Public Roads

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Smarter Highways
Atlanta's BeltLine
Primer on Road Diets

U.S. Department of Transportation
Federal Highway Administration

Public Roads

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

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Front cover—Washington State's Smarter Highways project uses high-tech overhead signs, like these in Seattle, to display variable speed limits, lane status, and real-time traffic information so drivers know what's happening ahead. This technology, also known as active traffic management, has shown potential to increase roadway mobility and safety in Europe. For more information, see "Fighting Congestion with Smarter Highways" on page 15 in this issue of PUBLIC ROADS. *Photo: Keith Anderson, WSDOT, Visual Engineering Resource Group.*

Back cover—General Motors envisions electrical vehicles with wireless connectivity and advanced innovation strategies leading the world toward sustainable urban mobility by 2030. The ElectricNetworked-Vehicle (EN-V), shown here, can go 25 miles (40 kilometers) on a single charge, enough for the average urban commute. For more information, see "What Does It Take to Change How We Do Business?" on page 2 in this issue of PUBLIC ROADS. *Photo: ©General Motors (licensed under Creative Commons: http://creativecommons.org/licenses/by-nc/3.0/).*

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Guest Editorial

Paths for Improving Quality of Life

Lucy Garliauskas

Gabe Rousseau

Communities across the country are eager to develop multimodal transportation networks that provide safe, convenient, and affordable travel options for motorists, transit riders, pedestrians, and bicyclists. In March 2010, U.S. Department of Transportation (USDOT) Secretary Ray LaHood called national attention to this topic with the release of "Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations." According to the statement, USDOT policy is to "incorporate safe and convenient walking and bicycling facilities into transportation projects. Every transportation agency… has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems."

Many transportation agencies already have embraced this vision. In each of fiscal years 2009 and 2010, more than $1 billion in Federal-aid funds went to walking and bicycling facilities and programs. The previous record for one year was $564 million.

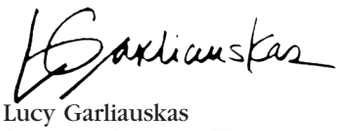
This increased investment is contributing to safer opportunities for walking. Annual pedestrian fatalities have declined nationally from 4,763 in 2000 to 4,092 in 2009. Bicycling fatalities too have declined, though less dramatically, from 693 in 2000 to 630 in 2009. Overall, walkers and bicyclists still comprise about 14 percent of all roadway fatalities despite accounting for almost 12 percent of all trips. Although recent trends in walking and bicycling safety have been positive, more work remains to ensure that all road users return home safely.

The Federal Highway Administration (FHWA) continues to work with transportation agencies nationwide to accommodate community transportation needs, including safer nonmotorized options and linkages to transit. Current funding programs like Safe Routes to School and Transportation Enhancements make it easier and safer for people to walk or bicycle. National clearinghouses like the FHWA-funded Pedestrian and Bicycle Information Center (www.pedbikeinfo.org) and the National Center for Safe Routes to School (www.saferoutesinfo.org) provide tools and case studies to help transportation professionals and the public understand how to improve walking and bicycling facilities.

In April 2011, the Pedestrian and Bicycle Information Center announced the first awardees for its new Walk Friendly Communities program (see page 44). Its organizers hope that the program will spur friendly competition as communities work to improve their pedestrian networks.

There are many reasons to provide walking and bicycling facilities within multimodal networks. These modes can benefit individuals by saving them money and providing opportunities for physical activity. In addition, well-integrated multimodal networks have the potential to improve air quality, revitalize communities, ensure efficient investment of public funds, and enhance transportation access for people of all ages and abilities.

Projects such as the Atlanta BeltLine (see page 20), which is improving multimodal transportation connectivity, are encouraging examples of how communities can take advantage of underused resources and create exciting, vibrant places to live, work, and play. FHWA strives to help communities identify their own transportation wants and needs and, ultimately, to improve quality of life by making sound transportation decisions and investments.



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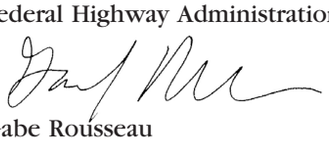


Gabe Rousseau
Bicycle & Pedestrian Program Manager
Federal Highway Administration

What Does It Take To Change How We *Do Business?*

by Kathleen A. Bergeron

Leaders in the transportation community ruminate about strategies to meet the challenges facing the highway world.

Car manufacturers are designing electric autos with advanced wireless technology to help avoid crashes. Shown here is an ElectricNetworked-Vehicle (EN-V) developed by General Motors' Advanced Vehicle Design program and exhibited at the World Expo 2010 Shanghai. *Photo: ©General Motors (licensed under Creative Commons: http://creativecommons.org/licenses/by-nc/3.0/).*

What's going on? Everywhere you look today, long-standing approaches, systems, organizations, even entire governments are being turned upside down. Natural disasters, a worldwide economic downturn, and challenges to centuries-old political, social, and religious dogmas are ushering in sweeping changes to the status quo.

The transportation community is not immune. Basic tenets of highway programs that have been around since the beginning of motorized transportation are no longer reliable. The funding bedrock of highway construction and maintenance—taxes on petroleum-based fuels—already has proven inadequate in the face of factors such as improved engine efficiencies, decreased travel brought on by the economic downturn, and a hesitance by leaders to increase the per-gallon tax rate or endorse other broad-based revenue enhancement alternatives. And an even greater technological challenge to that funding approach is looming: increased use of transit and electric cars.

"Today's cars and trucks are primarily mechanically driven, powered by internal combustion engines, energized by petroleum, controlled mechanically, and operated as stand-alone devices," writes General Motors' Director of Advanced Technology Vehicle Concepts Christopher E. Borroni-Bird. "In fact, they have essentially the same 'genetic makeup' as automobiles pioneered by Karl Benz, Ransom Olds, and Henry Ford over a century ago."

In *Reinventing the Automobile*, published in 2010, Borroni-Bird, with coauthors Lawrence D. Burns and the late William J. Mitchell, describes how General Motors and other car manufacturers are moving toward a "new automotive DNA," one that relies on newer technologies such as electric-powered vehicles that are wirelessly interconnected to avoid crashes and that can incorporate additional technologies as they come along. These changes, according to Borroni-Bird, will continue to unfold over the next 10, 20, or 30 years.

The transformation is underway already. Late in 2010, Osamu Suzuki, the 80-year-old chairman of Suzuki Motor Corporation, warned Japanese automotive parts makers to start gearing up for the changeover to

electric cars. "We are in the midst of an industrial revolution," he said, as quoted in *The New York Times*. "Our suppliers need to start studying how they can transform their business." At that time, according to the same article, almost 30 percent of sales in Japan's $430 billion auto parts industry came from parts that could be rendered obsolete by electric-powered vehicles.

The New Normal

Thomas K. Sorel, commissioner of the Minnesota Department of Transportation (Mn/DOT), speaks of the current environment as the "new normal." He adds, "The new normal means higher interest rates, slower economic growth, an increasing number of retirees, less consumption, more savings, a more diverse population, more uncertainty in our personal and national futures, and more uncertainty about the future in general." He further muses that, for highway organizations, "Maybe this is the new normal: the uncertainty in the way we live our lives, the uncertainty in the way we deliver our programs. And we just have to learn how to live with that and work with it."

Hal Kassoff, senior vice president at Parsons Brinckerhoff, one of the country's largest transportation planning and design firms, agrees that times are different. "I've been in the highway business going on 45 years," says Kassoff, "and the last 10 years [have] seen more in the way of change and innovation [than] the previous 30."

But recognizing the magnitude of change is only the first step. The big question is how can transportation organizations, both in the public and private sectors, meet the unprecedented challenges of change? How can they thrive or even survive in such an environment? As with any other problem, the best approach may be to find examples of people and organizations that have met those challenges successfully and are actively addressing them today.

Sorel and Mn/DOT fit the role. Both have received praise for providing Minnesotans with a high level of transportation service. Reporter Dave Beal of the MinnPost.com wrote, "When [new governor] Mark Dayton asked [Sorel] to stay on as commissioner at the Minnesota Department of Transportation, it was a telling confirmation of how much times have changed for the better at the agency under Sorel." (Sorel previously worked for a Republican administration and was reappointed under a Democratic administration.) Prior to leading Mn/DOT, Sorel headed the Minnesota Division of the Federal Highway Administration (FHWA).

> "It is not necessary to change. Survival is not mandatory."
>
> —W. Edwards Deming

How do Sorel and his agency deal with the new normal? Sorel points to a three-way relationship between the new normal and the concepts of sustainability and quality of life. To him, that approach has been key to the agency's success.

To determine sustainable solutions, Mn/DOT looks at how society, the economy, and the environment come together. Under society, for example, the agency studies aspects such as equity, health, culture and history, accessibility, involvement, livability, and values. "We've focused in on sustainability, and I really believe that that's the umbrella that's going to help us respond to the new normal," Sorel says. "The sustainability umbrella, I think, can really prompt innovation and creative thinking."

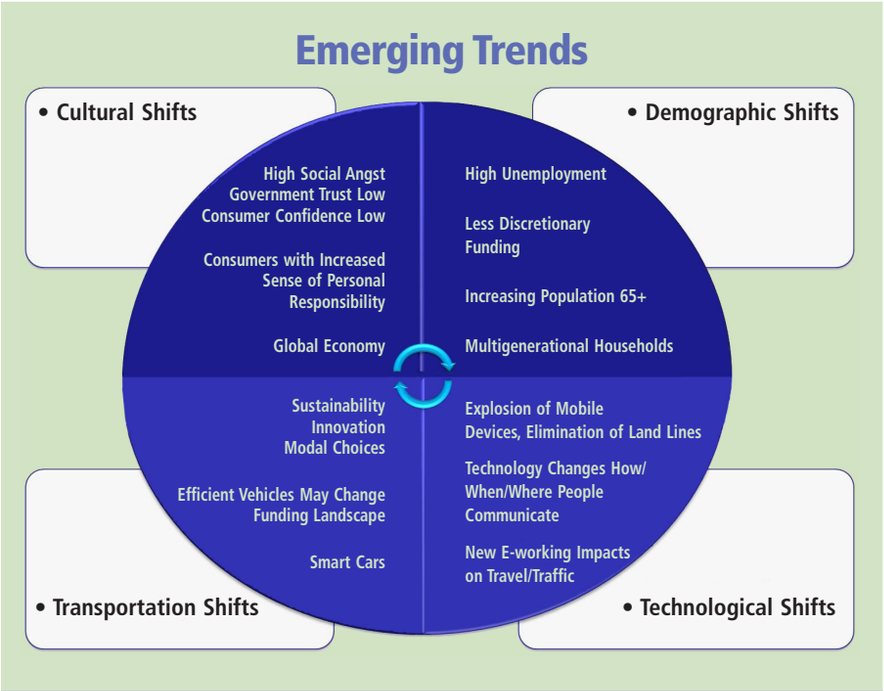
With regard to quality of life, he adds, the question is, What does it mean to Minnesotans? The agency has undertaken extensive market research to understand which transportation-related factors align with Minnesotans' views of quality of life, and whether those transportation quality-of-life influencers are in alignment with Mn/DOT's strategic directions.

"Piecing the transportation puzzle together," Sorel says, "we acknowledged that [uncertainty] and we managed our risks." Mn/DOT's approach has embraced the concept of risk management and combined it with market research for a market-based risk management approach in how it delivers programs and products.

Some, of course, dread venturing into unknown waters. Business guru Peter Drucker wrote in *Management Challenges for the*

David Gonzalez, Mn/DOT

Thomas K. Sorel (far right), commissioner of Mn/DOT, discusses business in flight to a district office with Qin Tang, information research services specialist with the Mn/DOT library, and Kevin Gutknecht, Mn/DOT communications director.



Cultural, demographic, technological, and transportation shifts combine to help define the new normal facing transportation decisionmakers. Mn/DOT's Tom Sorel notes that "the way people communicate and function in the workplace is going to change in the future, and technology is going to play a large role in helping to provide sustainable solutions in the future." *Source: Mn/DOT.*

21st Century, "We do not hear much anymore about 'overcoming resistance to change,' which, 10 or 15 years ago was one of the most popular topics of management books and management seminars. Everybody has accepted by now that 'change is unavoidable.' But this still implies that change is like 'death and taxes': It should be postponed as long as possible, and no change would be vastly preferable."

Minnesota's Sorel feels the opposite should be the case. "We shouldn't fear this. Why fear the new normal?" he asks. "It plays to our strengths!" He adds that productivity growth in the public sector will be essential to future economic growth.

Parsons Brinckerhoff's Kassoff agrees: "The bottom line is…knowing how to change through reinvigorating our organizations can lead to the resources we need to bring about even better changes for our customers in the long run."

Getting the Public's Attention

But, again, highway organizations face the challenge of insufficient resources to operate. Although much has been said about the possibility of a revised taxing structure, the dangers of outdated infrastructure, and the benefits of new technologies, the word does not seem to be getting to the people who matter: the motoring public.

Dr. Peter Ruane, president and CEO of the American Road & Transportation Builders Association (ARTBA), sees the problem as being, to some degree, the industry itself. To him, the highway community spends "most of our time talking to ourselves." He points to major articles on highway projects in national publications and notes that, all too often, they came about not by any effort by the highway community to tell its story, but rather by serendipity, sheer luck.

"Our industry must work together collectively to change how people think about us," he says. "We have been defined not by ourselves but by others."

Ruane notes the importance of recent major highway construction programs aimed at stimulating the economy and how they showcased the industry's capabilities. Yet, he grimaces at the phrase "shovel-ready" that came into favor in recent years. "I think that politically trite sound bite set us even further back as an industry in terms of how we approach our day-to-day business. The image of someone standing around on a shovel has been a false caricature that's been out there for years. Unfortunately, the shovel-ready characterization only served to reinforce that image…. My message to all industry professionals is simple. Take ownership of the good work you do in building a better America, and share your transportation success stories with your elected officials, local business leaders, and news media. We should be touting the engineering, construction, and technology achievements of projects like the Hoover Dam Bypass and the Woodrow Wilson Bridge. After all, if we don't tell the truth, who will?"

Kassoff notes that what got him into the highway industry was a *Reader's Digest* article that he read when he was 12 or 13 years old about the proposed interstate highway system. "It talked about this system [of highways] where you go coast to coast without a stoplight. That was unbelievable!" He adds when recalling a visit to the highways of the future exhibit at the New York World's Fair in 1964 and 1965: "We have to figure out a way, not just to be inspired, but to inspire others."

Parsons Brinckerhoff

Hal Kassoff is shown here at the Woodrow Wilson Bridge ribbon cutting May 18, 2006.

Prior to his position at Parsons Brinckerhoff, Kassoff led the Maryland State Highway Administration. In his 12 years as State highway administrator, he oversaw more than $6 billion in improvements delivered in a ramp-up that nearly tripled the size of the program, while adhering to schedules and budgets. He worked for six different Maryland secretaries of transportation during that period.

