

TranSearch

DELAWARE CENTER FOR TRANSPORTATION

YOUR MAIN RESOURCE FOR TRANSPORTATION EDUCATION,
RESEARCH & TECHNOLOGY TRANSFER

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DELAWARE | College of
Engineering

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for Transportation

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DCT is Going Green!

This is the last printed issue—
saving paper and hitting the internet.
See p.2 for more info.

A Banner Year for Engineering Student Chapters

Engineering students at the University of Delaware have set the bar higher in the past year or so through a resurgence of active membership in student chapters of professional organizations. The American Society of Civil Engineers (ASCE), the Institute of Transportation Engineers (ITE), the American Society of Highway Engineers (ASHE), and Engineers Without Borders (EWB) are all experiencing, not just significant student membership, but active students with a robust schedule of activities.



Engineering students were invited guests at the March 2010 Delaware Contractors Association luncheon, where UD President Patrick Harker recognized them as the key to future engineering excellence.

Active student involvement with professional societies like these is a win-win for everyone. Students gain valuable insight into the engineering world beyond their academic studies, they develop important professional contacts that may bear fruit once their academic studies are complete, they earn opportunities for internships before they graduate, they gain a sense of emerging challenges in the engineering field, and they begin an early understanding of how peer to peer contact can be of great benefit to the practicing engineer. Private and public sector engineers and organizations recognize student chapters as a means of "giving back" through mentoring and encouraging the next generation of engineers.
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Message from the Director

Despite the struggling economy, the Delaware Center for Transportation (DCT) remains strong in its main mission of providing quality research projects, training and service. During the last research cycle, the Center received a total of 40 research proposals from faculty in various University of Delaware colleges, as well as from engineers and planners from the Delaware Department of Transportation.

Of those proposals, nine were recommended for funding by the research committee. The funded projects represent a diverse group of fields, including issues related to planning, design, construction, maintenance, operations, control, economy and finance. Perhaps more than ever before, our University of Delaware faculty and research staff perform work on DCT projects with the involvement of planners and engineers from the private sector. This is a great combination of academic, government and consulting companies' engineers and planners all working together to tackle some of the most challenging transportation problems.

Another huge area of success during the last few months has been the recruitment of new Civil and Environmental Engineering students to join professional organizations such as the American Society of Highway Engineers (ASHE), the Institute of Transportation Engineers (ITE), and the American Society of Civil Engineers (ASCE). Because of the work of the DCT staff, the UD student chapters of these professional organizations are enjoying some of their largest

membership numbers in recent history. A few articles within this newsletter discuss these successes.

The staff at DCT has begun the planning process for the next Education and Research Forum. The last Forum, which took place in 2007, was a tremendous success, with more than 300 people in attendance from academia, government, private companies and civic groups. We are targeting November 2012 for our next forum. More detailed news will be forthcoming in the next few newsletters.

And finally, both as a cost saving measure, as well as an environmental-friendly approach to publishing our products, we have decided to discontinue the paper printing of our newsletters and, like almost all other transportation centers, send out an electronic version via email. You can also access a copy from our center's website. For more information, please see the related article on DCT Going Green within this issue and on our website at www.ce.udel.edu/dct. ■



Ardeshir Faghri,
Director

Going Green: DCT News Will Now Be Online Only

The Delaware Center for Transportation will be distributing its semi-annual newsletter via e-mail beginning with the next issue. **We need your help!** If you would like to receive the TranSearch newsletter, please visit our website (www.ce.udel.edu/dct) and enter your e-mail address. This is one way to "go green" by reducing paper and printing. ■



Engineering students won the prestigious Atterberg Cup at GeoFlorida 2010, with guidance from UD Professors Meehan and Leshchinsky, and financial support from six private industrial firms.

(Continued from p.1) These practitioners enjoy the enthusiasm with which engineering students engage as they socialize at professional dinner meetings, during field visits, and at social gatherings. When students are brought on board as interns, many practitioners quickly see beyond the “cheap labor” appeal and recognize the innovation and creativity that engineering students can bring to their work. These are the next generation of engineering leaders, and professional associations have proven to be great incubators for forging the best of both generations going forward.

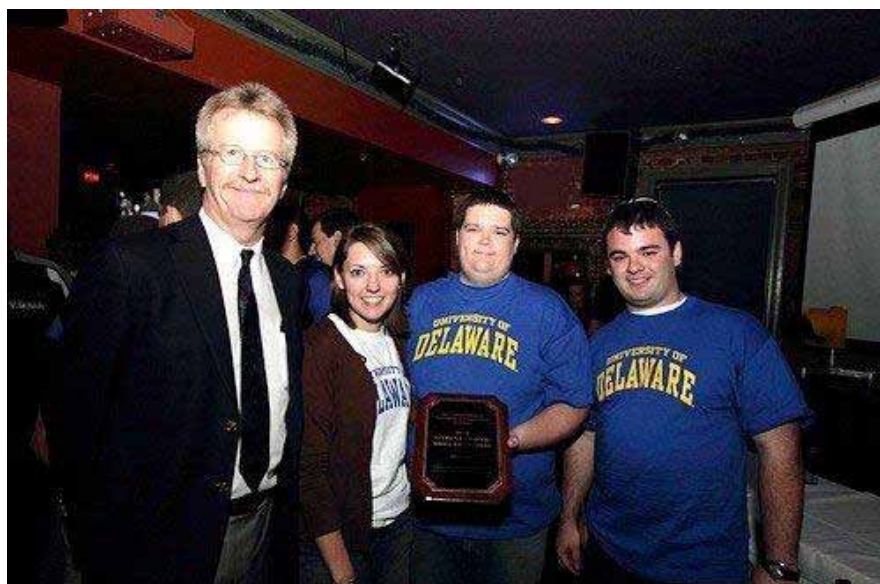
And membership in these professional student chapters hasn’t been higher for many years, which makes it an exciting time for everyone involved. Faculty and staff advisors of these chapters point to several factors that may explain the resurgence. Students today are better informed about the engineering field and the choices available to them upon graduation. This often makes them more focused in their studies and surer of what they wish to do with their education. Practitioners have seen the benefits of playing this type of role with tomorrow’s engineers and they recognize that internships can be far more than just cheap labor. Officers of these student chapters recognize that sustainability depends upon constant outreach to underclassmen and

ensuring that there are opportunities for all members to be involved actively. Robust field activities, opportunities to attend dinner meetings and conferences, and practitioners as invited speakers have allowed the student chapters to offer something to each of their members. In short, membership is viewed as an opportunity rather

than just a line to beef up a résumé.

Practitioners’ commitment to this important transition from academics to engineering practice has been evidenced in a number of ways. Public and private organizations have opened doors to active construction sites (e.g., bridges, paving, concrete roadway repairs, and soil cementing) and operational facilities (e.g., DeIDOT’s Transportation Management Center and the Amtrak training facility) for students to visit up close. Students are not only welcomed to professional dinner meetings, but they are engaged in a meaningful way, creating an early comfort for them among fellow professionals. Invited speakers have been gracious with their time at campus meetings of these student chapters. And several organizations (e.g., DeIDOT, AECOM, Pennoni, JMT, and Sabra Wang) have hired engineering students for meaningful internships this summer.

Too many engineers fail to learn the value of professional association until years after they have entered the field. The resurgence of student chapter activity will help reverse that trend and the students and organizations involved will be the beneficiaries. These students will not suffer those wasted years and these practitioners will not miss out on tomorrow’s engineering leaders. ■



ITE Chapter Advisor, Prof. Rusty Lee with UD engineering students Elisa Kropat, Bob McGurk and Kerry Yost winners of the 2010 Mid Colonial District Championship Traffic Bowl.

