Public Roads

www.fhwa.dot.gov

May/June 2015

Separated Bike Lanes
Excellence in Operations
Sustainability at FHWA

U.S. Department of Transportation
Federal Highway Administration

Public Roads

—featuring developments in Federal highway policies, programs, and research and technology—

May/June 2015 www.fhwa.dot.gov Vol. 78, No. 6

Articles

Page 20

Page 30

Page 36

Departments

Front cover—This cyclist in Seattle, WA, is traveling on a bicycle lane that is separated from the roadway by a bus stop and flexible delineator posts. By providing a more comfortable, appealing, and safe cycling infrastructure, separated bike lanes are designed to encourage more people to view bicycling as a viable transportation choice. For more information, see "Let's Ride!" on page 2 in this issue of PUBLIC ROADS. *Photo: PeopleForBikes.*

Back cover—Traffic congestion, like this backup outside Los Angeles, CA, costs the United States billions of dollars and billions of hours of travelers' time each year. A new National Operations Center of Excellence aims to help transportation agencies improve the operation of existing highways to optimize capacity. For more information, see "Smooth Operators" on page 8 in this issue of PUBLIC ROADS. *Photo: Shutterstock, American Spirit.*

U.S. Department of Transportation
Federal Highway Administration

U.S. Department of Transportation
Anthony Foxx, *Secretary*

Federal Highway Administration
Greg Nadeau, *Acting Administrator*

Office of Research, Development, and Technology
Michael Trentacoste, *Associate Administrator*

Lisa A. Shuler, *Editor-in-Chief*

TaMara McCrae, *Publication Manager, Creative Director*

Norah Davis, *Editor*

John J. Sullivan IV, *Managing Editor*

Alicia Sindlinger, *Associate Editor*

Lisa A. Shuler, *Distribution Manager*

Editorial Board
J. Paniati, chairman; J. Curtis, D. Elston, T. Furst, D. Kim, J. Lindley, A. Lucero, R. McElroy, G. Shepherd, W. Waidelich

Public Roads (ISSN 0033-3735; USPS 516-690) is published bimonthly by the Office of Research, Development, and Technology, Federal Highway Administration (FHWA), 1200 New Jersey Avenue, SE, Washington, DC 20590. Periodicals postage paid at Washington, DC, and additional mailing offices.

POSTMASTER: Send address changes to *Public Roads,* HRTM, FHWA, 6300 Georgetown Pike, McLean, VA 22101-2296.
The editorial office of *Public Roads* is located at the McLean address above.
Phone: 202–493–3375. Fax: 202–493–3475.
Email: lisa.a.shuler@dot.gov.

Public Roads is sold by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Requests for subscriptions should be sent directly to New Orders, Superintendent of Documents, P.O. Box 979050, St. Louis, MO 63197-9000. Subscriptions are available for 1-year periods. Paid subscribers should send change of address notices to the U.S. Government Printing Office, Claims Office, Washington, DC 20402.

The electronic version of *Public Roads* can be accessed through the Turner-Fairbank Highway Research Center home page (www.fhwa.dot.gov).

The Secretary of Transportation has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this department.

All articles are advisory or informational in nature and should not be construed as having regulatory effect.

Articles written by private individuals contain the personal views of the author and do not necessarily reflect those of FHWA.

All photographs are provided by FHWA unless otherwise credited.

Contents of this publication may be reprinted, provided credit is given to *Public Roads* and the authors.

For more information, representatives of the news media should contact FHWA's Office of Public Affairs at 202–366–0660.

NOTICE
The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the article.

Guest Editorial

Pedaling Toward a Safer System for Bicyclists

With the return of warmer weather, many people are heading out on two wheels. The increase of bicycling is evident in the growing number of bike share programs in cities across the country, upward trends in bike commuting, and the commitment of more and more communities to create connected bicycle transportation networks.

Communities, schools, and workplaces across the country are celebrating National Bike Month by holding events in May to promote bicycling. For example, Bike to School Day 2015 is May 6. More than 2,200 schools participated in this event in 2014, which is double the number of schools that took part in 2012. And 2015 is likely to show additional growth. The increased participation in this event is another indication of how bicycling has become more popular in recent years.

U.S. Secretary of Transportation Anthony Foxx is committed to improving safety throughout the transportation network and is mobilizing U.S. Department of Transportation resources to increase opportunities for Americans to walk and bike. For example, this year, in each State, division, and regional office, staff from the Federal Highway Administration, the National Highway Traffic Safety Administration, the Federal Transit Administration, the Federal Motor Carrier Safety Administration, and the Federal Railroad Administration are working together to conduct assessments of the real-world challenges that bicyclists and pedestrians face on roadways. The assessments bring together Federal, State, and community partners to identify challenges and barriers and to work together to make improvements.

Building on years of support for walking and bicycling options, FHWA is advancing new efforts to make bicycling safer, more convenient, and more comfortable. For instance, in October 2014, the agency released a new version of BIKESAFE, an online tool that communities can use to identify solutions for bicyclist safety issues.

The agency also has produced several new guides to help make infrastructure safer for bicyclists. The *Road Diet Information Guide* (FHWA-SA-14-028) supports and encourages the use of road diets because of their proven ability to improve the safety of all roadway users while also providing an opportunity to reallocate excess roadway width.

In addition, FHWA's *Separated Bike Lane Planning and Design Guide* will help practitioners plan and design separated bike lanes (also known as cycle tracks and protected bike lanes). Separated bike lanes are exclusive facilities for bicyclists that are located within or directly adjacent to the roadway. The lanes are physically separated from motor vehicle traffic, so many people feel more comfortable riding in them. For more information on separated bike lanes, see "Let's Ride!" on page 2 in this issue of PUBLIC ROADS.

These recent actions are the latest in a broad range of policies and tools provided by FHWA to support walking and biking. More information and resources are available on FHWA's Pedestrian and Bicycle Safety Web site at http://safety.fhwa.dot.gov/ped_bike and Bicycle & Pedestrian Program site at www.fhwa.dot.gov/environment/bicycle_pedestrian. And to each bicyclist riding to work, errands, or play this season, know that the safety of all users of the transportation network is USDOT's top priority.

Tony Furst
Associate Administrator
FHWA Office of Safety

Gloria Shepherd
Associate Administrator
FHWA Office of Planning, Environment, and Realty

Let's Ride!

This cyclist is traveling on a bicycle lane in Seattle, WA, that is separated from the roadway by a bus stop and flexible delineator posts. *Photo: PeopleForBikes.*

by Dan Goodman

FHWA has just published a guidebook on planning and designing separated bike lanes—innovative bicycle facilities that are being implemented in communities throughout the country.

In 2013, the number of deaths on the Nation's roads decreased by 3.1 percent compared with the prior year, falling to 32,719 fatalities. Despite this reduction in overall deaths, the number of bicyclists killed increased by 1.2 percent, according to the National Highway Traffic Safety Administration's Fatality Analysis Reporting System. The increase in bicyclist fatalities clearly demonstrates that more needs to be done. To that end, the U.S. Department of Transportation's Federal Highway Administration is focused on improving pedestrian and bicyclist safety and at the same time encouraging people to walk and bike for transportation by providing more comfortable, appealing, and safer bicycling infrastructure.

An increase in bicycling will contribute to a range of policy goals, including improved public health through regular physical activity, improved mobility, transportation equity, and increased economic activity. Planning and designing the U.S. transportation system to better accommodate bicycling

can enhance access to jobs and schools, while also contributing to economic development, for example, by increasing retail visibility, delivering customers to local businesses, and helping communities attract and retain talented workers.

One way to persuade more people to bike is to provide an experience that feels safer for people of all skill levels, especially the segment of the population that is interested in bicycling but concerned about riding alongside cars. Bicycle infrastructure that increases the lateral separation between bicycles and automobiles and enhances the distinction between car and bike spaces makes many cyclists and many drivers feel safer and more comfortable.

Well-designed separated bike lanes can serve as a high-quality link within a network of bicycle facilities that connect important destinations. These lanes are designed specifically to be appealing and attractive to a broad range of bicyclists, characteristics that enable the infrastructure to serve larger policy goals—improved health, the economy, mobility, transportation equity, and safety—effectively.

FHWA's Guide to Separated Bike Lanes

In May 2015, FHWA released a new publication, *Separated Bike Lane Planning and Design Guide*, to support development of these transportation facilities. The guide outlines planning considerations for separated bike lanes and provides a menu of design options covering typical one- and two-way scenarios. The guide highlights various alternatives for providing separation, while also documenting midblock design considerations for driveways, transit stops, accessible parking, and loading zones. It provides detailed information on intersection designs, covering such topics as turning movements, signalization, signage, and onroad markings.

Throughout the document, case studies highlight best practices and lessons learned from practitioners who are designing and implementing separated bike lanes around the United States. The case studies cover a range of topics—from Boulder's use of pilot projects to test designs and gather public input to Philadelphia's business support for separated bike lanes. In New York City, an approach for holistically evaluating the performance of their separated bike lanes is also highlighted as a case study.

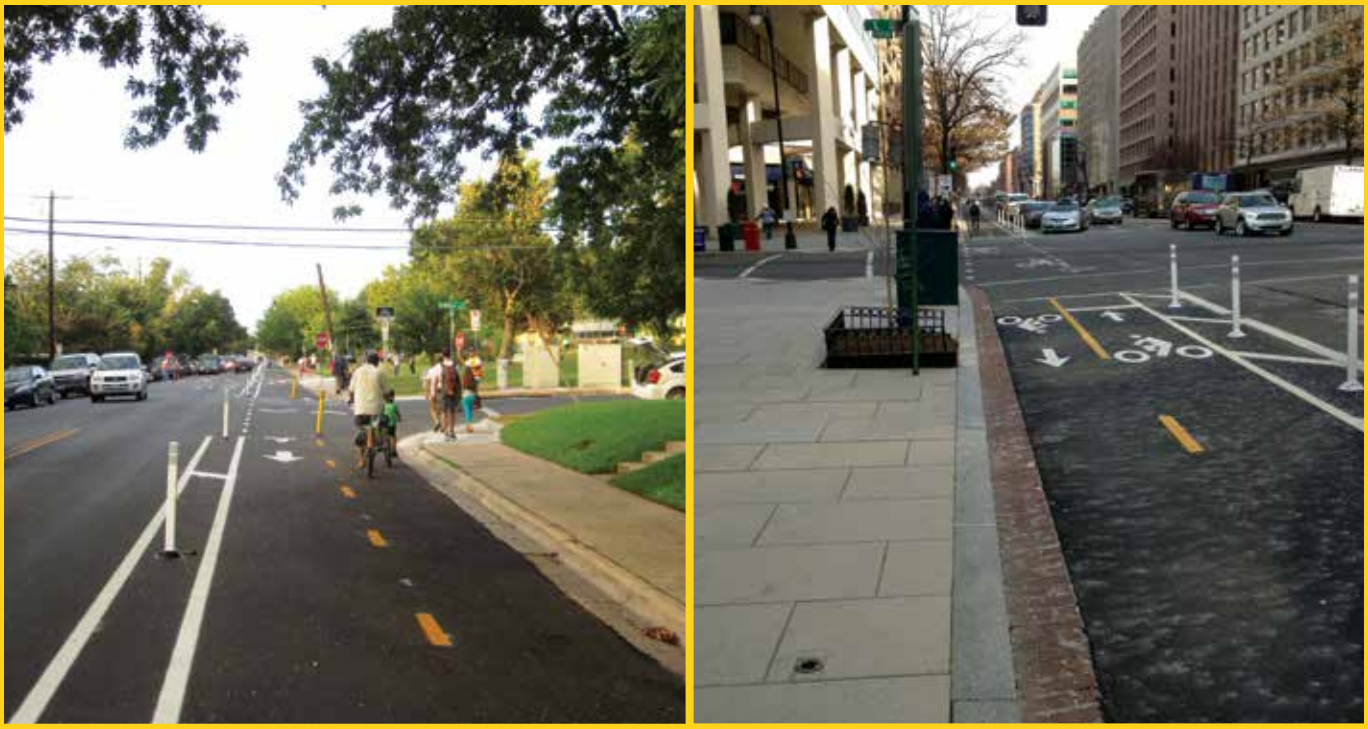
The FHWA publication attempts to capture the current state of the practice; however, it also recognizes that understanding of this type of facility is still evolving and that there is a need for design flexibility. As such, the guide builds on a memorandum released in August 2013, "Bicycle and Pedestrian Facility Design Flexibility," that expresses FHWA's support for taking a flexible approach to designing bicycle and pedestrian facilities.

To encourage continued development and refinement of techniques, the guide identifies specific data elements to collect before and after implementation of separated bike lanes in order to facilitate future analysis. The publication identifies potential future research, highlights the importance of ongoing peer exchanges and capacity building, and emphasizes the need to create comprehensive ways to evaluate the performance of separated bike lanes.

A technical workgroup provided input and feedback during the development of the guide. The workgroup included representatives from cities, a metropolitan planning organization, State departments of transportation, the National Association of City Transportation Officials, the American Association of State Highway and Transportation Officials, the Institute of Transportation Engineers, and the League of American Bicyclists.

What Is a Separated Bike Lane?

A separated bike lane is a facility designed exclusively for bicyclists, in contrast to side paths or multiuse trails that are intended to accommodate pedestrians and other users as well as bicyclists. Vertical design



Nathan Wilkes, City of Austin

Shown here are two examples of two-way separated bike lanes. The one on the left is located in Austin, TX. On the right is a two-way separated bike lane on 15th Street, NW, in Washington, DC.

elements, such as flexible delineator posts, placed between the bike and car travelways, distinguish a separated bike lane from standard or buffered bike lanes, which use paint to differentiate the automobile and bicycle spaces. Separated bike lanes are also sometimes called cycle tracks or protected bike lanes.

Although all separated bike lanes enhance physical and modal separation, wide variability exists in the design and operational characteristics of these facilities. For one thing, separated bike lanes can be one- or two-way facilities. They can be placed on the left or right side of the roadway, and the vertical separation can be provided by flexible posts, planters, raised medians, or even parked cars. The separated nature of the facility increases the complexity of intersection design and operations, especially for two-way separated bike lanes because of the number of turning movements that need to be accommodated safely.

Separated bicycle-only facilities are common in many countries; however, they are relatively new in the United States. Through practical project-based experience and with the assistance of design resources such as the National Association of City Transportation Officials' *Urban Bikeway Design Guide*, communities in the United States have constructed almost 200 separated bike lanes. Although commonly associated with urban locations in cities like New York and San Francisco, separated bike lanes now exist or are planned in small and midsized communities and also in suburban, rural, and campus settings.

For example, Austin, TX, is implementing separated bike lanes "as part of a broader strategy to build low-stress bicycle networks," according to Nathan Wilkes, a planner and designer with the city's Active Transportation Program. Wilkes notes that "if built, Austin's proposed $150 million all-ages-and-abilities bicycle network (both on- and offstreet) is estimated to capture 7 percent of downtown vehicular trips, reduce direct driving costs to citizens by $170 million per year, and result in the equivalent of 15

On a downtown street in Chicago, IL, parked cars and flexible delineator posts on both sides of the street separate the bike lanes from traffic.

City of Chicago

percent of Austinites meeting their daily recommended physical activity."

Investing in Infrastructure

Investments in transportation infrastructure need to result in improved mobility for everyone, including people who cannot afford to buy or lease a car, are unable to drive, or who need to be able to access transit safely. According to the U.S. Department of Transportation's Bureau of Transportation Statistics, approximately 10 million people, or about 9 percent of U.S. households, do not own or have access to a vehicle.

Infrastructure investments also need to foster economic development. Many communities are finding that economic growth can occur, in part, by creating appealing physical environments that facilitate transportation choice and prioritize quality of life. As a result, separated bike lanes and other pedestrian and bicycle infrastructure are being integrated into broader economic development strategies to attract talented workers and innovative companies.

For example, according to Mike Amsden, Chicago's assistant director of transportation planning, "Chicago is investing in bike and pedestrian infrastructure in order to foster vibrant commercial spaces, attract employers to the city, and provide safe and accessible transportation options for residents, employees, and visitors alike."

Given the high rate of obesity in the United States and the increasing social costs of health conditions associated with inactivity, such as diabetes, investments in infrastructure also need to consider public health. Separated bike lanes have shown particular promise in encouraging a broader cross section of people to pedal to meet their transportation needs. Over time, this increase in bicycling activity could lead to improved public health outcomes.

USDOT's Safer People, Safer Streets Initiative

U.S. Secretary of Transportation Anthony Foxx has made pedestrian and bicycle safety one of the top priorities of his administration. Secretary Foxx announced the Safer People, Safer Streets initiative on September 10, 2014, at the Pro Walk/Pro Bike/Pro Place conference in Pittsburgh, PA. In his remarks, the Secretary noted that the initiative "is aimed at reversing the recent rise in deaths and injuries among the growing number of Americans who bicycle or walk to work, to reach public transportation, and to other important destinations."

As part of the initiative, USDOT division and field office staff members are convening and leading pedestrian and bicycle safety assessments in every State. The initiative includes a Mayors' Challenge for Safer People, Safer Streets, which challenges local elected officials to take significant action over the next year to improve safety for bicyclists and pedestrians of all ages and abilities. USDOT is also working with University Transportation Centers and other stakeholders to identify and remove barriers to improving nonmotorized safety. To learn more about the Mayors' Challenge, visit www.dot.gov/mayors-challenge. To learn more about the broader initiative and to view the Secretary's Action Plan on Bike and Pedestrian Safety, see www.dot.gov/policy-initiatives/ped-bike-safety/safer-people-safer-streets-pedestrian-and-bicycle-safety.

A newly formed Pedestrian and Bicycle Safety Action Team of the USDOT Safety Council is implementing the initiative. The team includes representatives from throughout USDOT, including the Office of the Secretary, FHWA, the Federal Transit Administration, the National Highway Traffic Safety Administration, the Federal Motor Carrier Safety Administration, and the Federal Railroad Administration.

PeopleForBikes

These bicyclists in Washington, DC, are separated from vehicle traffic by flexible posts. This type of bicycle lane helps increase the comfort of cyclists who are commuting to and from work.

City of Boulder

www.pedbikeimages.org/Carl Sundstrom

(Above) This one-way bicycle lane in Boulder, CO, is separated from the roadway by a series of parking stops and delineator posts.

(Right) Small street trees in planter beds separate this bike lane from a street in Vancouver, British Columbia.

Investments in pedestrian and bicycle infrastructure address all of these public policy goals—mobility, economic development, transportation equity, and public health—in addition to the top public policy goal of improving safety. Comparing the costs of separated bike lanes with traditional facilities is difficult because the costs depend on the specific design features.

Examples of the FHWA Office of Planning, Environment, & Realty's Pedestrian and Bicycle Projects

As part of an aggressive research agenda, in partnership with the FHWA Office of Infrastructure, the Office of Planning, Environment, & Realty has initiated the following projects, all of which are currently underway:

- The Global Benchmarking Program Desktop Review, in conjunction with the Office of Safety and Office of International Programs, will identify and evaluate international best practices for establishing pedestrian and bicycle transportation networks and improving safety.
- Multimodal Conflict Points focuses on planning and design improvements needed in locations where various transportation modes come together, such as near transit stations, bus stops, street crossings, schools, and essential services.
- The Guidebook for Evaluating, Establishing, and Tracking Pedestrian and Bicycle Performance Measures will present the full range of potential measures, organized in categories useful to practitioners at the local, regional, State, and national levels.
- An FHWA team is developing the Workbook for Building On-Road Bike Networks Through Routine Resurfacing Programs to assist communities in jump-starting the creation of onroad bike networks by better capturing opportunities that arise as part of routine resurfacing.
- The Flexibility in Pedestrian and Bicycle Facility Design project will highlight specific examples of design flexibility as a followup to FHWA's "Bicycle and Pedestrian Facility Design Flexibility" memorandum.
- The Strategic Agenda for Pedestrian and Bicycle Transportation will provide an action-oriented framework for issues such as data collection and management, network implementation and documentation, research, training, and national design guidance.
- The Transportation Alternatives Program Performance Management Guidebook will provide sample performance objectives and measures that States, metropolitan planning organizations, and project sponsors may consider.

Separated Bike Lanes: Volume and Safety Impacts

As part of the planning process for FHWA's *Separated Bike Lane Planning and Design Guide*, the project team completed an assessment of available volume and crash data for existing separated bike lanes throughout the country. This assessment included facilities in cities ranging from Chicago, IL; New York, NY; and San Francisco, CA, to Austin, TX; Missoula, MT; and St. Petersburg, FL. From this analysis, the team found that the quantity and consistency of available data are insufficient, at this point in time, to draw specific conclusions about separated bike lanes, especially regarding particular design elements.

For future investigations, FHWA's guide identifies minimum recommendations for the collection of volume and crash data for all separated bike lanes. A clearer story, especially regarding specific design elements, will likely emerge over time.

That being said, of the 17 facilities included in the analysis, the study found increases in bike volumes after implementation and a general reduction in crashes for all modes. In some cases, bike crashes went up after implementation, and in other cases the number went down. When crashes did go up, the upsurge was generally

correlated with increases in bike volumes, which could suggest that exposure to risk did not increase.

By encouraging more people to cycle, separated bike lanes might contribute to a safety-in-numbers effect. As the number of people biking in a community increases, drivers become more aware of their presence and more accustomed to interacting with them on a routine basis. Over time, safety improves for everyone.