Kassoff states that the idea of innovation within organizations needs to be ingrained into employees: "Not just *allowing* innovation but actually *celebrating* innovation. It's a culture issue that needs to permeate vertically, from the front office to the front lines, and horizontally at all peer levels of an organization, from Skunk Works® [research and development services]…to stakeholders."

Performance Measures

Pete Rahn was brought into the Missouri Department of Transportation (MoDOT) in 2004 to institute change. Previously, he had headed New Mexico's dynamic State highway program. Rahn points to performance measures as the key to driving organizational change at MoDOT.

When he took over as head of the agency, he began "by gathering all the managers for a strategic advance," he says. "It was an 'advance' because I didn't want them to think we would be retreating from any challenge. During the first day of the advance, we hammered out a new mission statement and 17 value statements. The mission identified our direction, and value statements set our boundaries and playing field. The next day we spent looking at how MoDOT measures success. I challenged the group to list what our customers expected from MoDOT. The [outcome] was 18 tangible results. These were to be the driving force behind everything we do."

MoDOT's list included performance measures such as uninterrupted traffic flow; smooth and unrestricted roads and bridges; and personal, fast, courteous, and understandable responses to customer requests. "But there had to be a stronger link than some posters on the walls of our conference rooms," Rahn says. "That's why the second assignment to my managers was to identify measures that would give us the best indication of how we were doing at delivering those tangible results, such as pavement conditions...We also found gaps in our performance measures that had to be filled."

Ultimately, the department came up with several individual performance measures. Although Rahn has now left the agency, the concept has continued. Each quarter, MoDOT publishes the results of the measures and makes them available, both internally and externally, to decisionmakers, partners, and the Missouri citizenry.

Pete Rahn helped transform MoDOT's culture into one that is customer focused.

HNTB Companies

Internal Communications

Merely recognizing the need for change is not enough. That message must be delivered to everyone in the organization. Although experts in organizational change differ on any number of things needed to make for successful change, many agree that a high level of communication with employees about the proposed changes is critical.

For example, Harvard Business School Professor John P. Kotter writes in "Leading Change: Why Transformation Efforts Fail," published in the *Harvard Business Review*, that a common error of leaders is "undercommunicating the vision by a factor of 10." Management needs to use all the tools available to them to get their message out. "Employees will not make sacrifices, even if they are unhappy with the status quo, unless they believe that useful change is possible," Kotter writes. "Without credible communication, and a lot of it, the hearts and minds of the troops are never captured."

In Missouri, communication has taken many forms. In addition to publishing the results of the performance measures every quarter, Rahn held quarterly meetings with senior managers and those responsible for specific measurements to discuss strategies for how to drive change more effectively. Divisions and districts had their own versions of the list of performance measures, and individual employees' performance plans listed expectations that linked directly to specific organizational performance measures.

MoDOT set up what it called its Performance Plus employee incentive program, whereby an employee can earn up to $500 per quarter by meeting established performance goals that generate savings for the department. The department established an online database to store best practices that had been identified in evaluating and documenting how employees did their work on those performance measures.

Describing MoDOT's efforts, Rahn concludes with a list of the agency's accomplishments: Missouri had the largest drop in traffic-related fatalities of any State in the Nation (161) in 2006, and, while other States were canceling or delaying highway improvements, MoDOT delivered

FHWA Administrator Victor Mendez (at the podium) notes that his agency is changing how it moves new ideas throughout the organization and gets them out to State and local agencies.

record amounts of road improvements under budget and on time. And the agency was selected as a winner of a Missouri Quality Award in 2007, modeled after the annual Malcolm Baldrige National Quality Award presented by the President of the United States. In the Missouri award's 19-year history, only one other State agency had ever won.

The Role of Innovation in Organizational Change

Often, innovations are thought of as changes in themselves, rather than as the means of dealing with change and better managing the turmoil of the new normal. Faced with a backlog of projects demanding attention, organizations exhibit an understandable resistance to taking time out, even if it is to learn about a better, faster, less costly way of completing those projects.

To FHWA Administrator Victor Mendez, innovation is the key to dealing with change. "Our success will hinge on how creative and innovative we can become," he says. Like Sorel, Kassoff, Ruane, and Rahn, Mendez has been a leader in more than one highway arena. Before joining the Federal Government in July 2009, he served as director of the Arizona Department of Transportation (ADOT).

"In the industry, we have been very successful in doing what we do," Mendez says. "We have been very successful building [the Nation's] infrastructure. But I think to be even more successful, we're going to have to find other ways of delivering to the American people."

Mendez talks about how FHWA has raised the bar in recent years: "At FHWA we have been very focused on becoming a culture of innovation. We're changing how we move new ideas throughout our entire agency, and [how] to get them out to State and local transportation agencies, to the public and private sectors."

He sees partnerships as a critical element in accomplishing that transfer of ideas, and he gives an example of how, when he was with ADOT, the agency's partnerships with utilities in the Phoenix area were vital. "ADOT could not succeed if we did not have in place partnerships with the industry," he recalls. For example, in developing roadways, especially in downtown areas, having good relationships with the people who will relocate electrical, pipeline, and other utilities can mean the difference between getting a project delivered on time or having it delayed weeks or months.

FHWA's focus on innovation intensified in 2005 when industry consensus grew around the concept of faster project delivery. "FHWA at that point created Highways for LIFE," says Mendez. "Under the program, we did pioneer some ways of doing business that really are now standard within FHWA and the industry."

Mendez provides some examples: "Within FHWA, we created teams around specific technologies, a training program that we call Leap Not Creep that was intended to help us develop deployment plans, and identified how we would deploy grants for projects that put certain technologies out into the field in actual practice."

Shortly after becoming administrator of FHWA, Mendez gave the agency a challenge. "One of my priorities was to shorten project delivery time," he says. "The general consensus out there is that major projects take about 13 years. I established a goal for all of us: How can we reduce project delivery time by 50 percent?"

Naturally, there were skeptics. As might be expected, many people said that can't be done. But Mendez stresses persistence and insistence on looking at *how* to get there. "Maybe we don't get to 50 percent; that's still my goal, but we have to look at it. We can't just say, 'It can't be done.'"

As a vehicle to this goal, Mendez established Every Day Counts, an initiative with two business goals: to shorten project delivery and to speed up deployment of innovations and technologies. Mendez describes Every Day Counts as extending the efforts inaugurated by Highways for LIFE by introducing key leaders to Leap Not Creep and thereby continuing the focus on deploying technology faster. The agency initiated a series of 10 regional summits throughout the country to explain the Leap Not Creep initiative. "The intent of the innovation summits was to bring the critical stakeholders to the table," Mendez explains, "people at the front lines [who] actually have to deliver projects [and] who actually have to deploy technologies and new ideas."

Mendez notes that the summit concept for explaining innovations is totally new for FHWA. But the summits were just the beginning.

"Since the summits, we have engaged our individual [division] offices…to work with the States and the stakeholders [who] came to the summits to create State-specific implementation plans," Mendez says. "Something I feel very strongly about…: It's important for us not to think that everything needs to be driven from Washington, DC."

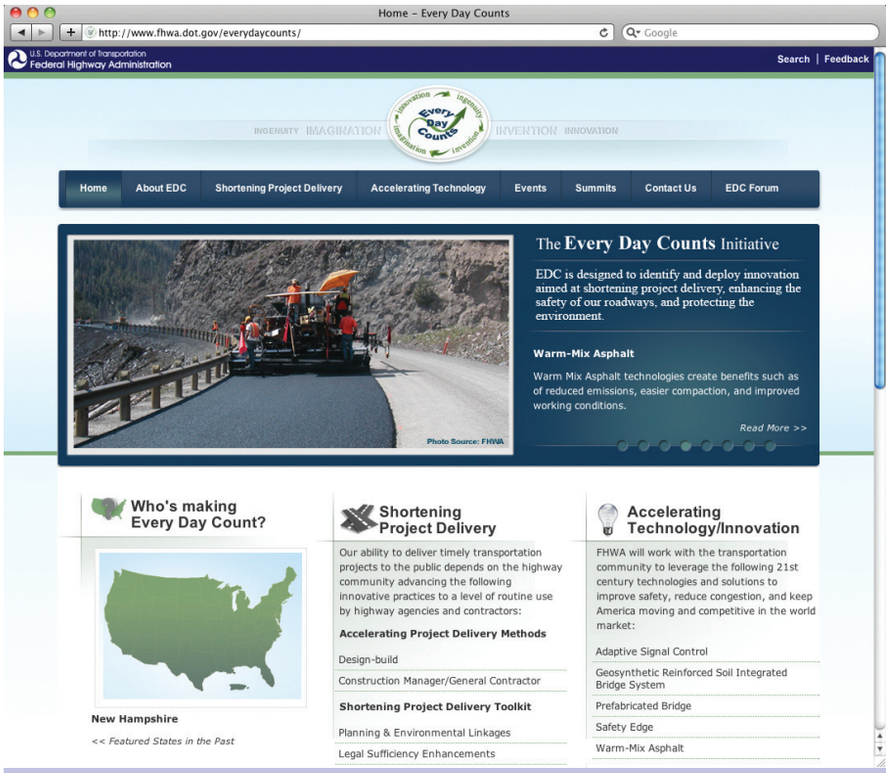
As FHWA's staff works with State and local agencies, plus the private sector, to encourage the adoption of innovations, Mendez points to a new mindset that he's encouraging FHWA employees to adopt. The new way of thinking, called "leaning forward" as Mendez describes it, is much like being a waiter at a fine restaurant. The waiter not only presents the menu, he also makes recommendations based on his knowledge. "It's different than when we sit back and wait for someone to ask the right questions. Our 'leaning forward' posture is to be at the table with new ideas, new suggestions, and to be asking the States, does this work for you?"

Of course, when a number of innovations are coming at one time, knowing how to deal with all of them is difficult, especially when trying to do that within an existing system built for another time. Minnesota's Sorel recognizes the challenge and refers to it as closing the gap between policy and technology: "We have a lot of innovations, a lot of technology that exists," he says. "But sometimes the policy is lagging behind the technology. And somehow, we've got to figure out how to close that gap—and not only at the State level but at the Federal level as well."

Sorel adds an example: "For instance, we know that information technologies can provide for sustainable solutions that enhance safety and mobility. However, legislative barriers may exist that prohibit their implementation. Thus, as an industry, we spend much time and resources educating policymakers about the benefits of such solutions."

ARTBA's Ruane asks, "Are we really doing all we can to remove those barriers [to the use of new technologies]?" Removing policy barriers to innovation is another challenge facing every individual and organization in the highway community. Dealing with that challenge and the funding issue is not going to be easy, and every organization's approach will be different. But trying new ideas and sharing them will be the only way to deal with the new normal—the world as it is today.

As President Barack Obama noted in his State of the Union address in January 2011, "The future is ours to win. But to get there, we can't just stand still."



Administrator Mendez's Every Day Counts initiative aims to identify and deploy innovative strategies and technologies to reduce project delivery times, enhance roadway safety, and protect the environment.

ARTBA

Peter Ruane, president and CEO of ARTBA.

Kathleen A. Bergeron is a marketing specialist with FHWA in Washington, DC, and works primarily on the Highways for LIFE program. Prior to joining FHWA, she managed communications and marketing programs for consulting engineering firms and transportation agencies at the State and local levels. She has a bachelor's degree in journalism from the University of Texas at Austin and a master's degree in transportation management from San José State University.

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Modeling Transportation Systems: Past, Present, and Future

by Joe Bared, C. Y. David Yang, Peter Huang, and Randall S. VanGorder

FHWA's new Concepts and Analysis testbed will advance visualization of traffic networks and strategies to help researchers improve safety, mobility, and performance.

Transportation professionals use computer simulations to study various highway concerns and complicated traffic relationships. The models use analytical or numerical procedures to create and evaluate future transportation designs and concepts before they are built. As new transportation challenges arise and new countermeasures are proposed, however, enhancements need to be incorporated into simulation tools to replicate issues accurately and enable researchers to draw valid conclusions.

The Federal Highway Administration's (FHWA) Turner-Fairbank Highway Research Center (TFHRC)

(Above) Researchers with FHWA's Office of Operations Research and Development are using computer simulation tools to help them develop and evaluate strategies to improve transportation operations.

initiated research on transportation modeling and simulation almost 40 years ago. In the 1990s, TFHRC researchers developed CORridor SIMulation (CORSIM), a widely used traffic simulation software program that is applicable to surface streets, freeways, and integrated transportation networks with a variety of control devices such as stop and yield signs, traffic signals, and ramp metering. Since then, researchers at TFHRC have been leading and overseeing numerous transportation simulation studies.

"FHWA is committed to continuing as a key contributor to future modeling and simulation research and will lead the development of computer simulation capabilities with the help of TFHRC's new Transportation Operations Laboratory [TOL]," says Dr. Joseph I. Peters, director of FHWA's Office of Operations Research and Development (R&D). One component of the TOL is the new Concepts and Analysis testbed. This testbed will incorporate a repository of transportation models at various levels to allow computer simulations and visualizations of representative traffic networks and experimental strategies to improve safety, mobility, and environmental performance.

But first, a look at the history of modeling and simulation research at TFHRC, plus a review of several current simulation studies.

History of Modeling and Simulation at TFHRC

In the early 1970s, FHWA led the development of NETwork SIMulation (NETSIM), a microscopic traffic simulation model for urban networks, and, in the 1980s, the development of FREeway SIMulation (FRESIM), a microscopic simulation for freeways. Microscopic simulation tracks the movement of individual vehicles, such as car-following and lane-changing behavior, as vehicles move through a traffic network. A microscopic simulation can be used to analyze, for example, key bottlenecks on freeways where the movement of individual vehicles on separate lanes needs to be represented.

Two decades later, researchers at TFHRC, with assistance and participation from universities and private industry, merged NETSIM and FRESIM into a single microscopic model, CORSIM, and developed the Traffic Software Integrated System (TSIS) package, which is a collection of software tools for use by traffic engineers and researchers. At the same time, several universities developed their own microscopic simulation tools for research purposes; however, TSIS/CORSIM was the only viable microscopic traffic simulation model available to practitioners.

By the late 1990s, a number of commercial vendors began offering their own versions of microscopic traffic simulation packages to meet the growing demand. Today, the popularity of microscopic simulation packages continues to increase, and a viable market now exists for commercial traffic simulations.

In the early 2000s, FHWA reevaluated its role in the traffic simulation market. As a result of this assessment, the agency decided to take a different role. Rather than compete with commercial simulation vendors by continuing to develop TSIS/CORSIM, the agency would act in a market facilitator role by focusing public resources on fostering an environment of public-private cooperation through research products that benefit the entire traffic simulation community of practitioners, vendors, and researchers.

During that time, TFHRC also led efforts to develop a variety of traffic analysis models. Major products include the Intelligent Transportation System (ITS) Deployment Analysis System tool, which helps planners analyze the costs and benefits of ITS investments; the QuickZone package for work zone planning and traffic analysis; and the DYnamic Network Assignment-Simulation Model for Advanced Road Telematics (DYNASMART), which supports network planning and operations decisions. Telematics is the integration

A screenshot from CORSIM, the microscopic traffic simulation developed by FHWA, and its accompanying manual.

