



A Partnership of the Virginia Department of Transportation  
and the University of Virginia since 1948

***BRINGING INNOVATION TO TRANSPORTATION***

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## **ANNUAL UPDATE for FY 2005**

(July 1, 2004 through June 30, 2005)



## Virginia Transportation Research Council

### PURPOSE OF THE VIRGINIA DEPARTMENT OF TRANSPORTATION'S RESEARCH & DEVELOPMENT PROGRAM: (from VDOT's corporate tenets)

- Improve transportation safety
- Build and maintain a better transportation infrastructure
- Make the transportation system operate more efficiently and effectively
- Introduce new technologies into practice
- Advance the state-of-the-art in transportation
- Strengthen VDOT's business and organizational policies and practices
- Protect environmental resources
- Provide a high return on the investment in the VTRC



Welcome to this year's review of the work of the Virginia Transportation Research Council. We are proud of the recognition the transportation profession has bestowed on VTRC as one of the nation's most comprehensive, high-quality research programs.

In FY 2005, we increased our outreach of VTRC's work. Part of this effort included creating a consistent branding scheme for our products, developing and staffing exhibits at the Transportation Research Board's annual meeting and the Virginia Transportation Conference and producing a new style for our "annual report"—this short, succinct snapshot of key research and other activities—while relying on our Web site to archive all current and completed research projects and other detailed information about VTRC.

It is significant that the Virginia Department of Transportation recognizes the Research Council as one of its mainstream businesses. VDOT this year adopted **eight corporate tenets** that focus and guide the agency's core principles and policies, such as financial stewardship, environmental compliance and stewardship, openness in government, and a strong system operations program.

Research is among these eight corporate tenets. This tenet establishes the principal roles, responsibilities and management practices that VDOT will follow in support of a **"nationally recognized transportation research center and the responsibilities of that center."** Simply put, they can be boiled down to developing and

delivering a research program that results in **saving lives, saving time and saving money.**

I believe measuring performance is essential. Not all research projects lend themselves to estimating benefits in monetary terms. However, for even a handful of the projects we completed in FY 2005 that can be easily quantified, **the total annual benefit is conservatively estimated at approximately \$19 million.** These nine projects more than pay for the entire research program and provide a return to VDOT of nearly 50 percent in terms of the cost of the program. The results of these projects, when fully implemented, will account for almost \$100 million in returns over a short five-year span.

An additional 48 projects address congestion mitigation, historic preservation, environmental quality, transportation planning and policy matters. Each project has unique benefits important to our customers at VDOT, which in turn improve their delivery of transportation services to all Virginians.

In FY 2005, we completed a record number of projects—57 formal research projects out of 66 planned projects. Several projects depended on weather and construction schedules, so we are quite proud of this 85 percent completion rate. Two of our teams, System Operations & Traffic Engineering and Environmental & Business Practices, completed 100 percent of their projects. We completed 65 percent of our projects on time, again a good number.

Of all of VTRC's accomplishments in FY 2005, however, its **research library** had the greatest transformation. This library, which primarily serves VDOT and the University of Virginia, now boasts a catalog whose holdings are on par with leading transportation libraries throughout the country. In 2002, none of its records were accessible online; at the end of FY 2005, its catalog had more than 25,000 records representing over 32,000 volumes. It is the only resource of its kind in Virginia and the largest such library in Region II of the American Association of State Highway Transportation Organizations (AASHTO).

The research library participates in a sizable network of libraries and other research centers, known nationally as the Online Computer Library Center. This system allows VDOT staff to access billions of resources worldwide, while sharing VDOT's own titles, research papers and other documents with more than 50,000 other institutions. Of the 20 state transportation departments in this online service, VTRC's library is number two in terms of holdings (as of June 30, 2005).

Our library's complete electronic conversion now saves VTRC and VDOT staff considerable time in retrieving information, in turn saving taxpayer dollars. It also supports decision-making throughout VDOT because it allows our researchers to build on the existing knowledge base.

The Commonwealth Transportation Commissioner also recognized the value of the research library to VDOT; in the spring, he presented the library director with a commissioner's award for outstanding achievement in "innovation and quality improvement" for the state-of-the-art changes he implemented.

Directly overseeing the research library now is the **Knowledge Management** division, also part of VDOT's Technology, Research & Innovation directorate, along with the Research Council and the Information Technology division. VDOT created the Knowledge Management division in 2003 to promote efficiency and ensure consistent use of "best practices" throughout the agency.