In addition, separated bike lanes have been shown to decrease sidewalk riding and thus opportunities for potential bicyclist-pedestrian conflicts, according to a 2012 study by the New York City Department of Transportation. When separated bike lanes are implemented as part of a road diet, they can be one component of a set of improvements that clearly contribute to increased safety for all roadway users.

In sum, separated bike lanes can provide premier linkages within an increasingly connected network of bicycle facilities in communities. They are designed to be comfortable and appealing and to encourage more people to view bicycling as a viable transportation choice. FHWA's *Separated Bike Lane Planning and Design Guide* is meant to contribute to the state of the practice for planning and designing such facilities so that they can continue to serve public policy goals in communities throughout the United States.

Separated bike lanes like this one in Chicago, IL, help commuters cycle to and from work safely.

PeopleForBikes

Shrubs in planting beds separate this bike lane from the street in San Francisco, CA.

Dan Goodman is a transportation specialist in the Office of Human Environment at FHWA. He is a member of the Transportation Research Board's Pedestrian Committee and chair of the subcommittee on pedestrian research. Goodman also is FHWA's representative to the American Association of State Highway and Transportation Officials' Joint Technical Committee on Non-Motorized Transportation.

For more information, see www.fhwa.dot.gov/environment/bicycle_pedestrian or contact Dan Goodman at 202-366-9064 or daniel.goodman@dot.gov. To see the status of various bike-related traffic control devices in the Manual on Uniform Traffic Control Devices, *which takes priority over the National Association of City Transportation Officials'* Urban Bikeway Design Guide, *visit www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/mutcd.*

by Grant Zammit and Ben Irwin

Smooth Operators

Even transportation professionals find themselves stuck in traffic at times. If you are among those who have been caught in highway congestion, you are not alone in your frustration. U.S. drivers know that feeling all too well. According to the Texas A&M Transportation Institute's *2012 Urban Mobility Report*, roadway congestion cost the United States $121 billion in delays and fuel in 2011 and gobbled up 5.5 billion hours of travelers' time.

In today's reality, funding and space constraints mean that State and local transportation agencies cannot simply construct new roads to address traffic congestion. Instead, transportation professionals are looking to improve the operations of existing highway networks to optimize capacity and improve reliable travel. Improving operations involves using new approaches and tools. Although the transportation community has quickly adopted strategies such as the coordination of traffic signals, management of work zones, electronic tolling, and traveler information systems, few departments of transportation have fully integrated these practices into their overall frameworks for transportation system management and operations (TSM&O).

As described in the article "A New Approach to Improving Travel Times," published in the November/December 2014 issue of PUBLIC ROADS, TSM&O is defined as "integrated strategies

Transportation system management and operations plays a significant role in addressing reliability and improving safety. Here, staff in the McConnell Public Safety Transportation Operations Center monitor roadways in northern Virginia. *Photo: Trevor Wrayton, Virginia Department of Transportation.*

AASHTO and its partners recently launched the National Operations Center of Excellence to help transportation agencies establish systems management and operations as a discipline.

to optimize the performance of existing infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of the transportation system."

Historically, TSM&O has not received broad institutional support, as evidenced by the lack of dedicated funding, established institutional structures, cost/benefit data, training in university curricula, and coordination among transportation partners. As a result, for those charged with solving the Nation's pressing congestion and safety challenges, the process of accessing the information and resources needed to improve operations has left many transportation professionals feeling, well, stuck in traffic.

With the January 2015 launch of a National Operations Center of Excellence, practitioners, researchers, and decisionmakers now have a central resource for finding information, training, and communities of interest focused on advancing improvements in reliability and safety. Operated through an agreement among the American Association of State Highway and Transportation Officials (AASHTO), the Intelligent Transportation Society of America (ITSA), and the Institute of Transportation Engineers (ITE), the center is a first-of-its-kind organization for advancing TSM&O.

The National Operations Center of Excellence identifies best practices so individual agencies and the transportation community as a whole can benefit from the improved safety and reduced costs associated with a better planned and operated highway system.

"Proactively operating the transportation system in the most efficient manner possible is vital to keeping America—both passengers and freight—moving," says Jeff Lindley, FHWA's associate administrator for operations.

Developed in part through the second Strategic Highway Research Program (SHRP2), the National Operations Center of Excellence seeks to institutionalize TSM&O across the country. The center provides State departments of transportation, metropolitan planning organizations, regional planning organizations, product developers, service providers, system designers, and a host of other interested organizations with a single, continually improving source of information and technical support. The goals include helping agencies use the center's resources to address congestion and improve safety on roadways, reduce delays and disruptions caused by incidents, minimize the adverse effects of work zones and inclement weather, provide timely and accurate information to travelers, and improve the linkages between modes for passengers and freight.

"The center provides an opportunity to bring together an emerging

Traffic delays, such as this backup on a detour route in Washington State, come with a high price tag for U.S. drivers and businesses.

Washington State Department of Transportation

iStock

Crashes on the Nation's roadways cause significant travel delays and put first responders and other road users in harm's way.

and diverse community of TSM&O practitioners," says Gummada Murthy, associate program director of operations with AASHTO. "Whether you work for a State, county, city, or a consultant, the center allows you to find the information you need to help do your job, and it also gives you the ability to share your knowledge with your peers."

SHRP2: The Beginnings of The Center of Excellence

The National Operations Center of Excellence is itself a story of innovation and partnership, from its roots within SHRP2 to ongoing collaboration. The Transportation Research Board (TRB), AASHTO, ITSA, and ITE work closely with the Federal Highway Administration to ensure the center meets the needs of practitioners, industry leaders, researchers, and policymakers.

The framework for the center stems from SHRP2, a national research program designed to identify solutions to help transportation professionals plan, operate, maintain, and ensure safety on the Nation's roadways. SHRP2 itself is a partnership among FHWA, AASHTO, and TRB, which administered the research phase of the program. Research on Reliability—one of four SHRP2 focus areas—is pursuing solutions to help agencies create more dependable and predictable travel times by reducing congestion.

Practitioners can use SHRP2 Reliability products and tools to analyze travel times, improve design strategies, establish programs to collect data and develop performance measures, improve agency and staff capabilities in TSM&O, and better implement strategies to manage traffic incidents. Among the products that emerged from the SHRP2 Reliability focus area is Organizing for Reliability Tools, a suite of workshops, guides, and online resources to help transportation agencies assess and enhance their TSM&O capabilities at an organizational level.

The SHRP2 research revealed that agencies needed a comprehensive and accessible resource to support an updated Reliability knowledge base and to help them locate guidelines and tools to meet their specific needs. Agency officials reported that finding the right information tailored to specific circumstances is challenging, given the volume, expanse, and changing nature of information available in publications and online. Therefore, another SHRP2 project, originally called A Framework for Improving Travel-Time Reliability (Project L17), studied the current state of the practice and knowledge base for TSM&O. The project identified knowledge gaps and opportunities to develop a comprehensive resource to capture the results of the Reliability focus area and make them available to agencies.

The SHRP2 framework study found that although a variety of organizations provided resources on how to improve highway operations, barriers still prevented establishment of an integrated TSM&O discipline. One barrier was lack of coordination. Organizations such as AASHTO, the National Transportation Operations Coalition, and the I-95 Corridor Coalition all make important contributions to improving the state of the practice of TSM&O. However, these and a host of other efforts exist within separate organizations and have less frequent interaction than necessary for a unified resource. Furthermore, the professionals who could benefit most from the available resources were often unaware of them or found the materials were not tailored to their needs.

Perhaps the most daunting barrier the researchers found to establishing a robust TSM&O discipline was the lack of a forum for transportation professionals to discuss challenges, share best practices, and make professional connections. In contrast to other disciplines within the highway community, such as construction and planning, a community of practice for TSM&O professionals was still quite new. Limited or relatively few agency or industry forums and professional conferences were being held, and few operations-focused publications had appeared. A clear need existed, the researchers concluded, for consolidated outreach and community building to engage practitioners, researchers, and policymakers in sharing and accessing existing and emerging insights about TSM&O.

"With the center's ability to focus on and highlight an array of

information resources for the TSM&O community, it will spur invaluable collaboration and innovation in the field to achieve the transportation outcomes [that are] important for our country," says Tom Kern, executive vice president of ITSA.

Supporting Knowledge Transfer

The SHRP2 L17 project took the first steps to address the need for a community of practice by developing an online resource known as the Knowledge Transfer System. The system facilitated access to SHRP2 Reliability products and provided a prototype for a Web portal for the TSM&O community. The Knowledge Transfer System also included a business case primer, which provided tools such as key messages, 30-second speeches, and talking points to help agencies effectively communicate the need for TSM&O to targeted audiences.

As part of the development of the Knowledge Transfer System, researchers identified groups of relevant knowledge that ultimately drove development of the National Operations Center of Excellence. Examples include definitions and frequently asked questions, technical understanding and analytic tools, facts and statistics about TSM&O, relevant standards and regulations, current news and events relevant to the community, outreach and marketing tools, and education and training.

During the implementation phase of SHRP2, FHWA worked with AASHTO, ITE, and ITSA to expand the capabilities and content of the Knowledge Transfer System significantly, creating the Enhanced Knowledge Transfer System. In an early step to develop the enhanced system, researchers conducted market studies of practitioners, policymakers, and others to learn about what they needed and wanted in the resource. Results of this research indicated several needs: the ability to sift through information quickly to find the most relevant resources, access to best practices and experiences of other agencies, interaction with others in the TSM&O community, a single location to house the latest information, and knowledgeable staff to answer questions and help direct users to the right information. FHWA and its SHRP2 partners addressed these needs in the design of the Enhanced Knowledge Transfer System by adding advanced search capabilities, interactive features (such as discussion forums and blogs), and on-demand training. This enhanced Web portal became the foundation for the National Operations Center of Excellence.

"The center will allow individuals from public, private, and academic perspectives to share information through an active discussion forum, knowledge database, events, and regular newsletter," says Douglas E. Noble, senior director of management and operations with ITE. "This will lift the knowledge of TSM&O practice for our entire profession as well as other interested stakeholders."

Building on Examples

In conjunction with the SHRP2 L17 project, TRB authorized additional research to design a National Operations Center of Excellence. Commissioned through TRB's National Cooperative Highway Research Program, the research outlined various approaches and recommendations for creating such a center. In addition, the researchers examined other centers of excellence, including AASHTO's Center for Environmental Excellence. The research provided examples of successful concepts, functions, and initial business cases from which came the beginnings of the new operations center of excellence.

The Center for Environmental Excellence was a useful comparison, given the similarities between its functions and the anticipated needs of the National Operations Center of Excellence. For example, the Center for Environmental Excellence is designed to serve as a resource for transportation professionals seeking technical assistance, training, information exchange, partnership-building opportunities, and quick and easy access to environmental tools. This center also includes a Web site, guidelines, peer exchanges, webinars and webcasts, and a library of handbooks and reports. Comparable funding demands and a similar organizational makeup also made the Center for Environmental Excellence a good initial model.

"As a founding board member for the AASHTO Center for Environmental Excellence, I have seen how it has grown to become an invaluable resource for environmental professionals in both State DOTs and environmental resource agencies," says Neil Pedersen, executive director of TRB. "We expect the National Operations Center of Excellence will serve a similar role for operations professionals."

What the Operations Center of Excellence Offers

How can you as a transportation professional benefit from using the National Operations Center of Excellence? For starters, the center is your first point of contact to find guidelines and regulations and to receive technical assistance. It is a repository for best practices and lessons learned from peers. The center also is your gateway for participating in a community of like-minded professionals, where you can stay informed about the latest news and events associated with highway operations and be connected to helpful products that have resulted from SHRP2.

"While acting as a catalyst to mainstream transportation operations, the center will strive to

What Is SHRP2 Reliability?

SHRP2 Reliability includes assessment, analysis, decisionmaking, knowledge transfer, training tools, and activities to help transportation agencies improve operations and realize more consistent, dependable highway travel time for travelers and freight.

By using the tools developed under SHRP2 to improve travel time reliability, agencies reduce the negative impacts of nonrecurring traffic, such as the unexpected congestion, the costs associated with late deliveries, the frustration of missed appointments, and the safety risks to travelers and responders involved in traffic incidents. Reliability products also help practitioners optimize existing highway capacity and make informed decisions about addressing future congestion.

For more information, visit www.fhwa.dot.gov/GoSHRP2.

The keystone of the National Operations Center of Excellence is its Web site.

become a trusted and a well-used Web site by TSM&O practitioners," says Dennis Motiani, director of the new center. "And [we hope the center will] become their first natural stop when searching or browsing for TSM&O topics or looking for lessons learned from best practices."

In response to the needs identified during the extensive SHRP2 research, the center transfers existing knowledge to audiences through assisted search functionality and refinement of content and makes TSM&O more visible within the transportation community. The center also facilitates peer exchanges and networking, and identifies new, relevant knowledge to disseminate, effectively curating the existing knowledge base to ensure that the most up-to-date information is available.

The knowledge base is one of the center's defining characteristics. The center's staff will continually update and improve the scope and quality of information provided, including expanding best practices, monitoring the needs of the TSM&O community, and periodically evaluating the effectiveness of the center's resources.

The primary resource currently offered by the operations center of excellence is its Web site at www.transportationops.org, which is a portal to the resources from the Enhanced Knowledge Transfer System. That system also builds upon the outreach and training resources developed by the National Transportation Operations Coalition, which has provided a forum for practitioners to discuss improving performance-based service delivery of TSM&O and supporting technologies. By incorporating functions derived from the coalition, such as discussion forums, newsletters, and webcasts, the National Operations Center of Excellence has begun to grow into a robust TSM&O community.

The center also offers a program of technical services that includes a series of webinars, workshops, and summits. In addition, center staff can answer questions and connect practitioners to applicable reports, products, and other informational resources. Individuals can submit questions through the center's Web site.

SHRP2 Solutions TSM&O Resources Tool

While the center of excellence will add information and opportunities for technical assistance and exchange over time, its backbone—the collection of SHRP2 Reliability products—will remain an accessible and useful resource. To help practitioners navigate through all the SHRP2 research and related products, FHWA and its SHRP2 partners developed an advanced search tool.

The advanced search tool is an important feature of the center's Web site. It enables any site visitor to enter specific parameters associated with his or her organization and needs and find the relevant SHRP2 resources. The search then pinpoints the exact location within those resources where the sought-after information is located.

By answering a few simple questions, Web site visitors can find precise starting points for achieving key goals such as building an organization to support TSM&O functions, improving the travel time reliability of roadways, achieving better performance on highway systems, and improving planning and management decisions. Through a simple interface, the search tool leads users to the most appropriate SHRP2 Reliability solutions.

What's Next?

With the National Operations Center of Excellence in its inaugural year, now is the time to become involved. Practitioners, researchers, and decisionmakers can visit the center's Web site to find the latest information about improving transportation systems management and operations within DOTs, MPOs, and throughout the transportation community.

By reviewing new resources, such as additional products emerging from SHRP2, and by engaging in the interactive forums, each visitor can play a role in addressing congestion, improving roadway safety, and building a lasting, integrated TSM&O practice to support the Nation's transportation network.

Grant Zammit is the manager of the Operations Technical Service Team in the FHWA Resource Center. The team provides training on operations and freight, technical assistance, and deployment support to Federal, State, and local partners. Zammit received his B.S. in civil engineering from Oregon State University and his M.S. in civil engineering from the Georgia Institute of Technology.

Ben Irwin is a senior communications specialist who works with the U.S. Department of Transportation's Volpe National Transportation Systems Center to help Federal, State, and local agencies promote transportation safety programs and innovations. He has a bachelor's degree from the University of Iowa.

For more information, contact Grant Zammit at 404-562-3575 or grant.zammit@dot.gov.

PARTNERS Across The Pacific

by Nelda Bravo, Phil Yen, and Agnes Vélez

For more than three decades, Japan and the United States have been cooperating on bridge engineering research to improve resistance to wind and earthquake damage.

Extreme earthquake and wind phenomena are highly destructive and can devastate transportation networks by destroying structures and severing highway linkages. When seismic or wind events take bridges out of service, highway system connectivity is lost, and efforts to evacuate people or provide rescue services are severely affected.

In the United States, areas of significant seismic activity occur in States and territories located within the Pacific Rim region, but also occur in the New Madrid seismic zone. In addition to earthquakes, the United States experiences destruction caused by catastrophic wind events, including hurricanes and tornados. These events have damaged communities and environments across the Nation.

Because the location, timing, and intensity of seismic activities cannot easily be predicted, investigating the effectiveness of technologies and practices designed to mitigate damages from these often tragic events is difficult and time-consuming.

A delegation of Japanese transportation engineers visited FHWA's Structures Laboratory, where they observed testing to enhance bridge performance. *Photo: David Sanders, University of Nevada in Reno.*

FHWA Acting Administrator Greg Nadeau (right) presents a commemorative plaque to Chief Executive Taketo Uomoto of Japan's Public Works Research Institute at a ceremony in October 2014 in Washington, DC, during the 30th U.S.–Japan Bridge Engineering Workshop. *Photo: Joseph Kohler, USDOT.*

Japan, as an island nation located in a seismically active zone of the Pacific Rim, has become a leader in research related to earthquakes and wind. The United States, by collaborating with a country that faces similar risks and has sophisticated research capabilities, increases its knowledge base and leverages the resources it assigns to investigate seismic and wind events. In particular, a joint U.S.–Japanese workshop that began 30 years ago provides a framework for collaboration, research, knowledge exchange, and reconnaissance.

"Working together expands the ability of both countries to explore the effects of these natural hazards on highway structures and to increase the resistance of the built environment to the destructive effects of wind and seismic events," says Acting Administrator Greg Nadeau, head of the Federal Highway Administration.

Roots of the Partnership

Japan and the United States have a long history of information exchanges related to science and technology. Over time, these joint efforts have evolved whenever participating agencies identified specific topics requiring more tightly focused study. To address these research needs and mutual concerns, the two countries established expert panels and task forces.

In 1964, the United States and Japan created the U.S.–Japan Cooperative Program in Natural Resources. This program focused on the need to improve engineering and scientific practices through the exchange of technical data and information, personnel, and research equipment.

The program's Web site states, "The impetus for forming [it] came from the bilateral Committee on Trade and Economic Affairs, which agreed that exchanging natural resources information, specialists, technical data, and research equipment would greatly benefit the economy and welfare of both countries. . . . The [program] is one of four research exchanges between the United States and Japan. The other three exchanges cover basic science, health/medical affairs, and social/cultural affairs."

In 1969, the two countries went on to establish the Wind and Seismic Effects Panel to develop a stronger technical focus in this area and to encourage collaboration on the development and exchange of wind and seismic technologies. According to the panel's Web site, "Panel activities have improved building and bridge standards and codes, and aided

Representatives from U.S. and Japanese public and private sectors as well as academia gathered in Washington, DC, for the 2014 annual meeting of the joint bridge workshop. *Photo: Joseph Kohler, USDOT.*

structure design and construction in Japan and the United States. In addition, panel members have created and exchanged digitized earthquake records; shared earthquake engineering information and strong motion measurement techniques with seismically active countries; produced database systems for improved prediction of soil liquefaction; and verified mathematical models of storm surge and tsunami warning systems."

Then, some 15 years later, FHWA joined with Japan's Ministry of Land, Infrastructure, Transport, and Tourism to address the effects of wind and seismic activity specifically on transportation systems. In 1981, at Tsukuba Science City in Japan, the Wind and Seismic Effects Panel members formed the Task Committee on Wind and Earthquake Engineering for Transportation Systems. Initially the committee focused on research related to the effects of wind resistance and seismic events on traffic facilities. FHWA was designated the lead U.S. agency on the committee, and bridge engineer delegates included a cross section of stakeholders: Federal, State, and local government agencies; academia; industry; and professional organizations.

The annual U.S.–Japan Bridge Engineering Workshop grew out of that committee, which held the first workshop in 1984, in Tsukuba Science City. Since then, the committee has held 30 annual bridge engineering workshops, alternating in location between Japan and the United States. U.S. locations have included Chicago, IL; St. Louis, MO; San Diego, CA; Seattle, WA; and Washington, DC. In Japan, the meetings are always held at Tsukuba Science City. During this 30-year collaboration, the University of Nevada in Reno, under contract with FHWA, has coordinated and organized U.S. participation in the workshops.

Joint Bridge Engineering Workshops

Activities at the annual workshops are usually spread over 2.5 days. This timeframe allows for extensive face-to-face meetings, presentations of formal technical papers, and site visits. Also incorporated into the workshop structure is a half-day bilateral, government-to-government meeting. This meeting provides government experts with an opportunity to discuss technical and policy issues in an informal environment.

Approximately 900 individual participants from both countries have attended the workshops over the past 30 years, averaging about 55 participants per meeting. Counting those who have attended multiple meetings makes participation numbers higher. Since 1984, more than 1,000 papers have been presented and later published in the workshop proceedings. On average, Japanese and U.S. participants present 36 papers at each workshop. The locations of site visits include bridges, airports, research laboratories, and university research facilities.

Sharing information on various practices and technologies provides an opportunity to explore diverse approaches to meeting similar challenges and technical issues encountered in bridge engineering. Through the annual workshops, U.S. and Japanese bridge engineers have identified potential technological advances, many of which were implemented into practice. For example, both Japan and the United States developed seismic retrofitting and seismic isolation technologies at approximately the same time.