Dr. Li-Yang Fang, Southeast Michigan Council of Governments

The Ambassador Bridge is shown here during the construction phase. Prior to construction, traffic simulation was used to analyze the impact of road closures.

of wireless communications and positioning systems technology.

In addition, TFHRC has conducted research that produced the first comprehensive and fully validated family of models that facilitated the parallel research, development, and testing of advanced traffic control systems. These models not only led to the development of traffic control systems but also enabled practicing traffic engineers to conduct operations analyses.

Currently, researchers at TFHRC continue to lead studies that use various types of simulation tools. For example, four recent research projects use computer simulations to examine topics related to driver behavior, work zones, roundabouts, and autonomous intersections.

Driver Behavior in Traffic

Existing traffic analysis and simulation tools cannot effectively model drivers' abilities to recognize and respond to their environment with behavior appropriate to the encountered driving situation. This research project, which began in 2009 and is funded under FHWA's Exploratory Advanced Research Program, aims to answer a number of questions related to driver and traffic performance: driving rules during normal and abnormal driving conditions, the magnitude of difference in driving rules practiced by different motorists, the impact of an incident on system performance, and the effect of drivers' interactions during incidents.

This study aims to characterize driver behavior using a naturalistic driving database (data captured from volunteer drivers' daily driving) and agent-based modeling techniques, which simulate the actions and interactions of autonomous agents such as drivers to assess their effects on the system as a whole. The project is developing intelligent agents (software representations of drivers) that are designed to learn drivers' temporal decisions in response to varying traffic situations retrieved from the naturalistic driving database. The driving rules of the agents will be coded in a computer simulation tool to test and study the collective effects of learned behaviors with multiple drivers under different situations.

The study uses reinforcement learning, a novel and successful area of artificial intelligence, to tackle how an independent agent that senses and acts on its environment can learn to choose logical actions to reach its long-term goals. This method enables the agent to keep learning from observations, actions conducted, and rewards received. At the conclusion of this project, expected at the end of 2011, agents will be developed to mimic realistic driver behaviors in various traffic scenarios. After verification and validation of the developed agents, the FHWA researchers will embed an abstraction of the agents' learned driving rules in VISSIM®, a microscopic traffic simulation tool. An example of a learned driving rule is the gap maintained between the agent's vehicle and the vehicle in front. Another example is the time taken to decelerate a vehicle when approaching a congested area or a red light.

Travel Patterns and Work Zones

Highway construction has become a main source of congestion, and traffic simulation models are widely used to analyze traffic problems related to work zones and to evaluate mitigation strategies. Traffic simulation models, especially microscopic ones, have become popular because they provide a controlled environment in which researchers can analyze and evaluate a wide range of scenarios, including highway bottlenecks, complex geometric configurations, and operational improvements.

Most work zone studies tend to focus on analyzing local traffic impacts. Small-scale work zones may be analyzed successfully without the computationally expensive iterations needed to reach an equilibrium condition (a balance of "origin trips" and "destination trips" in the simulated traffic network). But long-term and large-scale studies require analyses with an equilibrium approach.

Unlike other microscopic simulation models, this project used the TRansportation ANalysis SIMulation System (TRANSIMS) produced by FHWA's Travel Model Improvement Program to analyze changes in travel patterns and mobility impacts caused by work zones. As TRANSIMS is capable of analyzing the dynamic nature of a traffic stream as well as travelers' activity patterns, it could be a viable option for analyzing the impacts of major work zones. Especially in the case of long-term highway closures, understanding not only mobility impacts but also travelers' day-to-day route changes is important.

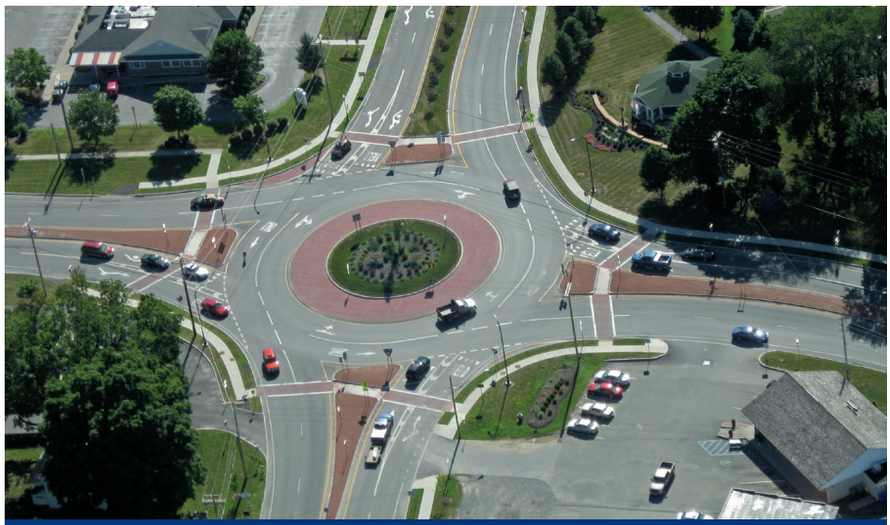
For a case study, the researchers built a TRANSIMS model for the southeast Michigan area, including Detroit and the surrounding seven counties, with a population of 4.9 million in 2000. By applying

a day-by-day evolutionary approach, the TRANSIMS model investigated mobility impacts, travel pattern changes, and departure time shifts with each freeway segment closure.

The highway work zone under investigation was the I–75/I–96 Ambassador Gateway Bridge reconstruction. During the reconstruction, the I–75 mainline and I–75/I–96 system interchange were closed for months. The scenario included complete closure of I–75 near the Ambassador Bridge area and the I–75/I–96 system interchange.

Using the TRANSIMS model, the researchers were able to analyze travel pattern changes as well as travel reliability. They also investigated departure time shifts as an impact of highway work zones. With a simple choice model for departure times, the researchers analyzed shifts by type of traveler.

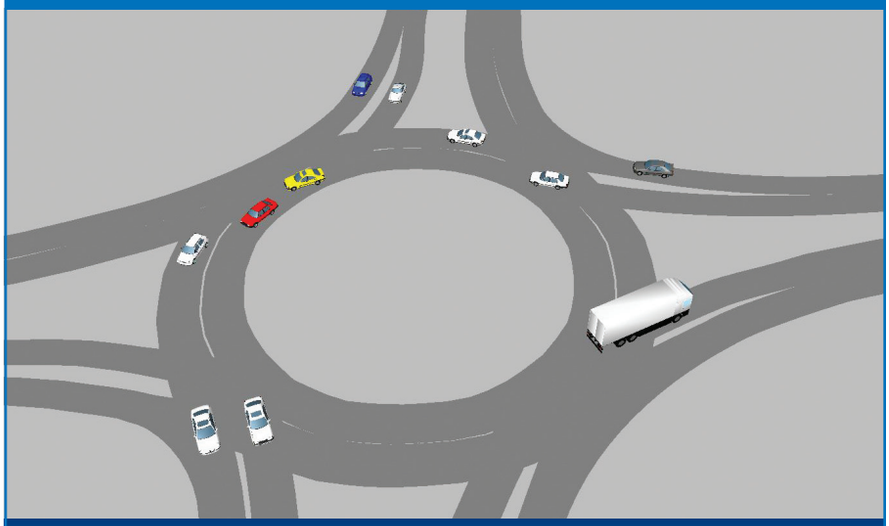
"This project demonstrated that TRANSIMS is a viable tool for traffic analysis of work zones," says Brian Gardner, leader of the transportation systems performance team in FHWA's Office of Planning and manager of FHWA's TRANSIMS program. "The study's approach sheds light on behavioral analysis as a component of work zone impacts."



NYSDOT

This aerial photograph shows one of the two roundabouts in Malta, NY, that FHWA researchers studied to obtain data for calibration of the VISSIM software.

Sample VISSIM Traffic Simulation



This VISSIM simulation shows traffic moving through a two-lane roundabout.

Calibration of Two-Lane Roundabouts

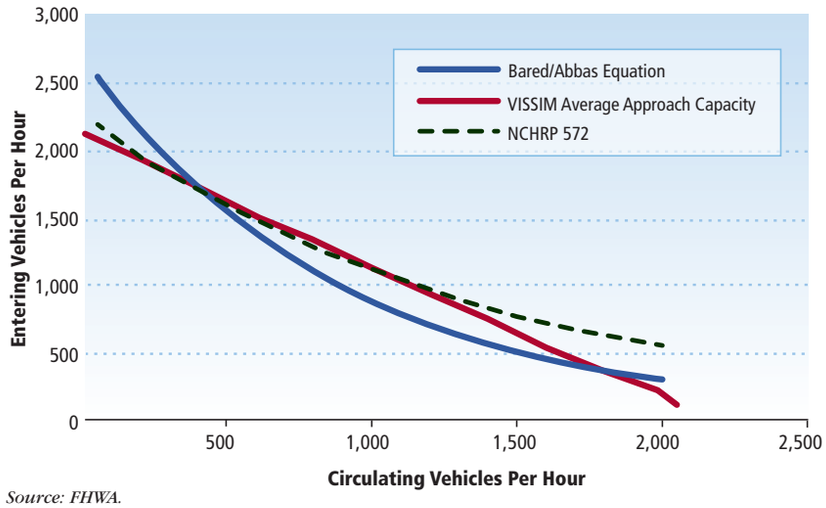
Accurate and realistic traffic simulation can help improve the reliability of analyses related to isolated roundabouts. Furthermore, it can be more reliable in analyzing road networks that combine signalized and unsignalized intersections, including interactions from spillback (traffic queuing at an intersection) and headways (time difference between consecutive vehicles).

The FHWA researchers studied three existing two-lane roundabouts in Malta, NY, to obtain data for reliable calibration of the VISSIM software. The researchers differentiated the data by interior and exterior lanes for the roundabouts' entry and circulatory lanes. They also studied multiple parameters in VISSIM to obtain more realistic results, including temporal gaps between vehicles, speed profiles (approaching and circulating speeds), and model parameters for following cars.

Results from those three factors (but mainly time gap) and priority rules in VISSIM show similarities with results reported in the National Cooperative Highway Research Program's *NCHRP 572: Roundabouts in the United States*. The capacity model described in NCHRP 572 was developed from U.S. field data from four sites in Maryland, Vermont, and Washington at seven approaches during congested or queuing periods only. The NCHRP 572 models used exponential functions to best fit field-collected capacity data.

The capacities from the NCHRP models based on field data are comparable to the VISSIM calibrated results along most of the circulating volumes, except at the upper boundary. The diverging differences after circulating volumes of about 1,400 vehicles per hour (vph) are due to a lack of field data points collected or available for higher circulating flows. This likely bias is caused by the model form being extended beyond available data. A user of the NCHRP model is likely to overestimate capacity beyond 1,400 vph, which could lead to congestion prior to the end of the life cycle of the proposed roundabout. In brief, calibrated traffic simulation for roundabouts seems to be more reliable than deterministic models under most traffic volume

Comparison of Capacity Curves for Roundabouts



Source: FHWA.

Except at higher traffic volumes, the VISSIM simulation of roundabout capacity correlated well with the NCHRP 572 model, but not as well with the Bared/Abbas equation, which was developed without field calibration.

conditions. Therefore, calibrated simulations also are more reliable for network traffic analysis.

Autonomous Control At Intersections

As population growth has gone beyond transportation systems' abilities to handle increased levels of demand, congestion has become one of the most challenging engineering issues today. The roadway system is a source of mobility not only for drivers, but also for goods and services. As such, the system's ability to handle vehicle demand is paramount to the Nation's economic prosperity. Traffic congestion accounted for an estimated $115 billion in losses in 2009. Facing limited budgets and available right-of-way to build excess capacity, transportation professionals are looking to operational improvements to address congestion.

Human error accounts for 70 to 80 percent of vehicle crashes. Prevention of those crashes—and reduction of traffic congestion—through semi-automated, and ultimately automated, driving is achievable, but requires new systems to coordinate the movement of autonomous vehicles in complex traffic situations. Recent research in artificial intelligence and robotics continues to make the feasibility of automated vehicles a much more tangible reality than it was in the past. Although not at a stage warranting mass deployment at present, this technology clearly has the potential to eventually become the standard.

Examining the consequences of what could amount to a major overhaul of traditional operating systems is therefore critical before automation is introduced. Just as congestion mitigation is an important societal problem, the operational efficiency derived from implementations aimed at exploiting the technological advantages of automated vehicles warrants serious consideration.

Toward that end, another current project under the Exploratory Advanced Research Program is examining the feasibility of autonomous vehicles and intersections for use within the next 20 years. This project is examining a new form of intersection control that can increase vehicle throughput dramatically by taking advantage of the capacity of autonomous vehicles. The study uses an automated mechanism for intersection control using a new first-come-first-served protocol that has the potential to process traffic much more efficiently than traffic signals—without compromising safety. Its development is guided by criteria that include the use of sensor technologies, adoption of a standardized communication protocol, and the ability to deploy incrementally, allowing expansion to other intersections and adaptation to increasing numbers of autonomous vehicles. Absolute collision prevention, even under conditions of communications failure, is the primary goal.

Improved intersection management will be a major step toward an infrastructure for fully autonomous vehicles that will revolutionize transportation of people and goods. To test the performance of protocols for automated intersection control, the use of microscopic simulation models becomes indispensible. Because the technology for autonomous vehicles currently is not at the level needed for real-world testing with any meaningful traffic flow, microscopic simulation is necessary to obtain an estimate of the performance of systems of autonomous vehicles. The FHWA project team developed and implemented a microscopic simulation tool from scratch so researchers can model the intersection control system and evaluate its performance.

The project team conducted experiments using a population of autonomous vehicles to compare the performance of an intersection outfitted with the automated first-come-first-served protocol versus an intersection with a traditional traffic signal. The results show that the first-come-first-served strategy performs significantly better than a traditional traffic signal, reducing average vehicle delay by an order of magnitude in all cases. The results are encouraging, but FHWA plans to conduct additional research to further validate the first-come-first-served intersection control strategy and to develop more efficient intersection control systems.

Transportation Operations Laboratory

Followup studies to these research projects are planned to be carried out in the Transportation Operations Laboratory at TFHRC. The lab will consist of three components: (1) a Concepts and Analysis testbed, (2) a Data Resources testbed, and (3) a Cooperative Vehicle-Highway testbed.

The testbeds are intended to provide FHWA researchers and others in the transportation community with innovative, reliable, and

accessible pools of resources to conduct research and tests, create visualizations, and present quality research findings in a dependable and cost-effective manner. Future articles in PUBLIC ROADS will describe the Data Resources and Cooperative-Vehicle Highway testbeds.

