 2) A pilot test was performed in the source area, and 3) Long-term risk was evaluated for receptors in consideration of MNA. **Results.** Results indicate that the source area continues to contribute to the dissolved phase, but the contribution can be managed with an updated and more sustainable approach.

3B-4 **Generation of In Situ Biodegradation-Sorption Barriers for Munitions Constituents**
Bilgen Yuncu, Solutions-IES, Inc.



Extensive use of firing ranges, explosive detonation areas, and open burn sites has led to accumulation of munition constituents such as TNT, RDX, HMX and perchlorate in soils. In high permeability soils, munitions residues may be transported to the groundwater leading to groundwater contamination and possible human exposure. However, leaching is much more limited in high organic carbon soils due to a combination of sorption and degradation processes. We are developing a low cost and easy to maintain process to reduce munitions leaching by enhancing the sorption and/or degradation in soils by spray application of an amendment solution containing glycerin and a soluble humic material on the soil surface. Natural rainfall and irrigation transports the amendments deeper into the soil profile where the glycerin quickly biodegrades, generating anaerobic conditions which are more favorable for degradation, and the slowly biodegradable humic material provides a large reservoir of reducing power to maintain long-term anaerobic conditions.

Session 4A – Implementation of Sustainability in Transportation Infrastructure

- 4A-1 **Beneficial Reuse of Coal Ash in North Carolina**
John L. Daniels, University of North Carolina Charlotte
Ellen Lorscheider, North Carolina Department of Environmental Quality
- 4A-2 **The Future for Coal Combustion Products**
Thomas Adams, American Coal Ash Association
- 4A-3 **Stabilization of Expansive Subgrade Soil with Chemical Additives**
Bora Cetin, Iowa State University
- 4A-4 **Use of Reclaimed Asphalt Pavement (RAP) in Unbound Base Aggregate for Sustainable Road Construction**
Saad Ullah, George Mason University
- 4A-5 **Sustainable Use of Quarry By Products and Fine Materials**
Kevin Vaughan, Vulcan Materials Company
- 4A-6 **Mining Byproducts and Recycled Materials for Better Roads and Road Repairs**
Lawrence Zanko and Sara Post, University of Minnesota Duluth
- 4A-7 **Nanoscope Phase Contrast and Mechanistic Properties of Waste Automobile Tires Modified Asphalts**
Zahid Hossain, Arkansas State University

4A-1 **Beneficial Reuse of Coal Ash in North Carolina**



John Daniels

John L. Daniels, University of North Carolina Charlotte; Ellen Lorscheider, North Carolina Department of Environmental Quality

Large scale use of coal ash for projects with beneficial end uses such as mine reclamation, roadway beds, embankments, and building bases has the potential to divert large quantities from disposal. This presentation will review production and use statistics in North Carolina while providing a regulatory perspective on beneficial use. In particular, elements of the North Carolina Coal Ash Management Act and the U.S. Environmental Protection Agency's Coal Combustion Rule will be discussed. Example case studies and technical challenges will be discussed.

Ellen
Lorscheider

4A-2 **The Future for Coal Combustion Products**

Thomas Adams, American Coal Ash Association



Since the U.S. EPA promulgated rules for management of coal combustion residuals, the beneficial use of these materials has once again begun to grow. However new regulatory initiatives have cast a shadow on the future for coal-fueled generation of electricity. This presentation will provide a forecast of the availability of fly ash and other coal combustion products.

4A-3

Stabilization of Expansive Subgrade Soil with Chemical Additives

Bora Cetin, Iowa State University



Mitigation of the swelling and shrinking potential of expansive soils is very critical in northern and mid-west regions of the United States. In this study, expansive Belle Fourche (BF) shale expansive subgrade clay, was mixed with the following chemical additives; class C fly ash and class F fly ash and lime. The swelling pressure and the unconfined compressive strength (UCS) of the mixtures were analyzed under different curing periods including 1 day, 7 days and 28 days. The results of this study indicated that the swelling pressure of (BF) clay decreased significantly in particular with addition of lime even under F-T effect. Even though lime showed the best performance on mitigating the swelling potential, class C fly ash also reduced the swelling pressure of expansive soil significantly for mixtures cured for 7 days. In terms of strength gain, the results of this study indicated that chemical treatment of BF clay increased its unconfined compression strength. With regard to the results, better strength gain performance of chemical additives can be ranged as class C fly ash, lime and class F Fly ash.

4A-4

Use of Reclaimed Asphalt Pavement (RAP) in Unbound Base Aggregate for Sustainable Road Construction

Saad Ullah, George Mason University



Reclaimed asphalt pavement (RAP) is produced when degraded surface layer(s) of flexible asphalt pavement are milled and removed during the rehabilitation and reconstruction of a road surface. More than 90% of roads in U.S. are constructed with Hot Mix Asphalt (HMA) or its variants (FHWA 2010). According to Taha et al. (1999), more than 50 million tons of asphalt roadways were milled in the U.S. in 1999 and in 2009, this number doubled to 100 million tons (NAPA, 2009). These two studies suggest that there has been an exponential increment in production of RAP in the U.S. over the period of a decade. Currently, the most common method to reuse RAP is in production of HMA, but at rates that appear to be insufficient to deplete the significant stockpiles of RAP. This presentation will summarize some of the previous studies in which others have attempted to implement an alternative use of RAP as unbound base aggregate and will provide an overview of a new research study initiated to develop a RAP-aggregate blends to overcome some of the issues previously noted.

4A-5

Sustainable Use of Quarry By Products and Fine Materials

Kevin Vaughan, Vulcan Materials Company



The aggregate industry produced approximately 1.46 billions tons of stone in the US in 2015. With this production, many quarries have a significant production of aggregate base and fine aggregate products that go unsold. In recent years, many factors have contributed to the reduction in sales of these products, including the increased demand for coarse aggregate, lack of new road construction and the increased use of recycled materials such as recycled asphalt pavement and crushed concrete. In order to use all quarry products in more sustainable way, quarry operators and those involved in construction must work together to find uses for these finer products. This presentation would review the sustainability issue as well as present several ideas for use of these fine products.

4A-6

Mining Byproducts and Recycled Materials for Better Roads and Road Repairs

Lawrence Zanko and Sara Post, University of Minnesota Duluth

Lawrence
Zanko

Sara Post

The University of Minnesota Duluth Natural Resources Research Institute (NRRI) has conducted research focused on investigating the construction aggregate potential of byproduct materials – such as waste rock and tailings – generated by Minnesota’s taconite (iron ore) mining industry. We have also conducted research on innovative pothole patching and road-repair techniques, including new taconite-based formulations and the use of materials such as recycled asphalt pavement (RAP) and recycled asphalt shingles (RAS) in combination with microwave technology. An overview of these research efforts and findings will be presented, along with a discussion of how those findings could be implemented. The goal of this research has been to expand the use of byproduct taconite aggregate materials in transportation infrastructure both inside and outside of Minnesota, and to address the on-going issue of road repair in difficult climatic and geological environment. The focus has been on improving the value-added prospects for regional materials.

4A-7

Nanoscopic Phase Contrast and Mechanistic Properties of Waste Automobile Tires Modified Asphalts

Zahid Hossain, Arkansas State University



Over 5.2 million tons of scrapped tires are produced each year in the United States. Disposal of this huge amount of scrapped tires has become a serious environmental issue and economical burden to the taxpayers. In recent years, the use scrapped tire in the form of Ground Tire Rubber (GTR) in road construction projects has been explored as it has potential to improve asphalt’s performance from stiffness, resilience and shock absorbance perspectives. Some researchers have started using the atomic force microscope (AFM)-based nanoindentation technique to characterize pavement materials to observe behavior of the materials at a molecular level. In this study, the PeakForce Quantitative Nanomechanical Mapping (PFQNM™) mode has been employed to find phase contrast and nanomechanistic properties and morphology of GTR-modified binders. A performance grade (PG 64-22) binder modified with two different grades (Mesh #30 and Mesh #40) of GTRs has been evaluated in this study. Surface Characterization (e.g., topography) and nanomechanical properties such as adhesion, hardness, and DMT (Derjaguin, Muller, and Toporov) modulus for each blend have been quantified. Each sample was scanned at three different areas to ascertain the repeatability of test results. Phase-contrast imaging in the PGQNM™ was found to be powerful method in surface characterization. Two distinct phases, namely, Catana and Peri-phase, were observed in GTR-modified samples. Two other phases, namely, Sol-phase and Perpetua-phase were also observed in some samples. The DMT moduli of GTR-modified binders were found to be in a close range. It was observed that modification of asphalt by GTR considerably changes the mechanistic properties of the base binder. The findings of this study are expected to be beneficial for pavement professionals and policy makers toward sustainable uses of waste automobile tires in road construction projects.