As VDOT's main information resource, it made good business sense this year to align the library within the Knowledge Management division. The library promotes research excellence and advances transportation technologies by helping VDOT and VTRC employees use its growing information base to create new knowledge and improve its technical services.

A notable venture VTRC initiated during FY 2005 with the University of Virginia, and now under way with the 2005-2006 academic year, is the new **graduate pavement engineering program**. For years, VTRC researchers have advised and instructed U.Va.'s undergraduate and graduate transportation students, so this additional teaching program will take our affiliation to a new level of cooperation.

VTRC's Structural, Pavement & Geotechnical Engineering team took the lead in developing this program in U.Va.'s civil engineering department. Ph.D.-level scientists from VTRC teach the courses as visiting

professors, a position that further recognizes the expertise our staff brings to U.Va.'s highly ranked engineering programs, since it now allows our scientist-professors both advising and thesis oversight.

The creation of this new curriculum also strengthened VTRC's own staffing by helping us attract several new scientists to the Research Council who also will serve as faculty for this program. Previously we had a single pavement expert; now we have four.

Finally, in completing our new strategic plan, known as the "First Place Strategy," in the spring, VTRC created a "road map" for its future that stresses increased use of performance measures, better accountability and even stronger partnerships, with both academic and professional organizations.

This plan will guide our organization as we focus on our core functions of the practical applications of research, expert consulting for VDOT, implementing our research results and educating future transportation professionals.

This annual progress report touches only on the **highlights** of our work during FY 2005. For more in-depth information about the Virginia Transportation Research Council, including a complete year-by-year online listing of our reports since 1996, please visit our Web site at [www.vtrc.net](http://www.vtrc.net).



Gary R. Allen, Ph.D.

Chief of Technology, Research & Innovation  
Virginia Department of Transportation





# Guiding Transportation Research at VTRC

The Virginia Transportation Research Council takes direction for its program from several sources:

- VDOT's corporate tenets
- The Advisory Board
- The research advisory committees



## VDOT'S CORPORATE TENETS

The Virginia Department of Transportation enacted **eight corporate tenets** during 2005 to "define sustainable principles and business practices that establish clear lines of responsibility and accountability" throughout VDOT, including VTRC. The research tenet strengthens the value of VTRC's mission within the agency, an opportunity that few such research centers have with their parent organizations.

## ADVISORY BOARD

The agreement between the Virginia Department of Transportation and the University of Virginia creating VTRC in 1948 also set up a governing body, now known as the **Advisory Board**, to guide our research activities to benefit both the Research Council and the University. The board meets twice yearly and includes the Commonwealth Transportation Commissioner, the director of VTRC, dean of U.Va.'s School of Engineering & Applied Sciences, chair of the civil engineering department and one representative each appointed by U.Va.'s president and the VDOT commissioner.

The Advisory Board reviews the research program to ensure its continued relevance, identifies new research initiatives—including ways to obtain more funding and grants—and evaluates new resources for transportation research and education. In February 2005, for example, the Advisory Board approved the new graduate pavement program at the University that will have VTRC researchers as its faculty.

## RESEARCH ADVISORY COMMITTEE

**Research advisory committees**, or RACs, provide a professional sounding board for new research ideas, help set research priorities and, because of the transportation experts and officials who serve on them, offer a direct line to those who can best implement the research. RAC membership is normally limited to staff from federal, state and local government agencies and appropriate university faculty from throughout Virginia.

The committees advise VTRC on the content and direction of its research program in the specific technical discipline within each panel's scope. This includes providing technical advice and guidance during the course of our research projects as well as assistance and support with implementing that research.

Current advisory committees include those overseeing VTRC's work in asphalt, concrete, environmental issues, geotechnical engineering, pavements, structures, system operations, traffic and safety and transportation planning.

# FY 2005—WHAT WE ACCOMPLISHED

## WORK OF THE RESEARCH TEAMS

### ENVIRONMENTAL & BUSINESS PRACTICES

Amy O'Leary, Ph.D., associate director

*Conducts research into air and water quality, waste management, natural-resource protection and wetland mitigation, plus surveys to identify and preserve Virginia's historic and cultural resources. Also conducts studies pertaining to transportation finance and VDOT's business practices, and provides economic analyses.*

Environmental & Business Practices staff and a VDOT team completed a project in FY 2005 that is absolutely vital for VDOT's overall accountability to Virginia taxpayers—creating a new “highway construction-project cost-estimation tool” to better estimate construction costs. Before this study, state and federal entities had criticized VDOT's imprecise construction cost estimates.