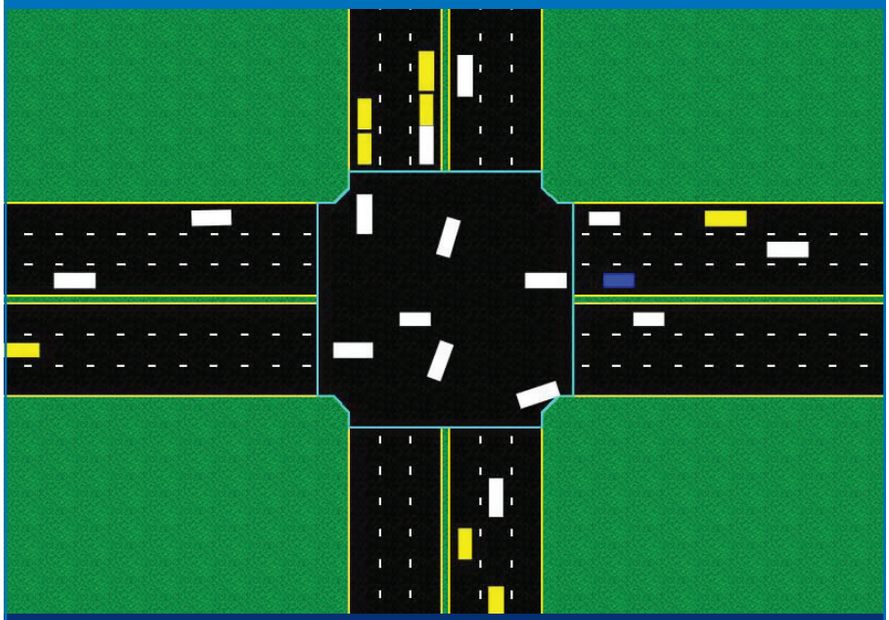
Concepts and Analysis Testbed

The Concepts and Analysis testbed will incorporate a repository of transportation models to allow computer simulation runs at the three levels of analysis—micro-, meso-, and macroscopic. As mentioned earlier, microscopic models track the movement of individual vehicles, such as car-following, as vehicles move through a network. Macroscopic simulations, on the other hand, model large geographic areas to simulate traffic flows, speeds, and densities. Mesoscopic models, such as DYNASMART, represent an intermediate level of analysis between micro- and macroscopic models, enabling simulation of individual vehicles at a corridor or regional level with visualizations that can reveal greater insights about congestion dynamics and sources of congestion. The visualizations will improve model performance. The outputs of simulation analyses can, for example, provide an authoritative basis for conducting benefit-cost analyses of experimental strategies.

The Concepts and Analysis testbed will support and benefit research being conducted by FHWA's emerging ITS and Exploratory Advanced Research projects, plus external needs from academia and other research institutes. Expectations for this testbed and the Transportation Operations Laboratory include the following:

- Enable FHWA research staff to refine experimental strategies through direct interaction with the models and to determine alternative strategies' potential value to various stakeholders.
- Provide a repository of authoritative and representative model application datasets that will enable researchers to compare technical and performance measures in realistic scenarios and across projects, regardless of partners and perhaps even choice of model platform, so that valid assessments can be made.
- Provide a venue for hosting technical and outreach meetings at which the above results could be reviewed and discussed by producers, FHWA research staff, other U.S. Department of Transportation staff, and stakeholders.
- Provide resources that consultants supporting FHWA research projects can use to improve the consistency, quality, efficiency, transparency, and availability of research results and government deliverables.
- Afford a venue and resources to support ongoing project work by FHWA's Traffic Analysis Tools team, the Traffic Analysis and Simulation Pooled Fund Study, and other internal research initiatives.
- Provide a venue and resources to support research by students and other outside research staff who can use the models for their own projects, with benefits to the larger community.

Simulation Tool for Autonomous Control Project



Dr. Peter Stone, University of Texas, Austin

This screenshot shows a computer simulation tool developed by researchers at the University of Texas, Austin. Their study is examining the feasibility of autonomous vehicles, represented by the rectangles in this screenshot, for FHWA's Exploratory Advanced Research Program.

The Testbed's Potential Applications

The Concepts and Analysis testbed provides a needed resource for many of FHWA's new ITS programs, such as Dynamic Mobility Applications and Applications for the Environment: Real-Time Information Synthesis programs. Other projects that stand to benefit include those under FHWA's Exploratory Advanced Research Program and traffic simulation research such as for innovative highway designs.

Dynamic Mobility Application Program. This program seeks to identify, develop, and deploy applications that leverage the full potential of connected vehicles, travelers, and infrastructure to enhance current operational practices and transform future management of surface transportation systems. Under proof-of-concept testing and tool development, the program will begin to assess innovative applications with potential to improve transportation operations. The FHWA researchers will test promising applications using simulated testbeds, which will assist in the assessment of whether specific applications can be expected to perform well in early deployment stages.

Applications for the Environment: Real-Time Information Synthesis Program. The overall objective of this program is to generate and acquire environmentally

Shown here is a three-dimensional conceptual representation of the new Transportation Operations Laboratory at TFHRC. This laboratory is set to open its doors to researchers in September 2011.

relevant real-time transportation data and innovative applications, and use them to create actionable information to support and facilitate green transportation choices by users and operators. Employing a multimodal approach, the program will work in partnership with other research efforts to better define how data and applications might contribute to mitigating some of the negative environmental impacts of surface transportation. The researchers will use sophisticated models and other analysis tools to determine how the proposed environmental improvement strategies will work, their effectiveness, how they compare to each other, and how they compare with strategies developed by other researchers to improve mobility and safety. The program will analyze potential evaluation tools, build an evaluation process, and develop baseline estimates for evaluating environmental assessment and improvement strategies.

Exploratory Advanced Research Program. Several of the current projects sponsored by this program are using simulation models to support ongoing work or else are developing and assessing innovative concepts that might benefit from follow-on research where the concepts can be simulated.

Innovative Intersections and Interchanges. Through in-house research, FHWA has explored, studied, and marketed a number of innovative designs for intersections and interchanges. As a result, several States are constructing many successful designs such as the double crossover diamond interchange and the displaced left-turn intersection. FHWA will study additional innovative designs and applications along corridors using traffic simulation to evaluate performance and visualize geometric layouts and interactions of drivers and vehicles.

(See www.fhwa.dot.gov /publications/research/safety/09060.)

Closing Remarks

As new transportation challenges arise and countermeasures are proposed, computer simulation plays a critical role by enabling researchers and practitioners to evaluate innovative designs and ideas. When the Transportation Operations Laboratory comes fully online in the near future, it will have the capability to host a variety of modeling and simulation studies so researchers can use a full range of analysis tools to assess the viability of potential solutions to tomorrow's transportation challenges.

Joe Bared, Ph.D., P.E., is team leader for the Transportation Operations Concepts and Analysis Team in FHWA's Office of Operations R&D. He has worked at FHWA for more than 20 years and managed the program area on intersection and interchange safety and operational effects of design. He managed development of the first roundabout guide in the United States and has promoted innovative intersection and interchange designs in a new FHWA publication, *Alternative Intersections/Interchanges: Informational Report* (FHWA-HRT-09-060).

C. Y. David Yang, Ph.D., is a research engineer with FHWA's Office of Operations R&D. He is responsible for traffic modeling and simulation research at TFHRC. He is chairman of the Transportation Research Board's User Information Systems Committee and serves on the editorial board of the *Journal of Intelligent Transportation Systems: Technology, Planning, and Operations*. He received his bachelor's, master's, and doctoral degrees in civil engineering from Purdue University.

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Randall S. VanGorder is a research engineer with FHWA's Office of Operations R&D. He has more than 20 years' experience in transportation and manages the Traffic Analysis and Simulation Pooled Fund Study, comanages the Traffic Management Center Pooled Fund Study and manages the day-to-day operations of the Traffic Research Laboratory. He received a bachelor's degree in civil engineering from Penn State University.

The authors would like to thank Robert Ferlis, technical director of FHWA's Office of Operations R&D for his encouragement during the preparation of this article and his suggestions on the content.

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Fighting Congestion with Smarter Highways

by Jennifer Charlebois, James Colyar, and Jessie Yung

Washington State is using active traffic management to operate its existing transportation system more efficiently.

In many parts of the country, continued growth in travel along congested urban freeways and limited funding for roadway expansion challenge the ability of transportation agencies to provide sufficient roadway capacity to ensure mobility. High construction costs, constrained rights-of-way, and environmental factors are driving agencies to explore alternatives and innovative concepts to mitigate traffic congestion while optimizing the use of limited resources. As a result, many States are championing use of advanced technologies, such as intelligent transportation systems (ITS), to operate roadways more efficiently.

Washington State, for example, is using active traffic management strategies to address safety and mobility issues. Active traffic management is an integrated approach to managing and potentially reducing traffic congestion and improving safety within the footprint of the existing infrastructure. Fueled by a partnership with the U.S. Department of Transportation (USDOT) and the Washington State Department of Transportation's (WSDOT) Moving Washington initiative, the

Greg Phipps, WSDOT

Traffic on northbound I–5 in Seattle, WA, travels under a gantry with variable speed limit signs posted above each travel lane. Installed in August 2010, the signs are part of Washington's Smarter Highways initiative to reduce congestion by helping make the best use of existing roadway capacity.

Seattle area is leading the State's fight against congestion by making its busiest highways "smarter."

Moving Washington and Smarter Highways

The Seattle metropolitan area, also known as the Puget Sound region, experiences some of the worst congestion in the Nation. A private traffic information provider, INRIX, issued the *National Traffic Scorecard 2010 Annual Report*, which ranks Seattle/Tacoma as the 10th most congested metropolitan area in the United States. The major freeways, including I–5, I–405, and SR–520, experience the area's worst congestion, as well as high numbers of incidents resulting from the congestion. Construction costs, environmental impacts, and difficult terrain prevent local transportation agencies from widening the roads to mitigate the problem.

Instead, WSDOT initiated in 2008 a program called Moving Washington that offers a balanced, integrated approach. Moving Washington combines three specific strategies: operating the existing transportation system more efficiently, providing travel choices that help manage demand, and adding road capacity strategically where feasible. The program incorporates 2-, 6-, and 10-year plans that focus on the most troublesome corridors in the State, starting with I–5. WSDOT's goals are to improve travel times by 10 percent, reduce crashes by 25 percent, improve trip reliability by 10 percent, and provide alternative travel choices for commuters in major corridors. Active traffic management systems, dubbed "Smarter Highways" by WSDOT, are a key component of the Moving Washington strategy.

Urban Partnerships

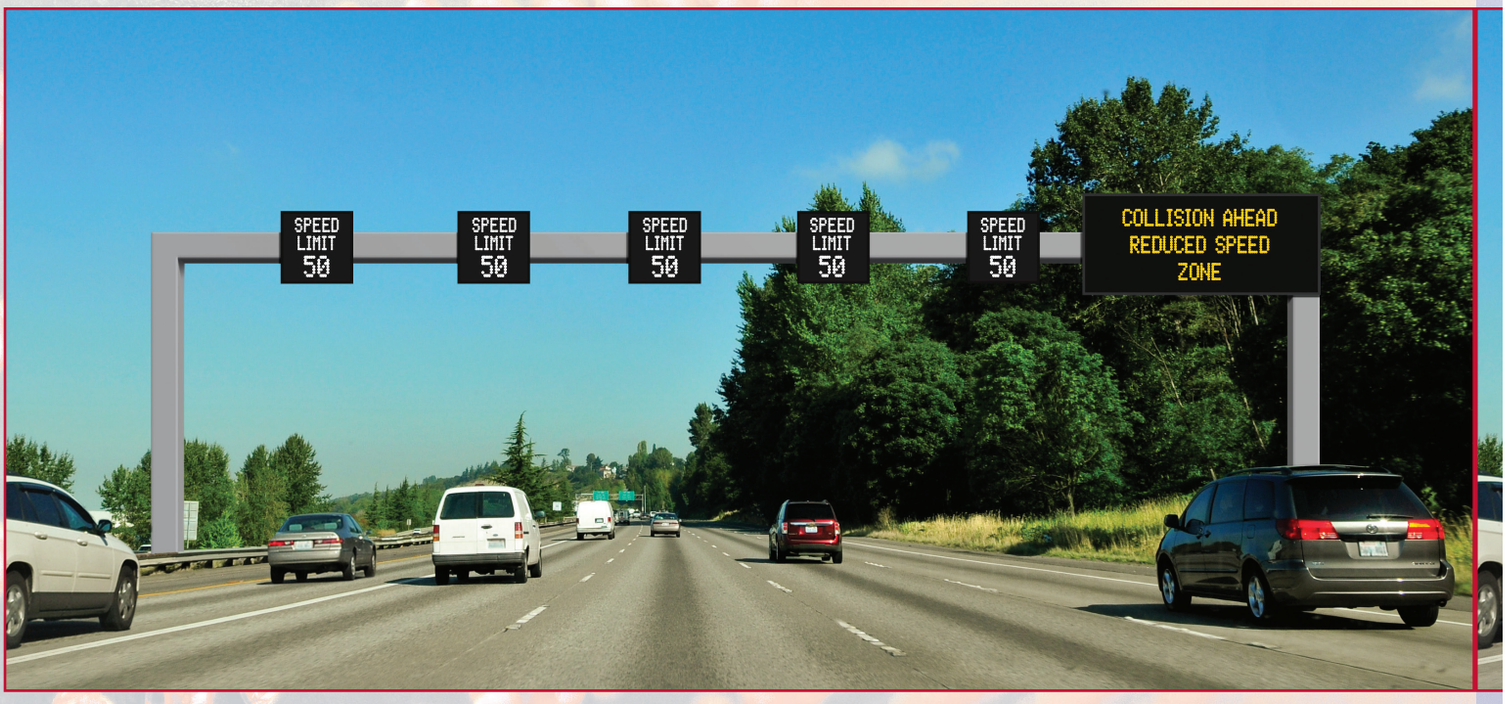
In 2006 and 2007, USDOT demonstrated its commitment to helping reduce traffic congestion in major urban areas by issuing two Federal Register Notices soliciting cities to apply for Urban Partnership status under the Urban Partnership Agreement and Congestion Reduction Demonstration Programs. The selected cities with the most aggressive congestion-relief programs would receive priority consideration for available Federal discretionary funds (approximately $1 billion) across 10 programs.

Between 2007 and 2008, following a competitive selection process, USDOT chose six metropolitan areas as urban partners: Atlanta, GA; Los Angeles, CA; Miami, FL; Minneapolis-St. Paul, MN; San Francisco, CA; and Seattle, WA. Each urban partner agreed to implement a comprehensive policy response to urban congestion that includes the four "T's": (1) a *tolling* (congestion pricing) demonstration, (2) enhanced *transit* services, (3) increased emphasis on *telecommuting* and flexible scheduling, and (4) deployment of advanced *technology*.

Although each partner's technical approach varies (for example, Miami is converting high-occupancy vehicle lanes to high-occupancy toll lanes, while Seattle is implementing full-facility variable pricing), all of the projects represent aggressive solutions to reduce urban congestion over the long run. "There is no single solution to relieving congestion, and only through a combination of investment and innovative approaches can we help address the problem," says Federal Highway Administrator Victor Mendez.