UD Wins ITE District Traffic Bowl

On April 29th, members of the student chapter of the Institute of Transportation Engineers (ITE) won the Mid Colonial District Championship Traffic Bowl. The competition was held in conjunction with the 2010 Annual Meeting of the Mid Colonial District of the ITE. Competing against teams from Villanova and Morgan State, they answered questions in the transportation field ranging from history, technical standards and traffic engineering. The competition was set up in a round robin format of 3 rounds, with the team's total score determining the winner. Reflecting the transportation theme of the event, pedestrian call buttons were used by the teams to ring in when they had the answer and traffic signals indicated which team had been the fastest.

This was Delaware's first appearance in the traffic bowl competition. The team of Bob McGurk, Kerry Yost and Elisa Kropat will represent the region at the National Traffic Bowl Championships, to be held in Vancouver, BC later this summer. The chapter is advised by Professor Rusty Lee, Adam Weiser of Delaware DOT and Kate Russo of McCormick Taylor. ■



ITE team members, Elisa Kropat, Bob McGurk and Kerry Yost win the Mid Colonial District Championship Traffic Bowl.

Larry Klepner, Delaware T² Program Coordinator Retires

As we mentioned in our last issue, Larry Klepner, Program Coordinator for the Delaware T² Center retired on January 31, 2010. Larry began his career at DelDOT in 1969, and became director of the T² Center in 1991. In July 2002, the T² Center was relocated to the University of Delaware bringing Larry as part of the staff of the Delaware Center for Transportation.

Larry's retirement party was held on January 29 at the La Casa Pasta Restaurant where his family, colleagues and friends gathered for dinner and a "roast." His excellent service to the T² Center will be missed by all. Larry will enjoy his retirement spending time with his family, traveling, and indulge in his hobby, photography.

DCT welcomes Dr. Earl "Rusty" Lee as Larry's replacement. ■



DCT Director Arde Faghri congratulates Larry Klepner on his retirement from the Delaware T² Center.



7th Annual Research Showcase

The Principal Investigator/Project Manager Research Showcase was held on May 5, 2010. This year's showcase, hosted by the Delaware Center for Transportation, was held in the Farmington/Felton room at the DelDOT Administrative Building in Dover, DE. The showcase/poster session is an opportunity for researchers, graduate students and undergraduate students to discuss ongoing projects that are funded by DelDOT and FHWA. Posters were on display from the following research areas: Bridge, Environment, ITS, Pavement & Materials, Planning, Traffic and Transit, as well as posters from UTC. DCT extends thanks to DelDOT for use of their facilities. ■

Graduate Students Sepideh Eshragh and Reza Taromi discuss the Travel Time and Delay Project with visitor Kaz Tabrizi of Advanced Infrastructure Design, Inc.

David Axe on Logistical Technologies

In April 2010 David Axe, a war correspondent specializing in logistical technologies, gave a UTC/DCT sponsored talk to faculty, students and staff about the movement of men and materiel during conflicts throughout the world.

Mr. Axe made the comparison of the changes in supplies between World War II and the Iraqi conflict: there was one quarter ton of supplies moved per person per month during the invasion of Normandy as compared to one full ton moved per person per month during Operation Iraqi Freedom, a four-fold difference. For the individual soldier this equated to 15 to 20 pounds of gear during World War II as opposed to 75 pounds of gear for those stationed in Iraq.

"Supply lines were one of our greatest strengths and also one of our biggest vulnerabilities," Mr. Axe noted. The key to defeating the US in the Gulf region lay in disrupting the war effort by attacking those supply lines coming from Kuwait. In order to stay ahead of insurgents, the military began exploring convoy active safety technology, or CAST, to reduce loss of human life due to attacks on convoy lines. This technology would use robotics to take the human element out of the system: robotic trucks would follow one truck driven by a soldier. The technology employed would have a sensor that could detect a lane and follow the lead truck. This would reduce the logistical demands of the convoy itself and could save thousands of lives a year.

Mr. Axe indicated that these advancements, along with those such as collision naming systems which would signal drivers with red light or video alerts, have long-ranging implications for highway safety in the United States. The biggest hindrance in getting these in place is not cost and not the lack of technology, but the issue of trust. This trust will be gained little by little as automakers incorporate emerging technologies in the cars that go to market. ■



Professor Earl "Rusty" Lee Appointed as Delaware T² Center Coordinator

Dr. Earl "Rusty" Lee was appointed as the Coordinator of the Delaware T²

Center. Dr. Lee came to the University of Delaware in 2007 as an assistant professor and coordinator of Advanced Traffic Operations for DCT. In addition, he will now head the T² Center where he has been evaluating the program, looking at what has been done in the past and create new ideas for the future which will benefit DelDOT, FHWA, local municipalities, public and private sectors. If you need to reach Rusty, email him at elee@udel.edu. ■

Graduate Students Win National Awards



In May 2010, [Amir Shahpar](#), a Masters student in Transportation Engineering at UD, and a research assistant at the Delaware Center for Transportation (DCT) was awarded a student travel grant by the National Science Foundation (NSF) to present his paper at the "Innovations in Pricing of Transportation Systems" conference which was held in Orlando, Florida.

His paper was titled "A Heuristic Congestion Pricing Scheme for

Capacitated Traffic Networks". Nearly twenty students (out of approximately two hundred) from twelve countries were offered a travel grant by NSF. The selection was based on idea originality, usefulness of the proposed methodology for practitioners, and recommendation letters from professors. The amount of the grant for the students who had applied from the United States was \$700. Amir says, "It was an informative and useful meeting. I became familiar with other researchers' point of view towards the congestion pricing strategies and how different approaches are going to change the travel behaviors". Amir holds a B.S. in Civil Engineering from Isfahan University of Technology, Isfahan, Iran, and an M.S. in Transportation Planning from Sharif University of Technology, Tehran, Iran.



In July 2009, [Sepideh Eshragh](#), a Ph.D. candidate in Transportation Engineering at UD, presented a paper at the 7th International Conference in Computing, Communications and Control Technologies, which was held in Orlando, Florida.

Her paper entitled "Bus Network Modeling Using Ant Algorithms" was rewarded the best paper by the vote of the presenters who were attending the conference.

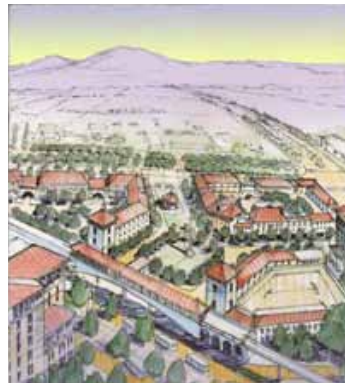
She also served as the co-chair of the session on contemporary computer techniques in transportation. Sepideh

says, "The proposed methodology can be considered as a new method for designing a transit bus network. Ant algorithm, a Meta Heuristic method, has been applied to transportation problems with noticeable success". The performance of her methodology was tested on a real network and the results showed that the proposed methodology and the solution algorithm can efficiently solve the problem. Sepideh holds an M.S. in Civil Engineering from Islamic Azad University, Tehran, Iran. She also worked from 2003 to 2007 for the Tehran Comprehensive Transportation and Traffic Studies Company, the largest MPO in Iran. ■

Transit-Oriented Development: Identification of Optimal Characteristics in Delaware