Session 4B – Environmental Management Systems

- 4B-1 **Implementing the new ISO 14001:2015 Standard for Transportation Agencies**
Peter Hall, Amec Foster Wheeler
- 4B-2 **Using Management System Concepts to Achieve Adaptation**
Elizabeth Delaney, First Environment, Inc.
- 4B-3 **Water Efficiency Management Program Guidebook**
James Jolley, The Cadmus Group, Inc.
- 4B-4 **Measuring Sustainability at Mother Clara Hale Bus Depot**
Steven Eget, Dewberry
- 4B-5 **Building a Strong and Award Worthy Environmental Management System**
Carissa Agnese, Skanska

- 4B-1 **Implementing the new ISO 14001:2015 Standard for Transportation Agencies**
Peter Hall, Amec Foster Wheeler



Transportation Agencies are increasingly turning to the ISO 14001 EMS standard to drive environmental performance and best practices across activities and operations. Leading agencies such as NYCT, LA Metro, Intercity Transit and Champaign-Urbana MTD are certified to ISO 14001 and in September 2015 a new version was released with several key changes that transit agencies will be required to conform with to remain certified. These include an increased emphasis on environmental performance, lifecycle approaches, risk management, integration with business goals and communications. An overview of key implementation steps to incorporate the new ISO 14001:2015 standard will be provided based on work completed across a range of industries and transportation agencies. EMS tools such as gap analysis frameworks, implementation planning and management review will be reviewed and discussed allowing attendees to understand the steps required to move to this new EMS standard. With the new standard in place, organizations will find it easier to incorporate their environmental management system into the core business processes and gain greater business benefits.

- 4B-2 **Using Management System Concepts to Achieve Adaptation**
Elizabeth (Betsy) Delaney, First Environment, Inc.



This presentation will consider how environmental management systems (EMSs), risk-based assessment, and other IT tools such as GIS and asset management systems can be leveraged to manage the broader concerns of climate change, sustainability, and adaption in the transportation industry. Specific examples draw from recent FTA-funded pilot studies on adaption and other transit experience to illustrate the use of these tools. The speaker will explain how climate change risk assessment can be used to develop community and organizational risk mitigation strategies. Focusing on the two components of climate change risk—criticality and vulnerability—the presentation will discuss the identification of inputs for assessing criticality which are highly community dependent and the use of exposure, sensitivity, and adaptive capacity in assessing vulnerability. The presentation will also discuss the development of short and long term strategies to address adaptation to climate change that include direct actions and capacity building needs.

4B-3 Water Efficiency Management Program Guidebook

James Jolley, The Cadmus Group, Inc.



Water Efficiency Management Program Guidebook provides details and tools airport operators can use to design and institute a water efficiency management program specific to their facility. This guidebook and the tools enables airport operators to understand water use at airports, generate a baseline water use profile specific to their airport activities and defines appropriate water use targets. The tools include a spreadsheet-based end-use water audit tool that will help airports establish water use baselines and water efficiency targets. It will also help to evaluate appropriate water efficiency measures and develop a water efficiency management action plan. Among the many topics this guidebook addresses are A water management tools and practices used worldwide within and outside of the airport industry; methods for collection, management, and analysis of data relevant to airport water management; collaboration and communication with the public and stakeholders, including water providers; program implementation strategies, including motivation for decision makers; infrastructure operation and maintenance considerations; and drought planning considerations.

4B-4 Measuring Sustainability at Mother Clara Hale Bus Depot

Steven Eget, Dewberry



The recently constructed Mother Clara Hale Bus Depot in Harlem, New York, is New York City Transit's first LEED Gold building. It incorporates numerous sustainable features including a 54,000SF green roof, passive solar wall, and rainwater reuse. New York City Transit is conducting a detailed study to determine the financial and environmental return on investment from these features, including detailed sustainable return on investment (SROI) calculations using the Institute for Sustainable Infrastructure's (ISI's) Envision model and air dispersion modeling. The presentation will highlight the features and findings from this research, and enable the audience to view their planned and existing improvement projects through the lens of this research.

4B-5 Building a Strong and Award Worthy Environmental Management System

Carissa Agnese, Skanska



A case study of the EMS program developed as part of the Midtown Tunnel Project in Portsmouth Virginia. Skanska developed an EMS system that not only resulted in 100% compliance but also numerous environmental awards. The program also helped the project to reach a recycling goal of 99% with only 1% of their waste going to a landfill.

Session 5A – Beneficial Uses of Transportation Corridors

5A-1 **Retention and Infiltration: Balancing Plant Growth and Function using Alternative Media for Bio-Retention Systems**

Debbie Stringer, Carolina Stalite Company

5A-2 **Hybrid Energy Harvesting and Sensing System For The Next Generation Smart Transportation Infrastructures**

Samer Dessouky, University of Texas at San Antonio

5A-3 **Pollinator Habitats and Highways**

David Harris, North Carolina Department of Transportation

5A-4 **The City of Asheville's Edible Mile**

Amber Weaver, City of Asheville

5A-1 **Retention and Infiltration: Balancing Plant Growth and Function using Alternative Media for Bio-Retention Systems**

Debbie Stringer, Carolina Stalite Company



Rain Gardens should look and perform like gardens. Because the process is relatively new, there has been some controversy over the soils used in bio-retention systems. It has been determined that the soils must drain at a rate of 2 to 4 inches per hour to provide enough ponding time (24 to 48 hours) to remediate nutrients and other contaminants. Unfortunately the complexity of the soils and influx of silt into the system from the runoff can result in the clogging and failure of the system. Most systems using these parameters may result in higher maintenance or total replacement in five years. Other systems propose using higher amounts of compost in the media. If the nutrient content is too high the opportunities for the nutrients to be discharged into a creek or other body of water during the establishment period are greater. The other concern is the aesthetics of the plants. It is difficult to find a plant that can survive saturated soil for a period of time and then try to survive during the dry periods for an undefined period of time. A bed of weedy suffering plants does little to promote the use of rain gardens.

Trials using expanded slate fines with a 20% organic component led to additional research using the expanded slate fines to provide additional air space deep in the system providing oxygen for the plant roots. Plant roots provide the perfect environment for the microbes to do their job. Do not underestimate the value that plants have in this process not only for cleansing the runoff but also by providing an attractive alternative to stagnant holding ponds. If rain gardens remain attractive while providing a function more people will be willing to spend the money and effort to incorporate them into the landscape. This presentation will showcase and review case studies showing how the selection of growing media can impact success or failure. The goal is to obtain the knowledge to select the proper media to maximize sustainability while meeting the expectations of the design intent.

5A-2 **Hybrid Energy Harvesting and Sensing System For The Next Generation Smart Transportation Infrastructures**

Samer Dessouky, University of Texas at San Antonio



Asphalt pavement roadway infrastructures are means for connecting people and facilitating accessibility and mobility. The traffic-induced strains and stresses generated by the vehicles can be potentially used for energy harvesting purposes. Piezoelectric devices are ideal candidates for harvesting energy in a pavement structure as they convert mechanical strain energy into electric voltage. In this study, an experimental program was conducted to evaluate the potential of harvesting energy from roadways using piezoelectric transducers embedded in pavement layer structures.

A prototype consists of piezoelectric transducer disks sandwiched between two copper plates was assembled in-between asphalt mixture specimens. A uniaxial compression test was performed to measure the output voltage under different numbers and arrangements of piezoelectric transducers. Moreover, the sensitivity of the voltage to asphalt layer thickness, loading frequency, vertical load, and loading time was also studied. A three-dimensional finite element model was developed to simulate the prototype performance under different loading modes. The experiment results showed that the quantity and arrangement of the piezoelectric sensors altered the applied stresses leading to variations in the generated output voltage. It was observed that the output voltage is slightly sensitive to the thickness of the top pavement layer.

5A-3 **Pollinator Habitats and Highways**

David Harris, North Carolina Department of Transportation



The presentation outlines the current crisis facing pollinator species and what NCDOT is doing to help find a solution. The presentation was given at the 2015 National Roadside Vegetation Management Conference.

5A-4 **The City of Asheville's Edible Mile**

Amber Weaver, City of Asheville



Asheville Buncombe Food Policy Council – Land Use Cluster identified a desire for an “Edible Mile” on public land. This also fits into the Sustainability Office’s Food Policy Action Plan, include use of edible landscaping as a priority for public property such as parks, greenways and/or right of ways. In response, the Greenway Coordinator and the Sustainability Officer determined that the French Broad River West Greenway, under construction in 2018, would be a great location to plant a percentage of edibles within the landscaping. The City is partnering with GreenWorks, a local nonprofit, on planning and implementing the edible landscaping along the greenway. The theme of this greenway will be “the edible mile.”

Session 5B – Panel Discussion: Reuse of Contaminate Media

- 5B-1 **Risk-based methodology as it applies to petroleum contaminated sites, the ESPCSR program and the various disposal and remediation options available for petroleum contaminated soil in the State of North Carolina**
Jeremy Poplawski, North Carolina Department of Environmental Quality
- 5B-2 **Discussion of the Virginia Department of Environmental Quality Management and Reuse of Contaminated Media State-wide Variance Guidance**
Justin Williams, Virginia Department of Environmental Quality
- 5B-3 **Using a multiple-lines-of-evidence approach and the Virginia Department of Environmental Quality Management and Reuse of Contaminated Media Variance Guidance to evaluate the Reuse of TPH and Cadmium Soil in a Proposed Roadway Improvement Corridor**
Chris Lalli, EEE Consulting, Inc.
- 5B-4 **Panel Discussion**
Virginia Department of Environmental Quality and NC Department of Environmental Quality
Jeremy Poplawski, Justin Williams, Chris Lalli
- 5B-1 **Risk-based methodology as it applies to petroleum contaminated sites, the ESPCSR program and the various disposal and remediation options available for petroleum contaminated soil in the State of North Carolina**
Jeremy Poplawski, North Carolina Department of Environmental Quality



The Underground Storage Tank (UST) Section manages the UST program, the Non-UST releases program (including petroleum Aboveground Storage Tank (AST) releases and other petroleum releases), and the Ex Situ Petroleum Contaminated Soil Remediation Permit (ESPCSRP) program. Prior to March 1, 2016, risk-based assessment and corrective action rules for petroleum contaminated sites only applied to releases associated with USTs. Risk-based rules provide a mechanism for the allocation of scarce public and private resources for the remediation of sites by prioritizing those which pose the greatest risk to public health and the environment. The process of corrective action and remediation, as well as N.C. Department of Transportation road construction projects, typically require the excavation of petroleum contaminated soil and proper disposal; this need is typically fulfilled at a designated soil remediation site. The ESPCSR program permits these designated soil remediation sites, as well issues one time land application certificates in certain cases. This presentation will discuss the risk-based methodology as it applies to petroleum contaminated sites, the ESPCSR program and the various disposal and remediation options available for petroleum contaminated soil in the State of North Carolina.