The cost-estimation tool—which also includes an improved project scoping process—now yields estimates at the time of project scoping that differ from actual final project costs by only 22 percent. This new tool has helped to improve the agency's credibility with state legislators, the public and the Federal Highway Administration.

Another study that should have a positive impact on Virginia's environment is the project to manage stormwater runoff from VDOT's road-salt storage facilities. This analysis examined the quality and quantity of salt-contaminated water from these locations and evaluated how to improve managing and treating the runoff. One of the options recommended—reverse osmosis—offers the potential for considerable savings statewide; VTRC is now testing this method at one of VDOT's area headquarters.

One ongoing project that brought VTRC extensive and positive public notice during the year sought to determine how well large animals, primarily deer, use highway underpasses or culverts to, literally, get to the other side of the road. This study speaks to an issue many drivers care about, deer-vehicle collisions, because about 200 people nationwide reportedly die in animal-related car crashes annually.

The research on the animal underpasses noted that while many successful crossing structures cost less than \$200,000, studies have estimated the cost of a single human traffic fatality at more than \$3 million in lost income, medical costs and property damage.

Data from remote cameras at seven underpasses throughout Virginia have revealed that animals do use such structures to cross roads and highways, making this a good investment for VDOT. Preliminary results showed more than 1,000 deer and 1,000 smaller mammals using some or all of these sites. The research noted that while many successful crossing structures cost less than \$200,000, studies have estimated the cost of a single human traffic fatality at more than \$3 million in lost income, medical costs and property damage.

### MATERIALS

Michael Sprinkel, P.E., associate director

*Performs field and lab studies in asphalt concrete, surface treatments, hydraulic cement concrete, concrete repair, corrosion, nondestructive testing and petrography. Research focuses on processes and materials used in the construction, rehabilitation, and maintenance of transportation facilities.*

The Materials team continued its work to develop longer-lasting asphalt and concrete surfaces for Virginia's roads and bridges; the longer these surfaces stand up to traffic and weather extremes without repair or replacement, the more money and time VDOT and the Commonwealth save.

Notable projects this year included the design and installation of a new asphalt drainage layer in VDOT's Lynchburg District, consisting of a new aggregate blend that yields greater permeability, since water strips away the asphalt, affecting the road's sub-base and thus its longevity. Along these same lines, other materials research resulted in a new test to implement the acceptance of asphalt permeability.

While VDOT has density tests for asphalt, none existed for permeability.

In the high-performance pavements area, VTRC and Virginia Tech examined 18 road sections to identify common characteristics of better-performing pavement structures. This study involved flexible, composite and rigid pavements and evaluated common and developing tools (falling-weight deflectometer, ground-penetrating radar, digital imaging) used to assess pavement conditions. VTRC also developed a new “performance specification” for a high-performance concrete overlay for bridge decks, a first for VDOT. The top surface of a bridge must be well-bonded to the deck to provide skid resistance and to reduce the water and salt seepage that damages the structure.

VTRC researchers also analyzed innovative testing methods and other applications to **increase the life of structures and reduce maintenance costs**. By installing a group of “sacrificial anodes” to prevent corrosion in bridge columns, scientists determined that if the units provide a certain level of electrical current, the anodes could help ward off a



## AWARDS

### GENE ARNOLD

Herman J. Hoose Distinguished Service Award, by the Southern District of the Institute of Traffic Engineers, for outstanding service to the transportation engineering profession.

### MICHAEL FONTAINE

Eno Transportation Foundation Fellow. Best paper award by TRB work zone traffic control committee for "Guidelines for using late-merge traffic control: results of a simulation-based study."

### BILL MAUPIN

2005 International Award of Merit and the title of "fellow" by ASTM International (formerly American Society for Testing & Materials) for work with the society's committee on road and paving materials in bituminous research, which helped incorporate new and better technologies into ASTM's standards.