EDWARD J. O'DONNELL, AICP AND THEODORE A. PATTERSON

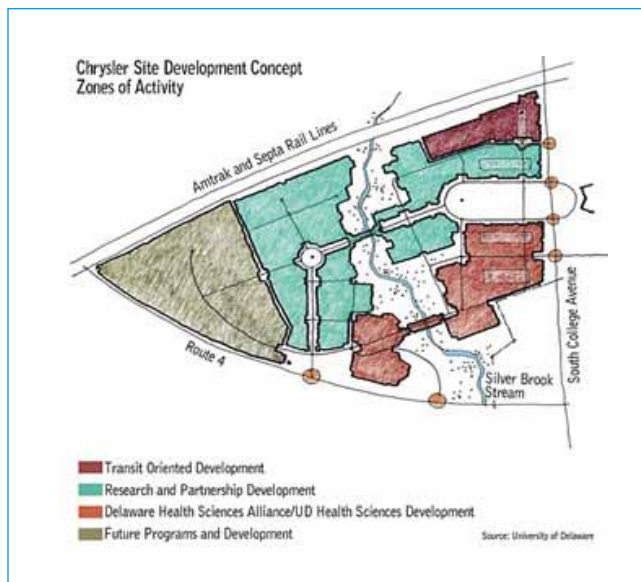
The Institute for Public Administration's Ed O'Donnell and Ted Patterson have been working with the Delaware Center for Transportation to create a preliminary framework for evaluation of potential transit-oriented development (TOD) sites and applying that framework to selected locations throughout Delaware. The paper provides public officials and Delawareans with a roadmap for TOD implementation and success in the 21st century. The project examines six key sites: Newark Train Station, Churchman's Crossing Train Station, Wilmington Train Station, Dover DART Bus Hub, Claymont Train Station, and potential Edgemoor Train Station. The below rendering provided by University of Delaware shows the Newark TOD site that is currently the old Chrysler Plant in Newark, Del.



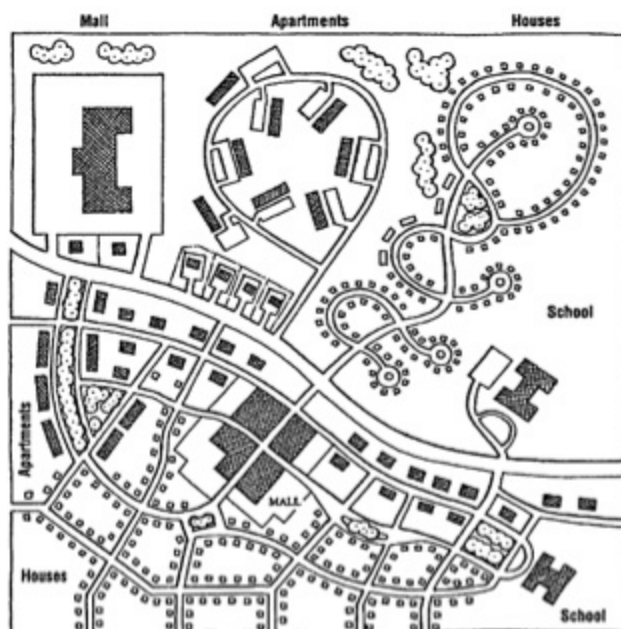
This article will provide a breakdown of the parameters used to give readers insight into the methodology used in this project. Evaluation parameters are listed below.

Evaluation Parameters

- Transit ridership, existence of a high capacity/high volume transit station (rail, bus, BRT, metro, street car, etc.)
- Adequate Zoning
- Congruence with State, Regional, and Local Land Use Plans
- Public Support
- Public-Private Partnerships
- Fully Integrated Transportation System



The Newark TOD site that is currently the old Chrysler Plant in Newark, Delaware. (Image courtesy of the University of Delaware).



Special consideration was given to make this IPA framework relevant to unique Delaware circumstances. The framework design is intended to balance specific TOD site design considerations with broader TOD policy goals for Delaware. During the project, a TOD working group met to consider the issue and provide input to UD staff for the report. Participants included representatives from government entities such as WILMAPCO, DelDOT, New Castle County, and the City of Dover as well as private sector organizations such as the Delaware Transportation Management Association and the American Council of Engineering Companies. Under each variable are sub-factors that define the several attributes associated with the variables. For each variable a score was assessed, a rating explanation was provided, and recommendations moving forward were listed. One point was awarded for each sub-factor that is deemed 'satisfactory' based on site review. The sum of sub-factor points were tallied as the overall rating. Listed below are the variables and sub-factors:

Existence of a high capacity/high volume transit station

Any successful TOD starts with a functional transit stop. A satisfactory transit stop is one that has adequate trip frequency and service capacity to handle current and future service demand. A satisfactory transit stop is one that through trip frequency and service capacity is equipped for conversion into TOD. This variable receives a 0 or 1 score dependent on whether or not the transit stop is deemed satisfactory for a future TOD site.

Adequate Zoning

Adequate Zoning was measured through the assessment of the following subcategories:

- **Station Area Plans/Circulation Plans:** If sites had a station area plan completed or were slated to have one completed they were awarded a point.
- **Transit-supportive Zoning:** Zoning ordinances and subdivision regulations from the local jurisdictions and New Castle County were reviewed and localities with transit-supportive zoning designations were given a point.
- **Mixed-Use:** The mixed-use sub-category was assessed through evaluation of the following components: quantity/quality of mixed-use structures, prevalence of vertical/horizontal mixed-use allowances, and access to various land uses such as grocery stores, assisted living, and office space.
- **Density:** Higher density allowances are more favorable to TOD.
- **Transfer of Development Rights (TDR):** Allow use of TDR credits at or near transit facilities as an incentive for transit-oriented design
- **Streetscape Design and Pedestrian Accessibility:** This sub-category was evaluated through use of the following components: prevalence of street trees/tree medians/ sidewalk buffers, street grid quality, prevalence of cul-de-sacs, use of traffic calming techniques, sidewalk quality, quality of street lighting, bicycle facilities (racks, lanes, lockers), and existence of multi-modal paths (does not include sidewalks).
- **Parking:** Parking was assessed based on two key characteristics of parking: minimum parking standards and alternative parking allowances. Local code and regulation was reviewed to see what minimum parking standards were in place and whether or not alternative parking arrangements were allowed under current zoning and regulation. The more flexibility that TOD projects have in fulfilling parking standards the higher the chances for an ultimately successful project.

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Congruence with Regional Land Use Plan

Any TOD site must compliment the community priorities at the local, regional, and state level. To assess whether or not a site was in line with the greater vision for a community the following plans were reviewed to measure compliance:

- Comprehensive Plan (municipal, county)
- Long-Range Transportation Plan (WILMAPCO, DelDOT, DTC)
- Local Area Plan
- Delaware Strategies for State Policies and Spending

The level of intergovernmental coordination among local, regional, and statewide governmental actors was also assessed generally under this variable. Favorable TOD components may exist within each plan, but are the various government entities synchronizing their work into one seamless strategy for TOD success?

Public Support

Public support is necessary for any TOD site to be successful. For TOD to occur, prior policy commitments must be agreed upon by the business, government, and citizen stakeholders in the community. Public support was assessed through review of news articles and public statements made by local community organizations and interest groups. Public officials also provided input on where public opposition originated from with regard to TOD at certain sites.

Public-Private Partnerships

Public-private partnerships are vital to the ultimate success of a TOD. Often, under normal market conditions, TOD sites are not feasible for private sector investment. Government agencies at all levels must make connections with the business community to create incentives-based TOD. The public-private partnerships variable was assessed through review of current progress on site development for potential TOD locations with focus being directed toward private sector incentives provided and public-private dialogue/coordination throughout the planning process.

Fully Integrated Transportation System

Biking facilities, pedestrian networks, mass transit routes and stops, roadways, and park-n-ride facilities must be linked into a seamless network orchestrated for time efficiency, interconnectivity, and convenient cross-system transfers. Deficiencies in inter-connections for various modes were highlighted in the report and recommendations were made to further enhance the transportation system in the TOD area.