5B-2 **Discussion of the Virginia Department of Environmental Quality Management and Reuse of Contaminated Media State-wide Variance Guidance**

Justin Williams, Virginia Department of Environmental Quality



In July 2012, the Virginia Department of Environmental Quality (VDEQ) Division of Land Protection and Revitalization issued state-wide variance guidance related the Management and Reuse of Contaminated Media. The Variance Guidance was developed and prepared to allow owners/operator to reuse soils/sediment generated within the Commonwealth, both on-site and off-site, as one option in managing excess media from property upgrade. One benefit of the guidance has been to revitalize and upgrade undeveloped properties with actual or perceived concerns of contamination or concerns about managing soils on-site with low concentrations of contaminants, which helps reduce blight and conserve land would otherwise be developed. This presentation will discuss the background, framework, and use of the media reuse variance.

5B-3 **Using a multiple-lines-of-evidence approach and the Virginia Department of Environmental Quality Management and Reuse of Contaminated Media Variance Guidance to evaluate the Reuse of TPH and Cadmium Soil in a Proposed Roadway Improvement Corridor**

Chris Lalli, EEE Consulting, Inc.



EEE completed a Phase II investigation to characterize 15,000 yards of soil that would be disturbed during a proposed VDOT roadway improvement project. Soil samples contained detectable total RCRA 8 metal and/or residual-phase petroleum concentrations. Select total cadmium concentrations exceeded the EPA ecological concentration of 1.0-mg/kg for soil in the Eastern U.S. The majority of the TPH concentrations were below the VSWMR limit of 50-mg/kg for fill material.

The geologic setting and associated data for the project area indicated that cadmium concentrations detected in excess of 1.0-mg/kg were potentially associated with localized mineralogy. The chromatographs of the detected petroleum concentrations also did not match the eluted peaks for the known TPH-ORO standard. Thus, it was determined that the detected petroleum concentrations were non-petroleum related. EEE utilized this information to evaluate alternative soil management options in comparison to off-site disposal at a regional landfill. The selected option will be reuse on-site in accordance with the VDEQ Variance Guidance. This option will result in significant cost savings by allowing the soil to be used as fill on the project, which reduces the carbon foot print by not utilizing trucks to transport an aggregate volume of 30,000 yards of material (soil and borrow).

5B-4 **Panel Discussion**

Virginia Department of Environmental Quality and NC Department of Environmental Quality

Jeremy Poplawski

Justin Williams

Chris Lalli

Session 6A – Sustainable North Carolina

- 6A-1 **Making North Carolina Department of Transportation More Sustainable Through Opportunities for Innovative Products and Technologies**
Natalie Roskam, North Carolina Department of Transportation
- 6A-2 **Sustainable Approach to Groundwater Remediation at Asphalt Testing Sites**
Thomas "Chris" Niver, North Carolina Department of Transportation
Matt Bramblett, Hart & Hickman
- 6A-3 **Bioremediation of an Asphalt Manufacturing Site**
Michael Jordan, Terracon
- 6A-4 **Sustainability at Biltmore**
Chuck Pickering, Biltmore

- 6A-1 **Making North Carolina Department of Transportation More Sustainable Through Opportunities for Innovative Products and Technologies**
Natalie Roskam, North Carolina Department of Transportation



The vision set forth by the North Carolina Department of Transportation (NCDOT) is to be a global leader in providing innovative transportation solutions. One way NCDOT is striving to fulfill this vision is to increase the use of innovative technologies and products by bringing greater visibility and public awareness to NCDOT's Product Evaluation Program. NCDOT is reimagining product-related websites and streamlining application processes including building a new web portal to assist product vendors, distributors, producers and suppliers with a one-stop shop for submission of new products and technologies. NCDOT's outreach focus shifts from a historically passive model to an active pursuit of new technologies and products highlighting identified product needs. This presentation will show how changes in the Product Evaluation Program will lead to improved sustainability and environmental management opportunities in NCDOT's transportation infrastructure. Learn how NCDOT is instituting measures to direct, track progress and implement strategies to demonstrate the Department's commitment to integrate innovation into transportation infrastructure for a more sustainable future.

- 6A-2 **Sustainable Approach to Groundwater Remediation at Asphalt Testing Sites**
Thomas "Chris" Niver, North Carolina Department of Transportation
Matt Bramblett, Hart & Hickman



Chris Niver

By the 1960's the North Carolina Department of Transportation (NCDOT) implemented an asphalt quality assurance program. Certified suppliers constructed and maintained onsite asphalt testing laboratories (ATL's). Parties performing asphalt tests used chlorinated solvents (e.g., carbon tetrachloride, trichloroethene, and 1,1,1-trichloroethane) per ASTM Methods. On-site solvent disposal from ATL's and other plant operations contaminated soil and groundwater at many facilities. Chlorinated solvents attenuate slowly. Groundwater remediation with



Matt
Bramblett

mechanical extraction technologies is marginally effective. In situ stimulation of indigenous microbial populations with energy substrates (e.g., sugars) is the best alternative, but the scale of the ATL remediation program makes the use of commercial products cost prohibitive making long-term programmatic budgeting difficult. Commercial beverage manufacturer, Pepsi Bottling Ventures (PBV), Raleigh, North Carolina uses High Fructose Corn Syrup (HFCS) in their formulations. The sugar concentrations in their products are comparable to commercially available bioremediation products.

In a public service collaboration with NCDOT, PBV provided infrastructure and labor to recover and repackage expired sugared beverages; material normally discharged to the City of Raleigh publicly owned treatment works (POTW). The new product is called Beverage Remediation Product (BRP). NCDOT transported 50,000 gallons of BRP from the Raleigh PBV facility to a groundwater remediation project in Richmond County. Injection and subsequent indigenous microbial stimulation reduced or eliminated contamination in treated areas. PBV has reduced its waste disposal cost, the load on Raleigh's POTW, as well as material and labor costs for NCDOT's cleanup in Richmond County. Our innovation will allow NCDOT to accelerate site cleanups, meet regulatory mandates more economically, and ultimately reduce risks to human and environmental health. BRP could also reduce risks to human and environmental health with lower cleanup costs in DEQ's dry cleaner program in addition to many other private industrial sites. This is a common sense solution to a complex problem, a positive change in the way we conduct business, and puts taxpayer dollars to good use.

6A-3

Bioremediation of an Asphalt Manufacturing Site

Michael Jordan, Terracon



A former asphalt manufacturing site utilized trichloroethene (TCE) in conducting quality control tests. On-site TCE releases resulted in groundwater contamination at concentrations up to 16,000 micrograms per liter. Contaminant mass was concentrated in a low permeability saprolite aquifer. The aquifer is characterized as having a low pH and aerobic and oxidizing conditions. Groundwater impacts extended into metavolcanic bedrock at depths greater than 160 feet. The source area and a downgradient barrier were targeted for treatment via bioremediation. A molasses solution augmented with sodium bicarbonate was injected during 14 events. Distribution was evaluated using a bromide tracer, sulfate concentrations, and visual evidence of the injectate solution. Injections resulted in initial total organic carbon (TOC) loading of up to 30,000 milligrams per liter and elevated concentrations were observed for four years. Despite the depletion of TOC, microbial analysis indicated an active population at 12 years post injection. Methanogenic conditions were established after two years and sulfate reducing conditions persisted for seven years. An increase of chlorinated ethene molar mass after injections was observed, which is indicative of residual DNAPL. The formation of degradation products was observed for approximately six years. TCE mass was reduced 95% compared to baseline conditions. Evidence of complete dechlorination was observed through consistent detections of ethene for three years. In an effort to supplement initial molasses injections, the source area was targeted for polishing via injections of beverage remediation product. TCE concentrations were reduced to below reportable concentrations only three months after injection.

6A-4

Sustainability at Biltmore

Chuck Pickering, Biltmore



Sustainability at Biltmore began at its inception with George Vanderbilt's vision, and continues today with the work across the Company to become the model of corporate environmental excellence in North Carolina. Ongoing projects include sustainable forestry, estate-raised beef and lamb for the restaurants, biofuel project, solar fields, propane project, and historic preservation. Additionally, there are a number of newer projects that are in various stages of development and implementation. These projects include pasture reclamation, estate raised product development, self-sufficient water sources and energy conservation.