The United States has successfully implemented retrofitting measures in high-seismicity areas in California, Oregon, and Washington. These retrofitting measures include restrainers, steel and concrete jackets, as well as fiber-reinforced polymer jackets for sheer strengthening and ductility enhancement of columns. Additional state-of-the-art and state-of-the-practice technologies exchanged between the two countries include those related to wind design for long-span bridges; advanced materials; bridge

Topics of Workshop Presentations

Topic	Number of Papers	Percent of Total Number of Papers
Seismic effects	423	40
Maintenance, inspection, and strengthening	188	18
Design and analysis	165	16
General	76	7
Wind	70	7
Construction	39	4
Materials	36	3
Management	30	3
Geotechnical engineering	21	2
Experimental investigation	15	1
TOTAL	**1,063**	**100**

Source: FHWA. Percentages are approximate due to rounding.

Other Seismicity Topics

U.S. exchanges at the workshops have included presentations on performance-based seismic design and retrofit, which strive to ensure that structures meet prescribed performance criteria under seismic loads. Other topics have included the use of buckling braces such as stiffeners to resolve stability issues and highlights from Washington State's seismic retrofit program.

Papers presented by Japanese engineers have addressed issues such as carbon fiber-reinforced polymer sheet jacketing on the Tsurumi Tsubasa cable-stayed bridge; the use of carbon fiber-reinforced polymer and steel plate sheet jacketing; and the use of anti-seismic devices and isolation bearings in the Honshu-Shikoku bridges.

As part of the 2014 bridge engineering workshop, U.S. and Japanese engineers visited this construction site in Sparrows Point, MD, to learn first-hand about an innovative construction method used to fabricate precast tunnel segments for the Elizabeth River Tunnels Project in Virginia.

Rodolfo Maruri, FHWA Virginia Division

management; and bridge inspection, assessment, and maintenance.

Cooperative Research Program

The annual workshops also have provided a forum through which U.S. and Japanese engineers participate on cooperative research projects. In addition to addressing issues of mutual concern, joint research projects facilitate collaboration among researchers in both countries, increase the exchange of research findings, and encourage sharing of state-of-the-art practices.

These cooperative research programs have resulted in the following achievements:

- The development of draft experimental testing guidelines for verification of seismic performance of bridges, including quasi-static cyclic loading tests and shake table tests for bridge columns.
- A comparative evaluation of U.S. and Japanese seismic control systems, testing protocols, and design of highway bridges.
- Collaborative improvements to the numerical modeling of tsunami effects, and validation of these methodologies through wave basin experiments.
- U.S.–Japanese joint reconnaissance of bridges damaged by earthquakes.

In addition to the cooperative research programs, the two countries held a number of specialty workshops in the 1990s that focused on specific areas such as earthquake protective systems and seismic retrofitting techniques. The engineers convened seven such events between 1990 and 1996. Exchanges on technologies and practices greatly accelerated the adoption of protective systems in both countries and the improvement and implementation of retrofit strategies. One study, for example, resulted in engineers in both countries better understanding the advantages of different approaches to seismic retrofitting and applying them to bridge design and construction.

Reconnaissance Work

Each year, millions of earthquakes occur across the globe. Most are insignificant, discernable only through use of sophisticated scientific equipment. The severe, destructive seismic event is uncommon, and its location and magnitude are difficult to predict.

This lack of frequency and predictability makes learning from earthquakes difficult because data are accrued slowly over time. As a result, sharing knowledge and technologies on bridge performance and behavior becomes even more important. When a significant earthquake does occur, typically it becomes a focus for researchers and engineers. They come together to share and exchange observations on bridge damage, structural performance, and evaluation of design and analysis practices.

The relationships built through the bridge engineering workshops are essential to facilitating extensive joint U.S. and Japanese reconnaissance efforts following severe earthquakes. Joint reconnaissance occurred after the Northridge Earthquake (California, 1994); Hyogoken-Nanbu Earthquake (Kobe, 1995); Maule Earthquake (Chile, 2010); and the Great East Japan Earthquake (Tohoku, 2011). The reconnaissance teams investigated damage that included collapsed bridge spans and sections, steel girder buckling, shear failure of abutment walls, and flange damage in concrete girders.

Recent Earthquakes Visited by Reconnaissance Teams

Name	Date	Location	Magnitude	Losses
Northridge Earthquake	January 17, 1994	Northridge, CA, USA	6.7	• 60 people were killed • About $20 billion was lost due to infrastructure damage
Hyogoken-Nanbu (Kobe) Earthquake	January 17, 1995	Awaji Island, Japan	6.9	• More than 6,000 people were killed • About 9.9 trillion yen ($100 billion) was lost due to infrastructure damage
Maule (Chile) Earthquake	February 27, 2010	Maule region, Chile	8.8	• About 550 people were killed or missing • $20.9 billion in infrastructure loss
Great East Japan (Tohoku) Earthquake	March 11, 2011	Tohoku region, Japan	9.0	• Nearly 20,000 people were killed or missing • About 16.9 trillion yen ($204 billion) was lost due to infrastructure damage

Note: The financial impacts are from the time of the event and not adjusted for inflation.
Source: FHWA.

The Great East Japan Earthquake, the most powerful ever recorded in Japan, triggered massive tsunami waves, which pushed seawater as far as 6 miles (9.7 kilometers) inland. The quake registered a magnitude of 9.0 on the Richter scale and is one of the largest ever recorded. Strong ground motion, tsunami inundation, and soil liquefaction damaged approximately 200 highway bridges and numerous railroad bridges.

A U.S. reconnaissance team conducted a post-earthquake investigation on bridge performance and evaluated the structural damage, which included unseated spans, foundation scour, ruptured bearings, column shear failures, and approach fill settlements. As a result of the reconnaissance, new research programs are underway to study the duration effects of strong ground motion and tsunami loads. The departments of transportation in the western coastal States of Alaska, California, Hawaii, Oregon, and Washington and FHWA are conducting a joint study that will involve cooperating with Japan's Public Works Research Institute to share the research results. The objective of the study is to develop bridge design guidelines for the estimation of tsunami loads on highway bridges. The work is proposed to include verification of the guidelines by model testing or comparison with observed results to calibrate the predictive capability of numerical models for analysis of tsunami loads on coastal bridges. Generalized bathymetry (the study of underwater depths) and topography parameters will be modeled analytically and replicated experimentally.

Sharing experiences on prompt response and recovery from devastating earthquakes and tsunamis is valuable in preparing for, responding to, and recovering from such natural disasters. Bridge engineers and public officials have benefited from the lessons learned from events worldwide. The knowledge gained through decades of information exchange and continuous revision of seismic design specifications in both countries presumably have helped lessen the loss of life and property during extreme events.

Oregon's Perspective On the Workshops

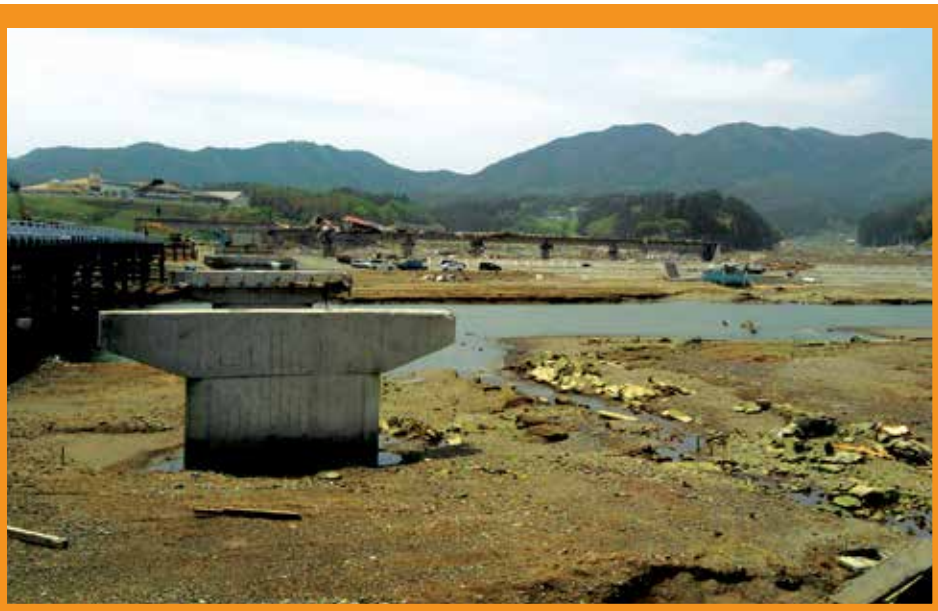
The Oregon Department of Transportation (ODOT), an active participant in the annual workshops, has benefited significantly from the information and technology exchanges, according to Bruce Johnson, State bridge engineer at ODOT.

"The workshops provide an opportunity to learn and share information and experiences with our Japanese counterparts," he says. "The specialists and experts from the Japan side are very open and willing to share lessons learned from their experience with recent extreme earthquakes and tsunamis."

Johnson continues, "The two most important things I've learned were how structural detailing can affect a bridge's survivability from tsunami waves, and how proper preparation can improve response and recovery from such a devastating event. I was

In 2014, this Japanese delegation visited the Hydraulics Research Laboratory at FHWA's Turner-Fairbank Highway Research Center.

David Sanders, University of Nevada in Reno



(Left) Shown here are bridge superstructures (girders and decks) washed out by the tsunami generated by the Tohoku Earthquake in Japan in 2011.

(Below) This bridge located along Japan's northeast shore was severely damaged, including superstructures washed out and piers displaced by the tsunami wave from the 2011 earthquake.

particularly interested to see and hear about the force of the tsunami waves and the extent of damage to transportation structures along the coast." Johnson notes that ODOT has been conducting research at Oregon State University to predict tsunami wave characteristics and resulting forces on highway structures.

"However, we are far from being able to quantify the damage we have witnessed in Japan," he says. "A very important thing I learned was that the structural resistance to tsunami wave forces is a bit like structural resistance to seismic forces. Some structures are much more resistant—not due to strength, but due to the structural detailing involving continuity, the height of the structure, and the area of the horizontal projection. This information will be very useful as Oregon continues to develop tsunami design guidelines for coastal bridges."

Professional Networking

Over the years, researchers and engineers from Japan and the United States have established professional networks focused on specific technical subjects. These relationships are effective in helping experts remain current on technologies and practices, and aware of emerging innovations in bridge engineering.

Many participants consider the workshops and networking groups as opportunities to conduct brainstorming sessions to discuss questions that are normally difficult to cover in written communication or published reports. The friendships formed between U.S. and Japanese participants also provide a strong foundation for new generations of bridge engineers who are mentored by the more experienced professionals.

Professor David Sanders of the Department of Civil and Environmental Engineering at the University of Nevada in Reno expresses appreciation for the opportunity to network on professional and personal levels with the Japanese members of the Public Works Research Institute and the National Institute for Land and Infrastructure Management.

"As we have gotten to know each other better, the ability to share valuable information has become much easier," he says. "This increased ability to share is now not only true for Japanese members that we have known for a long time, but also new contacts that we meet each time."

He adds that the exchange of information occurs during study tours as well as the workshops. "The Great East Japan Earthquake subjected a significant area to large ground motions and then to the tremendous effect of the tsunami. Many structures, including those retrofitted after the 1995 Kobe earthquake, did well. Older structures that had not been retrofitted suffered damage typically near supports."

Sanders continues: "It is important that the United States continue to work to retrofit our structures and

Reconnaissance Teams

Reconnaissance teams gather potentially perishable data and metadata, such as original design plans, construction drawings, and prior performance histories, to better understand how infrastructure performed during seismic events. Some structures perform well while others fail miserably. The reconnaissance teams try to document this performance, compared with the basis under which the structures were originally designed and constructed, and then report on the findings. The teams also indicate opportunities for improvement, areas for further investigation, and possible mitigation measures.

U.S. reconnaissance teams to Japan have included efforts undertaken by FHWA, but also by the American Society of Civil Engineers, the Earthquake Engineering Research Institute, the National Science Foundation, and others. The Japanese helped facilitate logistics and the collection of data, and helped to confirm assumptions and documentation during the preparation of subsequent reports.

–Prepared with the help of Ian Friedland, Turner-Fairbank Highway Research Center

look at the force path closely. Because the damaged structures had been retrofitted, they were brought back into service quickly. It is a good lesson for us, to be sure that we are prepared and know how to respond quickly."

Sanders also notes the impact of liquefaction. "Again, the Japanese have responded quickly to repair the damage. In one area, only a person who knew what happened would have been able to tell that there was damage due to settlement."

One of the key issues, he adds, is the level of event that structures should be designed for, especially in different regions of the United States. Japan has the same issue. "We can come up with better solutions working together," Sanders says.

Professional Exchange Program

In addition to networking, another benefit stemming from the workshops is a professional exchange program. Under this initiative, engineers and researchers from one country are invited to participate in technical visits to the other, and these professional exchanges range from 1 week to 1 year in duration. The exchanges provide opportunities to take part in joint research studies or pursue other technical interests.

Since 1983, a total of 23 engineers and researchers from both countries have participated in the professional exchange program. During these assignments, participants become familiar with current practices in the country they are visiting.

Continuing the Legacy

The extensive cooperation between the United States and Japan has produced synergistic approaches, including analysis methods such as seismic isolation design. Both countries have common interests in developing approaches that will reduce loss of life and preserve the transportation infrastructure in the face of devastating seismic and wind events.

The annual U.S.–Japan Bridge Engineering Workshop has provided a venue for increasing what is known about the effects of seismic and wind events on the built environment. The workshop also has created an opportunity to learn about practices or technologies that help mitigate damage, and to share experiences leading to prompt response and recovery.

The relationships forged over three decades of collaboration have proven to be mutually beneficial to both countries. Specific benefits include the following:

Cost sharing. Both countries face similar challenges in advancing bridge safety and performance, and have completed several cooperative research tasks on these topics. Examples include comparison of seismic design codes and experimental tests of bridge columns. Test results were used to improve bridge seismic safety, reducing costs by nearly 50 percent.

Technology and information sharing. The 2011 Tohoku Earthquake in Japan provided critical information on how bridges performed under the tsunami wave's impact. Leveraging the relationships developed at the U.S.–Japan workshops, FHWA, in collaboration with State DOTs, is conducting a pooled-fund study on Validation of Tsunami Design Guidelines for Coastal Bridges. Japanese researchers are supporting this research effort.

Joint reconnaissance and access to damaged sites. Information gathered from joint reconnaissance teams organized as part of the U.S.–Japan workshops was used to update the bridge design codes to improve seismic safety. For example, soon after the 1995 Kobe Earthquake, a joint bridge reconnaissance was organized to investigate bridge performance. The results collected on bridge performance with isolation bearing and steel bridge piers (buckling) were very beneficial in the validation of the bridge design codes.

Both countries are working to further strengthen cooperation. For future workshops, the countries will evaluate the implementation of various communications media, including the Internet and cloud storage, to improve the efficiency and effectiveness of workshop sessions and activities.

Nelda Bravo recently retired from FHWA after a productive career that included tenures in the Office of International Programs, Turner-Fairbank Highway Research Center, and the Bureau of Transportation Statistics.

Phil Yen is a principal bridge engineer with FHWA's Office of Bridges and Structures where he focuses on structural dynamics. He also serves as the U.S. chair of the workshop series. He received his master's and doctorate in civil engineering from the University of Virginia and is a registered professional engineer in Virginia.

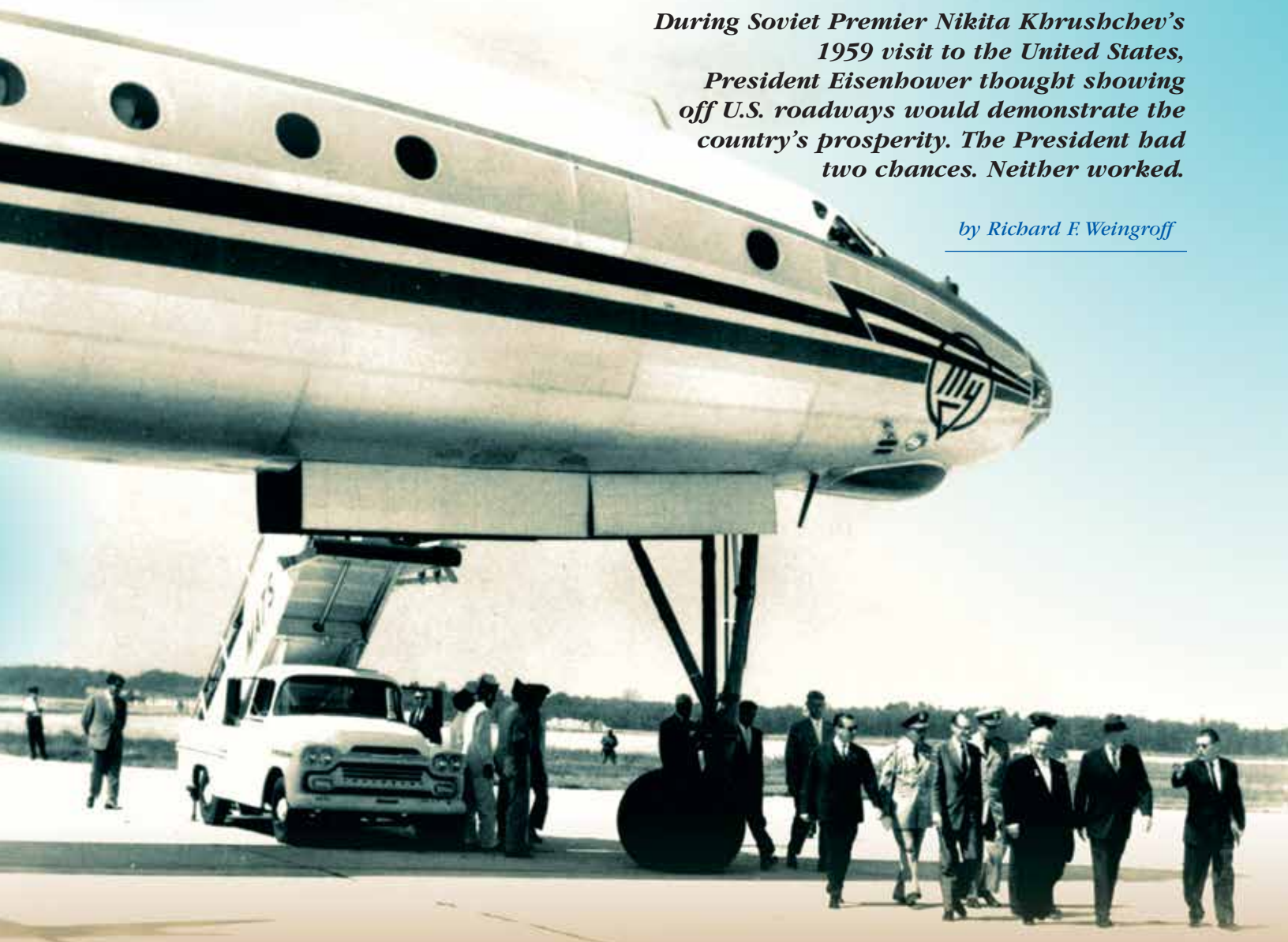
Agnes Vélez is a transportation specialist with FHWA's Office of International Programs where she oversees activities with Israel, Japan, and the World Road Association. She earned a B.A. in communications and an M.B.A. in marketing from Loyola University in New Orleans.

For more information, see www.fhwa.dot.gov/bridge or contact Agnes Vélez at 202-366-5771 or agnes.velez@dot.gov or Phil Yen at 202-366-5604 or wen-huei.yen@dot.gov.

On the Road with Ike and Niki

During Soviet Premier Nikita Khrushchev's 1959 visit to the United States, President Eisenhower thought showing off U.S. roadways would demonstrate the country's prosperity. The President had two chances. Neither worked.

by Richard F. Weingroff



At Andrews Air Force Base, President Eisenhower (second from right, with hat, in front row) and Premier Khrushchev (to the President's right) walk from the Premier's TU-114 airplane. After taking office in 1953, the Premier had been embarrassed by the Soviet Union's small official airplane. He ordered aircraft designer Andrei Tupolev to build the biggest airplane possible. According to author Peter Carlson, the TU-114 was "a 177-foot [54-meter], 220-passenger plane that stood 50 feet [15 meters] off the ground—the world's tallest aircraft." Carlson added, "Khrushchev was so pleased that he kept a model of the TU-114 on his desk in the Kremlin."
Photo: National Park Service, courtesy of Dwight D. Eisenhower Presidential Library.

On September 15, 1959, Premier Nikita Khrushchev of the Soviet Union arrived at Andrews Air Force Base in Maryland for talks with President Dwight D. ("Ike") Eisenhower and a whirlwind 2-week tour of the United States. After ceremonies and speeches, the President, the Premier, and Mrs. Khrushchev entered the President's open-topped limousine for the trip to the District of Columbia.

Dana Adams Schmidt of *The New York Times* reported: "In the President's open Lincoln automobile, General Eisenhower was to have been seated on the left, Mr. Khrushchev on the right and Mme. Khrushchev in the middle. But somehow President Eisenhower got in the middle and it seemed to be a tight squeeze for the three of them.

"Mr. Khrushchev looked as if he were sitting on something. Though he is a short man, his head was a little higher than the President's in the car. He sat with his arm on the back of the seat behind the President, waving his hat with his other hand whenever he heard applause."

Peter Carlson, author of *K Blows Top: A Cold War Comic Interlude Starring Nikita Khrushchev, America's Most Unlikely Tourist*, quoted iconoclastic journalist I. F. Stone as saying President Eisenhower looked "as if the [Central Intelligence Agency] had advised him to keep his famous smile carefully hidden lest the visiting Old Bolshevik appropriate it."