The Seattle area's Lake Washington Urban Partnership Agreement is between USDOT, WSDOT, King County, and the Puget Sound Regional Council. The agreement provides a conditional award

As illustrated in the renderings below and on the bottom of page 17, in active traffic management, operations engineers can modify the variable message signs over each lane to show speed limits (below) or directional arrows with "Merge" messages (next page) to help upstream motorists make safe and timely decisions in the case of blockages downstream. *Photos: WSDOT.*



Greg Phipps, WSDOT

FHWA Administrator Victor Mendez speaks at the opening event for the Smarter Highways system on I–5 in Seattle.

of $154.5 million to improve traffic flow within the SR–520 urban corridor and ferry services in the region. Known locally as the Lake Washington Congestion Management Program, the effort involves a series of projects including implementation of variable tolling on SR–520, use of active traffic management systems on SR–520 and alternate travel routes (I–90, I–5, and I–405), enhanced transit services in the region, and improvement of telecommuting and demand management programs.

Smarter Highways: Spotlight on Efficiency

In August 2010, WSDOT became the second State department of transportation to implement high-tech overhead signs displaying variable speed limits, lane status, and real-time traffic information so drivers know what is happening on the road ahead. The first installation was on northbound I–5, a major freeway traversing the southern part of Seattle. Since then, WSDOT has implemented similar systems on SR–520, completed in November 2010, and I–90, completed in June 2011, with funding under the Lake Washington Urban Partnership Agreement.

"For decades, WSDOT has fostered a culture of embracing technology to help solve transportation problems," says Craig Stone, director of the WSDOT Toll Division. "Active traffic management builds on our existing tools; it's the logical progression."

The existing tools include ramp meters, traffic cameras, and electronic message signs. The new systems feature a network of sensors and electronic signs that automatically respond to changing traffic conditions, with data verification and control modifications made by WSDOT staff. The overhead signs alert drivers to change lanes when an incident blocks traffic ahead or to adjust their speeds as they approach slower-moving traffic, helping to make more efficient use of roadway capacity and encouraging drivers to travel safer and smarter.

The system features gantries that span the travel lanes and display changeable speed limits and

Annie Johnson, WSDOT

These overhead electronic signs on SR–520 in Bellevue, WA, display different speed limits for each lane.

lane control symbols. Activation of the variable speed limit signs alerts motorists that they are approaching congestion, collisions, or backups and directs them to slow down or change lanes accordingly. Gantries are approximately one-half mile (0.8 kilometer) apart, so a minimum of one gantry is visible to drivers at all times. Other key aspects of the Seattle system include dynamic message signs on the roadside that provide drivers additional information on downstream conditions. Signs displaying estimated travel times and other traffic conditions enable motorists to take more control over their commutes and make on-the-road decisions about which routes to take.

Because the Seattle systems are based on real-time roadway conditions, they help reduce speeds upstream of congested areas, give drivers information about the causes of backups, and direct motorists to merge into appropriate lanes to avoid blockages caused by crashes, stalled vehicles, or work zones. To ensure that the data fed into the traffic management center that controls the signs are robust and accurate, WSDOT added new roadway traffic sensors and installed data-carrying fiber-optic cables, as well as new traffic cameras along the roadways for all three installations. Traffic engineers monitor data input 24 hours a day, 7 days a week and verify the information before activating the system.

Early Results at a Glance

Results so far have been encouraging. Motorists clearly understand the meaning of the signs and both first responders in the field and observers from the traffic management center have seen drivers change behavior in response to the signs. Although 1–2 years of collision data will be needed for a statistical analysis of collision frequency, WSDOT officials expect to see a measurable and statistically significant reduction in collisions.

"So far we've been happy with the active traffic management system," says Stone. "We see drivers getting out of closed lanes sooner and giving workers more room to safely accomplish their task."

WSDOT engineers are still in the process of evaluating the magnitude of mobility and congestion benefits afforded by the I–5 active traffic management system. In addition, USDOT is funding a comprehensive evaluation of all the Urban Partnerships projects, including the Seattle SR–520 and I–90 systems, which will shed additional light on the safety and mobility impacts.

Learning From Abroad

In Europe, some countries have been installing active traffic management strategies such as variable speed limits, lane controls, and hard shoulder running (using the shoulder as a travel lane during times of congestion and reduced travel speeds) for many years. Here in the United States, as highway agencies are seeking new methods to address traffic congestion problems and improve safety, interest in actively managing transportation networks is growing.

"After seeing working examples of active traffic management in Europe, we were convinced that these strategies could improve safety on our busy State corridors," says Stone. "We hope to duplicate Europe's success in reducing injury collisions by up to 30 percent. Smarter Highways helps break the cycle of congestion and collisions by providing advance warning to drivers. Many more of our busy corridors would benefit from this tool."

Next Steps

The early results from active traffic management applications in the United States, including those in Seattle, show positive impacts on crash reduction, and the concept is gaining traction within WSDOT and across the country. WSDOT is evaluating other corridors in the Puget Sound region for the feasibility of adding active traffic management systems. Stone says his department hopes that in the future it will become standard practice to include active traffic management installations in major corridor improvement projects, just as ITS improvements have now become standard.

"The active traffic management concept is not new, and it is not intended to replace legacy systems," says Robert Arnold, director of the

FHWA Office of Transportation Management. "The fundamental philosophy is to apply an integrated approach to actively balancing travel demand and traffic by combining existing or emerging applications and technologies to optimize the efficiency of the systems. There is no one-size-fits-all solution to fight congestion and safety problems. States must carefully evaluate their needs and available alternatives to select the appropriate applications that offer the most effectiveness and benefits to the network."

More cities and States are exploring and implementing variations and combinations of operational strategies and applications. To support this growing interest, FHWA recently created a national Active Transportation and Demand Management program that offers opportunities for peer exchanges, conducts foundational research, develops awareness and educational information, and provides technical assistance. The tools and assistance available through this program will help decisionmakers and practitioners with their active traffic management projects—from determining which strategies are feasible to selecting combinations of strategies that best work to solve local and regional problems. The goal is wider deployments with many more success stories to follow.

Jennifer Charlebois, P.E., is the tolling and systems project engineer for WSDOT. She has 10 years of experience at WSDOT, where she has focused on roadway design and construction. Charlebois is currently working on the implementation of variable tolling on SR–520. She received a bachelor's degree in civil engineering from Gonzaga University.

James Colyar, P.E., is a transportation specialist in the FHWA Office of Transportation Management. Previously, he was a mobility and ITS engineer for the FHWA Washington Division. He received a bachelor's degree in civil engineering from the University of Idaho and master's degrees in civil engineering from North Carolina State University and in transportation policy, operations, and logistics from George Mason University.

Jessie Yung, P.E., serves as the lead point of contact for FHWA's Urban Partnership Agreement and Congestion Reduction Demonstration Programs in Seattle and Atlanta, which total more than $250 million in Federal funds. She received her B.S. and M.S. in civil engineering from the University of Maryland. She is a registered professional engineer in the State of Maryland.

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These overhead electronic signs on SR–520 in Medina, WA, display "Speed Limit 50" for each lane.

Emily Pace, WSDOT

The Atlanta BeltLine: A Green Future

by Ethan Davidson

A grassroots solution to transportation challenges, this pedestrian-bicycle-transit loop will encircle Georgia's largest city. Could this be a model for other communities too?

These young people are walking their dog on the Northside Trail, shown here in April 2010. The trail is one of the completed sections of the new Atlanta BeltLine. *Photo: Marc Mauldin.*

Atlanta, a city built around the intersection of railroad lines, is known today for its congested highways and sprawling developments. The Atlanta region consistently ranks in the top 10 for the worst traffic congestion and commute times in the Nation. Is it possible that a partial solution to these chronic transportation problems could come from a graduate student's thesis about repurposing old rail corridors in Atlanta? The region will soon find out.

In 1999, Ryan Gravel wrote a graduate thesis, titled "Belt Line—Atlanta: Design of Infrastructure as a Reflection of Public Policy," that proposed reclaiming a 22-mile (35-kilometer) ring of mostly abandoned and underused rail corridor and transforming it into a new public transit system combined with economic development and connectivity strategies. Gravel's thesis sat on a shelf for a few years after graduation before it inspired a grassroots movement to build the most ambitious public works project in the city's history: the Atlanta BeltLine.

The completed Atlanta BeltLine will encircle the city's core with pedestrian- and bicyclist-friendly shared-use paths that are replacing the rail lines and connecting to parks and transit. The transit cars will be able to accommodate bicycles, and the shared-use paths will help reduce highway congestion by decreasing the number of short-distance motor vehicle trips. The goal is a total of 33 miles (53 kilometers) of trails to be built out over the life of the project: 22 miles (35 kilometers) are envisioned to follow the transit alignment in the corridor, with an additional 11 miles (18 kilometers) of "spur" trails that veer off the corridor, creating greater connectivity for many abutting neighborhoods. To date, roughly 11 miles of the trail system are open, including permanent paved trails and temporary hiking trails.

By attracting some of the region's future growth, the Atlanta BeltLine corridor, its promoters hope, will improve mobility and change the pattern of regional sprawl, while creating more vibrant, walkable, and livable communities.

According to Georgia Department of Transportation (GDOT) Commissioner Vance Smith, Jr., "The Atlanta BeltLine is a significant project not just for the Atlanta area, but for all of Georgia as well. This innovative approach to improving transportation challenges could potentially be implemented in any community. Reclaiming existing infrastructure for new uses, transit, trails, and green space will benefit all citizens. From an economic and a transportation perspective, it is an investment that will make the region better for generations to come, and that is one reason why we have helped fund some of the early trail projects through Transportation Enhancement grants. We also have partnered with the city of Atlanta to use State-owned right-of-way for the future transit and trails. We know this project is being watched by communities across the country and encourage everyone to keep working together toward its success."

Atlanta's Mobility Challenges

The city's uneven and low-density growth pattern is one reason for Atlanta's mobility, housing, and economic development challenges. Other causes include a lack of affordable housing, deficiencies in transportation connectivity across all modes, and limited transit, bicycle, and pedestrian options.

"Individually, each of these issues contributes to reduced quality of life, mobility, and economic competitiveness," says Brian Leary, president and CEO of Atlanta BeltLine, Inc. "Together, they constitute a severe impediment to creating sustainable growth and a vibrant livable community in the years to come. If the city is to address these problems proactively, a comprehensive and progressive solution is required to holistically integrate land use, economic development, social, and transportation needs."

Major barriers, including interstates and active and abandoned railroad lines, fragment the city's existing transportation network. These conditions are particularly acute along the proposed route of the Atlanta BeltLine where numerous large tracts of underutilized industrial land lacking an urban street network disrupt the continuity of the transportation network. Other issues along the route include several freeways and railroad-related facilities that have few existing crossings; discontinuous local roadway, bicycle, and pedestrian networks; and large blocks of retail development, such as strip malls, with little internal circulation.

The railroad right-of-way divides many adjacent neighborhoods physically and, in some cases, socially. Transit options are limited, and existing services are hard to access. As a result, Atlanta residents use their personal automobiles for the most common sort of travel within the city—short trips between communities, neighborhoods, and activity centers. They make many of these trips on the interstates and arterial roads, reducing capacity for regional and national through traffic.

This map of the Atlanta area shows the 22-mile (35-kilometer) loop that originally was railroad track and now will become the Atlanta BeltLine. For most of that loop, a trail will run adjacent to the loop, and another 11 miles (18 kilometers) of spur trails will connect neighborhoods to the loop. The transit vision is evolving but at present includes building streetcar segments that will connect to the loop. City officials hope to complete the entire green corridor within the next 10 years. *Source: Atlanta BeltLine Partnership.*

The overall impact for the city and region are reduced global competitiveness and local quality of life.

Turning an Idea into a Plan

Gravel's fascination with improving Atlanta's infrastructure was inspired by a senior year spent in Paris as part of Georgia Tech's architecture program. "When I lived in Paris and ate fresh food at the local market and walked and rode transit to everywhere I needed to go, it was an unbelievable experience," says Gravel. "When I moved back to Atlanta, where I grew up, my daily experience moving about the city was sitting in a car in traffic. While there are lots of great things about Atlanta, that isn't one of them. I wanted to live here, and I was interested in finding ways to make Atlanta the kind of place [where] you would want to live your whole life."

Gravel saw Atlanta's physical problem as rooted in the separation of land uses, residential from commercial, higher income residents from lower income residents, and an increasing dependence on the automobile to accomplish the most simple of daily tasks. Adding to this problem is that a city expanding into undeveloped areas is faced with the costs of providing infrastructure such as water lines and sewers over greater distances. Emergency vehicles, schoolbuses, and transit must travel greater distances to reach people, and public health declines due to more sedentary lifestyles, degraded air and water quality, and traffic-related injuries and fatalities.

Gravel began grappling with the question: "What kind of city do we want to be?" He thought the city should be asking itself this question before adopting policies about how to grow and the kinds of infrastructure to invest in. "It seemed like we were basing today's decisions on yesterday's answers," he adds.

After graduation, while working for an Atlanta architecture firm designing a mixed-use loft development, Gravel and his colleagues were trying to decide where to locate its parking garage. Should they place the parking along the abandoned rail corridor, or should they have the development face the corridor, which might develop into something else in the future? At that point, Gravel and his coworkers thought the BeltLine idea was worth sharing with government and business leaders. They put together packages with letters, Gravel's thesis, and maps and sent them to the region's elected officials and transportation agencies.

Former Atlanta City Council member, and later City Council president,

Atlanta BeltLine Facts and Figures

- 1,300 acres (527 hectares) of new green space and parks
- 33 miles (53 kilometers) of shared-use paths
- $20 billion of new economic development
- 30,000 new permanent jobs from new businesses in retail, entertainment, education, health care, professional services, hospitality, light industry, and the arts
- 5,600 new workforce housing units
- 50,000 new housing units anticipated along the corridor
- 45 neighborhoods gain new and greater connectivity
- 8 percent of the city's land mass covered in the planning area and 25 percent of Atlanta's residential population

These railroad tracks are shown in November 2009 before construction of the Eastside Trail in the BeltLine's northeast corridor.

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Cathy Woolard, who chaired the council's transportation committee, was increasingly frustrated with the region's transit infrastructure. Upon receiving Gravel's thesis, she immediately thought the idea had merit and was worth exploring with the community. She and Gravel began meeting with neighborhood groups in her district, and, after her successful election as president of the council, they expanded the conversation across the entire city.

They discovered that neighborhoods in the northern and eastern areas, which were already experiencing significant new development, saw the BeltLine as an opportunity to preserve their quality of life in the face of the new growth and traffic. On the southern and western parts of Atlanta, which had experienced economic disinvestment over several decades and had large transit-dependent populations, the BeltLine was an opportunity to attract growth that would bring jobs, improve transit options, and attract neighborhood amenities that were lacking, such as grocery stores.