From the very beginning, sustainable forestry, with the goal of preserving the natural beauty of the land, was a major priority of George Vanderbilt and Frederick Law Olmsted. This vision continues on the Estate today with our management of the forests that remain healthy and productive.

As much as we follow in George Vanderbilt's historic footsteps through preservation of forests and responsible agriculture, we also continue to keep the Biltmore on the cutting-edge of sustainable innovation. This is apparent through our efforts with 1.7 megawatt solar farm, our usage of propane in 13 of the estate vehicles, and our canola food grade oil to biofuel program.

Sustainability at Biltmore remains rooted in the history of the Estate and the original vision of George Vanderbilt. The original vision of George Vanderbilt and Frederick Law Olmsted continue to guide the next generations at Biltmore to preserve Biltmore as a privately owned, profitable, working estate.

Session 6B – Innovative Technologies and Strategies for Stormwater Management

- 6B-1 **Roadside Retrofits for Bacteria Reduction**
Hunter Freeman, WithersRavenel
- 6B-2 **Route 9 Drainage Improvements – Pervious Asphalt**
Michael Sears, HNTB
- 6B-3 **Research to Optimize the Nutrient Removal Performance of Storm water BMPs Within the Right-of-Way**
Brian Lipscomb, North Carolina Department of Transportation
- 6B-4 **Evaluation of the Effect of Highway and Bridge Facilities on Sediment Quality**
Chris Moody, The Intelligence Group

- 6B-1 **Roadside Retrofits for Bacteria Reduction**
Hunter Freeman, WithersRavenel



WithersRavenel worked with NCDOT and the North Carolina Coastal Federation to complete design and installation of six storm water retrofit sites in Wrightsville Beach NC. The project was part of a National Estuarine Research Reserve System grant obtained by the North Carolina Coastal Federation in partnership with the Town of Wrightsville Beach and the City of Wilmington. The goal of the retrofits was to reduce bacteria loading rates in the waters around Wrightsville Beach (mainly Banks Channel and Lee's Cut). Our strategy was to reduce the direct discharge of storm water runoff from the existing storm drainage system by diverting runoff to infiltration areas within the existing right of way. 5 sites used simple grass infiltration areas, and the sixth site used an underground pipe chamber system to control runoff. Monitoring of the project has shown dramatic bacteria reductions downstream of the pipe outfalls, far exceeding even the most aggressive pre-project modeling and estimates. The presentation will include a discussion of the strategy, design, construction, and monitoring results.

- 6B-2 **Route 9 Drainage Improvements – Pervious Asphalt**
Michael Sears, HNTB



A relatively flat, ¼-mile stretch of Route 9 in Stafford Township, Ocean County experienced prolonged flooding in the southbound shoulder during periods of moderate rainfall. Commercial driveways were often impassable for several days, resulting in adverse impacts to businesses within the corridor. The New Jersey Department of Transportation hired Dewberry Engineers Inc. to design a solution that would eliminate the flooding as quickly as possible. Percolation tests revealed very high infiltration rates throughout the project area. Hence, in order to avoid impacts to subsurface utilities, the need for environmental permitting, and the acquisition of private property, pervious asphalt was installed in lieu of traditional closed drainage systems and detention facilities. The pervious asphalt, which can quickly infiltrate storms of 25-year magnitude or less, was installed throughout the entire 7-foot wide shoulder for the full ¼-mile long project area. As a back-up to the pervious asphalt, the existing concrete curb was notched to allow runoff to drain into an island of river jack stone lying between the shoulder and the sidewalk. Last winter, the project area received very heavy snowfall with subsequent salt and sand treatment. Despite this, the pervious asphalt continues to function as originally designed.

6B-3 Research to Optimize the Nutrient Removal Performance of Storm water BMPs Within the Right-of-Way

Brian Lipscomb, North Carolina Department of Transportation



DOT's and other transportation facility managers are faced with many challenges in treating storm water runoff. One of those challenges is the limited right-of-way within a linear environment. NCDOT is looking into ways to optimize storm water treatment within the swale section of a typical roadway cross-section. NCDOT recently installed multiple swales and bio-swales in an interchange in piedmont North Carolina to meet retrofit requirements under the Department's NPDES permit and nutrient load reduction regulations for a local water supply reservoir. These devices have been modeled using a version of the Jordan/Falls Lake Storm water Nutrient Load Accounting Tool (JLSLAT) customized for transportation to estimate nutrient load reductions. These devices are also slated to be monitoring as part of an active NCDOT research project with NC State University-Biological and Agricultural Engineering Department. Results from this study will be used to develop design guidance as well as volume and nutrient load reduction credits for these device types for use in the JLSLAT.

6B-4 Evaluation of the Effect of Highway and Bridge Facilities on Sediment Quality

Chris Moody, The Intelligence Group



Storm water from highways and painted structures such as bridges, discharge to waterways through outfalls and direct run-off. However, quantifying the potential impacts on the receiving waters and sediments are necessary before conducting sediment remediation or to aid in determining the need for source control. This has been becoming increasingly important to state and local agencies as their facilities have been identified as key sources at sediment Superfund sites. In fact, there are three cases (two in WA and one in OR) where this issue has surfaced. As such, the need to develop methods for identifying which chemicals of concern (COCs) are associated with storm water from these facilities and solutions for evaluating the quantity and impact of that discharge to the adjacent waterways are necessary. The Intelligence Group is currently engaged in these sites, and will provide those attending with the methods ("how to") for evaluating sediment concentrations attributed to storm water run-off from roads and bridges. The results of this type of evaluation allow for the comparison of COC concentrations in sediments attributable to storm water to established preliminary remediation goals (PRGs) (or other clean-up goals) to determine the impact, if any, of storm water loading to a study area.

Session 7A – Emerging Sustainable Concepts

- 7A-1 **North Carolina Department of Transportation Resource Conservation: Where We Were, Where We Are, and Where We're Going**
Alyson Tamer, North Carolina Department of Transportation
- 7A-2 **Utilization of Intrinsic Vehicle Sensors to Enhance Winter Maintenance Operations**
Cristian Druta, Virginia Tech Transp. Institute
- 7A-3 **Related Global Trends: Smart/Resilient Mega-Cities, Sustainability and Big Data**
Thomas Lewis, Louis Berger Group
- 7A-4 **Evaluation of Waste Concrete Road Materials for Use in Oyster Aquaculture**
Dong Hee Kang, Morgan State University

- 7A-1 **North Carolina Department of Transportation Resource Conservation: Where We Were, Where We Are, and Where We're Going**
Alyson Tamer, North Carolina Department of Transportation



Since the introduction of the conservation initiative within the North Carolina Department of Transportation in 1989, efforts have been made to recycle, reuse, and repurpose materials along highway maintenance and construction projects. Pilot projects were initiated to reuse and repurpose scrap tires, demolition debris, and fly ash. Some of the projects yielded positive results, and in other cases additional ideas needed to be explored. Recycled plastic fence posts and recycled plastic barricades have not continued, however recycled plastic guardrail offset blocks have been overwhelmingly successful. It is common place now for NCDOT to instinctively incorporate recycled and repurposed material in many of its products and projects. But each year new ideas are being generated and more and more materials are being recycled, reused, or repurposed as they are incorporated into construction or maintenance projects. NCDOT utilizes recycled asphalt pavement (RAP) as well as recycled asphalt shingles (RAS) commonly throughout the state. But even with the great strides we have taken to conserve resources within NC, there is still opportunity for additional conservation and sustainability efforts. Our hope is for NCDOT to contribute to the overall goal of a sustainable North Carolina.

- 7A-2 **Utilization of Intrinsic Vehicle Sensors to Enhance Winter Maintenance Operations**
Cristian Druta, Virginia Tech Transp. Institute



Each year highway agencies spend more than 2.5 billion dollars on snow and ice control operations. As such, real-time identification of hazardous surface conditions such as compacted snow or black ice using onboard vehicle sensors will warn drivers to proceed with caution on compromised road sections, thus reducing the risks of crashes. A technique that detects a slippery road surface condition in real-time using wheel speed sensors data was developed at Virginia Tech Transportation Institute. The technique is capable of detecting instant road slipperiness such as an ice patch as well as continuous slick pavement condition function of vehicle speed and tire-road interaction by supplying a traction index indicating the current state of the pavement surface. The collected roadway information may also be used by highway agencies for more efficient and less costly winter maintenance operations through their Maintenance Decision Support System (MDSS). Under regular winter road maintenance when snowplow operators may misjudge the road surface condition thus under or over treat the surface with deicing material such a friction evaluation system provides a significantly more reliable measure of road surface conditions than does visual inspection.

7A-3 Related Global Trends: Smart/Resilient Mega-Cities, Sustainability and Big Data

Thomas Lewis, Louis Berger Group



With the unrelenting demographic shifts towards mega-cities and initiatives such as the USDOT Smart City Challenge as evidence, major urban centers that often are also most vulnerable to natural disasters and climate change impacts are becoming more and more critical to transportation infrastructure sustainability across all modes - highway/bridge, transit/rail, ports, airports, etc. This presentation will examine the root issues associated with this important shift as well as the pivotal and inter-related roles that sustainable, green solutions and big data management and technology transfer will play in this aspect of our transportation future.