The Motorcade To Washington

The motorcade left Andrews Air Force Base and entered Suitland Parkway. *The New York Times*' Schmidt reported: "The grass on the center strip and sides of this four-lane highway had been neatly clipped. . . . On both sides the trees, just beginning to turn to autumn hues, crowded the highway."

With the vehicle moving at a steady pace of 30 miles (48 kilometers) per hour, the President and his two visitors observed a motel under construction about 6 miles (10 kilometers) from Andrews Air Force Base and a new apartment house "with spacious balconies," Schmidt wrote. "A little farther on there was a playground, where a group of . . . school children gave the visitor's party perhaps the most enthusiastic and certainly the shrillest greeting of the day." The Ace and Van Storage Company displayed a huge sign: "Visit Our Warehouse. Product of Free Enterprise."

They crossed into the city and drove over the curving South Capitol Street Bridge (now called the Frederick Douglass Memorial Bridge), which had opened in 1950. The bridge provided a stunning view of the Capitol dome, at the time "clothed in scaffolding," wrote Schmidt. The motorcade passed through "several blocks of slums" in southwest Washington. Schmidt continued: "The first heavy crowds began as the motorcade swung from Canal Street into Independence Avenue. Now the Soviet Premier saw broad streets, monumental Government buildings, and well-kept public gardens."

They turned north on 14th Street and drove past the Treasury Building before turning left onto Pennsylvania Avenue.

The motorcade headed toward Blair House, where the Premier, his family, and entourage would stay, across Pennsylvania Avenue from the White House. Schmidt reported that "the faces of 200,000 multiracial Americans were what may have caught his eye as he rode into the capital."

The *Evening Star* (a DC newspaper of that time) described "the tightest security cordon ever arranged for a foreign dignitary." The paper continued: "The 15-mile [24-kilometer] parade route from Andrews Field to Blair House

President Eisenhower (center, dark suit, with hat) walked to the ceremonial greeting for Premier Khrushchev (behind the President) at Andrews Air Force Base. The Premier's wife, Nina (holding bouquet), watches. *Photo: U.S. Army Pictorial Agency, courtesy of Dwight D. Eisenhower Presidential Library.*

Suitland Parkway

The Public Roads Administration (now FHWA) built Suitland Parkway for the War Department during World War II to connect the new Camp Springs Army Air Field (later Andrews Air Force Base, now Joint Base Andrews) in Maryland with Bolling Field (later Bolling Air Force Base, now part of Joint Base Anacostia–Bolling) on the east bank of the Potomac River in the District of Columbia. The Public Roads Administration completed construction in 1944. President Harry S. Truman approved legislation on August 17, 1949, transferring the parkway to the Department of the Interior for operation by the National Park Service (NPS).

The transfer reflected the diminished military importance of the parkway after the war. While primarily serving local travel, the parkway is best known outside of the Washington area for its role in transporting dignitaries. An NPS history says that Suitland Parkway "has hosted both triumphal and mournful processions of public officials: from presidents returning from diplomatic achievements to the funeral procession of President John F. Kennedy." It also carried Soviet Premier Nikita Khrushchev during his visit to the United States in 1959.

The Suitland Parkway in Maryland.

was guarded by more than 4,000 police, National Guardsmen, soldiers, sailors, and Marines."

As for the public, the *Evening Star* reported: "However, only sparse crowds were along the route until the motorcade reached the downtown area. There the noon-hour pedestrians and spectators thronged the streets and a crowd estimated by police at 10,000 was in Lafayette Square and on the sidewalks in front of the White House."

Onlookers were uncertain how to react to this leader from the other side of the Iron Curtain who in 1956 had stated that history was on the Soviet's side and that "We will bury you." *The Washington Post and Times Herald* (the *Post* used the merged title for a time after buying out the *Herald*) said of the reaction: "The press in the United States uniformly described the reaction as quiet, courteous, restrained, undemonstrative, and curious, but with almost no show of hostility. British newspapers used phrases such as 'icy,' 'frozen mitt,' and 'deep-freeze treatment.'"

A woman on 14th Street told a *New York Times* reporter, "It seems more like a funeral procession than a parade."

In the Soviet Union, by contrast, *Pravda* reported that "shouts rolled up like waves [and] all around a sea of raised hands was swaying." The newspaper estimated that more than 300,000 people saw the motorcade, adding that "not even the end of World War II brought such a sea of people onto the streets of Washington."

Carlson, author of *K Blows Top*, recalled the Premier's reaction: "People were looking at us," Khrushchev noted, "as if we were some kind of oddity."

From Eisenhower's perspective, the trip into the city had been a good start because he wanted the Premier to see a diverse, prosperous America.

The Kitchen Debate

The President knew that Premier Krushchev would take every opportunity to comment on the superiority of the Soviet Union. Vice President Richard M. Nixon had encountered this tendency on July 24, 1959, when he and the Premier visited the U.S. exhibit at the American National Exhibition in Moscow's Sokolniki Park. Told that the United States was 150 years old, Khrushchev said that the Soviet Union, only 42 years old, "will be on the same level as America" in 7 years. As reported by Carlson, the Premier added with a mocking little wave, "When we catch up to you, in passing by, we will wave to you."

The two men entered a typical American subdivision house on display at the exhibition. Once in the kitchen, the Premier refused to be impressed by the labor-saving devices on display. Again, as reported by Carlson, when Nixon said these devices made life easier on American housewives, Khrushchev said, "The Soviets do not share this capitalist attitude toward women." He claimed that Soviet homes already had all these devices. Nixon suggested it would be better to compete in washing machines instead of rockets, but Khrushchev countered that it was U.S. generals who wanted to compete in rockets.

After a few more rounds of comparisons of consumer goods and which country was fighting harder for peace, they concluded what soon became known as the "kitchen debate." Leaving, Premier Khrushchev told Nixon, "Thank the housewife for letting us use her kitchen for our argument."

Boasting of Bumper-To-Bumper Traffic

During preparations for the Premier's visit, the President had proposed a brief sightseeing excursion over the city by helicopter. Eisenhower biographer Stephen Ambrose explained that with the Nixon-Khrushchev kitchen debate in mind, the President "wanted Khrushchev to see all those middle-class homes, and all those automobiles rushing out of Washington in the late afternoon to get to them." They symbolized the success of the American economic system.

Khrushchev initially declined the tour, saying he did not like helicopters. Actually, he feared it was a plot to assassinate him in a crash. However, during the drive into the city, he agreed to the tour when President Eisenhower said that he would be in the helicopter, too. As reported by Carlson and recalled in Ike's memoir, the Premier said, "If you are to be in the same helicopter, of course, I will go."

Following afternoon discussions, the two entered a Marine helicopter on the South Lawn of the White House and took off during the afternoon rush hour for what Earl H. Voss of the *Evening Star* called "the coup of the day." Voss, in one of the following helicopters, described the trip: "The bumper-to-bumper exodus to Virginia and Maryland suburbs was at its peak when the President and his guest took off. … The Premier was provided with a detailed map, in color, so he could follow the route his helicopter took."

The helicopter headed for the Washington Monument before turning toward the Capitol, hovering briefly over the Supreme Court building, the Library of Congress, and the Senate and House office buildings. Turning west, the helicopter passed over the Smithsonian Institution buildings on The National Mall and the Jefferson and Lincoln Memorials.

The aerial tourists then flew along the Potomac River, before turning south to follow the river to Jones Point in Alexandria, VA (site of the original Woodrow Wilson Memorial Bridge, then under construction, on the Capital Beltway). According to Voss, the Soviet Premier saw the "jammed highway bridges" carrying traffic out of the city and then the Washington National

On Independence Avenue near 4th Street, SW, a motorcade carries President Eisenhower and Premier Khrushchev (in the lead limousine) to the White House for discussions. The building on the right housed the Department of Health, Education, and Welfare at the time. It is now called the Wilbur J. Cohen Federal Building.

National Park Service, courtesy of Dwight D. Eisenhower Presidential Library

U.S. Naval Photographic Center, courtesy of Dwight D. Eisenhower Presidential Library

The first families formed a receiving line for a reception at the White House on September 15, 1959. From left: Nina Khrushchev, Mamie Eisenhower, Premier Khrushchev, and President Eisenhower.

Airport, the runways of which had been too short for his giant Soviet TU-114 turboprop airplane.

The helicopter flew over the George Washington Memorial Parkway to Alexandria and passed over the Hunting Towers Apartment. After passing the George Washington National Masonic Memorial, the helicopter crossed over the Fairlington and Parkfairfax apartments, the Shirley Highway (then designated I–95, now I–395), and "the giant Springfield housing development and several big shopping centers, including one at Seven Corners." Voss continued: "There were neatly landscaped areas, with trees and shrubs, along Arlington Boulevard, the sleepy community of Falls Church aroused for the evening traffic jam, the pretty homes in rural settings along the Leesburg Pike and the impressive Great Falls of the Potomac, where the Premier's party crossed into Maryland to see the plush, white-fence places along River Road."

In Maryland, they passed over Burning Tree Country Club, where the President often played golf, and passed the National Institutes of Health and the National Naval Medical Center (now the Walter Reed National Military Medical Center). Carlson, the author, added the detail that "Ike pointed out cars on the roads below—their red brake lights flashing on and off in the stop-and-go traffic."

Carlson wrote: "The president asked the chairman if he played golf. Khrushchev said he knew nothing about it. Eager to show the premier his favorite sport, Ike told the pilot to drop a little lower. The chopper swooped down over the sixteenth green, where the noise and wind of the rotors caused a golfer to muff an easy four-inch putt.

"By sheer coincidence, the golfer was Senator J. William Fulbright, who had invited Khrushchev to tea with the Senate Foreign Relations Committee the next day."

The helicopter flew back to the Potomac and followed it into the District, past the Naval Observatory and Georgetown before touching down at the White House before 6 p.m. Voss wrote that they had

President Eisenhower (leading the group at right) and Premier Khrushchev (partially hidden on the President's right) walk to a helicopter on the South Lawn of the White House for an aerial tour of the Washington area. The President wanted to show his Soviet counterpart the homes and traffic that reflected American prosperity. *Photo: U.S. Naval Photographic Center, courtesy of Dwight D. Eisenhower Presidential Library.*

The helicopter takes off from the South Lawn of the White House with the Washington Monument in the background. *Photo: U.S. Naval Photographic Center, courtesy of Dwight D. Eisenhower Presidential Library.*

seen: "Homes of the wealthy, the middle classes, and the poor, of the aged and the young, one-family houses of solid brick standing in great clusters, apartment villages, two-car driveways—all passed beneath Mr. Khrushchev's bubble-window."

The Strategy Fizzles

The Premier had seen exactly what the President wanted to display. The President was, however, disappointed in the Premier's reaction. As biographer Ambrose put it, Khrushchev "would not say anything, or even change expression."

In President Eisenhower's 1965 memoir, *Waging Peace*, he recalled: "I would have given a good deal to know what he thought of the spectacular flow of thousands of automobiles so dramatically displayed below us. In Moscow, Khrushchev had simply refused to believe Vice President Nixon's statement that most American families owned cars. Our helicopter trip occurred as the government offices were closing; so cars formed literally continuous ribbons of movement, on highways and bridges, for as far as we could see. He must have been persuaded of the truth of Nixon's statement, but stoically refrained from saying so or even changing expression."

The Premier did, however, admire the helicopter. He ordered three of them for his own use.

Premier Khrushchev received wide publicity throughout his trip across the country, especially when he visited the set of the movie *Can-Can*, ate with a crowd of Hollywood celebrities, and met Marilyn Monroe, the Nation's reigning sex symbol. (As reported by Carlson, the Premier told her, "You're a very lovely young lady." Later, she told reporters, "He looked at me the way a man looks on a woman.") One of the most widely recalled aspects of the tour was that Premier Khrushchev was angered and his family disappointed when their much-anticipated trip to Disneyland in Anaheim, CA, was canceled, reportedly for security reasons.

The most powerful tourists in the world—Premier Khrushchev (standing next to the officer) and President Eisenhower (on the ground after exiting)—leave the helicopter after their tour of the Washington area. *Photo: U.S. Naval Photographic Center, courtesy of Dwight D. Eisenhower Presidential Library.*

Presidential Limousines

In 1950, the Ford Motor Company leased 10 Lincoln Cosmopolitans (nine sedans and a convertible) to the White House for President Harry S. Truman's use in return for a nominal annual fee. All were black, with roofs high enough to accommodate top hats. Upon taking office on January 20, 1953, President Dwight D. Eisenhower continued using the limousines the company had provided to President Truman. In 1954, President Eisenhower had the convertible retrofitted with a dome-shaped Plexiglas® bubble-top that allowed spectators to see the occupants of the vehicle while protecting the occupants from the weather.

In 1954, President Eisenhower suggested adding a Plexiglas® cover to the White House convertible for all-weather use. In this photo, President Eisenhower salutes the crowd from the convertible on his way to participate in the bicentennial celebration of Fort Ligonier, PA, on September 26, 1958. *Photo: National Park Service, courtesy of Dwight D. Eisenhower Presidential Library.*

Back to DC

After a final stop in Pittsburgh, PA, Premier Khrushchev returned to Andrews Air Force Base on an Air Force plane, arriving around 5:30 p.m. on September 24. In the absence of President Eisenhower, officials held brief welcoming ceremonies before Khrushchev entered the White House's bubble-top limousine that enabled spectators to see the passengers. The motorcade traveled the Suitland Parkway again to Blair House. However, this trip was less momentous than the first, as Russell Baker explained in *The New York Times*: "Like the second All-Star baseball game [two were played each year from 1959 to 1962], Premier Khrushchev's second arrival in Washington today was one spectacle too many for a single season."

Baker wrote: "His first entry Sept. 15 had the sense of a great, if sober, occasion. Today, he was just another distinguished visitor in a town that has become blasé about them.

"Crowds on the sidewalks were thinner than at his first arrival. …The crowds seemed largely composed of office workers who paused en route home. There seemed to be more waving and cheering than when he first was here, but many visitors have attracted more."

The *Star* agreed that "the reception. …was again cool, if anything more restrained than on his first arrival here 10 days ago." Police estimated that about 100,000 people saw the motorcade on its return to Blair House. Most of those along the way "watched him pass in silence. The only cheers came from children."

Premier Khrushchev attended a reception at the Embassy of the Soviet Union. His next stop was at a hotel for a dinner. The *Star* reported: "The Soviet leader startled his cordon of security guards by walking the two blocks from the Embassy to the Sheraton-Carlton. Shunning a carefully arranged motorcade, he strolled down 16th Street surrounded by a swarm of newsmen, seemingly unperturbed by the chaos he was causing."

On to Camp David

The following day, he joined the President for a half-hour helicopter ride to Camp David in Maryland's Catoctin Mountains. There, talks lasted 2 days, but the two leaders took a break at one point for a helicopter ride to the President's farm in Gettysburg near U.S. 30, the Lincoln Highway, the same road a young Dwight D. Eisenhower had followed to California in 1919 with the U.S. Army's first transcontinental convoy of military motor vehicles.

During the visit to the farm, the Premier met the President's son John and daughter-in-law Barbara, and joked with grandchildren David, Barbara, Susan, and Mary. Khrushchev invited the children to join their grandfather for his planned visit to Moscow in June 1960. The children, if not the parents, were delighted by the invitation.

After talking with the President about the farm's Black Angus herd, Khrushchev described his country's efforts to produce more consumer goods. The President recalled that Khrushchev belittled the individual homes he had seen in the United States, saying they meant increased work and expense for their owners for heating, transportation, repairs, and upkeep for the surrounding grounds.

Then, President Eisenhower recalled in *Waging Peace*, the Premier turned to the highways he had observed: "When I again called his attention to our magnificent highways and the automobiles that crowded them—as I had done on our helicopter trip around Washington ten days earlier—he now had a ready answer. He said that in his country

On September 25, 1959, President Eisenhower (left in dark suit and hat) and Premier Khrushchev (center with medals) went to Camp David to resume negotiations on international issues. The Premier is shaking hands with White House press secretary James Hagerty. *Photo: U.S. Navy, courtesy of Dwight D. Eisenhower Presidential Library.*

there was little need for this type of road because the Soviet people lived close together, did not care for automobiles, had slight interest in driving around the countryside on a Sunday afternoon, and rarely changed their residences from one city to another. To this he added to my amusement: 'Your people do not seem to like the place where they live and always want to be on the move going someplace else.'"

A Race Against Time to DC

If the President was disappointed in Khrushchev's reaction to U.S. highways, he had a measure of revenge on September 27 when they returned to Washington. The Premier was due at the National Press Club at 4 p.m. and had to stop at Blair House first. Time was of the essence, but instead of taking the helicopter, the leaders and their entourages, as well as the assembled security forces and journalists, traveled by road. United Press International described the trip: "President Eisenhower treated Premier Khrushchev today to a breathtaking eighty-mile-an-hour [(mi/h), 129-kilometer-per-hour (km/h)] ride from Camp David to Washington. The driver [45-year-old special agent Deeter Flohr of the Secret Service] … took the two leaders on a trip that Mr. Khrushchev, at least, is not likely to forget.

"The way was paved by Maryland and District of Columbia troopers with sirens wide open most of the time. Every intersection between Camp David and Blair House was blocked. Down the mountain side, the speed was moderate, limited by one-lane roads, wooden bridges, and blind curves. But once on the highway, the driver opened up.

"'Speed Is More Dangerous Than a Cobra,' a sign said. The Presidential car went by at about seventy miles an hour [113 km/h]. The speed zones called for varying limits, sixty [97 km/h] on the highway and thirty [48 km/h] in the tiny towns, but these were ignored.

"When the sixteen-car motorcade reached U.S. 240, a dual highway, Mr. Flohr touched eighty-five [137 km/h] several times. The cars went down Wisconsin Avenue in Washington at seventy-five [121 km/h] and pulled to a stop in front of Blair House eighty minutes after leaving the Catoctin Mountain cabin. The distance is about forty-five miles [72 kilometers]."

According to reporters, they left Camp David shortly after 2 p.m. and arrived at Blair House at 3:29 p.m.

Khrushchev's reaction to the high-speed race to Washington is unknown. President Eisenhower reported that the Premier "was much interested in the countryside and continued to talk about his visit through the Nation."

At Blair House, the two leaders said goodbye, as the *Evening Star*'s John Barron described: "The Soviet leader remained in the limousine a full minute talking with the President.

"Standing on the steps of Blair House, Mr. Eisenhower, even in his dark business suit, looked like a general and displayed none of the uneasiness he had revealed in the past when near the Russian.

"As they talked, Mr. Khrushchev gripped Mr. Eisenhower's hand for a long time. The President looked him in the eye all the while. … Mr. Khrushchev watched as the President drove away to

Washington National Pike

When the convoy carrying President Eisenhower and Premier Khrushchev of the Soviet Union raced at high speeds from Camp David to Washington on September 27, 1959, they traveled the Washington National Pike, a new freeway designated I–70S.

The main road between Washington and Frederick, MD, had been U.S. 240, which continued along Wisconsin Avenue in the District and ended at a connection with U.S. 50 near the Lincoln Memorial. In 1949, the Maryland State Roads Commission began building a freeway alternative on a new alignment. By 1958, the Washington National Pike was nearing the District, but controversy over how it would continue through the city halted the freeway near the Capital Beltway. The south end of the freeway was split, with southeast and southwest legs connecting to the beltway.

In 1975, the Washington National Pike was renumbered I–270.

the cheers of several hundred persons gathered on the corner."

Carlson, the author, added: "Khrushchev reminded the President to bring his grandchildren with him when he came to Russia in the spring. 'I'll bring the whole family,' Ike said. 'You'll have more Eisenhowers there than you know what to do with.'"

Home to the Soviet Union

After a news conference at the National Press Club and a speech to the country on NBC, the Soviet Premier, his family, and his entourage returned along Suitland Parkway to Andrews Air Force Base. According to Barron, of the *Evening Star*, as the motorcade reached the floodlights at the base, "a resplendent guard drawn from all the armed services was arrayed in their honor." Vice President Nixon presided over the final ceremonies, which consisted of a few speeches of farewell and good wishes, a 21-gun salute, and goodbyes among the U.S. and Soviet officials, reporters, and others.

"Laden with large bouquets of roses," Barron reported, "Mr. and Mrs. Khrushchev walked down a red carpet," shaking hands with dignitaries: "A limousine took them a mile to the end of the runway, where the TU-114 waited. . . . An Air Force officer explained that the plane is so heavy that if moved on the ground when loaded with gasoline its front tire would burst. Thus, the prop-jet earlier was towed into position and gasoline pumped into it for six hours."

W.H. Lawrence of *The New York Times* added: "It appeared that the party had done some shopping during their twelve-day visit. Two big Army trucks were needed to cart their luggage to the airfield from Blair House. . . . Among the luggage were two suit boxes bearing the name Saks-Fifth Avenue. Other boxes bore the imprint of Woodward & Lothrop, a Washington department store.

"There also were twenty-six suitcases, fourteen packages wrapped in brown paper, six garment bags, two large cardboard packing boxes and a wooden crate which required two men to carry. In addition, there were two round hat-boxes and half a dozen small boxes.

"Several station wagons were used to carry hand baggage to the planes.

"Also among the luggage were two portable typewriters carrying labels marked in Russian: 'Do not put in baggage compartment.' This led to the speculation that some of the twenty-eight members of the party wanted to get in some work on the way home."

Carlson, described the TU-114's takeoff: "The plane lumbered down the runway, slowly picking up speed. It had almost run out of pavement by the time it finally managed to lift off, rising like an overstuffed goose. As spectators on the ground gasped, it just barely cleared the treetops and headed towards Moscow, 5,000 miles [8,057 kilometers] away."