Moving Forward

TOD implementation in Delaware depends on improving public policies to encourage private sector buy-in. General recommendations from the report include:

- Conduct Station Area Planning at Sites
- Integrate Transit-Supportive Zoning and TOD Districts into Code
- Use Community Charettes and other Forms of Interactive Public Engagement during TOD Planning Process
- Enhance Pedestrian and Bicycle Facilities at Stations and within Station Areas
- Improve Multi-Modal Interconnectivity
- Promote and Improve Public-Private Partnerships for TOD ■



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UTC NEWS INSERT

RESILIENCY OF TRANSPORTATION CORRIDORS

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Director's Message

The University of Delaware University Transportation Center has now awarded our fourth round of research projects, and funded our third contingent of summer undergraduate researchers and our third group of UTC Fellowships. We have designated two UD-UTC Student of the Year recipients. Our students have also won several other awards, and current and recent graduate and undergraduate researchers participated in the 2010 commencement exercises. A full slate of speakers and brown bag seminars this spring as well as active participation in conferences have kept faculty, staff and students busy over the spring semester. In this newsletter we provide an overview of our accomplishments and activities.

Now that grades are turned in and commencement is over, we now turn our attention to the summer and planning for the fall. The summer begins with UD hosting the 7th Annual Interuniversity Symposium on Infrastructure Management (AISIM) on June 19 (see <http://sites.google.com/site/aisim6>). This symposium is organized by students to showcase their work and provide an opportunity to build professional networks. Over 20 students from eight different universities presented their work.

From June 15 to 25 we kick off the inaugural infrastructure management "bootcamp," or more formally the Advanced Infrastructure Systems course. This intensive two week course is team taught by faculty from University of Waterloo, University of Texas at Austin, Virginia Tech and University of Iowa, and provides an immersion experience for students from UD and five other universities around the US and Canada.

Two brown bag seminars are scheduled for the fall semester and we are planning more DCT/ UTC Distinguished Lectures. Specific dates, times and locations will be posted on the UTC website. In the meantime, browse through the projects and explore the work done by the students and researchers.

Sue McNeil

Professor, Department of
Civil & Environmental Engineering

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| 3 | ENO Transportation Leadership
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Congratulations to Our May 2010 Graduates!

Civil Engineering Undergraduates:

- Kelly Ambrose (Summer 2009)
- Melissa Steward (Winter 2008)
- Chance Malkin (Summer 2009)
- Sarah Dalton (Summer 2008, Fall 2008, Spring 2009)
- Cory Castellucio (Winter 2009)

SUAPP MA:

- Laura Black

Civil Engineering MS:

- Sekine Rahimian
- Chuoran Wang
- Roy Wang

Civil Engineering PhD:

- Silvana Croope



UTC Director Sue McNeil with Dr. Silvana Croope



UTC students, staff and faculty explore transportation through dance.

Brown Bag Seminar—Dance and Transportation

It is not often that attendees at a brown bag lunch imitate planes, trains, and automobiles, but that was the case on February 17th when Dr. Lynette Overby, together with the ArtBridge scholars, presented their work on an interdisciplinary curriculum that combines dance and transportation.

As explained by Dr. Overby, the purpose of the study is to enhance the knowledge of geographic concepts, putting transportation through the lens of dance and theater. The team is currently working with second graders at the Thurgood Marshall Elementary School under the guidance of the classroom teacher, Judy McCord.

Prior to working with the students directly, the ArtBridge scholars researched the benefits of the interdisciplinary approach, attended workshops, met with the classroom teacher on several occasions, observed the class, and finally conducted a pre-test. They developed a transportation lesson plan using a mode of transportation which the students had selected. The lesson plans might teach globe skills one week, learning 'rules of the road' another week, or how to differentiate among urban, suburban, or rural. After the lesson, the scholars administered a post-test and analyzed the results.

Dr. Overby then encouraged those attending the brown bag lunch to become active participants and learn the vocabulary of dance which incorporates space, time, force, and the body. At first the participants mimicked movements of a partner and then gradually evolved to pantomime a mode of transportation on a journey.

Student Awards

Anne Lucey

- *Plant and Soil Sciences graduate student symposium May 5th— 2nd place for outstanding presentation of research*

Michelle Oswald

- *2010–2011 Eisenhower Fellow*
- *ITE Graduate Scholarship— Transoft Solutions Ahead of the Curve Scholarship for Graduate Study in Transportation Engineering—2010*
- *ENO Transportation Leadership Conference Fellow- Dr. Thomas D. Larson Fellowship—2010*
- *USA Funds Access to Education Scholarship Finalist—2010*

Spring UD-UTC/DCT Distinguished Lectures

A UTC-sponsored seminar series allowed students and faculty the opportunity to meet with transportation-related professionals during three Spring Semester events. The series organizer, Geoff Edwards, is the 2009-2010 UTC Graduate Fellow, 2009 UD-UTC Student of the Year, and a Ph.D. student with the School of Urban Affairs and Public Policy. Each of the three speakers represented a different aspect of practice or inquiry within the field of transportation: practitioner Richard Layman, policy analyst Adie Tomer, and journalist David Axe.

The series began on March 18th with speaker Richard Layman. Mr. Layman related his extensive experience as a transportation-activist and planner. His talk focused on the need for transportation planning to occur within a series of nested scales, from sub-local to international. Mr. Layman's discussion further introduced the concept of mobility-shed within this framework, pointing to a possible alternative for thinking about transit priorities and opportunities. He closed with a brief introduction to his work as a popular blogger within the D.C.-Baltimore planning community (at www.urbanplacesandspaces.blogspot.com).

Interestingly, all three speakers represent the vanguard of transportation professionals who are employing new media technologies both to inform and disseminate their work. Mr. Tomer is a frequent contributor to The New Republic's urban affairs blog. Mr. Axe is a longtime contributor to Wired Magazine's defense blog, in addition to editing his own widely-read military logistics blog (at warisboring.com).

The Brookings Institution's Adie Tomer spoke on March 25th. Mr. Tomer is a research analyst who works under the Brookings' Metro Program's Infrastructure Initiative, where his work primarily focuses on metropolitan transportation and infrastructure issues. In his seminar, he discussed Delaware's position within the broader transportation flows of the United



UD-UTC Student Geoff Edwards at the Council of University Transportation Centers Award Banquet Held During the TRB Annual Meeting.

States, particularly within the Northeast Corridor. His presentation was the first of the Brookings Institution's research season and therefore afforded University of Delaware students and faculty a sneak-preview of some of the work being done by one of the country's leading policy think tanks.

The seminar series concluded with an April 22nd appearance by journalist David Axe. Mr. Axe has extensive experience as a war correspondent and has spent much of his career reporting on military logistics, with an emphasis on robotic vehicles. His presentation described the feedback loop linking battlefield logistical challenges with civilian transportation technologies. During the past decade, the Pentagon has funded numerous competitions aimed at fielding unmanned logistics vehicles within military convoys in Iraq and Afghanistan. The Pentagon requires these vehicles to be fully autonomous, able to navigate complex terrain without human assistance. These aggressive requirements stem directly from a battlefield need to protect American soldiers and international participants from roadside bombs within the two theaters of war. In his presentation, Mr. Axe demonstrated that innovations created by the Pentagon-funded competitions have not only influenced but also been influenced by related technologies in the civilian automotive and trucking industries.

The successful seminar series has generated positive reviews among students, faculty, and the speakers themselves. All three speakers have also expressed an interest in future speaking opportunities at the University of Delaware and a continued relationship with the UTC.



Michelle Oswald with Steve Van Beek, President and CEO, Eno Transportation Foundation at the Eno Leadership Development Conference.