7A-4 Evaluation of Waste Concrete Road Materials for Use in Oyster Aquaculture

Dong Hee Kang, Morgan State University



Highway agencies remove old concrete, which is usually discarded and places a burden on landfills or other disposal sites. Instead of discarding this material, it may be of interest to Maryland's State Highway Administration (SHA) to recycle it into an alternative use, such as to condition portions of the Chesapeake Bay bottom to support spat-on-shell oyster restoration or aquaculture projects. For recycled concrete aggregate (RCA) to be used within the aquatic setting of the Chesapeake Bay, it must have no direct negative environmental impacts, that it is practical to use for this application, and it meets regulatory criteria. In this study, the chemical behavior of RCA under saturated conditions resulted in either no leaching of adverse materials or leaching at a rate that is orders of magnitude below regulatory levels. Further, the introduction of RCA did not raise pH above the minimum threshold for introduction in Maryland waters. Laboratory and field experiments showed there was no difference in RCA and oyster shell on oyster recruitment, survival, or growth, nor was there an effect on the associated community of organisms. The results indicate the suitability of recycled concrete from road projects as bottom conditioning material for on-bottom oyster aquaculture.

Session 7B – Improving Your Stormwater Program’s Triple Bottom Line

7B-1 **Reducing Storm water Infrastructure Costs through Better Soil Management**

Gary Gittere, North Carolina Composting Council

7B-2 **Prioritizing BMP Maintenance by Utilizing a Ranking System**

Kathleen Cabe, EEE Consulting

7B-3 **Using Research to Enhance North Carolina Department of Transportation's Highway Storm Water Program: An Overview**

Ryan Mullins, North Carolina Department of Transportation; Karthik Narayanaswamy, AECOM

7B-4 **Maryland's Critical Area Program: Challenges and Opportunities of Implementing a Watershed Management Program, A State DOT's Perspective**

Adriene Metzbower, Maryland Department of Transportation

7B-1 **Reducing Storm water Infrastructure Costs through Better Soil Management**

Gary Gittere, North Carolina Composting Council



This presentation will make the connection between the economic challenges of storm water management and the utilization of compost as a soil amendments as the first step to the reduction of storm water. No one strategy will be right for all situations, but if runoff from as much as 90% of all rain events can be reduced or eliminated by incorporating compost into the soil, then this level of performance and cost savings will lead to a wider adoption of compost-based strategies for storm water management. A healthy soil with sufficient levels of soil organic matter (SOM) and robust microbial activity holds water and degrades pollutants. Nature replenishes organic matter by recycling dead plants, animals, and their wastes through the process of decay. But human land disturbance has scraped, eroded and depleted topsoil without restoration, breaking the natural soil cycle. In many parts of the world, including the U.S., nature can no longer keep up with replenishment. Compost, with its high organic matter content, has been shown to have significant water-holding capacity, so much so, that there may be no runoff from low-to-moderate rain events where compost is used as a storm water BMP. According to the National Resources Conservation Service, every 1% of soil organic matter in the top 6” of soil holds about 27,000 gallons per acre -- the same volume as a typical rainfall. Fortunately, the natural soil cycle can be restored. When captured, composted and returned to the soil to rebuild organic matter content, residuals and by-products generated by modern societies in the form of organic waste can transform public parks, sports fields, suburban lawns and roadsides into mechanisms for water retention, percolation and pollutant filtration/degradation.

7B-2 **Prioritizing BMP Maintenance by Utilizing a Ranking System**

Kathleen Cabe, EEE Consulting



As storm water regulations have become more stringent, the number and types of BMP’s constructed have significantly increased. Inspection, maintenance and repair of these facilities is critical to ensure their long term functionality. This too has become more regulated, although budgets in this area have not significantly increased. Routine maintenance can prevent severe issues and expenditures. However, what is considered routine maintenance? How does that vary between different BMP types? With limited funding, how do you prioritize repairs and maintain compliance? EEE has developed a ranking system for inspection of BMP’s that translates into a maintenance plan and associated schedule. The ranking system breaks down the different types

of BMP's into groups based on their general functionality. For each general grouping an inspection form was developed that listed components of the facility and associated inspection criteria. The component is ranked according to the level of maintenance required. After all components are ranked, the overall facility is given a ranking based on the individual components. The components themselves are weighted in this ranking based on their impacts to the facility functionality and potential failure threat, thus generating a maintenance plan and repair schedule.

7B-3 **Using Research to Enhance North Carolina Department of Transportation's Highway Storm Water Program: An Overview**

Ryan Mullins, North Carolina Department of Transportation; Karthik Narayanaswamy, AECOM



Ryan Mullins



Karthik
Narayanaswamy

NCDOT has funded over \$10M of research to better understand storm water quality and treatment in the highways, bridges and non-road environment. NCDOT is relatively unique among NPDES permittees in North Carolina in the requirement to contract with universities and other independent outside researchers to assess storm water quality and evaluate mitigation strategies. For over 15 years now, NCDOT has sought to characterize runoff from primary and secondary roads and bridge decks, and evaluated the effectiveness of both traditional practices like swales and emerging practices like biofiltration conveyance to treat storm water. The results of this work have been used to guide the development of the NCDOT BMP Toolbox, an NCDOT-specific loading rate calculator to comply with watershed-based rules, and to support scientifically-driven Total Maximum Daily Loads (TMDLs). NCDOT is now looking into using these data with FHWA/USGS' Stochastic Empirical Loading and Dilution Model (SELDM) to support post-construction storm water BMP decision making. This presentation will provide an overview of the research program, highlight specific projects, discuss how the data is generated and used, and discuss future NCDOT initiatives to leverage these data to drive the storm water program.

7B-4 **Maryland's Critical Area Program: Challenges and Opportunities of Implementing a Watershed Management Program, A State DOT's Perspective**

Adriene Metzbower, Maryland Department of Transportation



This presentation discusses the challenges the Maryland Department of Transportation State Highway Administration (SHA) has encountered with Maryland's Critical Area program, but also highlights the tools Maryland is using to overcome these issues. The Critical Area Act (enacted in 1984) established a regulatory watershed management program with the goal of minimizing the adverse effect on water quality and natural habitats and foster consistent, uniform and more sensitive development activity within the Critical Area. Most states have watershed management programs in one capacity or another, and often these programs are developed with non-linear development in mind. These programs may be administered by either public or private entities, but often there are conflicting goals and interests between DOTs and watershed groups. In order to better serve the citizens of the State of Maryland, SHA is collaborating with the Critical Area Commission to better meet the goals of each organization. We're using tools such as interagency agreements, an MOU, and generally improving the lines of communication to eliminate the "us vs. you" mentality. We are also developing a fee-in-lieu mitigation banking system to improve project delivery and the quality of our mitigation. These tools have improved efficiency in project review and bridged the gap between the missions of our organizations.

Session 8A – Improving Project Sustainability

8A-1 **Recycled Material Web Map: Connecting Consumers and Producers**
Brittany Shake, The University of Alabama

8A-2 **Mobile to Real-Time Environmental Management Systems**
Frances Curtis, Apex Companies, LLC

8A-3 **Green Bond Financing Opportunities for Transportation Projects**
Phillip Ludvigsen, First Environment, Inc.

8A-4 **Forecasting Demand for Electric Bicycles and Their Sustainability Impacts:
Case Study for a University Campus**
Michael Maness, Oak Ridge National Laboratories

8A-1 **Recycled Material Web Map: Connecting Consumers and Producers**
Brittany Shake, The University of Alabama



An online Geographic Information System (GIS) web application that connects producers and consumers of recyclable material was developed to assist engineers and contractors in the beneficial reuse of recycled materials in transportation projects. The Recycled Material Web Map is comprised of four core layers: producers, stockpiles, specifications, and case studies. Producers of recycled material can locate their facility and enter contact information. The stockpile layer, connected to the producer layer, allows facility managers to add or update information about their recycled material stockpiles including material type(s), application(s), availability, and cost. Multiple stockpiles can be associated with each producer. The specification layer includes both Department of Transportation (DOT) specifications and environmental regulations pertaining to the beneficial reuse of nonhazardous recycled material based on specific location, material type, and application. The case study layer locates projects that successfully utilized recycled materials and includes information regarding the material type, application, volume data, and any additional documentation. As potential consumers of recycled material, engineers and contractors can pinpoint the location of a construction project, search for sources and quantities of recycled material that meet project specifications, and contact material producers. The web map utilizes search capabilities to locate nearby stockpiles to minimize transportation costs that typically dictate the use of large volumes of materials. The Recycled Material Web Map provides key information that engineers and contractors need to successfully utilize recycled materials, thereby preserving limited natural resources and benefiting the project and society as a whole. The web map is available at <http://rmwm.caps.ua.edu>.

8A-2 **Mobile to Real-Time Environmental Management Systems**
Frances Curtis, Apex Companies, LLC



What if you could quickly and easily – manage all of your assets and field activities in one place? Track all of your sampling, inspection, maintenance and repair issues? Meet your regulatory requirements? Address your business and sustainability goals? The use of flexible mobile field data collection tools and centralized cloud-based environmental management systems are a great cost effective solution for industries who want to be proactive with their environmental program. Using the Software as a Service (SaaS) model, removes the need to invest in hardware, software and specialized labor to implement an enterprise wide system,

providing digital data collection to real-time reporting with a short implementation period. Once critical data is collected in a database format, the ability to run Key Performance Indicators (KPI) is streamlined, and centralized allowing companies to track their performance across different metrics.