Or, as Barron of the *Evening Star* put it, "For about 30 seconds, [the TU-114] acted as if it intended to remain, in one form or another, on American soil." He added: "When it finally was airborne, American and even Russian officials remained on the field, wandering about in the manner of people who cannot decide whether to straighten up or go to bed."

As for the President's visit to the Soviet Union with his large family of Eisenhowers, it never happened. On May 1, 1960, the Soviet Union shot down an American U-2 spy plane flown by a Central Intelligence Agency pilot named Francis Gary Powers. After initially denying that the plane was spying on the Soviet Union, President Eisenhower had to admit that it was, indeed, a spy plane after Premier Khrushchev released photos the plane had taken of Soviet military sites. When Eisenhower refused to apologize for sending spy planes over the Soviet Union, Premier Khrushchev canceled the President's visit to that country.

U.S. Navy, courtesy of Dwight D. Eisenhower Presidential Library

In front of the Aspen Lodge at Camp David, President Eisenhower and Premier Khrushchev posed for photographers.

Ribbon Cutting

Presidents have attended highway ribbon-cutting ceremonies only on rare occasions, but President Eisenhower attended two within 1 year.

A few weeks after Premier Khrushchev left Washington, President Eisenhower took part in two ceremonies, one of them a highway opening, on November 3, 1959. The highway ceremony took place in Virginia on the George Washington Memorial Parkway. His motorcade stopped at Spout Run so he could cut a ribbon opening a 5-mile (8-kilometer) section of the parkway. In a ceremony lasting about 2 minutes, he used two gold-plated scissors bearing the seal of the National Park Service. The *Evening Star* reported: "After clipping the red, white, and blue ribbon in two places, Mr. Eisenhower was presented with one of the shears as a memento of the occasion. The President also kept a bit of the ribbon as a trophy."

The motorcade then drove to Langley for a nonhighway ceremony, namely the ceremony for laying the cornerstone for the headquarters of the Central Intelligence Agency. The CIA headquarters was to be built on a Federal tract partly occupied by a research facility (now called FHWA's Turner-Fairbank Highway Research Center).

President Eisenhower also participated in a highway ribbon cutting on October 17, 1960. He said the Hiawatha Bridge (later renamed the Eisenhower Bridge in his honor) carrying U.S. 63 across the Mississippi River between Minnesota and Wisconsin was "another effective example of Federal-State partnership in meeting both local and national needs."

Opening a section of the George Washington Memorial Parkway in Virginia, President Eisenhower (center) snips the ribbon held by Director Conrad L. Wirth (left), of the National Park Service, and Assistant Secretary of the Interior Roger Ernst (right). Behind them are Harry T. Thompson (left), superintendent of National Capital Parks, and U.S. Representative Joel T. Broyhill (R-VA). *Photo: National Park Service, courtesy of Dwight D. Eisenhower Presidential Library.*

Instead, his former Vice President became the first U.S. President to visit the Soviet Union. On May 22–30, 1972, President Richard M. Nixon visited the Soviet Union for a summit with General Secretary Leonid Brezhnev. The summit, which included the signing of the Treaty on the Limitation of Anti-Ballistic Missile Systems and the Strategic Arms Limitation Treaty, was a major milestone in relations between the two superpowers.

A Mighty Network

President Eisenhower was in Walter Reed Army Medical Center following surgery when he launched the interstate construction program by signing the Federal-Aid Highway Act of 1956 on June 29. Despite this inauspicious beginning, he was proud of the new program, often citing it in his reelection campaign speeches. At the University of Kentucky Coliseum on October 1, he outlined his vision of what he would like the country to accomplish in the next 4 years, including: "I see an America … where a mighty network of highways spreads across our country." At Madison Square Garden in New York City on October 25, he asked his critics, "Was it they who inspired and launched the greatest highway-building program in our history?"

Despite Premier Khrushchev's reaction, or nonreaction, to Washington's bumper-to-bumper peak period traffic and Deeter Flohr's pedal-to-the-metal driving, the interstate system was by far Eisenhower's favorite domestic program, according to biographer Ambrose. President Eisenhower's pride in what he helped create never diminished. He explained why in his 1963 memoir, *Mandate for Change 1953–1956*: "More than any single action by the government since the end of the war, this one would change the face of America. …Its impact on the American economy—the jobs it would produce in manufacturing and construction, the rural areas it would open up—was beyond calculation."

In 1990, Congress changed the name of the interstate system to honor the man who once showed off America's bumper-to-bumper traffic to the Cold War rival who promised to wave goodbye as the Soviet Union passed the United States by. Its official name is The Dwight D. Eisenhower System of Interstate and Defense Highways.

Richard F. Weingroff is an information liaison specialist in FHWA's Office of Infrastructure. He also writes articles for the agency's "Highway History" Web site (www.fhwa.dot.gov/infrastructure/history.cfm), where all of his PUBLIC ROADS articles also can be found.

For more information, contact Richard Weingroff at 202-366-4856 or richard.weingroff@dot.gov.

A Pivotal Job for Police

by Jeffrey A. King

(Above) Not all traffic incidents mean a crash with traffic cones, response vehicles, and damaged cars. Traffic incidents also include routine traffic stops, motorist assists, and other unexpected incidents that occur along roadways. Law enforcement personnel are on the frontlines of collecting data on all types of traffic incidents, from routine stops like this one to more complex crash scenarios. *Photo: California Highway Patrol.*

Law enforcement officials play a crucial role in collecting performance measurement data for traffic incident management. In many ways, the future of TIM is in their hands.

Imagine a traffic incident. Chances are you're picturing traffic cones, damaged cars, and response vehicles—the typical scene at a crash. To the average motorist, each traffic incident probably looks pretty much like any other. But in reality, each crash requires a complex, coordinated response from a multidisciplinary team of responders who have varying roles.

Further, the history of traffic incident management (TIM) reveals several different interpretations of

strategies and priorities among the many disciplines involved: law enforcement, fire, emergency medical services (EMS), transportation and public works departments, safety/service patrols, towing companies, and others. In recent years, the differing TIM roles among the various disciplines have begun to merge as responders increasingly work as a unified team to clear incidents, making the Nation's roadways safer while reducing related congestion.

One area of TIM that is essential to continuing to improve the practice is the collection, reporting, and assessment of performance data related to secondary crashes and clearance times. Traditional practices were typically limited to responder agencies' analyses of major incidents that resulted in tragic outcomes, but many agencies now realize the benefits associated with collecting performance data on routine traffic incidents. TIM programs at all levels are beginning to recognize the need to use performance measurements to assess the strengths of their responses and to identify opportunities for improvement. Although all disciplines dispatched to the scene may collect some performance data, most often the responsibility lies with law enforcement.

But data collection is complicated by the varying degrees and frequencies of involvement among the various disciplines. Some incidents may only require a response from specific disciplines. For example, a property damage only crash may only involve law enforcement and towing or just law enforcement. In other cases, when multiple disciplines respond, some may only be on scene for a limited time while they complete their specific duties.

In addition, defining secondary crashes, a key factor in TIM performance measurement, continues to be a challenge. That is why the Federal Highway Administration is working to develop clear guidance and current practices to aid agencies, specifically law enforcement, in measuring the performance of TIM efforts at the scene.

Secondary Crashes

The merging of TIM strategies and priorities among the involved disciplines has been in the works for a long time. One of the earliest formal coalitions to address the issues of traffic incident management began following a 1990 report published by the American Trucking Associations Foundation. But in many cases, greater coordination among disciplines occurs only subsequent to high-profile incidents that result in major traffic issues or secondary crashes—those resulting from or caused by a primary incident—including crashes involving injuries or fatalities among emergency responders.

All disciplines have experienced line-of-duty deaths at traffic incidents, making safety, especially the reduction of secondary crashes, a driving force behind improving TIM programs. For more information, see "*Living* in the Line of Duty" in

Traffic cones are deployed here to close the right lane on this highway while responders work to clear an incident from the roadway. Efforts to increase the collection of data and thus the speed of response and incident clearance could help improve safety for responders. *Photo: California Highway Patrol.*

Collecting data on traffic incident management can provide valuable insights to help responders improve onsite performance and minimize the duration of traffic backups. *Photo: Arizona Department of Transportation.*

the July/August 2014 issue of PUBLIC ROADS.

Although many agency officials can recount from memory the number of responders they have lost in the line of duty, only a few may be able to tell you how many of their employees were lost due to automobile crashes in the line of duty. And even fewer can tell you, without further research, how many of those were involved in secondary crashes.

Why is it important to collect data on secondary crashes? Many videos captured by cameras on vehicle dashboards have shown that the difference between a fatal responder strike and a property damage strike involving the responder's vehicle is mere inches or fractions of a second. Minor property damage crashes and near misses involving responders happen every day, but without collecting the related performance measures, these incidents do not make it onto the radar of decisionmakers. Through the collection of performance measures on *all* incidents, agencies are able to see trends and identify strategies that will work for them—without waiting for tragedy to strike.

Collecting performance measures on secondary incidents can provide valuable information. For example, when the Arizona Department of Public Safety (DPS) began collecting data on all secondary crashes, the results played a key role in the evolution of its TIM program. According to department officials, 29 officers lost their lives in the line of duty from 1958 to 2013—17 related to automobile crashes, 11 of which were a result of a secondary crash. Of those 11 fatalities due to secondary crashes, only 5 of the officers were attending to primary incidents that were crashes. The other 6 fatalities from secondary crashes occurred as the officers were attending to other types of primary incidents, such as traffic stops and motorist assists. Collecting performance measures on all traffic incidents, large and small, has prompted the Arizona DPS to shift its focus from a few major crashes occurring a few times per month to all incidents that occur hundreds of times per day.

The Arizona DPS investigates an average of 30,000 vehicle crashes a year within its jurisdiction, which includes approximately 6,000 miles (9,656 kilometers) of State and Federal highways. "On average, 250 to 300 [of the crashes investigated by Arizona DPS on the State highway system annually] are fatal crashes, 4,000 to 5,000 are injury crashes, and [another] 24,000 to 25,000 crashes are property damage only," says Lieutenant Colonel James McGuffin with the Highway Patrol Division of the Arizona DPS. "In addition to these calls for service, officers initiate 500,000 traffic stops and assist approximately 70,000 motorists each year. Considering the total number of traffic incidents responded to by the Arizona DPS, [the] focus on traffic incident management had to broaden from 30,000 primary incidents to 600,000 primary incidents."

A study, *ITS Impacts on Safety and Traffic Management: An*

Investigation of Secondary Crash Causes, published in the *ITS Journal* in 1999 found that the average secondary crash rate was 35 percent of all crashes in the study area. Analyzing the duration of the primary incidents in this same area showed that for every minute a primary incident remained on the roadway, the odds of a secondary collision increased by 2.8 percent. Given these findings, reducing the overall duration of incidents should mean reducing the risk—and therefore the number—of secondary crashes that occur on highways.

"Traffic incident management should not be considered just a good idea," says McGuffin. "It is a public and officer safety strategy that should be part of every. . . responder agency's standard operating procedures."

FHWA and Performance Measurement

FHWA leadership recognizes the crucial role of performance measurement for TIM and the challenges it presents. To provide clear guidance and develop current practices for responder agencies, FHWA initiated the TIM Performance Measurement Focus States Initiative in 2005. The initiative identified 11 States (California, Connecticut, Florida, Georgia, Maryland, New York, North Carolina, Texas, Utah, Washington, and Wisconsin) as leaders and convened TIM program managers from transportation and law enforcement in those States for a series of workshops that concluded in 2007.

Workshop participants developed three basic measures to assist TIM practitioners in evaluating their performance during incidents: roadway clearance time, incident clearance time, and number of secondary crashes. *Roadway clearance time* refers to the time between the first recordable awareness of an incident by a responsible agency and the first confirmation that all lanes are once again available for traffic flow. *Incident clearance time* refers to the time between the first recordable awareness of an incident by a responsible agency and the time at which the last responder has left the scene. Lastly, *secondary crashes* are the number of additional crashes that occur as a result of the original incident between the time of the detection and clearance of the primary incident. Secondary crashes may occur within the primary incident scene or within the traffic queue, including within traffic traveling in the opposite direction.

However, since FHWA convened the performance measurement initiative, stakeholders have debated the definition of a secondary crash. The original definition identifies all secondary crashes where the original incident was a crash or any other type of primary incident (such as enforcement activities or motorist assists). However, many TIM practitioners have voiced concerns over the challenges related to collecting secondary crash data when the original incident is not a crash, given the difficulties of defining what constitutes a primary incident.

Despite efforts to better define performance measures, the 2013 annual TIM Self Assessment, a formal process for State and local transportation, public safety, and private sector partners to collaboratively assess their TIM programs and identify opportunities for improvement, indicated that, nationally, the collection, reporting, and assessment of performance data was the one area that had lost ground. All other areas—such as use of technology and involvement of traffic operation centers to aid in quick clearance of incidents—had improved over the previous years.

To expand collection of TIM performance data, individual stakeholders and the TIM subcommittee of the International Association of Chiefs of Police have engaged in indepth discussions in recent years. Discussion has focused on identifying hurdles, such as the definition of a secondary crash, and working to overcome them. The current recommendation of these stakeholders and FHWA is to begin collecting data when the primary incident is a crash. After that is established, an agency may then find it easier to begin collecting data for other types of primary incidents as well.

In addition, FHWA officials recommend that agencies not limit themselves to only the three basic performance measures (roadway clearance time, incident clearance time, and secondary crashes). As agencies become more comfortable with collecting data, they can add measures specific to secondary crashes involving responders, and secondary crashes resulting from enforcement actions, motorist assists, or other primary incidents that are easily defined within their disciplines. For example, a law enforcement agency could choose to replace a simple "yes" or "no" selection from the secondary crash field with more specific choices, such as "none," "motorist," and a list of responder disciplines (law enforcement, fire, EMS, transportation, towing, and other responders).

"We know most agencies today understand the need and importance of collecting performance data," says Paul Jodoin, TIM program manager in FHWA's Office of Operations. "And we hope that by providing these recommendations, they can build their systems to more reliably track data, particularly on secondary crashes, and ultimately create a safer, more efficient TIM program."

The Role of Law Enforcement

Collecting data on the three basic performance measures may be easier for some TIM disciplines than others. So while a few disciplines involved in TIM collect performance measures to improve their programs, and ultimately, safety and mobility on the transportation system, FHWA looks to law enforcement professionals and their partners to assist with improving data collection.

From FHWA's perspective, law enforcement is best equipped to document the most complete set of TIM performance data because in most jurisdictions secondary crashes are documented like any other crash using the standard crash report—a report usually completed by law enforcement. Law enforcement officers also attend the largest number and greatest diversity of traffic incident types.

Although law enforcement officers complete crash reports, usually their agencies do not set the minimum required data on those reports. In fact, to be eligible for many of the Federal grant programs, States are required to form traffic records coordinating committees to assist in determining what information to collect on crash reports. These committees typically are housed under the agency within the State that gathers

Responder training like this lesson from the TIM training program underscores the important role that traffic incident management can play in reducing collisions involving "D" drivers.

and stores crash data. Committee membership usually represents many of the TIM disciplines. In many cases, the traffic records coordinating committee plays a critical role in adding TIM performance measures to the statewide crash database. However, many agencies have supplemental forms for gathering specific crash data for agency use only. Often agencies can use these supplemental forms to gather TIM performance data while they seek approval to add TIM performance measures to crash report forms.

By participating in the collection of TIM performance measures, law enforcement agencies might find the measures useful in developing strategies to improve overall highway safety. Nearly every traffic safety program administered by law enforcement has two primary principles at its core: reduce crashes and improve the transportation system and its mobility. These goals are accomplished through programs and strategies related to education and enforcement of traffic laws, but also include collaboration with engineering departments and emergency medical services.

Performance Measurement As a Strategy

Responders are overrepresented in secondary collisions because they spend a lot of time in harm's way at traffic incidents. Based on multiple studies, FHWA estimates that approximately 20 percent of all crashes are secondary in nature and 18 percent of all fatal crashes are secondary crashes. That means if an agency investigates 30,000 crashes a year and its secondary crash rate is 20 percent, it experiences 6,000 secondary crashes. Likewise, if an agency experiences 300 fatal crashes a year, 54 of those would be related to secondary crashes.

Arizona DPS began collecting the basic TIM performance measures in late 2010. In addition, via a division order in 2012, the State's Highway Patrol Division added active TIM as one of its six priorities. By making TIM a priority, Arizona DPS committed to concentrating efforts on addressing it in the department's day-to-day operations and ensuring that its personnel are appropriately trained and equipped.

What has been the result? The numbers speak for themselves. In 2014, the agency investigated 29,725 total crashes, of which 1,895 were secondary (a secondary crash rate of 6.4 percent). Compared to the national average 20-percent crash rate, that is 4,050 fewer secondary crashes. Using the national average as a baseline, the data show that Arizona DPS spent an average of 84 minutes per crash investigation, resulting in a calculated savings of nearly 5,600 man-hours.

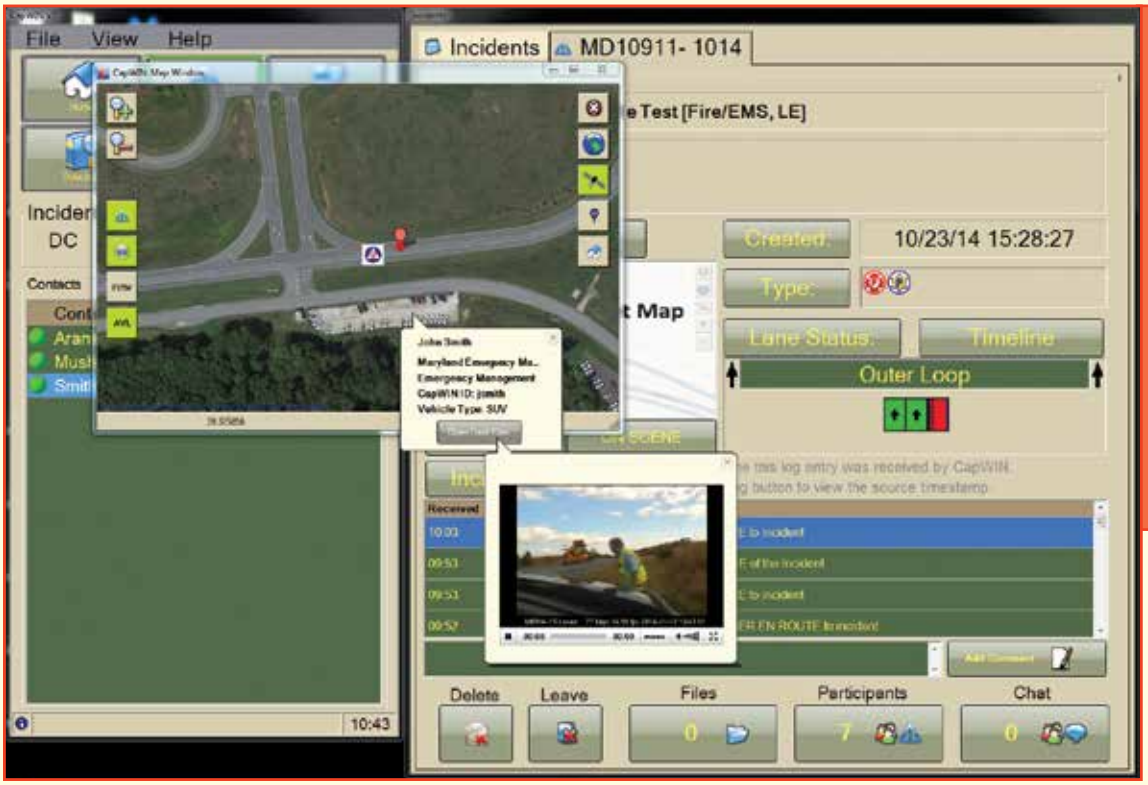
"Consider what your agency could do with an additional [5,600] hours of proactive enforcement time," says Arizona DPS's McGuffin. "And with the current costs of overtime, think about how much additional funding you would need to provide that much proactive enforcement dedicated to key problem areas. The potential is staggering."

Although TIM does not remove impaired or distracted drivers from the road, its strategies can reduce secondary crashes involving those and other driver errors. Most secondary crashes involve what is referred to in TIM training as the "D" driver, which represents "drunk, drugged, drowsy, distracted, or just plain dumb." Enforcement programs targeting these problem areas can be time consuming and costly. So, though TIM is not a replacement for such enforcement programs, it can reduce collisions involving these factors, which frees up reactive hours spent on crash investigations for proactive enforcement of those programs.

"Like getting a flu shot or putting on your ballistic vest, TIM is an added layer of protection to assist in your overall traffic safety program," says Captain Michael Prochko with Arizona DPS. "Over time, details can be expensive and manpower-intensive. Unlike enforcement programs, TIM programs involve changing the culture and procedures rather than adding workload."

Tracking Data

Although data can be collected in hardcopy format, more and more law enforcement agencies are using mobile reporting software, such as the Traffic and Criminal Software (TraCS) system used by Arizona DPS, invehicle and hand-held computer systems, and video capture hardware. Agencies that use these systems have found them to improve not only data collection but also



CapWIN, University of Maryland

As shown in this screen capture from the CapWIN software, live video feeds can help other responders and traffic operations centers make more informed decisions, such as about which resources to send to the incident scene.

data quality. Some technology even enables realtime situation updates. For example, some systems such as the Capital Wireless Information Net (CapWIN), which is located in the University of Maryland's Center for Advanced Transportation Technology and was part of a demonstration under the Response, Emergency Staging and Communications, Uniform Management, and Evacuation (R.E.S.C.U.M.E.) project in November 2014, can provide live video feeds. Live video feeds from the scene provide firsthand images to traffic operations centers and others to use in decisionmaking related to additional response and traffic operations.