As Gravel and Woolard were building grassroots support, other key individuals and institutions set in

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Shovels ready, Atlanta officials and stakeholders are posing at the groundbreaking of the Eastside Trail in October 2010.

The BeltLine's Economic Benefits

Sarah Price and Tyler Blind have no doubts that the BeltLine is benefitting them economically. Both purchased their homes because of proximity to the new amenity.

Price, a medical sales representative and single mother, bought her triplex unit in April 2010. Her home, located in a midtown neighborhood, is conveniently within walking distance of groceries, pharmacies, shops, and restaurants. The northern tip of the BeltLine's Eastside Trail will connect her property to Piedmont Park.

"Being close to or on the BeltLine was one of the top two things I was looking for—that and a multifamily property," says Price. She expects that the BeltLine will transform the landscape and attract families into moving back from the suburbs into the city.

That is exactly what motivated Tyler Blind, who relocated from an Atlanta suburb "to take advantage of living in a big city." Blind is a project manager for Reeves Contracting Company, which is building two of the BeltLine's parks. One park has an amphitheater, elevated walking platform, and a waterfall. Blind's condo is in the Old Fourth Ward neighborhood, where old factories are being renovated into lofts, restaurants, and businesses.

Blind says that realtors are "selling the BeltLine hard, showcasing it as a key focal point that will bring value to your place." Likewise, Price adds that increasing her property value by being adjacent to the BeltLine was "part of my long-term strategy."

In 1995 the National Park Service published a research survey on the *Economic Impacts of Protecting Rivers, Trails, and Greenway Corridors*. The survey cited open spaces and trails as "prime attractions for potential home buyers." Amenities such as views and convenient recreation opportunities "can be reflected in increased real property values and increased marketability for property located near open space." To back up these assertions, the researchers cited a number of studies that reveal increases in property values. For example, a study in Boulder, CO, indicated that the average value of property adjacent to a greenbelt would be 32 percent higher than those 3,200 feet (975 meters) away.

—Norah Davis, Editor of PUBLIC ROADS

motion a series of events that would propel the project forward. In 1992, the PATH Foundation, a nonprofit dedicated to building trails for the purposes of recreation and transportation in the State of Georgia, developed a comprehensive master plan for a trail system in Atlanta. The PATH Foundation is one of the Atlanta BeltLine project's key partners, building out its trail system.

Ed McBrayer, executive director of the PATH Foundation, recalls that back in the 1990s, the Atlanta region was out of compliance with the U.S. Environmental Protection Agency's air regulations: "When we decided that we wanted to try and retrofit Atlanta with a trail system, we were responding to a need to clean up the city's dirty air. Our primary focus was to build trails that would promote nonmotorized commuters. When the Olympics were awarded to Atlanta, our mission was expanded to include connecting the primary Olympic venues to encourage visitors to walk and bike during their visit. After the Olympics, all of the trails we built were used for both commuting and recreation.

"Most of the BeltLine route was part of the original trail master plan we developed back in 1992. We envisioned what is now the Atlanta BeltLine as a circumferential trail that would tie the city's trail system

Although still under construction, the Eastside Trail section of the Atlanta BeltLine is already attracting hikers and people walking their dogs, suggesting that the Atlanta BeltLine will be very popular indeed, once completed.

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together. It is very rewarding for us to still be involved and to see our original thoughts put into the ground."

Another key partner that has helped turn the Atlanta BeltLine into a reality is The Trust for Public Land (TPL), a nonprofit that secures land to preserve it as public green space. In 2004, TPL commissioned renowned urban designer Alexander Garvin to study the BeltLine concept as an opportunity to expand parks and green space in Atlanta. Garvin produced a report, *The Beltline Emerald Necklace: Atlanta's New Public Realm*, that called for the addition of thousands of acres of green space along the BeltLine's route. Garvin says, "The idea of introducing parks into the BeltLine concept was a way to further build support for the project because it brought together several constituencies. I think of planning as having a political and financial dimension, not just design."

With the momentum generated by the activism of Gravel and Woolard, the research of Garvin, and the support of the PATH Foundation, a broad coalition of supporters from environmentalists to community groups was galvanized to influence the city to implement the project. Building on Atlanta's history of collaboration between the public and private sectors, the business community embraced the project. In recent decades, the city has attracted a number of corporate headquarters relocations. To maintain this momentum, the business community recognized that Atlanta must attract and retain talent in an increasingly dense urban core served by new mobility options with a quality of life enhanced by new green space. Atlanta's corporate leadership has been crucial in raising private sector capital to leverage public sector investment.

In 2005, then Mayor Shirley Franklin turned to the business community to create the Atlanta BeltLine Partnership, which began raising private funds to support the BeltLine concept. She also tasked The Atlanta Development Authority, the city's economic development agency, with developing the BeltLine Redevelopment Plan, a 25-year financial plan that the city council approved in 2005. Around the same time, the council approved the project's main source of funding, a 6,500-acre (2,633-hectare) tax increment financing district, which is expected to generate $1.7 billion for the project over 25 years.

In 2006, the development authority created a new entity, Atlanta BeltLine, Inc., to plan and execute the implementation in partnership with other public and private organizations, including city departments.

Progress to Date

Now in its fifth year of implementation, the BeltLine is well underway. Land acquisition and construction have begun, and four new parks and nearly 11 miles (18 kilometers) of shared-use paths have opened to the public. The environmental impact statement for transit and trails is complete, and nearly half of the 22-mile (35-kilometer) right-of-way is now set aside for the project. In addition, the corridor design process is well underway, and a transit implementation strategy is complete.

Since 2005, more than 50 new developments have been completed or are under construction within the tax increment financing district, with a value of more than $1 billion. These new developments have created more than 700,000 square feet (65,100 square meters) of new commercial space and more than 9,000 residential units.

Equally as important as the implementation is the planning activity. Atlanta BeltLine, Inc., and the city's

The BeltLine's Health Benefits

A 2007 study by researchers and practitioners with expertise in public health, city planning, and transportation planning researched the BeltLine's potential health impacts. Led by Catherine L. Ross, Ph.D., director of the Center for Quality Growth and Regional Development at the Georgia Institute of Technology, the core research team produced a report, *Atlanta BeltLine: Health Impact Assessment*, with technical assistance from the Centers for Disease Control and Prevention. The report explores the linkage between the built environment and respiratory and cardiovascular health, fatal and nonfatal injuries, physical fitness, obesity, and mental health.

The researchers concluded that the BeltLine "can encourage healthy behaviors by providing people with the infrastructure and urban design to encourage walking, biking, and transit as viable transportation options; by providing parks and trails for physical activity and social interaction; and by locating jobs and services, such as grocery stores and health care centers, closer to where people live."

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This group of walkers is enjoying the health benefits of the Eastside Trail even before the beginning of construction. The "urban art" graffiti is on a temporary fence.

The BeltLine's effect on air quality, however, is likely to be minimal. The Atlanta Regional Commission projects a 36 percent increase in traffic volume per day in the Atlanta region if the BeltLine is completed versus a 40 percent increase if it is not. Therefore, the BeltLine "is not anticipated to have a significant impact on regional health related to air quality," the report concluded.

—Norah Davis, Editor of PUBLIC ROADS

Atlanta BeltLine, Inc./Perkins+Will and Field Operations

This artist's rendering shows a section of the Atlanta BeltLine corridor that will include transit, trails, green space, and abutting development.

Department of Planning and Community Development divided the Atlanta BeltLine planning area, roughly 16,000 acres (6,480 hectares) within a half-mile of the rail corridor, into 10 subareas for the purposes of master planning for land use, transportation improvements, and green space. As of May 2011, the Atlanta City Council had adopted seven of these subarea master plans with the remaining three ready for adoption.

The master plans call for future land uses and street networks that will support transit; denser, more compact urban development that promotes walking and bicycling; and green spaces large and small along the corridor. The master plans support a framework for urban growth that will be more sustainable for the city and the region and will be served by the planned improvements in infrastructure the Atlanta BeltLine will bring.

Shown here is D.H. Stanton Park with the rail corridor in the foreground where the Atlanta BeltLine's transit and trail will run.

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These volunteers are helping clean up the Atlanta BeltLine rail corridor on Earth Day 2011.

So far, the Atlanta Regional Commission and GDOT have provided nearly $21 million of Federal Highway Administration funds to the project: $18 million in Congestion Mitigation and Air Quality (CMAQ) Improvement Program funds and approximately $2.8 million programmed through Transportation Enhancement grants.

Continuing Community Involvement

Atlanta BeltLine, Inc., and its partners have maintained the project's grassroots spirit and engaged the community to an unprecedented degree for Atlanta. Community engagement is a cornerstone of the project, as first documented in the community engagement framework—a new structure adopted by the city council in 2006 with various channels for the community to become involved. The structure includes study groups for the five geographic regions of the Atlanta BeltLine with two subareas in each study group, dedicated staff, and two citizen advisory boards.

In addition, Atlanta BeltLine, Inc., has used social and digital media extensively, as well as traditional public and media relations, engaging tens of thousands of passionate, grassroots advocates. The Atlanta BeltLine Partnership has helped maintain and grow enthusiasm in the community through programs that include free tours; an Atlanta BeltLine Ambassadors program, which promotes the project and shares opportunities for residents to play a role; and a cadre of more than 1,000 volunteers to help spread awareness in the community. Working together, the community engagement framework and the Atlanta BeltLine, Inc., have helped deepen the community's awareness and support for the project.

Current Mayor Kasim Reed has made implementation of the Atlanta BeltLine one of his administration's top priorities. Under his leadership, the city submitted a successful application to the U.S. Department of Transportation (USDOT) for the beginning of a network of streetcars to connect key points along and within the Atlanta BeltLine. In October 2010, USDOT awarded Atlanta $47 million for the first new segment of its streetcar system in downtown Atlanta, which will soon include the Atlanta BeltLine.

"I am proud of the work we have accomplished to date," says Mayor Reed, "and I am eager to keep accelerating the transformative elements of this project, which will create a more economically competitive, environmentally sustainable, and increasingly connected city and region."

Ethan Davidson is director of communications for Atlanta BeltLine, Inc. Davidson has a B.A. in history from Columbia University.

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Historic Fourth Ward Park, one of the first new Atlanta BeltLine parks to be completed, is shown here in April 2011. Adjacent to the rail corridor on the east side of the Atlanta BeltLine, the park already has spurred the development of more than 1,000 new residential units in the immediate vicinity.

Going on a Road Diet

by Carol H. Tan

(Top, Before) A road diet conversion helped turn this five-lane Main Street in Pottstown, PA, into a more livable downtown with facilities for motorists and other users. (Bottom, After) Pottstown's Main Street after repaving and implementation of a road diet now has travel and bicycle lanes, a center left-turn lane, and parallel parking on one side changed to back-in diagonal parking. Increasing parking can help local businesses attract shoppers. *Photos: Michael Ronkin.*

Lane reduction can increase safety for pedestrians, bicyclists, and motorists while improving the quality of life in downtowns across the country.

Have you ever had a problem walking across a street because you felt it was too wide or had too many lanes to cross comfortably? Have you ever wanted to ride your bicycle to your destination but felt uncomfortable because the direct route lacked bike lanes? Have you ever been through a downtown that seemed drab, dull, lifeless?

You're not alone. Pedestrians generally have difficulty crossing wide roads that have multiple lanes in both directions. In some areas, crossing opportunities for pedestrians are located only at signalized intersections that are spaced at uncomfortable walking distances. In some cases, the number of lanes may be unnecessary for the actual volume of motor vehicle travel. Some roads with lower traffic volumes might be good candidates for bicycle travel, but bicyclists avoid them because of the lack of dedicated bike lanes.

Historically, adding more lanes has been one of the preferred solutions for reducing traffic congestion. In some downtown areas, however, accommodations such as adding lanes and removing parking spaces have resulted in fewer opportunities for people to stop and shop, reducing business for retail stores.

One approach that engineers and planners use to address these problems is the road diet. Not only can this tactic improve pedestrian and bicyclist mobility and revitalize a downtown, but also it can increase safety by reducing conflicts between motor vehicles.

What Is a Road Diet?

The road diet approach involves narrowing travel lanes or shoulders or eliminating some of them to provide more space for pedestrians and bicyclists. A typical road diet consists of converting a four-lane roadway (two in each direction) to a three-lane (one in each direction plus a center

turn lane) and adding sidewalks and/or bicycle lanes. At times, this reconfiguration can be accomplished by simply restriping the lanes in conjunction with a resurfacing project.

Peter Lagerwey, former coordinator of Seattle's pedestrian and bicycle program and now senior planner with the Toole Design Group, sees street rights-of-way as an urban resource that various users are competing for. The rights-of-way provide space for general-purpose lanes, turning lanes, bus and bicycle lanes, parking, sidewalks, buffers, street plantings, and outdoor restaurants. "Roads are to serve all of us," says Lagerwey. "Streets exist 24/7, but peak traffic may be a concern for as little as 30 minutes a day. If you build to peak traffic, you are going to have excess capacity. The good news is that we have overbuilt many of our roadways, and we have a lot of opportunities to do road diets."

Gabe Rousseau, bicycle and pedestrian program manager for the Federal Highway Administration (FHWA), notes, "Road diets offer a number of community benefits from increasing roadway safety to improving mobility for pedestrians of all ages and abilities, and even helping with traffic congestion."

Benefits

In theory, road diets have potential drawbacks, but in fact, case studies in a number of States suggest that problems usually do not occur. Instead, this approach offers a number of benefits in terms of traffic operations, safety, and livability when applied in the appropriate situations.

Operations. On a four-lane street, speeds can vary between lanes. Due to slower vehicles stopped in the left lane waiting to make a turn, drivers must slow or change lanes. On the other hand, road diet streets with two through lanes plus a center turn lane separate left-turning vehicles from the through vehicles. The speeds of motorists in the through lanes are limited only by the speed of the lead vehicle in their own lanes.

Safety. The reduction in vehicle interactions resulting from a road diet potentially can decrease the number and severity of crashes. Typical incidents that occur on four-lane streets include rear-end crashes from left turns, side swipes, left turn/broadsides, and multiple-threat crashes in which a vehicle stopped for a pedestrian blocks the view of the driver in the adjacent lane. Reducing the number of through lanes and providing a center turn lane addresses these crashes by (1) separating left-turning traffic from through traffic, (2) reducing the number of oncoming lanes through which a left-turning driver must search for a gap, and (3) removing the multiple-threat situation because there is no longer an adjacent lane. (See, for example, http://guide.saferoutesinfo.org/engineering/tools_to_reduce_crossing_distances_for_pedestrians.cfm.)

A Highway Safety Information System (HSIS) summary documents research that analyzed data from California, Iowa, and Washington State used in earlier separate road diets safety evaluations. Their study, summarized by FHWA in *Evaluation of Lane Reduction "Road Diet" Measures on Crashes* (FHWA-HRT-10-053), measured crash reductions of 47 percent on predominantly U.S. and State routes in small urban areas (average population: 17,000) and 19 percent on corridors in suburban areas surrounding larger cities (average population: 269,000).