8A-3

Green Bond Financing Opportunities for Transportation Projects

Phillip Ludvigsen, First Environment, Inc.



Climate change impacts represent a significant technical and financial challenge for the transportation industry. Once risk-based decisions are made, it will take trillions of dollars in financing to pay for actions to address vulnerabilities. Where is this money going to come from? One of the fastest growing new fix-asset investment classes is “Green Bonds” – that is, bonds that provide an environmental or climate-related benefit. Growing numbers of long-term investors are driving up the demand for this form of environmentally responsible financing. Current examples in the transportation industry include improved mass transit management, high efficiency rapid bus transit, low-carbon electrified railway and sustainable urban transport. This presentation will summarize the green bond process as defined by the Green Bond Principles including Project Selection, Use of Proceeds, Management of Proceeds and Reporting/Assurance. The speaker will also address considerations for bond development, underwriting, pre-issuance review, issuance, and reporting/assurance under the new Low Carbon Land Transport and the Climate Bonds Standard 2.0. Attendees will learn about the unique risks and rewards associated with these types of bonds, and how to apply best practices to manage risks and attract investors. Case studies from the transportation agencies pioneering green bonds in North America will be presented.

8A-4

Forecasting Demand for Electric Bicycles and Their Sustainability Impacts: Case Study for a University Campus

Michael Maness, Oak Ridge National Laboratories



Electric bicycles – while popular in some Chinese cities – have seen limited use in the United States. The sustainability impacts of electric bicycles are mixed. On the one hand, an electric bike trip powered from non-renewable energy sources has a greater carbon footprint than an equivalent normal bike trip. But on the other hand, an electric bike trip will have a significantly smaller carbon footprint than a motor vehicle trip. Thus, an important factor in understanding the sustainability aspects of electric bikes is to forecast changes in mode share for trips. This will have impacts on policy recommendations regarding electric bicycles. In this study, a case study is undertaken to estimate the energy and greenhouse gas emission impacts of increasing electric bicycle usage on the University of Maryland campus. Using a campus travel survey and discrete choice models, various behavioral and policy scenarios are explored. Results show that energy and emission reductions could be found with infrastructure improvements.

Session 8B – Environmental Risk Management

8B-1 **Environmental Liability and Right of Way/Easement Acquisition – Martin Luther King Expressway Extension, Portsmouth, Virginia**

Douglas Fraser, EEE Consulting, Inc.

8B-2 **A Practical Approach to Environmental Risk Prioritization**

Daniel Smith, Apex Companies, LLC

8B-3 **North Carolina DEQ's Implementation of Risk-based Remediation**

Janet Macdonald, North Carolina Department of Environmental Quality

8B-4 **Statistical Evaluation to Determine Background Metal Soil Concentrations**

Matt Jenny, Geosyntec; Gordon Box, North Carolina Department of Transportation

8B-1 **Environmental Liability and Right of Way/Easement Acquisition – Martin Luther King Expressway Extension, Portsmouth, Virginia**

Douglas Fraser, EEE Consulting, Inc.



The Martin Luther King (MLK) Expressway Extension is an elevated four lane interstate from London Boulevard and the expanded Midtown Tunnel to existing I-264. The MLK extension project is part of a VDOT Public Private Partnership (P3) project that includes a new two-lane Midtown tunnel under the Elizabeth River adjacent to the existing Midtown Tunnel, and add fire and safety upgrades to the downtown tunnels. The MLK extension involved a complex alignment and right of way/easement acquisition program through a mixed residential, commercial, and industrial section of Portsmouth, Virginia that dates to the early 1800's. One of the more complicated sites was Old Dominion Demolition (ODD) which occupied two parcels in the central part of the MLK Extension. The approximately 3.0-acre ODD facility which has occupied the site since 1992 includes a "Scrap Yard" that was used for storage of miscellaneous materials removed from demolition sites and demolition equipment, and an equipment workshop. The main part of the facility consisted of multiple large piles of demolition debris. Facility operations consisted of the segregation, crushing, and recycling of concrete, bricks, and stone, and other construction demolition materials (i.e., wood, fiberglass, metal). Reportedly plastics, fiberglass, wood, and metals were segregated from the construction debris for re-sale or recycling. Non-recycled materials were reportedly disposed of at the Bethel Sanitary Landfill in Hampton, Virginia.

Several pre-construction environmental assessments indicated multiple recognized environmental conditions (RECs) including evidence of releases from bulk oil storage areas (i.e., buckets, 55-gallon drums, and ASTs (many without secondary containment), potential ACM and medical waste were reportedly mixed/ground up as part of the facility's recycling operations, piles of batteries and universal waste, and the unknown contents of numerous trailers and conex boxes. In addition, the contents and potential chemical hazards in the multiple large debris piles was a significant unknown. As the roadway alignment bisected the property, VDOT originally (pre-P3 contract) intended to execute a fee simple take of the both parcels, retaining less than one-acre for the ROW and possibly re-selling the excess property for repurposing. The elevated roadway through the site only required minor ground disturbance for construction of two bridge piers, and a short stormwater conveyance. Never-the-less the potential liability associated with a full take was significant due to the potential RECs presented above. As the ROW acquisition was going to eminent domain, the site owner barred VDOT and project P3 contractor responsible for facilitating the ROW acquisition and business relocation, from

conducting any further Phase II site investigations. Preliminary remediation estimates were developed for entire property. VDOT successfully negotiated (outside of eminent domain) a partial acquisition of the property necessary for the roadway as well as relocation payments for the entire business assets on property.

8B-2 **A Practical Approach to Environmental Risk Prioritization**

Daniel Smith, Apex Companies, LLC



Intelligent prioritization of environmental issues is critical in the transportation industry where budget constraints and staffing limitations often make it impractical to address all environmental needs concurrently. Most organizations focus on the pressing environmental issue of the day without formalizing an approach to better understand their overall environmental risks and where their resources can best be applied to reduce those risks most effectively. This presentation presents a structured approach to analyze environmental concerns to prioritize where resources (in the form of staff and dollars) can best be applied to reduce risks and provide the best return on intellectual and capital investment. The presentation will identify environmental concerns with the most potential for exposure and enforcement actions as well as strategies to eliminate risks that have been determined to be the highest priority. In addition, the presentation will discuss establishment and reduction of proper environmental reserves for both short- and long-term environmental program management.

8B-3 **North Carolina DEQ's Implementation of Risk-based Remediation**

Janet Macdonald, North Carolina Department of Environmental Quality



In North Carolina, risk-based remediation for all media has historically been available only under Programs regulating leaking UST sites, contaminated dry-cleaning sites, and pre-regulatory landfill sites. In 2011, Session Law 2011-186 allowed risk based cleanups for industrial properties with releases reported prior to March 1, 2011 that were confined to the source property. In October 2015, Session Law 2015-286 further expanded the use of risk-based remediation across NC DEQ cleanup programs, by allowing risk-based remedies for sites where contamination has migrated or will migrate off-site. This presentation will review the directives required by Session Law 2015-286 and provide a summary of the steps taken to satisfy those directives. The presenter(s) will provide an update on the status of: (I) the development of remediation guidance across the DEQ cleanup programs, (ii) the administrative procedures for pursuing a risk-based remedy under SL 2015-286; (iii) the risk evaluation tools available to remediating parties; and (iv) the GIS tools available to the public to locate known sources of contamination and properties where land-use restrictions are part of an approved risk-based remedy.

8B-4

Statistical Evaluation to Determine Background Metal Soil Concentrations

Matt Jenny, Geosyntec; Gordon Box, North Carolina Department of Transportation



Matt Jenny

Many naturally-occurring Resource Conservation and Recovery (RCRA) metals are commonly found in soil elevated above the respective North Carolina Soil-to Groundwater Maximum Contaminant Concentration (SG-MCC) values. As part of a Preliminary Site Investigation, a statistical analysis was performed to establish threshold values that are likely to represent naturally-occurring background levels of select metals in the site soils.