ENO Transportation Leadership Development Conference

Each year, the Eno Leadership Development Conference gives 20 of the nation's top graduate students in transportation a first-hand look at how national transportation policies are developed. Students apply to the program early in the year, and those selected as "Eno Fellows" come to Washington, DC, for a week of meetings with federal officials and leaders of business and non-profit organizations in the spring.

Michelle Oswald, doctoral student in transportation engineering was to participate in the 2010 Eno Transportation Leadership Conference. She spent four days in Washington D.C. meeting with leaders within the field of transportation both from the public and private sector. Organizations such as the United States Department of Transportation, the American Association of State Highway and Transportation Officials, and the American Public Transportation Association were represented. She also participated in a mock congressional hearing where she represented the Washington Metropolitan Area Transportation Authority on a current transportation issue. Through this experience her knowledge and interest in the field of transportation planning was greatly expanded and she plans on using information gained to further her research in sustainable transportation planning.



Upcoming Events and Opportunities

BROWN BAGS

Wed., Sept. 22, 12:15-1:15 pm

The Impact of Disruptions along the I-95 Corridor on Congestion and Air Quality, Rusty Lee and Dzung Ngo.

Wed. Oct. 20, 12:15-1:15 pm

Historic Resiliency of Bridges on the BOSFOLK Corridor, Tripp Shenton and Peter Seymour

Date/Time TBD

UD-UTC/ DCT Distinguished Lecture: Willem Ebersöhn—Strategic Asset Management at Amtrak—watch the UTC website for a date!

DEADLINES

Wed., Sept. 15, 2010

Student of the Year nominations (www.ce.udel.edu/UTC/SOY.html).

Mon., Nov. 1, 2010

Winter undergraduate research applications (www.ce.udel.edu/UTC/Undergraduate.html).

2010–2011 Projects

Five projects were selected for funding as part of the 2010-2011 UTC research projects. These projects involve four different colleges and engage both graduate and undergraduate students.

Resilient Cartography: Interactive Online Mapping as a Method for Understanding the Dynamics of the Corridor Transportation System

Principal Investigator: Doug Tuttle, Institute for Public Administration

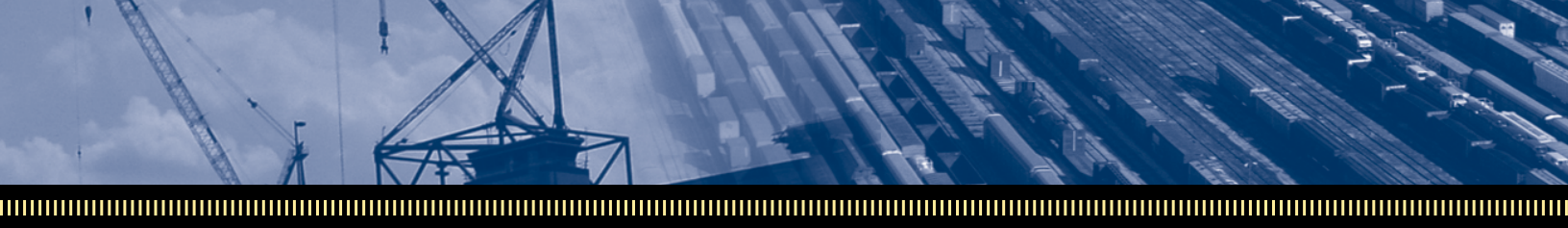
While transportation planners and civil engineers rely on cartographic representations of transportation infrastructure in the conduct of their work, maps are an underestimated method for providing policy-makers and the public with a better understanding of the relationships that exist among different modes of transportation at the regional and local levels. While traditional cartographic approaches provide adequate descriptions of many aspects of corridor spatiality, they fail to capture and clearly illustrate many other aspects of corridor resiliency, including travel-time and route-redundancy.

This project proposes to create two maps for use by corridor users, transportation policy-makers and regional transportation researchers. The purpose of the central map in this project is to reinforce and demonstrate the idea that travel-times between key nodes within the corridor network is highly contingent on transportation mode and spatial location. Additionally, this map will allow UD-UTC to demonstrate to the public and policy-makers a novel presentation and research method related to corridor resiliency—one that provides a clear illustration of the rapidity and redundancy properties of regional resiliency as developed by Bruneau et al.

The Impact of Disruptions along the I-95 Corridor on Congestion and Air Quality – Phase II

Principal Investigators: Earl (Rusty) Lee, Department of Civil and Environmental Engineering, and James Corbett, College of Marine and Earth Studies

The resilience of a corridor can be defined as its ability to maintain its full functionality during an incident. While transportation corridors may be viewed as highly resilient due to the number of alternative paths that generally exist, the principal path and the alternatives may not have similar capacity. This research will evaluate resilience of the Interstate 95 corridor in Delaware and the impact of disruptions on congestion and air quality. This work will build upon prior work that evaluated complete closures of specific sections of I-95. This work will look at partial closures where some lanes remain open and closures at interchanges where freeway and arterial lanes are blocked.



The Implications of Climate Change on Pavement Performance and Design

*Principal Investigators: Qiang (Joshua) Li and Sue McNeil,
Department of Civil and Environmental Engineering*

Current highways are designed based on typical historic climatic patterns, reflecting local climate and incorporating assumptions about a reasonable range of temperatures and precipitation levels. Given anticipated climate changes and the inherent uncertainty associated with such changes, a pavement could be subjected to very different climatic conditions over the design life and might be inadequate to withstand future climate forces that impose stresses beyond environmental factors currently considered in the design process.

Our objective of this research is to explore the impacts of potential climate change and its uncertainty on pavement performance deterioration and therefore pavement design, which includes the following subobjectives:

1. Catalog climatic factors that affect pavement performance
2. Review of pavement design practices and engineering models used to assess and predict pavement performance and deteriorations revealed to climate
3. Explore uncertainties of climate change and understanding how the frequency, severity and duration of these conditions change
4. Simulate pavement performance deterioration over time for a selection of sites with various traffic levels, environmental factors and pavement structures
5. Perform analysis to assess the statistical significance of climate change pavement performance
6. Conduct risk analysis to understand how climate change concomitantly impacts on pavement life-cycle costs
7. Develop guidance on when and how to integrate climate change into pavement design as an adaption strategy

Expected products include a literature review, documentation of the climate change uncertainties, simulation of pavement deterioration over time, statistical analysis and risk analysis of the results, outline of guidelines and next steps, and a final report.

Investigation of Load-Path Redundancy in Aging Steel Bridges

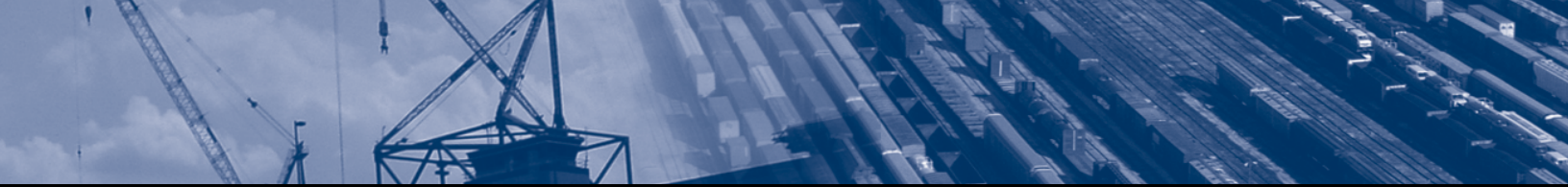
Principal Investigator: Jennifer Righman McConnell

A key factor affecting the resiliency of transportation infrastructure is aging. Furthermore, the current age of the nation's transportation infrastructure relative to the financial resources available for infrastructure investments causes aging to be one of the biggest challenges facing civil engineers in the coming years. The objective of this work is to better quantify the actual capacity of aging steel bridges. This is accomplished through investigating load-path redundancy, which is a source of reserve capacity that is not currently accounted for in bridge design or rating, as a function of the condition of the concrete bridge deck. Specifically, finite element analysis of hypothetical bridges with various levels of deck deterioration will be performed. The sensitivity of these results to other geometric parameters of bridges will also be investigated. The research will be limited to analysis of steel I-girder bridges, which are one of the most common bridge configurations in the local region and nationwide, so that the project may be completed within a relatively short timeframe. The project will result in information that will allow the aging structures that are in the greatest need of rehabilitation or replacement to be better identified.