### KEN WINTER

Commissioner's Award for Outstanding Achievement in innovation and quality improvement to VTRC's chief librarian for his electronic conversion of the VDOT research library. Nominated by VDOT (one of eight employees) for a Governor's Award for the same achievement.

greater amount of chloride-induced decomposition in the structure's steel rebar. A U.Va. professor has applied for a patent for a product based on his research for VTRC—a wireless video-inspection system to inspect the condition of light poles concurrent with light replacement, allowing VDOT to conduct both maintenance jobs at the same time, reducing field time and other costs.

## SAFETY, PLANNING & LEGAL

Wayne Ferguson, associate director

*Applies legal and operational methods to reduce motor-vehicle accidents, including: analyzing human behavioral factors (e.g., drug and alcohol use); monitoring safety-restraint use; evaluating impacts of raising and lowering speed limits; and studying safety-related traffic-engineering issues, such as work-zone safety, truck accidents, roadway geometry and signs. Its studies also focus on improved coordination between transportation and land-use planning and risk management of VDOT's infrastructure and activities.*

In addition to its traditional annual safety studies that track activities such as seat-belt and motorcycle helmet use, the Safety, Planning & Legal team assisted VDOT this year in taking the longer view of integrating transportation planning into the overall grid that keeps Virginia moving.

One study detailed 30 years of planning decisions in three Virginia locales—Fairfax County, Spotsylvania County and Newport News—to determine the impacts of building or not building roads and the consequences these choices have had on growth. The results suggest that, in many ways, transportation investments are a "blunt policy instrument," affecting travel choices but difficult to use to manage growth. The researchers found that when planned roads were not built to inhibit growth, growth did occur; when roads were built to encourage development, growth occurred elsewhere.

Another project concentrated on using a single approach to coordinate transportation and land-use planning. For this study, VDOT took potential zoning scenarios and estimated the likely impacts of each on the transportation network. Botetourt County, the test site, benefitted from VDOT's engineering expertise, while VDOT in turn benefitted from the county's zoning and land-use planning knowledge. The

bottom line of this study included a template—focusing on adding data in an iterative manner, communicating consistently throughout the process and recognizing the county as the client—for all Virginia counties to use.

In other work, a series of studies, conducted for VTRC through U.Va.'s Center for Risk Management, have brought VDOT a new system to prioritize projects in its State Highway Plan. The methodology the researchers used helped develop an objective empirical data-driven system to support informed executive decision-making.

Finally, at the request of the Secretary of Transportation, the team produced a report on the "Evaluation of Red Light Camera (Photo-Red) Enforcement Programs in Virginia" to determine whether such equipment deters drivers from running red lights. Results showed that while red-light cameras do positively affect driver behavior (citations were reduced 21 percent at test sites), the researchers could not determine a definite safety improvement related to total numbers of crashes. While the General Assembly voted to end the state's official red-light camera program, VTRC continues to work with Fairfax County to collect more data without enforcement.

## STRUCTURAL, PAVEMENT & GEOTECHNICAL ENGINEERING

Jose Gomez, Ph.D., P.E., associate director

*Analyzes design and performance aspects of bridges and structures; develops, implements and evaluates pavement, structures and maintenance management systems; seeks improvements in maintenance strategies, technology, equipment and operations; and assesses design traits of soils as applied to the construction of structures and pavements.*

The Structural, Pavement & Geotechnical Engineering team received \$1.2 million for three projects this year from the Federal Highway Administration under FHWA's **Innovative Bridge Research & Construction program**. This initiative helps state and local governments integrate new materials and other technologies in their bridge work to reduce traffic congestion related to bridge construction and maintenance, increase savings and productivity by lowering life-cycle costs and generally enhance safety.

VTRC, in collaboration with Virginia Tech, will spend this money on two projects in



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Scott County on U.S. 58 and one in Fauquier County at U.S. 15/17/29. In turn, researchers will use these projects to separately evaluate self-consolidating lightweight concrete in bridge girders, a composite steel-polymer “sandwich panel system” on a bridge deck, and Grade 300 prestressing strand in yet other bridge girders.

Through this team, VTRC stepped up its oversight of the Smart Road at the Virginia Tech Transportation Institute (VTTI) on behalf of VDOT, which owns the facility, with the appointment of a new program manager. The Smart Road is a state-of-the-art, full-scale 2.2-mile-long road and bridge system with lighting, intersection signaling and weather-producing equipment used to conduct research on pavements and Intelligent Transportation Systems technologies to improve driving safety.