Gordon Box

Session 9 – Poster Session

- P-1 **Synergistic Approach to Processing Aggregate Fines and Coal Fly Ash for Beneficial Re-use**
Robert Mensah-Biney, North Carolina State Minerals Research Laboratory
- P-2 **Environmentally Friendly Pervious Concrete with Fly ash as Sole Binder**
Gang Xu and Xianming Shi, Washington State University
- P-3 **Blending Use – An Innovative Way to Fully Utilization of Nontraditional Materials or Byproducts**
George Wang, East Carolina University
- P-4 **Compliance Analysis of CAFE and GHG Standards from Market Acceptance’s Prospective**
Fei Xie, Oak Ridge National Laboratories
- P-5 **Modeling of Oxyanion Speciations Released from Geopolymer Using PHREEQC**
Sanusi Et al, University of North Carolina Charlotte
- P-6 **A Dynamic Contact Angle Measurement Technique for Water Repellent Coal Fly Ash**
Jenberu Feyyisa and John Daniels, University of North Carolina Charlotte
- P-7 **Water Retention Characteristics of Compacted Coal Combustion Residuals from SE US Power Plants**
Livingstone Dumenu, Mehrab Moid, Carlos Rodriguez, Miguel A. Pando, Vincent Ogunro, and John Daniels, University of North Carolina Charlotte
- P-8 **Bio-based Renewable Additives for Anti-icing Applications**
Mehdi Honarvarnazari and Xianming Shi, Washington State University
- P-9 **Water Absorptivity and Permeability of High Volume Fly Ash Mortars with Various Chemical Admixtures**
Sen Du and Xianming Shi, Washington State University; Yong Ge, Harbin Institute of Technology

- P-1 **Synergistic Approach to Processing Aggregate Fines and Coal Fly Ash for Beneficial Re-use**
Robert Mensah-Biney, North Carolina State Minerals Research Laboratory



Robert
Mensah-
Biney

Synergistic Approach to Processing Aggregate Fines and Coal Fly Ash for Beneficial Re-use
Gemma Dove, Johnathan Simms, Fred Thompson, Hamid Akbari, Robert Mensah-Biney North Carolina State Minerals Research Laboratory, 180 Coxe Ave, Asheville, NC 28801 Abstract
An extended research study of the effectiveness of producing synthetic aggregates and concrete using combinations of quarry ponded fines and coal fly ash is ongoing at the NC State Minerals Research Laboratory (MRL) in Asheville. The initial study evaluated production of synthetic aggregates (fired pellets) from ponded fines using colloidal silica as a binder. The next study evaluated production of synthetic aggregates (fired pellets) from the fines using bentonite as a binder. Variables tested during these studies included weight % binder, initial moisture content



Gemma
Dove

of green pellets, firing temperature and operation conditions of the disc pelletizer. The current ongoing study is evaluating production of synthetic aggregates from the ponded fines using geo-polymer cement as the binder. The geo-polymer cement was produced from coal fly ash according to the standard procedure by Davidovits et al. Variables tested during the current study included weight ratio of ponded fines to coal fly ash, moisture content, ratio of sodium silicate to sodium hydroxide, curing temperature and curing time for the geo-polymer cement. The testing methods for the synthetic aggregates followed the North Carolina Department of Transportation guidelines for coarse aggregate. They included sieve analysis, Los Angeles abrasion, absorption, specific gravity, SEM, and soundness tests. The poster presentation will show the methodology, the results and conclusions for the studies. In general, the study has shown that synthetic aggregates of comparable strength (with natural aggregates) can be produced from ponded quarry fines. The current study using the combination of quarry fines and coal fly ash is ongoing and will in the future include preliminary economic feasibility studies.



Hamid
Akbari

P-2

Environmentally Friendly Pervious Concrete with Fly ash as Sole Binder

Gang Xu and Xianming Shi, Washington State University



Gang Xu

An environmentally friendly pervious concrete mix design was developed by using fly ash as sole binder with the desirable workability, compressive strength and split tensile strength. The durability of this pervious concrete was tested as well, which includes salt scaling, freeze-thaw and abrasion resistance. The mix design in this study will not only reduce the demand for Portland cement in pervious concrete application, but also divert the fly ash from industrial wastes.

P-3

Blending Use – An Innovative Way to Fully Utilization of Nontraditional Materials or Byproducts

George Wang, East Carolina University



Inhibiting factors exist in users and public in slag and other recycled materials utilization. These factors come from the following: inherent variability; liability concerns for innovative technology; inappropriate environmental constraints; user conservatism; obsolete specifications; lack of technical guidance. In these factors, only the last one is technical related, i.e. lack of technical guidance. Any restrictions that prohibit the use of nontraditional or byproduct materials without technical basis should be removed. The questions facing researchers are what is the technical basis? How to develop the technical basis? Quantifying the properties, developing usability criteria, and developing the optimum proportions of multiple recycled materials can answer these questions. This presentation enunciates why blending use of a nontraditional material with other recycled material(s) is an innovative way to fully utilize any solid recycled materials.

P-4

Compliance Analysis of CAFE and GHG Standards from Market Acceptance's Prospective

Fei Xie, Oak Ridge National Laboratories



In this study, we evaluated the compliance of both CAFE and GHG standards with a time framework spanning over two phases of the National Program (phase I: 2012 ~ 2016 and phase II: 2017 ~ 2025). To evaluate the compliance of the standards, we considered a simulation approach to estimate the market acceptance of advanced vehicle technologies in new vehicle sales for the entire national light-duty vehicle fleet. This simulation work was conducted using the Department of Energy's Market Adoption of Advanced Automotive Technologies (MA3T) model which is a market simulation tool. In particular, this study aimed at answering two

research questions: (1) at what level the CAFE and GHG standards will be met based on the market choices of conventional vehicle technologies without considerations of alternative fuel vehicle, and (2) by how much additional benefit can be generated for the National Program if alternative fuel vehicles (e.g., electric vehicles) are included in the market.

P-5

Modeling of Oxyanion Speciations Released from Geopolymer Using PHREEQC

O. Sanusi, W. Langley, and V.O. Ogunro, University of North Carolina Charlotte



Vincent
Ogunro

The suitability of fly ash based geopolymer concrete as a replacement for ordinary Portland cement (OPC) concrete depends on the mobility of elements from the material. Due to the alkaline nature of geopolymer concrete, there is a potential for the release of oxyanion forming elements such as As, Cr and Se which are characterized by their high mobility in the alkaline environment. In this study, geopolymer concretes were subjected to tests that include pH dependence test, Dutch availability test, tank test, water leach test, mineralogical, microstructural analysis and geochemical modeling using PHREEQC/PHREEPLOT. The results of this study confirmed that As and Se and other oxyanion forming elements exhibit higher mobility in the alkaline pH. Further investigation using the Dutch availability and tank test showed that As have the highest mobility from all the geopolymer concretes. It also reveals that the mobility of As and Se reduces with time as the element becomes depleted in the matrix. Finally, PHREEQC/PHREEPLOT identifies species of leached oxyanion elements (As, Cr, Se) as As (5), Se (6) and Cr (6). These species of As and Se have low toxicity whereas the species of Cr is of the more toxic form, but it is released in level far below the Maximum Concentration Level (MCL) set by EPA for drinking water.

P-6

A Dynamic Contact Angle Measurement Technique for Water Repellent Coal Fly Ash

Jenberu Feyyisa and John Daniels, University of North Carolina Charlotte



Jenberu
Feyyisa

Approximately 60 million tons of Coal Fly Ash (CFA) are produced in the U.S. each year. As a construction material, CFA finds considerable use as a partial replacement for Portland cement, as structural fill, and as an additive for waste stabilization and environmental remediation. These and other applications result in a recycling rate of nearly 45%, with the remaining relegated to disposal in ash impoundments or landfills.

P-7

Water Retention Characteristics of Compacted Coal Combustion Residuals from SE US Power Plants

Livingstone Dumenu, Mehrab Moid, Carlos Rodriguez, Miguel A. Pando, Vincent Ogunro, and John Daniels, University of North Carolina Charlotte



Livingstone
Dumenu

Recent regulation by U.S. Environmental Protection Agency aims to minimize risk associated with handling and disposal of coal combustion residuals (CCR). In that regard, there is the need to develop new disposal approaches with structural and hydraulic applications of engineered CCR. This paper presents the results of an ongoing research on seven CCR from three power utilities across the US. The study focuses on the engineering properties specifically index properties, XRF, XRD and compaction characteristics; and the development of ash-water characteristics curves (AWCC) to understand the relationship between suction and moisture content and evaluate hysteresis. The CCR samples are compacted at optimum water content and maximum dry density applying standard proctor energy. Measurement of the suction and moisture content relationship are determined by the pressure-plate device, filter paper method and a dewpoint potentiometer. Each device/test procedure has been calibrated using soil sample to minimize variability in measured data from these various devices. Also investigated in this

study, is the hydraulic behavior of organo-silane (OS) chemical treated CCR, which essentially renders the compacted CCR hydrophobic, by measuring the breakthrough head which may ultimately govern design applications. The findings of this study would be relevant towards proposing an alternative and effective management practices in handling and disposal of CCR.

P-8

Bio-based Renewable Additives for Anti-icing Applications

Mehdi Honarvarnazari and Xianming Shi, Washington State University

Xianming
Shi

In this work, we evaluated the performance and impacts of several bio-based anti-icers along with traditional chloride-based anti-icer (salt brine). A statistical design of experiments (uniform design) was employed for developing anti-icing liquids consisting of cost-competitive chemicals such as bio-based compounds (e.g. sugar beet extract and dandelion extract), rock salt, sodium metasilicate, and sodium formate. We examined the following experimentally-obtained parameters as a function of the formulation design: ice-melting capacity and ice penetration at 25°F (-3.9°C) and 15°F (-9.4°C), compressive strength of Portland cement mortar (PCM) samples after ten freeze-thaw/deicer cycles, the corrosivity towards C1010 carbon steel after 24-hour immersion, and impact on asphalt binder's stiffness. Finally, one viable formula ("best performer") was tested for: freezing point depression phase diagram (ASTM D 1177-88) and friction coefficient of asphalt pavement treated by this anti-icing formulation (vs. 23 wt.% NaCl) at a certain temperature near 25°F or 30°F after being applied at 30 gallons per lane mile (1 hour after simulated trafficking and plowing). The laboratory data shed light on the selecting and formulating the innovative bio-based snow and ice control chemicals which can significantly reduce the costs of winter maintenance operations. This exploratory investigation paves the road toward a more systematic study to optimize "greener" anti-icers using renewable resources.