The Effects of Learning through the Arts on Transportation Knowledge and Skills of Elementary and Middle School Students, University Students and Classroom Teachers

Principal Investigator: Lynnette Overby, Department of Theater

The purpose of this study is to enhance knowledge of geographic concepts, particularly transportation, through the lens of dance and theatre. Students and their teachers will gain knowledge through an interdisciplinary approach that combines the teaching of geography with the arts. This project will benefit current and future educators, artists, and geography researchers. The participants will include elementary and middle school students attending schools in Newark, Delaware, their teachers, and University of Delaware students with expertise in the arts and geography. This project will build on the work of the previous grant cycle, by adapting and augmenting curricula for middle school students



Transportation Research Board Annual Meeting

The Transportation Research Board (TRB) Annual Meeting, held in Washington DC in January, attracts over 10,000 attendees from all around the world. Policy makers, administrators, practitioners, researchers, and representatives of government, industry, and academic institutions listen to presentations, present their research and participate in poster sessions, committee meetings and panel discussions. There are over 3000 presentations—including 13 from UD (see Winter newsletter) – in nearly 600 sessions.

Delaware Center for Transportation and the UTC joined forces to support the participation of a contingent including 8 faculty and staff, 24 graduate students and 1 undergraduate student. We asked the students what they gained from attending this event and what advice they would offer for students attending next year. Here is what they said. ●

What students gained from attending the TRB Annual Meeting:

- Opportunity to present research
- Identified new research opportunities
- New contacts
- Access to shared data
- Background and context for research
- Understanding of the breadth of transportation research
- Focus on specific topics
- Awareness of new technology demonstrated in the Exhibit Hall
- Discussions with authors in poster session

Advice for next year

- Plan ahead
- Use the interactive program
- Take advantage of the opportunity to meet friends, new people, and “famous” people
- Collect and distribute business cards in the exhibition hall. Note connections and topics on the back of the business cards you collect
- Look for sessions sponsored by professional organizations.

UD-UTC Graduate Fellowships

Tim (Todd) O’Boyle and Peter Seymour have been selected to receive the 2010-2011 UD-UTC Graduate Fellowships. The fellowships are awarded to students pursuing master’s and PhD degrees in areas of relevance to the theme of the UD-UTC; selection is based on academic qualifications and relevance to the UDUTC theme and goals. UTC Fellowships cover graduate school tuition, pay a stipend of \$2000 per month for 12 months, beginning September 1, and include a \$1000 allowance for travel and supplies and a \$1500 allowance for computing.

Todd O’Boyle is a first year Ph.D. student in the School of Urban Affairs and Public Policy. He completed his undergraduate degree at Guilford College in German and Psychology and his master’s degree in Social Welfare Policy at North Carolina Agricultural and Technical State University. He is currently working on a project partially funded by the UTC investigating inter-jurisdictional coordination to promote economic development and resolve transportation problems. This project has evolved into an interest in mobility for the mobility impaired. Todd’s advisor, Professor Warren described Todd’s work as follows “His academic work shows a first-rate intellect, fine analytic ability, and the capacity to design and carry out research projects that show rigor as well as imagination.”

Pete Seymour has completed his first year of his MS degree. He is a graduate of the University of Delaware’s program in Civil and Environmental Engineering and has been working with Dr. Shenton on the UTC-funded project on “Historic Resiliency of Bridges on the BOSFOLK Corridor”. The UTC fellowship will allow Pete to continue this research project and use the project for his Master’s thesis which he plans to complete by next summer. Pete and Professor Shenton will present a Brown Bag Seminar on their work on October 20, 2010. Pete’s energy and enthusiasm are recognized as infectious. He “has jumped head-first into the work” and has already brought a new perspective to the work. We look forward to seeing the results of this important research.

Contact Us

To learn more about the UTC, please visit our website—
www.ce.udel.edu/UTC/index.html

To join our email list about UDUTC events, funding opportunities, and graduate fellowships, please send an email to Marikka Beach (marikka@udel.edu).

New Research Projects Selected

Following are the projects approved by the DCT Policy Council for our FY'10 Annual Research Program beginning on September 1, 2009 and ending August 31, 2010:

IMPACTS OF BIRD DROPPINGS AND DEICING SALTS ON HIGHWAY STRUCTURES: MONITORING, DIAGNOSIS AND PREVENTION

This research project will develop decision-making criteria and tools useful to DelDOT in monitoring, diagnosis and corrosion prevention brought about by bird droppings and deicing salts. The information to be established in this research will be valuable to life cycle cost modeling of transportation structures.

Principal Investigator

Chin-Pao Huang, Department of Civil and Environmental Engineering

Project Manager

Jiten Soneji, Bridge Design

ENHANCED PEDESTRIAN CROSSINGS

This research will focus on two issues: 1) experimenting with alternatives to MUTCD standards for crossing signals and 2) determining best practices for installing accessible pedestrian signals.

Principal Investigator

Earl "Rusty" Lee, Department of Civil and Environmental Engineering

Project Manager

Mark Luszcz, Traffic Engineering

A META-ANALYSIS OF STUDIES, PROJECTS AND PRACTICES ON PLANNING FOR A SUSTAINABLE ENVIRONMENT WITH SPECIAL EMPHASIS ON THE STATES OF VERMONT AND DELAWARE – PHASE III

This is a continuation of last year's project.

Principal Investigator: Chandra Aleong, Delaware State University

Principal Investigator

Ralph Reeb, Division of Planning

USING ELECTRICAL DENSITY GAUGES FOR FIELD COMPACTION CONTROL

This project will allow DelDOT to assess the accuracy and repeatability of the Electrical Density Gauge (EDG) for quality control of soil compaction. It will also allow DelDOT to make a smooth transition towards adoption of the EDG as the primary quality control tool for soil compaction, should this outcome be desired by DelDOT upon completion of this research.

Principal Investigator

Chris Meehan, Department of Civil and Environmental Engineering

Project Manager

Jim Pappas, Materials and Research

TRANSIT-ORIENTED DEVELOPMENT (TOD): IDENTIFICATION OF OPTIMAL CHARACTERISTICS IN DELAWARE

The concept of TOD is being more widely implemented by communities throughout the U.S. as a tool to promote smart growth, enhance mobility, curb sprawl, foster multi-modal transportation options, and boost transit ridership. This project will identify optimum site characteristics and if these optimum characteristics apply to potential sites in Delaware. Additionally, strategies will be developed on how to apply these to our state.

Principal Investigator

Ed O'Donnell, Institute for Public Administration

Project Manager

Cathy Smith, Delaware Transit Corporation

DEVELOPMENT AND EVALUATION OF A RESIDENTIAL ALLOCATION MODEL USING TIME-SERIES TAX PARCEL DATA IN GIS

The product of this research will be a GIS model allowing interactive analysis of growth management problems using tax parcels at the community level while at the same time accounting for countywide growth allocation forecasts. The project will greatly support travel demand forecasting responsibilities and initiatives at DelDOT and will support comment and analysis of development proposals at a more detailed level of geography.