(Top) This "during construction" photograph shows a four-lane road in a neighborhood in Charlotte, NC. (Bottom) As shown in this "after" photo of the same location, reclaiming road space by turning the four-lane road into two lanes plus bicycle lanes created room for a pedestrian refuge island. *Photos: Dan Gallagher.*

(Top) Stone Way North in Seattle, WA, looking north at N 36th Street before the road diet conversion. The roadway surface was in poor condition, there were no bicycle facilities, and there were several uncontrolled marked crosswalks where pedestrians had to navigate across four lanes of traffic. (Bottom) Stone Way North looking north from the same vantage point after the conversion. The roadway was resurfaced, one travel lane in each direction was provided, along with a two-way left-turn lane. A dedicated bicycle lane was added uphill with shared lane markings downhill. Pedestrian crossings were upgraded to include high-visibility fluorescent-green signage. *Photos: SDOT.*

Lagerwey says, "In general, when you complete a road diet, you can expect close to a 30 percent overall crash reduction factor. There are at least 50 to 60 standard traffic operation tools that we have to reduce crashes. Getting close to a 30 percent crash reduction factor is a really high number in terms of the effectiveness of a particular treatment."

Besides reducing crashes between motor vehicles, road diets can decrease other incidents by providing designated spaces—sidewalks and bicycle lanes—that reduce opportunities for conflicts between motor vehicles and other road users. Creating these spaces reduces the number of motor vehicle travel lanes, so pedestrians have fewer lanes of traffic to cross, again decreasing the potential for incidents. The center left-turn lanes also provide space for pedestrian crossing islands, which reduce crossing distances and can help prevent motorists from using the center turn lane as a passing lane.

The new street environment created by a road diet enables motorists to be more aware of the presence of pedestrians and bicyclists. Changing the environment of a street to one where motorists are expecting to see bicyclists and pedestrians can make it safer for those users.

One of the foremost reasons for increased safety from road diets is the reduced instances of speeding. Road diets encourage motorists to drive at the desired speed of the roadway.

Livability. If sufficient space is available, highway agencies can add street trees along the sidewalks for aesthetics. According to Lagerwey, street trees change the feel and character of a street. After a road diet and addition of landscaping, the messaging given by a street is: Slow down, this is a neighborhood, a place to respect bicyclists and pedestrians. Overall, road diets can lead to an improvement in livability, making walking and bicycling in downtown areas more pleasant. Other benefits include the economic impacts on businesses of a street that caters to all users, as well as increases in real estate values.

Edgewater Drive in Orlando

In January 2000, the city council of Orlando, FL, adopted the *Neighborhood Horizon Plan* governing future improvement projects for the city's College Park neighborhood. The previous year, the residents of College Park had participated in workshops with the city to formulate the official plan.

The vision described in the *Horizon Plan* was to reinvent College Park's Edgewater Drive into a vibrant, pedestrian-friendly commercial area with cafés and shops. The plan identified improvements such as placing utilities underground, installing new crosswalks enhanced with pavers at various crossing points, and calling for new traffic signals, safer parking, bicycle lanes, and wider sidewalks.

The 1.5-mile (2.4-kilometer) section of Edgewater Drive from Par Street to Lakeview Drive serves as

the main street through College Park, with an average daily traffic (ADT) of 20,000 at the time of the project. Edgewater Drive's previous four-lane configuration did not allow sufficient room for streetscaping and other *Horizon Plan* improvements. The plan's authors concluded that the only way to create wider sidewalks and a more pedestrian-friendly commercial district was to eliminate one vehicle lane. Since the Florida Department of Transportation (FDOT) already had budgeted to resurface Edgewater Drive in 2001–2002, the College Park Neighborhood Association asked the city to restripe the road from four lanes to three during the resurfacing.

FDOT was amenable to the road diet provided that the city would take over jurisdiction of that section of Edgewater Drive, the neighborhood and business associations would accept the proposed changes, and the city would conduct a before-and-after study to evaluate the effectiveness of the implemented changes. Some sections of Edgewater Drive were already under the jurisdiction of the city of Orlando. The neighborhood residents viewed the transfer of jurisdiction to the city as important because then the city could better implement improvement to the entire Edgewater Drive corridor as defined in the *Neighborhood Horizon Plan* without having to coordinate with FDOT. For the study, researchers used an average of 3 years of "before" data and 4 months of "after" data annualized to 1 year. The researchers examined crash rates, vehicle speeds, and traffic volumes.

The road diet reduced crash rates by 34 percent and injury rates by 68 percent per million vehicle miles driven on the segment of Edgewater Drive that received treatment. Before the road diet, this section experienced a crash every 2.5 days (146 crashes per year) and, after the road diet installation, a crash every 4.2 days (87 crashes per year).

The researchers measured vehicle speeds at three locations along the corridor (northern end, middle, and southern end) under the before-and-after conditions. The percentage of vehicles traveling at excessive speeds, defined by the researchers as over 36 miles per hour (mi/h) (60 kilometers per hour, km/h), showed a reduction in all three segments. Although the middle section experienced only a slight decrease in excessive speeds, the northern and southern segments showed noticeable reductions of 8 and 10 percent.

Traffic volumes for all users actually increased. Initially, the volume for motor vehicles decreased from 20,500 to 18,100 immediately after the road diet treatment. However, the volume eventually increased to 21,000. Lagerwey attributes initial decreases to motorists taking another route out of fear of increased congestion. "Then they discover that the road diet works really well, and they come back," he says.

In terms of pedestrian volumes, the city's researchers counted walkers at various locations and in both north-south and east-west directions. Overall, the increase in total pedestrian traffic was 23 percent, from 2,136 to 2,632 pedestrians per day. The largest increase of 738 to 1,151 pedestrians per day (56 percent) was in the number of pedestrians traveling east-west (crossing Edgewater Drive), indicating that they may have found the three lanes easier to cross than the previous configuration.

As with the pedestrian counts, the researchers took bicycle counts at various locations in both directions. The overall increase in bicycle volume, from 375 to 486 bicycles per day, was 30 percent, with the largest increase of 80 to 118 bicycles per day (48 percent) similarly in the east-west direction.

Stone Way North in Seattle

For almost three decades, Seattle, WA, has implemented road diets in an effort to improve the city's streets and encourage walking, bicycling, and transit use. Since 1972, the Seattle Department of Transportation (SDOT) has installed 29 road diets. SDOT completed five in 2010, planned five more for installation in 2011, and is determining the feasibility of another two for 2012.

In 2007 Seattle passed a Complete Street Ordinance that required SDOT to plan, design, and construct new transportation improvements to accommodate pedestrians, bicycles, and transit while promoting safe operation for all users. In addition, the ordinance required SDOT to incorporate complete streets principles into its transportation strategic plan, pedestrian and bicycle master plans, transit plan, and various other SDOT plans, manuals, rules, and regulations. Complete streets is a nationwide movement to design and build road networks that are welcoming to everyone: young and old, motorist and bicyclist, walker and wheelchair user, bus rider and shopkeeper.

For a corridor to be considered as a candidate for a road diet, SDOT requires that it be identified in the city's list of complete streets capital

(Left) Grand Boulevard in Vancouver, WA, before road diet conversion. (Right) Grand Boulevard after road diet conversion. *Photos: Jennifer Rosales.*

(Left) Fourth Plain Boulevard in Vancouver, WA, before road diet conversion. (Right) Fourth Plain Boulevard after conversion. *Photos: City of Vancouver.*

projects or its pedestrian or bicyclist master plans. Another approach is for the candidate street's residents to request a road diet as part of the implementation of their neighborhood improvement plan. SDOT considers the following facets of transportation operations, mobility, and safety in the selection of a road diet corridor:

- Volume of traffic—less than 25,000 vehicles per day
- Number of collisions—all modes (motor vehicle, pedestrian, bicycle)
- Vehicle speed
- Number of lanes
- Freight usage
- Bus stops and routing
- Travel time
- Accessibility

Common stakeholder concerns include increased congestion, diverted or cut-through traffic leaving the treated road for other neighborhood streets, and impeded exits from driveways. As for congestion, SDOT has found an actual gain in efficiency by removing left turns from travel lanes.

In terms of the second concern, SDOT monitors traffic through the affected neighborhood pre- and post-implementation to determine whether diverted traffic causes a problem. "Increasing traffic on neighborhood streets always comes up as a worry," says Lagerwey. "But it's just something that doesn't happen with road diets. People stay on the street."

On the third concern, left-turn access from side streets and driveways is improved because motorists now have only one travel lane to traverse to reach the center two-way left-turn lane. Left turns into driveways and side streets are facilitated because drivers have only one opposing lane of traffic to cross and sight distance is improved.

SDOT conducts followup studies to determine the effects on each treated corridor. Specifically, the department compares the before-and-after conditions for the following:

- Volume of the principal street's peak hour capacity
- Speed and collisions
- Traffic signal level of service
- Volume of traffic on parallel arterials
- Travel times
- Bicycle volumes

In 2008, SDOT implemented a road diet on a 1.2-mile (1.9-kilometer) section of Stone Way North from N 34th Street to N 50th Street. In addition to serving motor vehicles, this segment of Stone Way North helps connect a bicycle path with a park. Within five blocks are eight schools, two libraries, and five parks.

The segment that was modified was originally a four-lane roadway carrying 13,000 vehicles per day. It had parking on both sides, a posted speed limit of 30 mi/h (48 km/h), and four uncontrolled, marked crosswalks that were noncompliant under SDOT's 2004 revised crosswalk guidelines. For this corridor, the city's 2007 bicycle master plan recommended climbing lanes and shared lane markings (previously known as "sharrows"). The road diet cross section became two lanes plus a two-way left-turn lane, bicycle lanes, and parking on both sides. Reducing the number of motor vehicle travel lanes made the four crosswalks compliant.

Speeds decreased after the road diet installation. The 85th percentile speed was 37 mi/h (60 km/h) prior to the road diet. In the northbound direction, the 85th percentile speed dropped to 36 mi/h (58 km/h) and, in the southbound direction, 34 mi/h (55 km/h). Three percent of vehicles traveled at 40 mi/h (64 km/h) and faster prior to the road diet. Less than 1 percent traveled at 40 mi/h and faster afterwards.

Average daily traffic (ADT) dropped 6 percent, which was consistent with a citywide trend between 2006 and 2008. Peak hour volume dropped approximately 5 percent. Offpeak volume actually increased south of 45th Street by 2 percent.

Bicycle volume increased 35 percent, representing almost 15 percent of the peak hour traffic volume. Traffic did not divert after restriping, as indicated by the fact that volume did not increase on the four nonarterial streets commonly known as alternatives to Stone Way North.

A comparison of 2 years of crash data before (2006–2007) and after (2008–2009) the installation showed an overall decline in incidents. Total crashes decreased 14 percent, injury crashes went down by 33 percent, and angle crashes dropped by 56 percent. Bicycle crashes showed no change, but the rate decreased because the number of cyclists increased. Pedestrian crashes declined 80 percent.

Other Case Studies

A number of additional case studies on road diets confirm the results

from Stone Way North and Edgewater Drive as typical. At the 2005 international meeting of the Institute of Transportation Engineers (ITE), Jennifer A. Rosales, P.E., formerly lead transportation engineer at Parsons Brinckerhoff and now senior program officer, public transportation engineer, with the Transportation Research Board, presented case studies from three States.

A road diet project in Vancouver, WA, reduced crashes by 52 percent on an arterial with ADT of 17,000 vehicles. Traffic speeds went down 18 percent, traffic diversions did not occur, and an overwhelming majority (67 percent) of users surveyed felt safer.

A road diet conversion in Athens, GA, on an arterial with 20,000 ADT resulted in crashes going down 53 percent in general and 60 percent at unsignalized locations. Traffic diversion was less than 4 percent, and 47 percent of users perceived the number of lanes and street width as "just right." Another 33 percent were unsure, and only 20 percent were unhappy.

In Clear Lake, IA, a downtown segment of U.S. 18 with 12,000 ADT was converted from four to two lanes plus a center turn lane. A significant reduction in crashes was evident, and aggressive speeding went down by 52 percent.

Public Acceptance

Gaining public acceptance is important but can be challenging. Without the support of the residents and business owners, the road diet may not happen or, if it is installed, residents may criticize the transportation department's efforts. Common concerns include impact on traffic flow, congestion, cost, increased traffic on neighborhood streets, and access to and from driveways and side streets.

A transportation agency can address concerns about traffic flow and congestion by providing the results of success stories where road diets improved mobility for all road users. When road diets are applied appropriately, traffic will remain relatively unchanged. Lagerwey offers a word of caution, however: "Pay attention to the signalization to avoid potential backups. See if you need to put in a left-turn arrow so your road diet doesn't backfire. The public reaction will be that there is a problem—not with the signal, but with the road diet—and they will want to get rid of it."

Road diets are relatively low-cost improvements, especially if a repaving project is ongoing. In the case of reconstruction or repaving, most of the effort for a road diet improvement involves restriping only. In the larger picture, however, it is important to note that implementing a road diet can result in changing the roadway design to match the context of the desired land use. Land use and transportation need to be integrated. A road diet's success can be dependent upon land use policies that support the desired transportation function.

Safety and economics are the major positives. As discussed earlier, research has shown that road diets potentially can result in significant reductions in total crashes, depending on the type of roadway and land use. As for economics, easier left turns into driveways and private parking lots can encourage more customers to stop for shopping, thus improving business.

Agencies can gain public acceptance for road diets by holding workshops like the one for College Park residents in Orlando. To measure and document the success of a project, before-and-after satisfaction surveys are crucial. In Orlando, the surveys indicated a high level of public satisfaction with the road diet improvement.

Next Steps

Nearly every community in the United States has opportunities to implement road diets. Highway agencies can use street and location criteria to identify potential candidates for road diets. In "Road Diets: Fixing the Big Roads," Lagerwey and coauthor Dan Burden describe a number of additional case studies and suggest that candidate roadways meet some of the following criteria (see www.walkable.org/assets/downloads/roaddiets.pdf):

- Moderate volumes (8,000–15,000 ADT)
- Roads with safety issues
- Transit corridors
- Popular or essential bicycle routes and links
- Commercial reinvestment areas
- Economic enterprise zones
- Historic streets
- Scenic roads
- Entertainment districts
- Main streets

When deciding to implement this treatment, road managers, engineers, and planners need to consider whether the street meets any of these criteria and whether it is on a transportation improvement plan. Lagerwey offers a rule of thumb: If the prospective road is in an urbanized situation with a number of left turns, short blocks, and a signal at every corner, then a road diet could be appropriate in some situations with a traffic volume as high as 25,000. On the other hand, if a road has virtually no left turns and few signals, a road diet might be inappropriate if the ADT is over 18,000.

The steps for implementing road diets will vary from community to community. The process depends on who owns the road, plus the local and State regulations. Requirements probably will differ on the kind of study and analysis needed.