The use of technology at incident scenes can have a direct impact on incident clearance time. For example, technology that scans barcodes on driver's licenses and registration documents, such as that included in TraCS, can reduce data entry time by automatically entering duplicate data on multiple forms (crash reports, towing authorization forms, and citations). When using paper documents, much of the same data has to be repeated on multiple forms, but with the electronic software, these data fields can auto-populate from one form to the next, eliminating duplicate entries by the officer in the field. The growing use of such technology among law enforcement agencies creates an ideal improvement for collecting the basic TIM performance measures.

FHWA is seeking agreement with law enforcement to support and adopt the collection of key scene-specific data on crash reports. The agency will continue to engage other TIM responders in collecting basic and additional measures for all incidents, not just crashes, using other methods available to those responder groups. As more data become available, trends will become clear, enabling FHWA and its TIM partners to develop and apply corrective actions and continue to improve TIM programs and the safety of responders.

Successful TIM practices require collaboration and coordination among a diverse group of responders in a highly stressful and fluid environment. These responders must be able to communicate and work closely together under extreme time pressures toward a common set of goals, while reporting to different agencies with different priorities. Deploying a successful TIM program—and gathering performance measures on that program—hold the promise of enhancing on-scene activities and ultimately increasing safety for responders and motorists alike.

Jeffrey A. King is the public safety liaison for the FHWA Traffic Incident and Event Management Team within the Office of Highway Operations and alternate emergency coordinator for FHWA in Washington, DC. He is a retired captain from the Arizona DPS, where he served for 28 years. King has a B.S. in life science from Arizona State University (ASU), and he is also a graduate of Northwestern University's School of Police Staff and Command, the Federal Bureau of Investigation's National Academy, the Operations Academy™, and the Certified Public Manager® Program at ASU. In 2013, he received the J. Stannard Baker Award for Highway Safety for outstanding lifetime contributions to highway safety.

For more information, see www.ops.fhwa.dot.gov/eto_tim_pse/index.htm or contact Jeffrey King at 202-366-5280 or jeffrey.king@dot.gov.

Advancing the Triple Bottom Line

Through its own work, FHWA shows how to incorporate sustainability into transportation activities to deliver environmental, economic, and social benefits now and in the future.

by Alexandra Oster

(Above) Crews are paving a new road with warm-mix asphalt for an FHWA Highways for LIFE project in Texas. Lowering the temperatures at which asphalt is mixed and placed on the road offers several benefits, including reducing energy consumption by an average of 20 percent.

Transportation projects and systems serve many different and sometimes competing objectives, including safety, mobility, environmental protection, livability, and asset management. A sustainable highway system seeks to meet all of these needs plus economic targets for cost-effectiveness throughout a highway's life cycle. For the Federal Highway Administration, sustainability means making balanced and efficient choices to uphold environmental, economic, and social values—the triple bottom line of sustainability—to provide the best benefits to the natural and human environments. In times of diminishing public and natural resources, using sustainable approaches in transportation will enable FHWA and its partners to continue to enhance the quality of life and serve present transportation needs without compromising the needs of future generations.

Transportation accounted for 70 percent of U.S. petroleum consumption in 2010 and nearly a third of the Nation's greenhouse gas emissions. Light-duty vehicles and heavy trucks are the greatest petroleum users in the transportation sector. Transportation systems also impact the Nation's economy and society. Highway congestion, for example, causes many commuters to spend long hours stuck in traffic and raises the costs of delivering goods and services. Congestion costs the U.S. economy an estimated $121 billion each year in wasted time and fuel,

which amounts to an average of about $800 per commuter.

Incorporating sustainable practices into FHWA's work helps to promote energy and natural resource conservation, decreases greenhouse gas emissions, reduces pollution and contamination, enhances the workplace by minimizing exposure to hazardous materials and chemicals, and strengthens national interests by encouraging energy independence. It also helps improve accessibility and safety, advance efficiency, increase mobility, reduce project costs, accelerate project delivery, preserve and extend the life of infrastructure, enhance relationships with stakeholders, and make communities more livable.

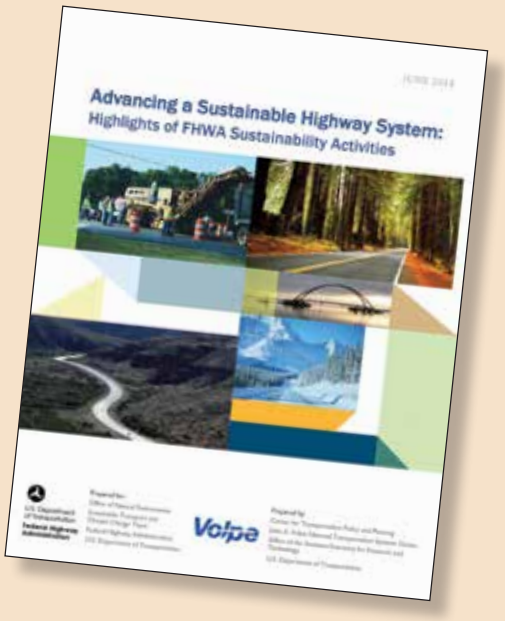
To highlight how FHWA has incorporated sustainability into a wide variety of programs, projects, policies, processes, and partnerships, in June 2014 FHWA released *Advancing a Sustainable Highway System: Highlights of FHWA Sustainability Activities* (FHWA-HEP-14-021). Developed with input from an FHWA working group on sustainability, the report showcases several of the agency's longstanding, well-established programs. It also highlights opportunities for new growth and advancement to achieve sustainability goals.

Efforts featured in the report range from projects to mitigate climate change, to initiatives that promote sustainable pavements and improve safety, to developing tools to better assess the benefits and costs of transportation investments. The report serves as a resource to the public, transportation stakeholders, and FHWA staff, to help them learn about and understand what the agency is doing to address and advance sustainability.

"We felt that it was important to document the broad range of activities that support different aspects of sustainability, not only as a form of outreach and communication with external stakeholders, but also as a team-building and educational process for our staff," says Mike Culp, team leader of the Sustainable Transport and Climate Change Team at FHWA. "By documenting these activities, we helped define sustainability as it actually takes place in the real world—not just in broad terms."

Sustainable Highways

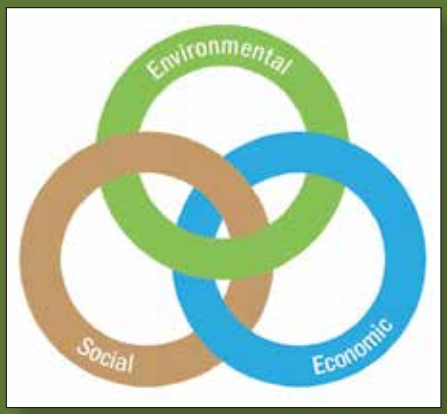
Sustainability means satisfying basic social and economic needs, both present and future, by promoting the responsible use of natural resources, while maintaining or improving the environment on which life depends. FHWA is committed to working hand in hand with stakeholders nationwide to demonstrate the benefits of sustainability and stewardship through practices such as expedited program delivery, accelerated transportation decisionmaking, and improved environmental streamlining.



For years, FHWA has supported research, development, and implementation efforts at the forefront of the sustainability movement. In FHWA's Office of Natural Environment, a Sustainable Highways Initiative supports programs and activities conducted across the agency to facilitate balanced decisionmaking that advances sustainability. Three such efforts include the Infrastructure Voluntary Evaluation Sustainability Tool (INVEST), the Sustainability Working Group, and the Sustainable Pavements Program.

Infrastructure Voluntary Evaluation Sustainability Tool. Launched in October 2012, INVEST is a practical, Web-based collection of best practices to help organizations such as State departments of transportation, metropolitan planning organizations (MPOs), councils of government, and public works departments integrate sustainability into their programs and projects. INVEST provides criteria and practices that DOTs and their consultants and partners can use to evaluate and aid the integration of sustainability into their system planning, project development, and operations and maintenance. FHWA is currently partnering with transportation agencies to implement INVEST, develop case studies based on lessons learned, and gather feedback on ways to enhance and improve the tool for future use.

Sustainability Working Group. FHWA formed a working group in 2010 to lead, coordinate, promote, and communicate the agency's sustainability activities in a centralized and integrated manner. The Sustainability Working Group represents nearly all of the agency's major program areas, as well as headquarters, division offices, the Resource Center, and the Office of Federal Lands Highway. The group was actively involved in the development of INVEST and will continue to serve as a resource for advice



Sustainability means making balanced and efficient choices among environmental, economic, and social values—the triple bottom line of sustainability.

INVEST
ECONOMIC • SOCIAL • ENVIRONMENTAL

FHWA developed INVEST (Infrastructure Voluntary Evaluation Sustainability Tool) to help transportation agencies evaluate and aid the integration of sustainability into their system planning, project development, and operations and maintenance.

and guidance on internal sustainability activities, to recommend and assist with outreach efforts, and to provide input on current and future research activities.

Sustainable Pavements Program. The design, construction, and maintenance of highway pavements can affect the quality and supply of water resources, stormwater flows, air quality, and heat absorption, among other environmental impacts. To better address potentially adverse environmental effects and employ more sustainable materials and techniques, the FHWA Office of Infrastructure created the Sustainable Pavements Program in 2010. This program aims to increase awareness of the sustainability of asphalt, concrete, granular materials, and other materials used in pavement systems, including new and emerging materials; and to increase the use of sustainable technologies and practices.

Taking Action

In 2012, the Sustainability Working Group identified and shared sustainability priorities among FHWA offices to better leverage activities across the agency. In spring 2013, the group identified the following eight action areas that are likely to affect sustainability goals and benefits in the near term.

Safety. In 2010, economic impacts and lost quality of life from motor vehicle crashes in the United States cost an estimated $870.8 billion. Reducing fatal and serious injuries upholds the social and economic tenets of sustainability by reducing loss of life and injury, and the impacts associated with personal and public property damage. The FHWA Office of Safety works with Federal, State, and local partners and other transportation stakeholders to improve safety performance. In 2013, FHWA released a strategic plan to provide a common vision for research, policy, and implementation to address roadway departures, which account for more than half of highway fatalities in the United States.

To improve intersection safety, the agency released the second edition of *Signalized Intersections Informational Guide* (FHWA-SA-13-027) in 2013, documenting methods for evaluating the safety and operations of signalized intersections and tools to remedy deficiencies. The agency also issued a guidance memorandum in 2012 to advance nine countermeasures known to improve safety, such as roundabouts and "road diets" (roadway reconfiguration). Converting a two-way stop to a roundabout has been shown to reduce the number of overall crashes by as much as 44 percent and the number of severe injury and fatal crashes by as much as 82 percent.

Freight and Goods Movement. Planning the movement of freight supports economic prosperity through improved efficiency, reduced fuel consumption, and fewer adverse effects on communities. FHWA is conducting pilot projects in California, Florida, and Texas for the Freight Advanced Traveler Information System (FRATIS), which brings realtime messages on incidents, congestion, and travel time to the freight industry. The agency also is carrying out a study to examine each State's capability to assess commercial motor vehicle volume, provide truck parking and rest facilities, and develop metrics to measure the adequacy of truck parking facilities.

Similarly, FHWA is partnering with the Federal Motor Carrier Safety Administration on the Smart Roadside Initiative, a project to enhance the collection of information on commercial vehicles, such as truck weights, by gathering data using roadside technologies while trucks are traveling at highway speeds. Because the vehicles do not need to slow down, the initiative reduces the emissions and safety risks associated with stop-and-go truck traffic.

Linking Asset Management and Planning. Asset management is a strategic and systematic process of operating, maintaining, and improving physical assets. Linking asset management and planning advances environmental and economic sustainability by improving investment decisions, extending the life of assets, and reducing the demand for raw materials.

The enactment of the Moving Ahead for Progress in the 21st Century Act by Congress stipulated that each State DOT develop a risk-based transportation asset management plan. To help States understand what such plans should include, FHWA created a *Generic Work Plan for Developing a Transportation*

Continued on page 40

State, Regional, and Local Perspectives

Advancing a Sustainable Highway System also highlights exemplary sustainability activities at the State, regional, and local levels. Here are a few examples.

Sustainable Pavements

Western Federal Lands Pavement Recycling

FHWA's Western Federal Lands Highway Division has participated in pavement recycling efforts since the 1980s, using cold in-place recycling, full-depth reclamation, cement-treated base, and foamed asphalt for many of its projects. In an example on its Lakeside–Nelson Road Project in Helena National Forest, MT, the division used foamed asphalt. In another example on the Wise River–Polaris Road Project just south of Wise River, MT, Western Federal Lands used cold in-place recycling.

Road Weather Management

Iowa Salt Usage Dashboard

Spreading salt on road surfaces is one of the primary means of removing and preventing accumulation of snow and ice. However, salt runoff can damage roadside ecosystems, pose risks to human health, and cause infrastructure to deteriorate. The Iowa DOT developed a management dashboard featuring actual salt usage during maintenance operations compared to estimated usage amounts, based on road weather conditions. Managers monitor this dashboard to make sure current usage is reasonable given the weather and within Iowa DOT's standard guidelines for application rates. This tool was implemented in August 2011 before the start of the winter season and has already resulted in tighter control of salt usage.

Infrastructure Resiliency

Capital Area Metropolitan Planning Organization (CAMPO) Climate Resilience Pilot

FHWA selected CAMPO, the MPO in Austin, TX, for one of the agency's 2013–2014 climate resilience pilots. CAMPO used FHWA's framework to conduct a vulnerability assessment of climate-related impacts—including temperatures and extreme heat, extreme precipitation and flooding, drought, and wildfire—on transportation infrastructure in its region. At the conclusion of the study, CAMPO conducted a regional symposium to share the report's findings.

A construction vehicle compacts the roadway surface on Nelson Road in Helena National Forest, MT, where FHWA's Western Federal Lands Highway Division has used foamed asphalt as part of an in-place pavement recycling effort. Using cost-effective, recycled materials in pavement construction preserves resources and the natural environment and reduces waste.

CAMPO

FHWA supported CAMPO in conducting a vulnerability assessment of climate-related effects on transportation infrastructure in its region (Austin, TX). Wildfires, such as the one shown here along State Highway 71 in Bastrop County, TX, could become more common in a warmer climate.

Volpe Center

FHWA's ongoing work to help States mitigate the effects of climate change on transportation infrastructure has included pilot projects like this one in Albuquerque, NM. These stakeholders are attending an FHWA scenario planning workshop to consider the impacts of growth on climate change and evaluate the costs and benefits of various mitigation efforts.

Asset Management Plan in 2013. Using this document as a starting point, FHWA has worked with DOTs in Louisiana, Minnesota, and New York to develop asset management plans specific to those States. In Minnesota, for example, the DOT will use the plan to establish asset condition performance measures and targets, develop investment strategies, and inform established capital and operations planning efforts.

In addition, in 2013, FHWA produced the *Performance-Based Programming Guidebook* (FHWA-HEP-13-041) to help transportation professionals understand the key elements of a performance-based planning and programming process. The guidebook also provides examples of best practices to help support implementation. FHWA also released *A Performance-Based Approach to Addressing Greenhouse Gas Emissions through Transportation Planning* (FHWA-HEP-14-020) in 2013 to help agencies identify potential greenhouse gas performance measures and analysis practices to support a public vision of sustainable transportation and climate policy.

Access and Affordability. Improving access to transportation and its affordability benefits the social and economic aspects of sustainability by improving employment opportunities, enhancing interaction with the community, and incorporating social equity principles inherent in civil rights. In addition, access improvements that increase the modal choices available to the public advance environmental sustainability by offering alternatives to motorized travel, such as walking and bicycling.

"FHWA's commitment to sustainability includes ensuring not only that transportation systems are safe, convenient, healthy, renewable, and efficient, but also that they operate fairly and are accessible to persons of all abilities," explains Candace Groudine, a senior policy and regulatory specialist with FHWA's Office of Civil Rights. "As planners, environmental specialists, and civil rights specialists, we all need to realize that anybody, at any time, can have a temporary or permanent disability that can affect their ability to function in society."

FHWA supports sustainable practices by providing targeted technical assistance and training to help its division offices and State DOTs implement the 1990 Americans with Disabilities Act (ADA). The agency works to ensure that pedestrians with disabilities have opportunities to use the transportation system in an accessible and safe manner. Key accomplishments include the establishment of an ADA transition plan performance metric for the U.S. Department of Transportation and for the FHWA 2014 Strategic Implementation Plan. An ADA transition plan describes in detail the steps a public entity believes are necessary to make its facilities, programs, activities, and services accessible to persons with disabilities, and the schedule it has set to make the improvements.

Incorporating accessibility considerations into all aspects of project development and delivery will help ensure compliance with standards and minimize implementation costs over time. The Florida Department of Transportation (FDOT), for example, improves or installs accessibility features as part of every project in its 5-year work plan. After 20 years of this comprehensive approach, FDOT finds its facilities are fully transitioned, requiring only minimal maintenance and upgrades to keep up with changing accessibility standards.

Infrastructure Resiliency. Resiliency means the ability to plan for, recover from, and adapt more successfully to adverse events. Planning for resilient transportation infrastructure supports sustainability by reducing expenditures on replacement, improving the safety and security of users of the multimodal transportation system, and providing energy savings from long-lasting investments.

Creating a more resilient transportation system is a priority for FHWA, especially due to the need for adapting to climate change and extreme weather events. FHWA recently completed a 2013–2014 pilot program for resilience projects, for which researchers studied climate change impacts in the central gulf coast region, and developed technical guidance on incorporating extreme event considerations into

highway planning and design in coastal environments. FHWA sponsored 24 climate resilience pilots with State DOTs and MPOs, and 4 cooperative projects with multiple stakeholders around the country.

For one such project, FHWA and the USDOT Center for Climate Change and Environmental Forecasting partnered with the U.S. Geological Survey and Texas Tech University to conduct the Gulf Coast Study. The study examined the risks and impacts of climate change on coastal ports and road, air, rail, and public transit systems in the central gulf coast. Researchers estimated that if the sea level in the region were to rise 4 feet (1.2 meters), 27 percent of its major highways, 9 percent of its rail lines, and 72 percent of its ports would be inundated. (See "Bracing for Hard Times Ahead" in the November/December 2014 issue of PUBLIC ROADS.)

For Phase 2 of the study, USDOT developed methods for evaluating vulnerability and adaptation measures that could be used by other transportation agencies and pilot tested them on the transportation system in Mobile, AL. The project resulted in a detailed assessment of the vulnerability of Mobile's transportation system, as well as approaches for using climate data in transportation vulnerability assessments, methods for evaluating vulnerability and adaptation options, and tools and resources that will assist other transportation agencies in conducting similar work.

Economic and Life-Cycle Cost Analyses. Economic analysis in the context of sustainability and transportation examines how to make the best use of constrained resources over time. Benefit-cost analysis measures returns on investment. Traditional benefit-cost analysis for transportation includes benefits for travelers (reducing delays and vehicle operating costs, improving safety) and benefits for the environment (improvements in air quality, noise reduction, and land preservation) along with capital, operations, preservation, and maintenance costs. Life-cycle cost analysis is an evaluation technique that supports informed investment decisions by considering both near- and long-term activities required to maintain highway assets above some minimum performance level.

FHWA provides various resources that transportation professionals can use to conduct economic and life-cycle cost analyses. The agency's BCA.net tool, for example, is a free Web-based software application that performs benefit-cost analysis at the project level. The tool enables decisionmakers to consider a broad range of design, timing, and strategic alternatives based on an array of benefit-cost measures. The BCA.net tool is available at https://fhwaapps.fhwa.dot.gov/bcap/BaseLogin/LoginReg.aspx; the software is free for public use upon user registration.

Another software tool, the National Bridge Investment Analysis Software enables agencies to evaluate bridge investments at a network or system level. The tool uses performance data every State currently collects on bridges to calculate performance trends, financial needs for maintaining specified performance levels, and the outcomes of various funding scenarios. For more information about this software, visit www.fhwa.dot.gov/policy/2013cpr/appendixb.htm.

In addition, to support the application of life-cycle cost analysis for pavement design, FHWA offers RealCost, a free Microsoft® Excel®-based software that facilitates the consideration of initial and future costs and road user impacts in making investment decisions. Many DOTs use RealCost to conduct life-cycle cost analysis. The Colorado DOT, for example, has used RealCost since the late 1990s to analyze pavement construction and rehabilitation, and to evaluate its transportation asset investment decisions. The agency has demonstrated that the use of life-cycle cost analysis can be cost effective. For more information about RealCost, visit www.fhwa.dot.gov/infrastructure/asstmgmt/lccasoft.cfm.

Sustainable Pavements. FHWA is committed to advancing sustainability through the design, construction, preservation, and rehabilitation of highway pavements. This includes work conducted through the Sustainable Pavements Program,

FHWA places a high priority on identifying and deploying innovative, cost-effective techniques and technologies for winter roadway maintenance.

FHWA supports numerous activities to promote multimodal transportation, which provides travelers with bicycle, pedestrian, and transit networks in addition to motor vehicle infrastructure. These networks increase transportation options, reduce traffic congestion and emissions, and enhance public health.

which supports the use of recycled materials and the reuse of industrial byproducts in highway applications by developing technology, building partnerships, and providing training.