Principal Investigator

David Racca, Center for Applied Demography and Survey Research

Project Manager

Mike DuRoss, Division of Planning

IN-SERVICE MONITORING FOR IMPROVED MAINTENANCE AND MANAGEMENT OF DELDOT BRIDGES

The goal of this project is to continue enhancement of DelDOT's bridge management efforts through the collection and utilization of in-service strain response data for bridges. This is a continuation of earlier projects which initiated the effort to collect in-service data on a series of bridges in Delaware.

Principal Investigator

Tripp Shenton, Department of Civil and Environmental Engineering

Project Manager

Jiten Soneji, Bridge Design

IN-DEPTH EVALUATION OF DTC FUEL EFFICIENCY AND EMISSIONS

There is a tremendous need to make the DTC fleet as energy efficient and air quality friendly as possible. For this study, 1) the DTC fleet will be analyzed for its fuel efficiency and emissions, 2) the latest world-wide technological developments for buses with new alternative fuels will be researched, and 3) technologies most suited for Delaware will be identified.

Principal Investigator

Arde Faghri, Department of Civil and Environmental Engineering

Project Manager

Mark Glaze, Division of Planning

DELAWARE SIGNAL TIMING ENHANCEMENT PARTNERSHIP (DSTEP)

The goals of the DSTEP project are to involve students in traffic engineering services for DelDOT, to develop a continuous research program that addresses DelDOT's needs while minimizing the use of DelDOT's resources, and to maintain a high level of quality so that DelDOT may apply the results to improve intersection operations across the state.

Principal Investigator

Earl "Rusty" Lee, Department of Civil and Environmental Engineering

Project Manager

Gene Donaldson, Transportation Management Center

Continuing Active Research Projects Sponsored By Deldot

As each project is completed, an abstract will be available on the DCT website: www.ce.udel.edu/dct.

INSTRUMENTATION AND MONITORING OF THE INDIAN RIVER INLET BRIDGE

This project involves installing a long-term structural health monitoring (SHM) system on the Indian River Inlet Bridge during its construction and monitoring the bridge through the first bi-annual inspection. Following this installation, DelDOT will be able to understand how the as-built bridge is functioning and through long-term monitoring, will be in a better position to efficiently and effectively manage this significant resource.

Principal Investigator

Tripp Shenton and Michael Chajes, Department of Civil and Environmental Engineering and College of Engineering respectively; Robert Hunsperger, Electrical and Computer Engineering

Project Manager

Doug Robb, Bridge Design

NEAR REAL-TIME MONITORING OF INDIAN RIVER INLET SCOUR HOLE EDGE EVOLUTION SEAWARD OF THE BRIDGE PIERS: PHASE I

Bridge pier scour is a problem that occurs in riverine and tidal environments. Funding for this project will be used to install a monitoring system that will image the sea bed adjacent to the bridge piers. Additionally, current meter data will yield critical forcing conditions that can be related to scour hole variability. The resulting data can be used to make informed management decisions and develop appropriate plans of action.

Principal Investigator

Jack Puleo, Center for Applied Coastal Research

Project Manager

Doug Robb, Bridge Design

ESTABLISHMENT OF A GEOTECHNICAL INFORMATION DATABASE

DelDOT currently has numerous subsurface investigation test results and pile driving analyzer test results for foundation studies located through the state. This information is on paper, tape, and disks. This project will develop a geotechnical database that can be used by DelDOT for storing, organizing, and easily accessing this data.

Principal Investigator

Chris Meehan, Department of Civil and Environmental Engineering

Project Manager

Jim Pappas, Materials and Research

PAVEMENT PERFORMANCE MODELS

DelDOT collects Pavement Condition data from all the pavements in their network, and uses this data to develop Annual Paving Programs that address the roads requiring work for each year. This condition data, collected over several years, could be analyzed to predict future condition, predict when maintenance should be applied, and predict the end of a pavement's useful life. Combined with data from initial construction quality records and maintenance activity records, one could develop performance prediction models for similar pavements in the DelDOT network. With these models, DelDOT could better anticipate future needs of each pavement, and could better target the appropriate rehabilitation techniques to pavements at the opportune time.

Principal Investigator

Sue McNeil and Nii Attoh-Okine, Department of Civil and Environmental Engineering

Project Manager

Jennifer Pinkerton, Materials and Research

INFRASTRUCTURE SECURITY AND EMERGENCY PREPAREDNESS

Delaware is in need of an emergency notification plan. This project will evaluate the ripple effect of evacuating, the need to monitor bridges and tunnels, a plan for rapid construction of roads and bridges, and gas supply during emergencies to prevent vehicles from stalling during evacuation. Additionally, security issues will be investigated if there is a bottleneck for travel along I-95 from Washington to New York.

Principal Investigator

Sue McNeil, Department of Civil and Environmental Engineering

Project Manager

Dwayne Day, Transportation Management Center

ADVANCING ASSET MANAGEMENT IN DELDOT

Asset management is about the best way to use limited resources. The concepts are based on performance measures and goals and focus on both the long and short term goals of the organization. Asset management provides an opportunity to respond proactively to land use changes, growing demands, aging infrastructure, and safety and security challenges. Many asset management activities are ongoing, however, there is a need to link these various activities, begin to fill the gaps in data and procedures, and explore new tools to support the integration of existing tools to decision-making tools.

Principal Investigator

Sue McNeil, Department of Civil and Environmental Engineering

Project Manager

Curt Cole, Maintenance and Operations

INVESTIGATION OF INTELLIGENT COMPACTION TECHNOLOGY: PHASE 2 – A FIELD STUDY

Successful adoption of intelligent compaction technology requires careful demonstration and validation with local soils. There is a need to calibrate this technology for local soils in Delaware, a need to demonstrate the utility of this technology to local contractors to ensure that is successfully adopted, and a need to show DelDOT the improvements in compaction monitoring and construction quality that can result when this technology is used.

Principal Investigator

Chris Meehan, Department of Civil and Environmental Engineering

Project Manager

Jim Pappas, Materials and Research

ITS LAB BASELINE SERVICE

The objectives of this project are to establish the Delaware Center for Transportation ITS Lab as a state of the art facility with three main focus areas: 1) service to DelDOT; 2) training for DelDOT and support classroom instruction; and 3) research for faculty and students

Principal Investigator

Earl “Rusty” Lee, Department of Civil and Environmental Engineering

Project Manager

Gene Donaldson, Transportation Management Center

TESTING AND OPERATION OF DELAWARE’S FIRST “SMART BRIDGE” – CONTINUATION

Funding for this project will support diagnostic tests, analysis and interpretation of data from Bridge 1-821 located on Interstate 495 in New Castle County. Additionally guidelines for maintenance of the SB system and integration of new sensor systems will be developed.

Principal Investigator

Tripp Shenton, Department of Civil and Environmental Engineering

Project Manager

Jiten Soneji, Bridge Design

LONG-TERM PERFORMANCE MONITORING OF A RECYCLED TIRE EMBANKMENT IN WILMINGTON, DELAWARE

This is a continuation of a one-year project requiring additional data analysis. This project will determine the environmental and engineering properties that should be monitored during the construction of shredded tire embankments including instrumentation, installation, monitoring and an analysis plan. The project will investigate what instruments are needed and how to construct plus monitor them. Delaware summer temperatures will be taken into account.