P-9

Water Absorptivity and Permeability of High Volume Fly Ash Mortars with Various Chemical Admixtures

Sen Du and Xianming Shi, Washington State University; Yong Ge, Harbin Institute of Technology

Xianming
Shi

The transport properties of concretes and mortars are known to be important indicators of their durability, and may have a close relationship with their resistance to salt scaling as well. This work aims to optimize the transport properties of the high volume fly ash (HVFA) mortars which replace Portland cement with Class C fly ash at 60% by weight. Ten chemical admixtures (five non-polymers and five polymers) were investigated as waterproof admixtures for HVFA mortars. The compressive strength, splitting tensile strength, and water sorptivity of all mortar mixtures and gas permeability of selected mixtures were tested. Experiment results show that the water sorptivity of some HVFA mixtures were reduced due to the admixing of chemical admixtures, while the other mixtures show an increased water sorptivity as admixing different dosage of the chemical admixtures. However, for the gas permeability of selected mortars, some of the polymers showed some improvement while all the non-polymers exhibited adverse effect. In addition, the surface free energy of the selected mortars was calculated from the results of contact angle test to characterize the water sorptivity. Similarly, the gas permeability was also featured using the porosity obtained from both the standard test and Electron Probe Micro-Analysis.

Hotel Floor Plan

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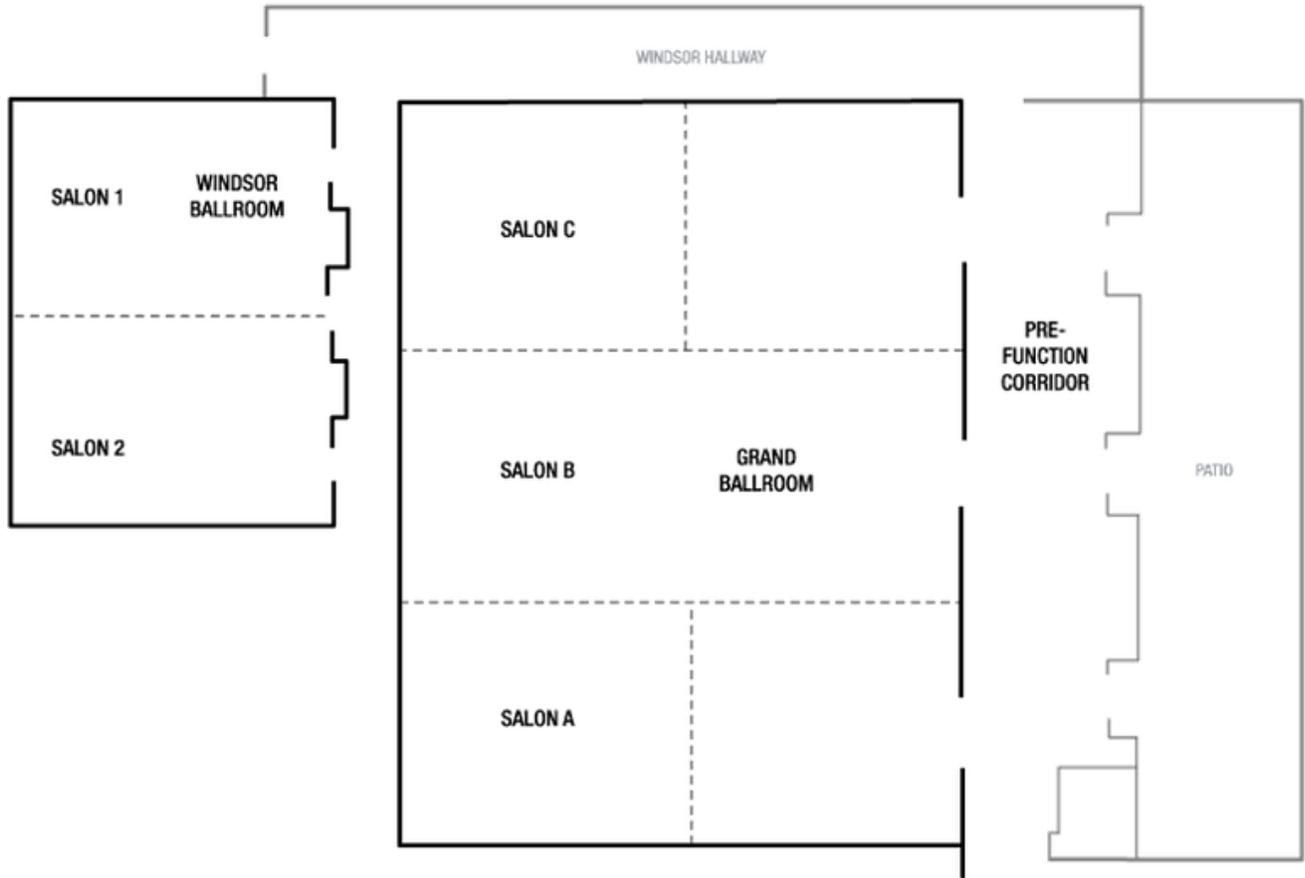
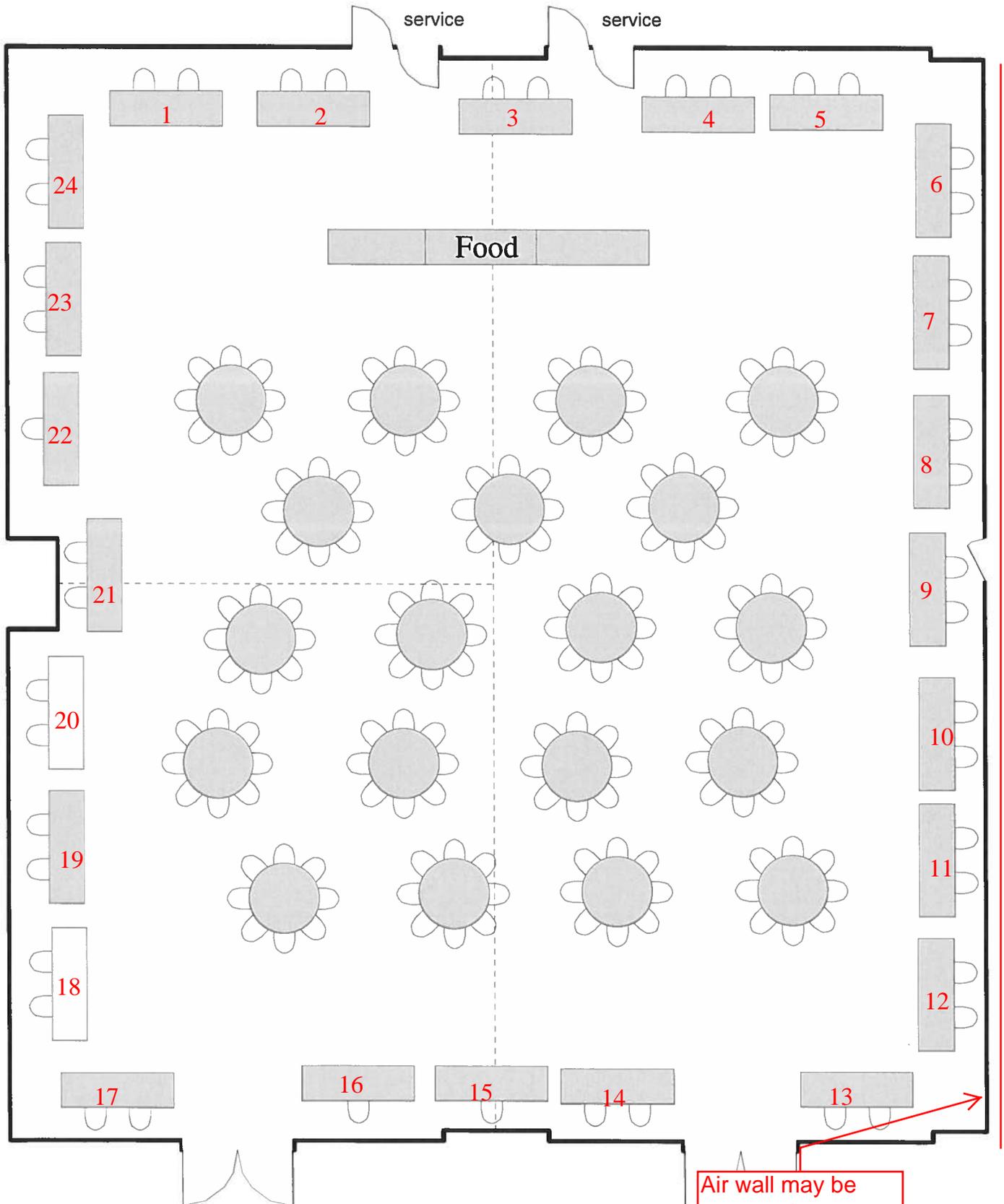


Exhibit Area Floor Plan



Salon A2
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Salon B



Air wall may be open to the Ballroom C Session

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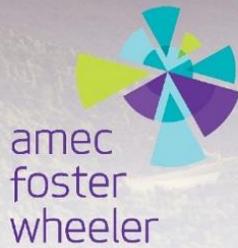
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