"Increasing knowledge of sustainable materials and pavements can ultimately help to lower costs, improve durability, and enhance our surroundings," says Gina Ahlstrom, a senior pavement engineer in the Office of Asset Management, Pavements, and Construction at FHWA. "It is important to incorporate sustainability in all of the design aspects of a transportation project."

For example, FHWA has advanced the use of warm-mix asphalt to lower the temperatures at which the material is mixed and placed on the road. Applying warm-mix asphalt reduces energy consumption by an average of 20 percent, provides good material workability, lowers emissions from burning fossil fuels, and limits fumes and odors at plants and paving sites.

To quantify the environmental impacts associated with pavements and transportation infrastructure, FHWA developed the Infrastructure Carbon Estimator, a spreadsheet tool that estimates the life-cycle energy and greenhouse gas emissions from the construction and maintenance of transportation facilities. Practitioners can use the tool to help demonstrate the benefits of green strategies in reducing infrastructure carbon emissions. The estimator is available at www.fhwa.dot.gov/environment/climate_change/mitigation/publications_and_tools/carbon_estimator.

Road Weather Management. FHWA seeks to better understand the impacts of weather on roadways and promote strategies to mitigate those impacts through its Road Weather Management Program. Implementing an effective program supports all the tenets of sustainability by improving safety, increasing mobility, reducing delays, and minimizing impacts on the human and natural environments.

FHWA recently released *Planning for Systems Management and Operations as Part of Climate Change Adaptation* (FHWA-HOP-13-030), a white paper that summarizes potential climate change effects on the management and operations of the transportation system. The paper also highlights possible issues, challenges, and approaches for State DOTs and local operating agencies to consider under shifting climate-related conditions.

In addition, FHWA has worked to develop best practices for road weather management and define program performance measurements, publishing *Best Practices for Road Weather Management* (FHWA-HOP-12-046) in 2012 and *Road Weather Management Program Performance Measurement: 2012 Update* (FHWA-JPO-13-87) in 2013.

The *Best Practices* report includes 27 case studies of systems in 22 States that improve roadway operations under inclement weather conditions. For example, in 2008 the Alabama DOT upgraded a low-visibility warning system near Mobile that has improved safety by reducing average traffic speeds and minimizing crash risk in foggy conditions.

Looking Ahead

Measures to improve the sustainability of the transportation system have the potential to reap a multitude of environmental, economic, and social benefits. FHWA's efforts to advance sustainability are helping to improve public health, increase transportation options, increase accessibility, reduce traffic congestion and emissions, reduce energy usage and costs, improve the quality of life for communities, reduce spending on infrastructure replacement, and improve economic prosperity.

FHWA will continue to advance sustainability through its Sustainable Highways Initiative, INVEST, and the practices of its program and division offices. FHWA also will continue to engage the Sustainability Working Group to further sustainability goals and plans for the agency, recommend and assist with outreach efforts, and provide input on research activities.

The agency plans to provide periodic updates to the sustainability report and will host a webinar series to go into more detail about each of the sustainability action areas. The series will be geared toward FHWA staff, State DOTs, MPOs, and other partners and stakeholders.

"We hope that the sustainability report will better inform readers about the breadth and depth of FHWA sustainability activities, and spur greater application and implementation of sustainability practices at all levels of government," says FHWA's Culp. "We also hope it encourages greater collaboration and communication within the agency and with leaders in the field to continue to advance a more sustainable highway system."

Alexandra Oster is a community planner with the Organizational Performance Division at the Volpe National Transportation Systems Center in Cambridge, MA. She has a B.A. in the environment from the University of Michigan and an M.A. in urban planning from the University of California, Los Angeles.

For more information, visit www.sustainablehighways.dot.gov, or contact Connie Hill at 804-775-3378 or connie.hill@dot.gov, or Alexandra Oster at 617-494-3539 or alexandra.oster@dot.gov. Advancing a Sustainable Highway System: Highlights of FHWA Sustainability Activities *is available at www.sustainablehighways.dot.gov/FHWA_Sustainability_Activities_June2014.aspx.*

Along the Road

Along the Road is the place to look for information about current and upcoming activities, developments, trends, and items of general interest to the highway community. This information comes from U.S. Department of Transportation sources unless otherwise indicated. Your suggestions and input are welcome. Let's meet along the road.

Management and Administration

Secretary Foxx Unveils 30-Year Transportation Outlook

U.S. Secretary of Transportation Anthony Foxx recently unveiled *Beyond Traffic 2045: Trends and Choices*, a forward-looking analysis from USDOT outlining the trends that are likely to shape the needs of the Nation's transportation system over the next three decades. The report is intended to start a national conversation about the future of the U.S. transportation system and to objectively frame critical policy choices that need to be made. The department will release a final report later in 2015 based on the ideas and public feedback generated by this analysis.

Beyond Traffic is structured in three parts. The first part discusses the major trends shaping the changing transportation system. The second part offers insights into the potential implications of these trends for each mode of transportation: highways, transit, pedestrian and bicycle, aviation, intercity and freight rail, maritime, and pipeline. The third part presents a description of a possible future scenario based on the trends analyzed in the previous sections. The document concludes with a discussion of policy options based on the implications of these trends.

The critical questions identified in *Beyond Traffic* include: How will the United States build a transportation system to accommodate a growing population and changing travel patterns? How will it reduce freight chokepoints that drive up the cost of owning a business? How will the Nation knock down barriers to new technologies that promise to make travel safer and more convenient? How will it adapt to climate change and make the infrastructure more resilient to extreme weather events like Hurricane Sandy? And also, how will transportation decisionmakers align decisions and dollars?

On February 2, Secretary Foxx and Eric Schmidt, executive chairman of Google, discussed the analysis during a Google "fireside chat" broadcast live on YouTube. The recorded talk is available at www.dot.gov/beyondtraffic.

The draft report also is available at www.dot.gov /beyondtraffic. USDOT welcomes feedback on the analysis through a comment form at www.dot.gov /beyondtraffic/shareyourideas, or by email to BeyondTraffic@dot.gov.

FHWA Ranks "Best Place to Work" For Third Consecutive Year

In 2014, FHWA was named the eighth best place to work in the Federal Government by the Partnership for Public Service. The annual ranking compares 389 Federal agencies and subcomponents.

The new ranking makes the third straight year the agency has been listed in the top 10. Federal employees were surveyed about their respective workplaces between April and June.

"I see each day the commitment to public service throughout the Department of Transportation, and it makes me very proud to see the results of this survey reflect that," said U.S. Transportation Secretary Anthony Foxx. "FHWA's nearly 3,000 employees deserve this important recognition. Because of their professionalism, and passion for innovation and public service, the Nation's roads and bridges are safer for millions of our fellow Americans."

Agency subcomponents are not only measured on overall employee satisfaction, but they also are scored in 13 workplace categories, such as effective leadership, training, employee skills/mission match, support for diversity, and pay. FHWA is ranked in the top tier of every category and improved its scores in teamwork and work-life balance.

For more information, visit http://bestplacestowork .org/BPTW/index.php.

FHWA, Volpe Look Ahead 30 Years

With support from Volpe, the National Transportation Systems Center, FHWA is offering projections on what the country's miles traveled by vehicle might look like in 30 years.

Historically, auto usage has paralleled economic growth, dipping with recessions and rising with recoveries. However, current auto travel has yet to bounce back from the recession that began in the late 2000s. Volpe, sponsored by FHWA, developed a model to produce new vehicle miles traveled (VMT) projections that shows growth is likely to pick up slightly in coming years, but will remain well below its historical rate, aligning more closely with population growth over the next few decades.

FHWA released its current VMT projections, based on the model developed by Volpe, in summer 2014. The projections show just 0.75 percent annual growth, a much slower rate than the previous 30 years, which averaged more than 2 percent annually.

According to Volpe's model, slower future growth in VMT is likely to have several effects. First, it means slower revenue growth for the Highway Trust Fund, which supports highway construction, transit facilities, and other infrastructure improvements. Second, while congestion levels in urban areas seem unlikely to decline, they also are unlikely to become much worse except in a few isolated locations. Lastly, environmental benefits are possible from a slowing rate of growth in the number of miles traveled because of fewer vehicle emissions.

VMT trends and projections affect FHWA research and policies, and are also used in State pilot programs testing fees based on distance traveled.

For more information on FHWA's projections, visit www.fhwa.dot.gov/policyinformation/tables/vmt/vmt_forecast_sum.pdf.

Technical News

USDOT Releases Tools to Assess Vulnerability to Climate Change

USDOT recently launched a Web portal and a set of resources to assist State and local transportation stakeholders in evaluating their vulnerability to climate change and options for adaptation at the facility level. The tools were announced in January 2015 during a live Web event, "Climate/Extreme Weather Risk Management Tools—Learning from the Gulf Coast."

The set of resources represent the culmination of a comprehensive 5-year assessment of the vulnerability of Mobile, AL's transportation system to climate change. The effort is called Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: The Gulf Coast Study, Phase 2.

The resources range from engineering case studies to videos to an Excel®-based tool that processes climate projection data. Transportation agencies have employed several of these resources through FHWA's Climate Change Resilience Pilot Program. Together, they can significantly reduce the amount of time and resources needed to conduct high-quality vulnerability assessments. (For more information, see "Bracing for Hard Times Ahead" in the November/December 2014 issue of PUBLIC ROADS.)

During a January 22, 2015, webcast, Acting Administrator Greg Nadeau discussed FHWA's goals for increasing the resiliency of the transportation system to climate change.

Approximately 500 people tuned into January's webcast, which featured remarks from FHWA Acting Administrator Greg Nadeau, background discussions on the motivation behind the project and tools, presentations from two State agencies that have successfully used some of the resources, and an overview of FHWA's new Web-based Adaptation Framework.

A video recording of the Web event is available at http://mp163422.cdn.mediaplatform.com/163422/wc/mp/4000/15208/15211/43719/Lobby/default.htm. The resources are available at www.fhwa.dot.gov/environment/adaptationframework.

New Guide Helps Inform Decisions About Road Diets

FHWA is working to make sure that road diets are not just a passing fad. A typical road diet takes a segment of four-lane undivided roadway and reconfigures it into three lanes with two through lanes and a center two-way, left-turn lane. The streamlined configuration improves safety by providing a protected left-turn lane for motorists, reducing crossing distance for pedestrians, and lowering travel speeds with little increase in travel times. Road diets also can create space for bicycle lanes.

VDOT

A road diet implemented along this stretch of Soapstone Drive in Reston, VA, changed the configuration from two lanes in each direction to the three lanes shown here and reduced crashes by 65 percent.

To help cities and towns deliver this safety innovation to their residents, FHWA recently published a *Road Diet Informational Guide* (FHWA-SA-14-028). The guide walks communities through the decisionmaking process to determine whether a road diet is a good fit.

One community where a road diet was a good fit is Reston, VA, where the Virginia Department of Transportation (VDOT) implemented one on a 2-mile (3.2-kilometer) segment of Lawyers Road during a 2009 repaving project. Reaction among residents was mixed before the project, but views shifted to strong support after the project helped reduce crashes in the corridor by 67 percent. VDOT installed a second road diet on nearby Soapstone Drive in 2011, and that diet resulted in a 65-percent reduction in crashes.

FHWA's Office of Safety recommends road diets as one of nine proven safety countermeasures for reducing fatalities and serious injuries on the Nation's roadways. The other countermeasures are roundabouts, corridor access management, backplates with retroreflective borders, longitudinal rumble strips and stripes on two-lane roads, enhanced delineation and friction for horizontal curves, Safety Edge$_{SM}$, medians and pedestrian crossing islands in urban and suburban areas, and pedestrian hybrid beacons.

For more information and to download the guide, visit http://safety.fhwa.dot.gov/road_diets/info_guide/es.cfm.

NCHRP Report Offers Guidance On the Width of Bicycle Lanes

The Transportation Research Board's National Cooperative Highway Research Program (NCHRP) recently released a report that provides recommendations for bicycle lane widths for various roadway and traffic characteristics. *Report 766: Recommended Bicycle Lane Widths for Various Roadway Characteristics* presents an analysis of research and guidance for determining the width of bicycle lanes based on widths of existing travel and parking lanes.

Nathan Roseberry, T.Y. Lin International Group

NCHRP's report offers guidance for determining the width of bicycle lanes, such as this 5-foot (1.5-meter)-wide lane with a 2-foot (0.6-meter)-wide buffer on the right side along Clark Street in Chicago, IL.

The American Association of State Highway and Transportation Officials' *Guide for the Development of Bicycle Facilities*, often referred to as the *Bike Guide*, defines a bicycle lane as "a portion of a roadway that has been designated for preferential or exclusive use by bicyclists by pavement markings and, if used, signs." And while the *Bike Guide* provides general guidance on appropriate bicycle lane widths—5 feet (1.5 meters) in most situations—it does not provide specific guidance on the width of bicycle lanes for various roadway conditions. Therefore, the NCHRP research aimed to fill that gap.

The recommendations in *Report 766* consider a number of roadway characteristics, such as whether a roadway has on-street parking. The conclusions are most applicable to urban and suburban roadways with level grade and a posted speed limit of 30 miles per hour (48 kilometers per hour) and should be used cautiously for the design of roadways with motor vehicle speeds outside of the range of 25 to 35 miles per hour (40 to 56 kilometers per hour), and in particular for roadways with higher speeds.

For more information, visit http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_766.pdf.

New Resource Available for Transportation Planning Across Boundaries

FHWA's Office of Planning completed a white paper on the participation of rural communities in transportation planning at a megaregions scale. The *Role of Regional Planning Organizations in Transportation Planning Across Boundaries* (FHWA-HEP-14-043) assesses the mutual benefits of rural jurisdictions participating in megaregions projects and programs, specifically in the areas of economic development, freight, and natural resources.

A megaregion is a network of urban clusters and their surrounding areas, connected by the existing economic, social, and infrastructure relationships. As more regions plan their transportation networks for global competitiveness, planners will increasingly need to incorporate rural areas in their large-scale planning efforts. Rural areas are a critical part of the identities, economies, and infrastructure of megaregions.

However, regional planning organizations have limited resources and staff. The white paper discusses the institutional barriers to entry for these organizations in cross-regional transportation planning. The document also considers partnerships that could lead to greater involvement in megaregions initiatives.

Through three case studies in Arizona, Michigan, and Washington, the paper describes best practices for regional planning organizations in innovative partnerships and joint planning with metropolitan planning organizations and State departments of transportation. The recommendations demonstrate how transportation planning can be the mechanism to support rural participation in plans and projects at a megaregions scale.

For more information, visit www.fhwa.dot.gov/planning/megaregions/reports/regional_planning_organizations/index.cfm.

VDOT Implements Composting for Better Management of Roadkill

Virginia ranks among the top 10 States in the Nation for deer-vehicle collisions. That means VDOT must dispose of thousands of carcasses along State-maintained roads and adjacent rights-of-way each year. The department recently introduced a more environmentally friendly method of managing these animal carcasses: composting.

VDOT began deploying forced-air composting facilities at several locations around the State. The system uses forced air to create an environment where microbes can help break down the carcasses of deer and other small animals, layered in sawdust, into compost. VDOT will use the resulting compost on vegetation and for erosion control along State roads and at its facilities. The average cost of the forced-air composting systems is about $140,000 each.

The department's research division, the Virginia Center for Transportation Innovation and Research, is evaluating how composting can help reduce some of the costs

VDOT

A highway maintenance worker uses a front-end loader to place a deer carcass into the sawdust in a forced-air composting facility in Virginia.

WSDOT

WSDOT's Bridge Vertical Clearance Trip Planner helps truck drivers research bridge heights to avoid potential conflicts, such as the overheight impact from a commercial truck that caused this section of the Skagit River Bridge in Mount Vernon, WA, to collapse in May 2013.

associated with transporting roadkill to offsite disposal sites. Previously, VDOT's predominant means of managing roadkill included transporting the carcasses to landfills and, where possible, burying individual carcasses within highway rights-of-way. However, some landfills no longer accept roadkill, and there is a growing scarcity of other viable burial sites. Maintenance staff in some areas were driving an hour a day to reach appropriate disposal sites.

Carcass composting results in a clean end product with environmental benefits. It can also reduce costs, particularly when it eliminates lengthy trips to disposal sites. Researchers recently completed a study on getting the best return on investment in siting composting facilities. Recommendations include sharing facilities located between two area maintenance headquarters to maximize cost-effectiveness.

Virginia was the first State to pilot forced-air composting technology, with pilot facilities in VDOT's Lynchburg, Salem, and Staunton districts. The State now has composting facilities in the Hampton Roads and Richmond districts, as well, with two additional planned in the Lynchburg district.

VDOT

Online Tool Helps Truckers Avoid Striking Bridges

A new trip planning tool from the Washington State Department of Transportation (WSDOT) enables truck drivers to more easily research bridge heights—and be alert to potential conflicts—before they hit the road. The Bridge Vertical Clearance Trip Planner is now available at www.wsdot.wa.gov/Bridge/Structures/BVCTP.htm.

WSDOT was updating its information on bridge clearances when an oversize commercial truck struck the Skagit River Bridge on I–5 in northwestern Washington State in 2013, damaging the upper bridge supports and causing the structure to collapse. (For more information on the collapse, see "Surviving an Interstate Bridge Collapse" in the November/December 2014 issue of PUBLIC ROADS.) As part of WSDOT's response to the collapse, the agency developed the Bridge Vertical Clearance Trip Planner with the updated bridge clearance data.

Using geographic information system (GIS) mapping, the trip planner shows drivers which bridges on their proposed routes they should avoid or approach with caution because heights may vary by lane. While the ultimate responsibility for checking clearance levels remains with the truck driver, this tool makes it easier to fulfill that obligation when applying for trip permits.

WSDOT developed the trip planner in consultation with the Washington Trucking Association, whose members also conducted beta testing of the tool. The planner's database will be available to third-party developers who have expressed interest in creating navigation apps for mobile devices. This open data approach enables the private sector to use State-generated data to develop even more tools to improve highway and motorist safety.

WSDOT also will continue to expand the trip planner features, including displaying lane-by-lane height information. That work will be completed by 2017.

WSDOT

Public Information and Information Exchange

NHTSA Reports Decline in Traffic Fatalities in 2013

In late 2014, the National Highway Traffic Safety Administration (NHTSA) released 2013 data from its Fatality Analysis Reporting System showing a 3.1-percent decrease in the number of fatalities compared to the previous year. The data also reveal a nearly 25-percent decline in overall highway deaths since 2004.

According to these most recent statistics, 32,719 people died in traffic crashes in 2013. The estimated number of people injured in crashes also declined by 2.1 percent. In addition, 34 States experienced reductions in overall traffic fatalities, led by Ohio (132 fewer fatalities), Kentucky (108 fewer), Pennsylvania (102 fewer), South Carolina (96 fewer), and Arkansas (77 fewer).

The more than 3-percent decline in traffic fatalities continues a long-term downward trend leading to the fatality rate matching a historic low—1.10 deaths per 100 million vehicle miles traveled in 2013, down from 1.14 deaths per 100 million vehicle miles traveled in 2012.

Earlier in 2014, U.S. Secretary of Transportation Anthony Foxx announced grants totaling approximately $1.6 million for public education and enforcement initiatives to improve pedestrian safety. The grants are part of USDOT's Everyone Is a Pedestrian campaign to help communities reduce the number of pedestrian deaths and injuries. In addition, the department also promoted its 2014 "Drive Sober or Get Pulled Over" holiday crackdown on drunk driving by unveiling a new mobile app, SaferRide, to help people who have been drinking get a safe ride home.

For more information, visit www-nrd.nhtsa.dot.gov/Pubs/812101.pdf.

NHTSA

Maine's Kennebec Bridge Opens to Traffic

FHWA recently joined the Maine Department of Transportation (MaineDOT) to celebrate the opening of the Kennebec Bridge on State Route 197 in central Maine. The $18 million project, which relied on a $10.8 million Transportation Investment Generating Economic Recovery (TIGER III) grant, will improve mobility to and from the towns of Richmond and Dresden.

Jeff Wood Photography

The new Kennebec bridge (foreground) significantly increased the vertical clearance for marine traffic compared to the old bridge, eliminating the need for a moveable span and improving regional mobility.

Construction on the Kennebec Bridge began in June 2013. The project replaced an 80-year-old bridge that was at the end of its service life and unable to carry heavy cargo. With close to 3,000 vehicles using it each day, the bridge is an important crossing over the Kennebec River. The old bridge was structurally deficient, with only one movable section to enable larger vessels to pass the navigable portion of the Kennebec River. In addition, it was only 20 feet (6 meters) wide, often acting as a single-lane bridge.

In addition to Federal support received through the TIGER program, this project was part of the Obama Administration's ongoing efforts to modernize Federal permitting of infrastructure projects and posted to the Federal Infrastructure Projects Permitting Dashboard. Under this effort, Federal agencies and the project sponsor—MaineDOT—collaborated extensively to accelerate permits and reviews related to the environmental assessment process.

Among other criteria, the Kennebec Bridge project was selected to receive Federal support based on the safety benefits of the improved structure, its ability to improve the condition of the existing transportation system, and its enhancement of the quality of life for the nearby communities by increasing travel choices and connections. The new structure is wider, with two travel lanes and shoulders to safely accommodate trucks, bicycles, and pedestrians. In addition, it is taller, with sufficient vertical clearance to eliminate the need for a movable span. The new bridge provides reliable access and regional mobility for both highway and marine traffic.