VTRC also sponsors and funds several research projects through VTTI using the Smart Road each year. These include the recent “100-car study” by VTTI, which collected real-time, real-world driver and vehicle information to assess causes and behaviors that influence crashes and near-crashes, and factors that affect successful versus unsuccessful evasive driver maneuvers.

Other recent VTRC projects employing the Smart Road have involved applications to avoid intersection collisions, improvements in lighting and visibility during inclement weather at night, and the use of ground-penetrating radar as a non-destructive means to determine the physical condition of various pavement layers.

## SYSTEM OPERATIONS & TRAFFIC ENGINEERING

**Michael Perfater**, associate director

*Focuses on work that impacts the capacity and efficiency of existing transportation systems in real time without investing in new construction. Research includes intelligent transportation systems and system-management projects that enhance the*

*operation of VDOT's highway infrastructure, improve visibility and safety performance of traffic-control systems, and derive useful information from system condition data.*

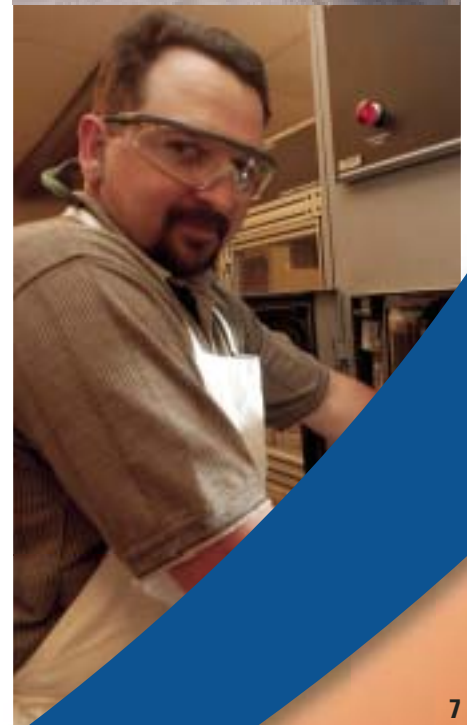
The System Operations & Traffic Engineering team got a big boost this year when the Transportation Commissioner created the system operations directorate at VDOT, elevating system operations to a core VDOT function. He then directed VTRC and VDOT to create a \$1.5 million research program that would support this new group's work.

A system operations research panel, appointed by VDOT's Chief of Technology, Research and Innovation and the Chief of System Operations, developed the system operations research program that grew to 20 planned projects by the end of FY 2005. VDOT and VTRC jointly oversee disbursing the funds for the research projects, of which 18 got under way by year's end.

This team also devoted significant resources to assisting VDOT's Smart Travel Program. That initiative includes VDOT's five **Smart Traffic Centers**, which provide real-time traffic management capabilities in Virginia's urban areas and along key corridors, and the **Smart Travel Lab**, a joint venture of VTRC and U.Va., created in 1997 and based at the University to provide technical assistance to the state's Smart Travel Program.

The most prominent collaborative effort VTRC completed for the Smart Travel Program was “ADMS Virginia,” or the archived data-management system, for which VTRC received a \$1 million federal grant. This application collects, processes and stores data from several sources, including the Smart Traffic Centers in Northern Virginia and Hampton Roads, the Traffic Monitoring System continuous count stations and the signal system in Norfolk.

ADMS data are available to VDOT staff and those outside the agency—such as urban planners in Hampton Roads and other local transportation entities. A Web interface provides access as well as query tools and services.





## FY 2005 REVENUES

State Funds	\$5,795,503
Federal & state grants	\$3,169,619
State planning & research funds (SPR)	\$4,004,768
<b>Revenue Total</b>	<b>\$12,969,890</b>
<b>ANCILLARY</b>	
Local Technical Assistance Program	\$200,000
Contributions to FHWA pooled-fund studies	\$125,000
National Cooperative Highway Research Program	\$873,752
Transportation Research Board correlation service	\$141,075
TEA-21 Smart Road program	\$1,305,193
Smart Road management agreement	\$375,000
Mid-Atlantic University Transportation Center match	
To University of Virginia	\$120,000
To Virginia Tech	\$120,000
<b>ANCILLARY FUNDING TOTAL</b>	<b>\$3,260,020</b>
<b>OVERALL TOTAL REVENUE &amp; FUNDING</b>	<b>\$16,229,910</b>



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