Principal Investigators

Nii Attoh-Okine, Paul Imhoff, Victor Kaliakin and Chris Meehan, Department of Civil and Environmental Engineering

Project Manager

Jim Pappas, Materials and Research

SAFE ROUTES TO SCHOOLS FOR CHILDREN – MODE SHARE DATA ANALYSIS

The consequences of children not walking or biking to school include environmental impacts, increased traffic in the vicinity of schools, increased rates of obesity in children and other associated health problems, and often a decrease in the social health of communities. The purpose of this project is to provide mode share data for a sampling of elementary school students for the Delaware SRTS program. Federal funding is now available specifically for SRTS initiatives, the need for data on transportation modes of K-8 grade children to and from school is more urgent. Having baseline data and trend analysis for Delaware would enable comparison and evaluation of the progress and success of the program once data is collected after projects and local programs have been implemented.

Principal Investigator

William DeCoursey, Institute of Public Administration

Project Manager

Sara Coakley, Division of Planning

2009-2010 GPS TRAVEL TIME AND DELAY DATA COLLECTION AND ANALYSIS

This project entails data collection during peak travel times on roadway segments throughout the state. Each segment will be traveled at least four times for maximum accuracy. Once data collection is completed, data will be transformed into the GIS database and transported to the ARCGIS software.

Principal Investigator

Arde Faghri, Department of Civil and Environmental Engineering

Project Manager

Mark Eastburn, Division of Planning

LETTING SCENIC AND HISTORIC ROADS IN DELAWARE TELL THEIR STORY

A web-based manual to facilitate the identification, designation and management of scenic and historic highways

Principal Investigator

David Ames, Center for Historical Architecture and Design

Project Manager

Maria Andaya, Roadside Environment

ENHANCING DELAWARE’S HIGHWAYS: A NATURAL VEGETATION PROJECT

The project will investigate vegetation models conceived to restore Delaware’s roadside landscapes to a more natural state reflecting the regional flora.

Principal Investigator

Sue Barton, Department of Plant and Soil Sciences

Project Manager

Chip Rosan, Roadside Environment ■



Overgrowth of emergent vegetation promotes mosquito breeding in stormwater ponds.

Managing Stormwater: Best Management Practices to Minimize Mosquito Breeding

MARIANNE WALCH, PH.D., ENVIRONMENTAL SCIENTIST,
DELDOT NPDES PROGRAM

The Problem

Management of stormwater runoff is an important component of roadway design and maintenance. In recent years, stormwater management strategies have fallen under increasingly stringent federal and state water quality regulations, requiring implementation of numerous structural stormwater controls, or best management practices (BMPs). These BMPs include retention and detention ponds, bioretention cells, biofiltration swales, infiltration basins, sand filters, underground storage vaults and a variety of proprietary treatment devices.

Regulations governing stormwater discharges – including the federal Clean Water Act's National Pollutant Discharge Elimination System (NPDES) permits and Total Maximum Daily Load (TMDL) requirements – have challenged DOTs across the nation to improve runoff quality through the construction of ever increasing numbers of BMPs. DelDOT currently has more than 500 stormwater BMPs in its inventory, and hundreds more are anticipated to be added soon as part of new roadway construction projects or as retrofits into areas that currently are inadequately protected.

One issue associated with modern stormwater management programs that has recently received a lot of attention is the potential of stormwater treatment BMPs to provide abundant habitat for the propagation of mosquitoes if they are not properly designed and maintained.

Approximately 60 species of mosquitoes are found in Delaware, and of these about 19 species can be aggressive biters of humans. Not only is their biting activity a nuisance, but some mosquitoes also are potential vectors of human and animal diseases. All require standing water to complete their life cycles. The recent threat of West Nile virus has compounded concerns about the potential of stormwater ponds, infiltration basins and other BMPs to provide habitats that are particularly favorable for mosquito breeding.

Project Description

DelDOT's NPDES Program provided funding to Dr. Jack Gingrich, of the University's Department of Entomology and Wildlife Ecology, to conduct a study of the potential for DelDOT-owned stormwater retention ponds and sand filters to produce nuisance mosquitoes and West Nile Virus vectors. The study focused on determining factors that are predictive for BMPs that are high producers of mosquitoes versus those that are low producers.

Mosquito vector production and larval abundance was monitored in a number of different ponds, mitigation wetlands and sand filters over several years. BMP characteristics examined included steepness or shallowness of pond slopes, shade, presence of invertebrate predators, and a variety of water quality factors.

Detention ponds (or "dry" ponds) were found to produce more larval mosquitoes than all other pond types, particularly if they do not drain properly. Some sand filters that drain slowly or hold water in sediment traps also produced large numbers of larvae. The data also suggested that mosquito breeding in ponds is highly correlated with overgrowth of vegetation such as cattails and Phragmites on shallow benches, and with high levels of nutrients such as phosphates. Shallow ponds with heavily vegetated edges often supported high numbers of mosquito larvae. Mosquitoes are basically filter feeders that feed on a variety of phytoplankton, zooplankton, and fine organic debris. Thus, stagnant, eutrophic conditions in ponds tend to favor mosquito production. Heavy growths of invasive vegetation may also protect larvae from predators.

The Payoff for DelDOT

Mosquitoes need a minimum of four to six consecutive days of stagnant water for larvae to hatch to adulthood. Although many modern "green technology" stormwater treatment BMPs, such as bioretention areas and bioswales, detain water temporarily provide water quality improvements, nearly all are designed to drain completely within 72 hours. So if they are functioning properly, the likelihood that mosquito larvae will survive and emerge as adults is low. As these structures slowly clog due to age and lack of maintenance, however, they can retain water long enough to allow floodwater mosquito pupae and larvae to reach maturity.

Thus proper design, construction and maintenance of BMPs are critical to reducing the suitability of BMPs for producing mosquitoes. The results of Dr. Gingrich's study have assisted DelDOT's NPDES Group in developing and improving its routine BMP inspection and maintenance protocols.

Vegetation Management

Overgrowth of emergent vegetation, such as cattails and Phragmites, provides mosquito larvae with refuge from predators, protection from surface disturbances, and increased organic debris and nutrients. These weeds can also impair the functioning of the pond. DelDOT has developed a proactive strategy to remove undesirable vegetation from stormwater BMPs that includes annual inspections, herbicide treatments when needed, excavation of accumulated sediments that promote plant growth, and follow-up monitoring. Although shallow safety benches are required by law around pond perimeters, we try to limit the growth of emergent plants on the benches.

BMP Design and Maintenance

All of DelDOT's detention and infiltration BMPs are designed to drain completely within 72 hours following a storm event and remain dry. Annual BMP inspections alert us when these structures are beginning to clog due to accumulations of sediment or other structural defects. Maintenance work orders are then submitted to correct the problems. Occasionally BMPs fail to function as designed. These are either completely renovated or replaced with a more appropriate BMP design. DelDOT no longer accepts designs that include dry ponds. In addition to promoting mosquito breeding, they have been found to provide only limited water quality treatment.

Control of Nutrient Enrichment

Dr. Gingrich's research demonstrated that high levels of nutrients such as phosphorus may contribute to algal and bacterial blooms, providing abundant food sources for mosquito larvae. In a follow-up component of his group's research, different methods of reducing phosphate concentrations in stormwater ponds were evaluated for their effectiveness in controlling mosquito larval abundance. Of these, treatment with aluminum sulfate (alum) showed some preliminary promise. This has provided us with another tool to supplement other BMP maintenance methods.

Long-term management and maintenance of stormwater treatment practices is an increasingly expensive and challenging task for DelDOT. Minimizing their mosquito production potential is only one of these challenges, but an important one. Research provided through the Delaware Center for Transportation has provided the Department with additional tools to maintain our assets in an efficient and environmentally sensitive way. ■

The mission of the Delaware Center for Transportation is to improve the movement of people, goods, and ideas, and be viewed as a valuable resource for transportation-related issues and challenges within the state, the mid-Atlantic region and beyond.

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