U.S. Bicycle Route System Grows To More Than 8,000 Miles

Adventure Cycling Association and AASHTO recently announced the addition of 1,253 miles (2,016 kilometers) of new U.S. bicycle routes to the U.S. Bicycle Route System. The system is a developing national network of numbered and signed bicycle routes that connect people and communities across the country. The system now encompasses 8,042 miles (12,942 kilometers) of routes in 16 States and the District of Columbia.

Dennis Coello

Cyclists ride along USBR 76 in Missouri, part of the recently expanded U.S. Bicycle Route System.

The approved routes include U.S. Bicycle Route (USBR) 1 in Florida (584 miles, 940 kilometers), USBR 90 in Florida (424 miles, 682 kilometers), USBR 11 in Maryland (34 miles, 55 kilometers), a segment of USBR 1 in Massachusetts (18 miles, 29 kilometers), and USBR 10 in Michigan (193 miles, 311 kilometers). The longest new route, USBR 1 in Florida, passes by scenic beaches and intersects cities and towns along the State's Atlantic coast from Key West to Jacksonville. In addition to the new routes, AASHTO approved realignments in Virginia that added 6 miles (10 kilometers) to USBR 1 and removed 6 miles (10 kilometers) from USBR 76. Routes are nominated for designation every fall and spring and approved by the AASHTO Special Committee on U.S. Route Numbering.

The Adventure Cycling Association's goal is to grow the U.S. Bicycle Route System into the largest bicycle route network in the world, encompassing more than

50,000 miles (80,467 kilometers). Currently, more than 40 States are working to develop route corridors into official routes.

For more information, visit www.adventurecycling.org/usbrs.

Adventure Cycling Association

Cherokee Nation Completes First Joint Traffic Light Project

In November 2014, the Cherokee Nation activated its first traffic light project completed jointly with the Oklahoma Department of Transportation (ODOT) in Tahlequah, OK. Most traffic light projects are managed entirely by the city or by ODOT without tribal involvement. The project installed a traffic light at a highly trafficked intersection at the entrance to Sequoya High School, a Cherokee language charter school, and an early childhood development center, all operated by the Cherokee Nation.

Cherokee Nation

ODOT Executive Director Mike Patterson (center, in suit and green tie) joined local and tribal leaders and ODOT staff for the ribbon-cutting ceremony for the Cherokee Nation's first joint traffic light project with ODOT in Tahlequah, OK.

The Cherokee Nation received a half-million-dollar grant from FHWA's Tribal Transportation Program, and the tribe's roads department funded the remainder of the total $750,000 project cost. ODOT also approved the plans and provided oversight. Construction began in July 2014.

The traffic light is at the intersection of U.S. Highway 62 and Coffee Hollow Road, where 11,000 drivers pass through daily. Prior to installation of the traffic light, the busy intersection was prone to lengthy backups and vehicle crashes. Tribal and city officials, as well as ODOT leadership, have praised the collaborative project for improving the quality of life and safety of drivers.

In addition to the traffic light, the Cherokee Nation completed 64 miles (103 kilometers) of road and bridge projects throughout the tribe's 14-county jurisdiction in 2014. More than $13 million in tribal and Federal funds made the 28 projects possible.

Cherokee Nation

Pennsylvania Funds Green Light-Go Program

In late 2014, the Pennsylvania Department of Transportation (PennDOT) announced the award of $1.8 million for 38 municipalities to underwrite the costs of upgrading traffic signals through the department's Municipal Signal Partnership Program, referred to as Green Light-Go. The program aims to increase safety and mobility by reducing congestion and improving the efficiency of existing traffic signals on State highways. Grant recipients may use the funding for activities such as installing light-emitting diode (LED) technology, performing regional operations, developing special event plans, monitoring traffic signals, and upgrading traffic signals to the latest technologies.

In Pennsylvania, municipalities manage traffic signals and sometimes struggle to find the resources to keep the systems operating at peak efficiency. Green Light-Go provides a 50-50 funding split between PennDOT and municipalities. Under Green Light-Go, upgrade projects on corridors with fewer than 10,000 vehicles per day are managed by the municipality, and PennDOT manages any project with signals on corridors that carry more than 10,000 vehicles per day.

As part of the program, PennDOT is undertaking a comprehensive project to collect data on traffic signal assets. This effort, deemed critical to improving the program, involves collecting existing data from PennDOT, municipalities, contractors, and other sources to create one complete record. PennDOT will use the combined data for its statewide electronic Traffic Signal Asset Management System, which will be available to all municipalities at no cost.

For more information, visit www.dot.state.pa.us/signals.

PennDOT

Reporting Changes of Address

PUBLIC ROADS has two categories of subscribers. One includes the organizations and people who receive the magazine without charge; the editorial office of the magazine maintains the mailing list for this group. The other category is the group of people and companies that pay to receive the magazine; the mailing list for this group is maintained by the Superintendent of Documents for the U.S. Government Printing Office.

Free copies are distributed to offices of the Federal Highway Administration, State highway agencies, technology transfer centers, and selected leaders who have responsibility for highway-related issues. Most of these copies are mailed to offices for their internal distribution or to people by position title rather than by name. If any office or individual subscriber in this category has a change of address, please send the complete previous mailing address and the complete new address to our distribution manager, Lisa A. Shuler, via email (lisa.shuler@dot.gov), telephone (202–493–3375), or mail [Lisa A. Shuler, PUBLIC ROADS Distribution Manager (HRTM), Federal Highway Administration, 6300 Georgetown Pike, McLean, VA, 22101-2296].

Paid subscribers who have an address change should notify the U.S. Government Printing Office, Claims Office, Washington, DC, 20402; or call 202–512–1800; or fax 202–512–2168. Please do not send an address change for a paid subscription to the editorial office of PUBLIC ROADS. We do not manage the paid subscription program or mailing list, and we are not able to make the requested change.

Internet Watch

by Carrie Boris

Improving Safety for Cyclists

In 2012, conflicts between bicyclists and motor vehicles resulted in 726 cyclist fatalities and about 49,000 injuries. This represents an increase from 2011, when 682 cyclists were killed and about 48,000 were injured. This uptick prompted U.S. Secretary of Transportation Anthony Foxx to announce the "Safer People, Safer Streets" initiative last year. The initiative aims to improve bicycle and pedestrian safety by rolling out a variety of new resources, issuing new research, and highlighting existing tools for a range of transportation professionals.

As one part of that initiative, the Federal Highway Administration recently released its new Bicycle Safety Guide and Countermeasure Selection System (BIKESAFE), available at www.pedbikesafe.org/BIKESAFE. The first update to the guide in 8 years, BIKESAFE is now available as an interactive tool, accessible by computer, tablet, or smartphone.

"BIKESAFE is intended as a resource for State departments of transportation, local governments, and community planners and safety advocates for how to make streets safer for all users," says Tamara Redmon, program manager for pedestrian safety in FHWA's Office of Safety.

Insight and Interactive Assistance

BIKESAFE offers guidance on implementing countermeasures to improve the safety and mobility of bicyclists. It provides practitioners with information and tools to review and select engineering and roadway infrastructure improvements to reduce bicyclist injuries and fatalities.

BIKESAFE includes four sections: a guide of basic information, specific countermeasure details and a selection tool, case studies, and a compilation of links to dozens of other Web resources.

Guide. This section helps practitioners better understand the issues facing bicyclists, how to analyze crashes, and how to implement new treatments. The guide offers background information including explanations of the complete streets concept, how land use decisions affect bicycling safety, bicycling and public health, and other topics. The guide introduces a number of statistics that point to the magnitude of the problem of bicycle safety and the factors involved. Analysis and implementation discussions help practitioners understand how to identify relevant safety factors, access and analyze crash data, establish goals, and select and implement countermeasures.

Countermeasures. The countermeasures section includes a comprehensive list of 46 engineering, education, and enforcement countermeasures, as well as details of each, including its description, purpose, considerations, safety effect, and cost.

The countermeasures are grouped into categories for shared roadways, onroad bike facilities, intersection treatments, maintenance, traffic calming, trails and shared-use paths, and markings, signs, and signals. Two matrices in this section help users see the relationship between these categories and 13 crash types and

Home page of BIKESAFE Web site.

7 performance objectives. The matrix of crash types includes a variety of crash designations, such as a motorist failing to yield in a signalized intersection and a bicyclist merging right into the path of a motorist. The performance objectives matrix shows which countermeasure types relate to objectives like providing off-road paths for bicyclists and improving motorists' behavior and compliance with traffic laws.

The countermeasures section also features an interactive selection tool to help users determine appropriate countermeasures or treatments to address specific bicycling objectives or crash problems. Users input the basic safety problem and site conditions and the system proposes a short list of candidate treatment options that likely would be suited to address the bicyclist safety problem for that situation.

Case Studies. BIKESAFE also includes 34 case studies that document implementation of one or more countermeasures, along with background on the problems, bicycle safety solutions selected, and the results of the treatments. The case studies are grouped by both State and countermeasure group, so users can focus either on a particular issue or find what communities in their area have done.

Resources. This section of the guide includes more than 40 links to other Web resources including guidelines from FHWA, the American Association of State Highway and Transportation Officials, the National Association of City Transportation Officials, the Institute of Transportation Engineers, and more. It includes Federal and State programs and initiatives, as well as additional plans and examples from States and cities around the country.

FHWA's number one mission is the safety of all road users, Redmon says. "The updated BIKESAFE guide is a critical part of the agency's latest initiative to improve pedestrian and bicycle safety. It will help planners, engineers, and safety advocates at all levels determine what can be done to increase safety, and how to implement improvements."

Carrie Boris is a contributing editor for PUBLIC ROADS.

Training Update

NATIONAL HIGHWAY INSTITUTE

by Carrie Boris

NHI Announces New and Updated Courses

NHI has revamped its menu of offerings for 2015 with five new and revised Web-based courses: a series of four air quality planning courses as well as one course on transportation asset management plans. In addition, a new classroom training on integrating geometric design and traffic control is now available.

Understanding Air Quality Planning

The series of four trainings on air quality planning cover the basics of the Clean Air Act, State implementation plans (SIPs), transportation control measures (TCMs), and the transportation conformity rule, among other topics.

- *Course 142068: Clean Air Act Overview* provides participants with an overview of air quality planning and an understanding of the purpose of the Clean Air Act and the 1990 amendments to it. The course explains the provisions relevant to transportation and presents the impacts of the legislation on environmental and transportation planning.
- *Course 142069: SIP and TCM Requirements and Policies* differentiates the various types of SIPs, explains their purposes, and identifies requirements for SIPs and TCMs in the Clean Air Act. The course also teaches participants about reasonably available control measures and how they apply to TCMs.
- *Course 142070: SIP Development Process* focuses on agency roles in the SIP development process, including the U.S. Environmental Protection Agency's procedures for approving or disapproving SIPs. The course also covers preparing emissions inventories and determining SIP emission reductions.

Paolo Bona/Shutterstock.com

NHI's new Web-based course 142070: SIP Development Process discusses emission budgets for motor vehicles, which identify the limits for onroad emissions needed to meet air quality standards. These caps on emissions are included in SIPs and used in conformity determinations.

- *Course 142071: Transportation Conformity* is intended for participants with little or no experience with the transportation conformity rule, which requires federally supported transportation plans, improvement programs, and projects to conform to the State air quality implementation plan. The training defines transportation conformity, the activities covered by it, and the requirements and timeframes for various activities.

The target audience for the series includes transportation and air quality planners from State and local agencies. Other stakeholders in the planning process, such as public officials, community leaders, and public interest groups, may also benefit from the series. Each course costs $25 under NHI's pricing structure introduced for 2015.

Additional Web and Classroom Offerings

The updated course 131106C: Introduction to a Transportation Asset Management Plan (Web-Based) provides an overview of the content and organization of an asset management plan and the typical development process. Updated material covers key components including performance projections, financial summaries, and a comparison with requirements in the Moving Ahead for Progress in the 21st Century Act. NHI designed the course for mid- and senior-level managers from State departments of transportation and other agencies who typically are decisionmakers in one or more areas addressed by transportation asset management.

The Web-based course serves as a free prerequisite for a more indepth classroom training, course 131106B: Developing a Transportation Asset Management Plan. The classroom course is a 1.5-day, instructor-led training that teaches participants to develop or enhance an asset management plan.

In addition to the Web-based offerings, NHI launched course 380118: Integrating Geometric Design & Traffic Control for Improved Safety. This 1-day, instructor-led training provides an overview of the interrelationship of geometric design and traffic control device applications. The course focuses on interchange areas, such as lane eliminations, that may present challenges for designers and motorists. Discussion points include human factors concepts, evaluating lane configurations and methods for eliminating lanes, and the role of signs and pavement markings.

Group exercises help participants apply the principles covered in the training. The course is intended for engineers and planners involved in highway design, construction, and operations, and includes guidance in meeting driver expectations of roadway geometry and traffic control devices.

For more information, visit NHI's Web site at www.nhi.fhwa.dot.gov. To register for a session or to sign up to receive email alerts when sessions are scheduled, visit the course description page.

Carrie Boris is a contributing editor for PUBLIC ROADS.

Communication Product Updates

Compiled by Lisa A. Shuler of FHWA's Office of Corporate Research, Technology, and Innovation Management

Below are brief descriptions of communications products recently developed by the Federal Highway Administration's Office of Research, Development, and Technology. All of the reports are or will soon be available from the National Technical Information Service (NTIS). In some cases, limited copies of the communications products are available from FHWA's Research and Technology (R&T) Product Distribution Center (PDC).

When ordering from NTIS, include the NTIS publication number (PB number) and the publication title. You also may visit the NTIS Web site at www.ntis.gov to order publications online. Call NTIS for current prices. For customers outside the United States, Canada, and Mexico, the cost is usually double the listed price. Address requests to:

National Technical Information Service
5301 Shawnee Road
Alexandria, VA 22312
Telephone: 703–605–6050
Toll-free number: 1–888–584–8332
Web site: www.ntis.gov
Email: customerservice@ntis.gov

Requests for items available from the R&T Product Distribution Center should be addressed to:

R&T Product Distribution Center
Szanca Solutions/FHWA PDC
13710 Dunnings Highway
Claysburg, PA 16625
Telephone: 814–239–1160
Fax: 814–239–2156
Email: report.center@dot.gov

For more information on R&T communications products available from FHWA, visit FHWA's Web site at www.fhwa.dot.gov, the FHWA Research Library at www.fhwa.dot.gov/research/library (or email fhwalibrary@dot.gov), or the National Transportation Library at ntl.bts.gov (or email library@dot.gov).

Nondestructive Inspection Protocol for Reinforced Concrete Barriers (TechBrief)
Publication Number: FHWA-HRT-14-071

This technical brief summarizes the results of a study conducted in response to a recommendation from the National Transportation Safety Board to "expand the research and development of nondestructive evaluation technologies to develop bridge inspection methods that augment visual inspections; offer reliable measurement techniques; are practical, both in terms of time and cost, for field inspection work; and promote the use of these technologies by bridge owners."

The research team considered four nondestructive evaluation technologies: ground-penetrating radar, low-frequency ultrasonic tomography, infrared thermography, and digital radiography. To test the effectiveness of the technologies in assessing barrier connections—bolt connections and embedded reinforcing steel connections—researchers constructed a mock bridge deck. They then altered the connecting rebars and bolts by machining away steel to produce varying levels of cross section losses. The team conducted the testing on two concrete barrier configurations: the F-shape bolt-down barrier and the New Jersey freestanding portable barrier.

Of the four methods, ground-penetrating radar could detect rebars at all levels of cross section loss in concrete for the F-shape bolt-down barrier, but could not differentiate between levels of cross section loss or quantify the loss. However, this method could not detect and locate the rebars in the New Jersey concrete barrier because these barriers were tested with a high-frequency antenna, which prevents the deep penetration of electromagnetic waves. The researchers recommend using a low-frequency antenna for future studies.

The low-frequency ultrasonic tomographer detected reinforcing steel with a low level of cross section loss. The team found it difficult to detect and locate reinforcing steel with a high level of cross section loss. Similar to ground-penetrating radar, the ultrasonic tomographer could not quantify the rebar's cross section loss. However, this method could differentiate between rebars with varying levels of cross section loss.

Because of the thickness of the concrete, the researchers did not find infrared thermography and digital radiography to be successful in locating rebars in either type of barrier.

As a result, the research team suggests using ground-penetrating radar and ultrasonic tomographer data in combination to provide complimentary information when assessing the condition of concrete barriers. The report also includes the researchers' recommendations for further testing.

This document is available to download at www.fhwa.dot.gov/publications/research/infrastructure/structures/14071/index.cfm. Printed copies are available from the PDC.

Design and Construction of Field-Cast UHPC Connections (TechNote)
Publication Number: FHWA-HRT-14-084

Ultra-high performance concrete (UHPC) exhibits mechanical and durability properties that make it an ideal candidate for developing new solutions for construction, repair, and replacement of highway infrastructure. UHPC is a fiber-reinforced, portland cement-based material with advantageous fresh and hardened properties. Field-cast UHPC details connecting prefabricated structural elements used for bridge construction can be simpler to

construct and provide more robust long-term performance than connections constructed through conventional methods. This document provides guidance on the design and deployment of field-cast UHPC connections.

UHPC provides new opportunities to create robust structures from prefabricated components. Lab research demonstrates the improved performance of UHPC connections, while initial real-world deployments in the highway bridge inventory validate the constructability and field performance of these systems. Over the past 5 years, agencies in the United States have completed dozens of highway bridge projects using field-cast UHPC connections between prefabricated elements.

This document covers common UHPC connection concepts, designs, material and construction specifications, and inspection. It also includes a case study featuring the construction of a set of interstate highway bridges on I–81 in Syracuse, NY. The document aims to facilitate broader deployment of prefabricated bridge elements by providing owners and contractors with the tools necessary to specify, design, and construct a new class of robust connection details.

This document is available to download at www.fhwa.dot.gov/publications/research/infrastructure/structures/14084/index.cfm. Printed copies are available from the PDC.

The Use of Phosphoric Acid to Stiffen Binders (Report)
Publication Number: FHWA-HRT-14-086

Phosphoric acid offers the ability to modify asphalt binders in various ways. This report offers guidelines for its use to stiffen asphalt binders for hot-mix paving applications.

As an additive, phosphoric acid increases the high-temperature performance grade. It also can reduce the amount of styrene butadiene styrene polymer needed to meet the Strategic Highway Research Program's Superpave (SUperior PERforming Asphalt PAVEments) Plus specifications. Phosphoric acid also facilitates the dispersion of some polymers in asphalt.

Researchers developed guidelines for the use of phosphoric acid as an asphalt modifier and addressed concerns such as the effect on aging, moisture damage, reaction with limestone aggregates, and liquid amine antistrip additives. The research plan includes an analysis focused on developing quantitative and qualitative methods for detecting the presence of phosphoric acid in asphalt and determining the effect on key components of asphalt binders. Analytical procedures discussed include x-ray fluorescence spectroscopy as well as a simple rapid test method.

This document also covers the expected effect on pavement life. The guidelines in this report will be useful to producers of asphalt binders, hot-mix paving contractors, State departments of transportation, and local highway agencies.

The document is available to download at www.fhwa.dot.gov/publications/research/infrastructure/pavements/14086/index.cfm.

www.pedbikeimages.org/Laura Sandt

Safer Walking and Biking Are Just a Click Away

The safety of all road users is a top priority for the Federal Highway Administration.

Check out these resources to help your community improve pedestrian and bicycle safety.

A Guide for Maintaining Pedestrian Facilities for Enhanced Safety
safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa13037

A Resident's Guide for Creating Safer Communities for Walking and Biking
safety.fhwa.dot.gov/ped_bike/ped_cmnity

Bicycle Road Safety Audit Guidelines and Prompt Lists
safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa12018

Bicycle Safety Guide and Countermeasure Selection System (BIKESAFE)
pedbikesafe.org/BIKESAFE

Costs for Pedestrian and Bicycle Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public
pedbikeinfo.org/data/library/details.cfm?id=4876

Handbook for Designing Roadways for the Aging Population
safety.fhwa.dot.gov/older_users/handbook

National Center for Safe Routes to School
saferoutesinfo.org

Pedestrian and Bicycle Information Center
pedbikeinfo.org

Pedestrian Road Safety Audit Guidelines and Prompt Lists
safety.fhwa.dot.gov/ped_bike/tools_solve/ped_rsa

Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE)
pedbikesafe.org/PEDSAFE

Proven Safety Countermeasures
safety.fhwa.dot.gov/provencountermeasures

Road Diet Informational Guide
safety.fhwa.dot.gov/road_diets/info_guide

Statewide Pedestrian and Bicycle Planning Handbook
www.fhwa.dot.gov/planning/processes/pedestrian_bicycle/pedestrian_bicycle_handbook

Learn More.

For more about FHWA research, programs, and resources, visit www.fhwa.dot.gov/environment/bicycle_pedestrian or safety.fhwa.dot.gov/ped_bike.

U.S. Department of Transportation
Federal Highway Administration

U.S. Department
of Transportation
Federal Highway Administration
Attn: HRTM
1200 New Jersey Avenue, SE
Washington, DC 20590

Official Business
Penalty for Private Use $300

PERIODICALS
POSTAGE & FEES PAID
FEDERAL HIGHWAY ADMINISTRATION
ISSN NO. 033-3735
USPS NO. 516-690

FHWA-HRT-15-004
HRTM-20/5-15(5M200)E