Road diets help to reclaim the street space for enhanced use rather than devoting them just to moving peak hour traffic. "When you start looking at total street capacity, the story we have to tell about road diets becomes even better," says Lagerwey. "This is more than just something for bicyclists and pedestrians; this is energizing the street, it's economic development, it's a way we can reclaim and 're-peoplize' our streets. The good news is this: literally every community in America has opportunities to do road diets."

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At a recent workshop, experts tackled the problems of source depletion and future supply issues related to this critical construction material.

by Richard C. Meininger and Steven J. Stokowski

Wherefore Art Thou Aggregate Resources for Highways?

Sand, gravel, crushed stone, and, increasingly, industrial byproducts and reclaimed construction materials quite literally are the foundation of the Nation's transportation infrastructure. Collectively referred to as aggregates, these materials are essential to constructing, preserving, and rehabilitating roads and bridges. Aggregates affect durability, strength, modulus, thermal properties, and the all-important, safety-related properties of driving surfaces: friction and traction.

Crushed stone and crushed gravel are the major sources of most pavement aggregates. Their angular shapes perform well in applications where interparticle friction adds to pavement strength, such as granular bases and asphalt layers. For portland cement concrete, natural sand, gravel, and crushed stone are widely used in pavements and structures as well. Natural sand, as the fine aggregate for concrete, is entrenched in highway agencies' specifications because its rounded shape contributes to concrete workability. Using crushed, angular, and manufactured fine aggregates in concrete, mortar, and grout applications is more difficult, but may be necessary in some areas.

To be useful to highway agencies, first and foremost, aggregates must be of a sufficient quality to meet both initial design needs and long-term, life-cycle performance objectives. Industry decisionmakers regularly consider alternative blends, recycled sources, and gradings, as well as other aggregates specified for the project designs. Developing specifications that allow more blending to meet performance objectives can help preserve premium aggregates for critical uses.

Ensuring a sustainable supply of aggregates requires advance

(Above) Sustainable sources of aggregates, such as this quarry and aggregate plant located near a Northern Virginia growth region, and concerns about the future supply of sand, gravel, and other highway construction materials were the focus of a recent TRB workshop. *Photo: Steven J. Stokowski, SES Group & Associates, LLC.*

planning and balancing a complex matrix of engineering, geographical, and geological variables and community interests. Aggregate resources—whether quarries, pits, recycled materials, or industrial byproducts—are more sustainable when located close to projects. In many cases, however, materials must be trucked to project sites from distant locations.

"The highway industry and the public need to become more educated about the importance of aggregates to local economies and regional transportation infrastructure," says Jorge E. Pagán-Ortiz, director of the Federal Highway Administration's (FHWA) Office of Infrastructure Research and Development. "Knowing the locations of current and potential future aggregate sources is important for strategic planning and resource protection."

By knowing more about local resources, officials can plan and design highway projects to optimize the use of various types of locally available natural and recycled aggregates. Using locally available aggregates reduces transportation costs and energy expended in moving these heavy bulk materials. Optimal use of local aggregates also reduces truck traffic and the number of axle loadings on the highway system. Further still, communities can extract high-quality aggregates before committing land to other uses, such as lakes, parks, or new developments. However, advance planning and environmental and landscape architectural considerations are critical in reclaiming and developing aggregate lands.

In January 2011, at the Transportation Research Board's (TRB) 90th annual meeting, experts from the United States and Europe gathered for a workshop on "Aggregate Source Depletion and Future Supply." Representatives from FHWA, the U.S. Geological Survey (USGS), State departments of transportation (DOTs), industry, and academia discussed the future of sustainable sources of mineral aggregates and related issues facing many States and transportation agencies. What follows are highlights from their presentations.

Aggregate Needs for Highways and Structures

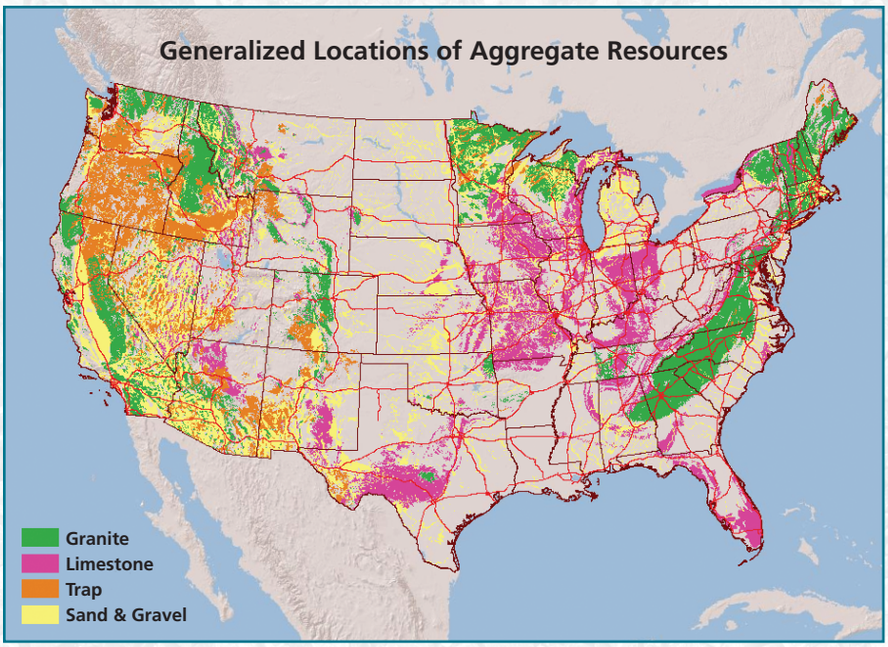
Both by volume and tonnage, aggregates surpass all other materials used in the built infrastructure of roads and bridges. As defined by ASTM International in ASTM D 8-02, an aggregate is "a granular material of mineral composition such as sand, gravel, shell, slag, or crushed stone, used with a cementing medium to form mortars or concrete, or alone as in base courses, railroad ballasts, etc."

USGS Circular 1176 *Aggregates from Natural and Recycled Sources: Economic Assessments for Construction Applications—A Materials Flow Analysis* (1998) further refines the definition as follows: "aggregates are…materials, either natural or manufactured, that are either crushed and combined with a binding agent to form bituminous or cement concrete, or treated alone to form products such as railroad ballast, filter beds, or fluxed material." Treated and untreated aggregates are also used for local gravel roads or other aggregate-surfaced roads, driveways, and parking areas.

In general, natural aggregates are mined from stone quarries and from sand and gravel pits. Increasingly, however, agencies are using recycled, reclaimed, and alternative byproduct aggregate materials, such as blast furnace and steel slag, other mining or industrial byproducts, and reclaimed asphalt pavement and recycled concrete aggregate. However, these alternative materials currently fill only a small fraction of the total aggregate needs for highways. A 2010 survey of State DOT materials engineers by the American Association of State Highway and Transportation Officials' (AASHTO) Subcommittee on Materials reveals use of reclaimed asphalt pavement (in asphalt mixtures) and use of recycled concrete aggregate (mostly in base course applications) in most of the States.

According to USGS reports, production and use of aggregates in the United States declined during the economic downturn in 2008–2010. However, the demand for all types and uses of aggregates in 2007 and 2008 was on the order of 2.5 to 3 billion tons (2.2 to 2.7 metric tons) per year and may return to that level when construction volumes return. Bill Langer, a USGS aggregates research geologist who delivered two presentations at the TRB workshop, says that to meet the reported current and future infrastructure needs, an increase in annual aggregate production as much as 70 percent may be required over a 5-year period,

Shown here are examples of natural aggregates used in construction: (a) natural gravel often used as coarse aggregate in concrete, (b) crushed stone coarse aggregate typically used in asphalt mixtures in paving and in concrete, and (c) a compacted crushed stone layer used as granular base material. *Photos: Richard Meininger, FHWA.*



This map shows the generalized location of aggregate resources in the conterminous United States. *Source: Bill Langer, USGS.*

if infrastructure repair is begun in earnest. Further, he adds, "natural aggregate is widespread through the conterminous United States, but the location of aggregate is determined by geology and is nonnegotiable."

Few, if any, deposits of sand, gravel, and rock suitable for making crushed stone are geologically available in some regions. For example, natural aggregate is in short supply in the Coastal Plain and Mississippi embayment, Colorado Plateau and Wyoming Basin, glaciated Midwest, High Plains, and the nonglaciated Northern Plains. Furthermore, many sources of aggregate in other areas, such as parts of the Pacific Northwest, do not meet physical and durability requirements, or they contain contaminants or deleterious materials that limit use.

In other regions, development or community actions may preempt resource extraction. In populated areas, encroachment of conflicting land uses, community pressures, permitting conditions, environmental issues, and opposition from an increasing number of Web-based antimining groups prevent or limit development of many suitable resources.

The problem of limited supply becomes particularly acute in the case of friction aggregates needed for the wearing surfaces of pavements and bridges, which require aggregates with hard minerals that will not abrade or polish readily under traffic. In many parts of the country, where limestone is the predominant aggregate, polish-resistant materials need to be transported from great distances and at increased cost. As State DOTs continue efforts to improve safety on rural and two-lane roads, higher quality, good-friction aggregates or blends for surfacing will become increasingly important. Blends of durable aggregates with different wear resistance can be used for a multitextural surface.

Use of Recycled Materials

FHWA estimates the U.S. transportation industry's need for aggregates for pavements at about 700 million tons (630 million metric tons) per year. According to a 2009 presentation by Peter Stephanos, director of FHWA's Office of Pavement Technology, there is a tremendous need to reduce the demand for virgin mineral resources in the Nation's highway system, and one way of doing that is recycling.

As reported in the FHWA study *Reclaimed Asphalt Pavement in Asphalt Mixtures: State of the Practice* (FHWA-HRT-11-021), as of 2007, the highway industry was using as much as 100 million tons (91 million metric tons) of reclaimed asphalt pavement. Similarly, the American Concrete Pavement Association (ACPA), in its 2009 *Engineering Bulletin* (EB043P), estimates that the construction industry uses another 100 million tons (91 million metric tons) of reclaimed concrete aggregate and other crushed and broken concrete materials per year. The Construction Materials Recycling Association (CMRA) estimates

Estimated Aggregate Use in the United States (Millions of Tons)

Aggregate Type	2007	2008	2009
Sand and Gravel	1,380	1,170	921
Crushed Stone	1,820	1,610	1,290
Reclaimed Asphalt Pavement*	11	16	18
Recycled Concrete Aggregate*	11	17	14
Sum of Above	**3,222**	**2,813**	**2,243**
Sand and Gravel Imported into United States	5	6	3
Crushed Stone Imported into United States	21	23	13
Sum of Above	**3,248**	**2,842**	**2,259**

*Source: USGS. *Converted from metric tons and reported to three or fewer digits without decimals. Estimates by USGS for 2010 are about the same or a little less than 2009: 909 million tons for sand and gravel and 1,320 million tons for crushed stone. Note that these data for reclaimed asphalt pavement and recycled concrete aggregate are as reported to USGS and are likely extremely low, in part due to limited survey information. The highway industry (ACPA, CMRA, FHWA, and the National Asphalt Pavement Association) has estimated the quantities of reclaimed and recycled asphalt and concrete materials used in construction at quantities closer to 100 million tons each. Reuse activities include use by a contractor or maintenance forces on the same project or a nearby project for base course materials or shoulder materials, or use as a select material where subgrade strengthening of modification is required.*

even larger quantities of crushed or broken concrete are recycled into various uses and products (including aggregates) each year. Specifically, the association points to recycled concrete aggregate use in aggregate base course (road base), ready-mix concrete, asphalt pavement, soil stabilization, pipe bedding, and landscape materials.

Providing precise quantities is difficult because recycled and reclaimed materials often are reused on the same project. The USGS estimates of recycled and reclaimed materials are based on quantities stockpiled and marketed for use elsewhere, only by producers or contractors who replied to its annual survey, so the true volume of reclaimed materials in use is likely much higher. In fact, only about one-third of construction companies and aggregate recyclers surveyed responded to the questionnaire. USGS now is annually surveying these companies that produce recycled materials and is working to improve the data collection on the use of reclaimed asphalt pavement and reclaimed concrete aggregate.

States' Sustainability Efforts

Evidence suggests that reclaimed aggregate use at the State level is on the rise. *Public Works* magazine reports in its March 2011 issue that the Texas Department of Transportation (TxDOT) increased its use of reclaimed asphalt pavement from 467,000 tons (424,000 metric tons) in 2008 to 827,000 tons (750,000 metric tons) in 2010. Despite this large increase, reclaimed aggregates still only meet a small percentage of TxDOT's needs.

The Oregon Department of Transportation's (ODOT) materials sustainability program aims to reduce, reuse, recycle, and "proactively manage all earthen materials needed for and/or generated by ODOT construction and maintenance activities." The objective of the program is to identify and meet the department's material source and disposal needs through site identification and management, strategic planning, and salvage and utilization of excess or waste materials from one project to another.

According to Russell Frost, statewide aggregate resource coordinator at ODOT, in 2009 the department's bridge construction program reused or recycled more than 21,000 tons (19,000 metric tons) of clean fill, 40,000 tons (36,000 metric tons) of concrete, and 44,000 tons (40,000 metric tons) of asphalt materials.

Oregon, like a number of other States and agencies, examined its aggregate resources and set aside a portion of that supply for future uses to protect it from competing land uses. In 2002 the State produced a report in cooperation with FHWA, *Aggregate Resource Inventory and Needs Forecast Study* (FHWA-OR-RD-03-03), based on Oregon's planning goal to protect natural resources and conserve scenic and historic areas and open spaces. The report explains how ODOT can evaluate aggregate-producing sites and initiate land use actions to conserve and protect significant sites. Oregon also maintains an Aggregate Source Information System database housed on its intranet site. The database is the primary tool ODOT uses to manage its nearly 700 material sources statewide.

Other States such as Alaska, California, Maryland, and the six New England States have also conducted studies or passed legislation regarding aggregate resources. California, for example, passed the Surface Mining and Reclamation Act in 1975, requiring counties to have sufficient permitted aggregate resources to meet the demand for the next 50 years. Furthermore, most States require reclamation and reuse plans for sites after permitted aggregate resources have been extracted. In some cases, a State or local agency will take over the land for public purposes such as roads, parkland, water storage, or groundwater recharge facilities.

Alaska's Materials Inventory Management Program

According to David Stanley, chief engineering geologist with the Alaska Department of Transportation & Public Facilities, and Peter Hardcastle, senior engineering geologist at R&M Consultants, Inc., Alaska is developing a program to manage material sites within the framework of geotechnical asset management. Geotechnical assets include materials sites and others that require monitoring, such as rock and soil slopes, rockfall mesh, rock bolts and anchors, embankments and pavement subgrades, retaining walls, foundations, tunnels, and geotechnical instruments. The project includes assessments of inventory and site conditions guided by the principles

Audrey Copeland, FHWA

This asphalt plant is located at a sand and gravel mining source, where a stockpile of reclaimed asphalt pavement is being prepared for blending and processing into asphalt mixtures.

Richard Meininger, FHWA

At this quarry in Harrisonburg, VA, processed crushed stone is stockpiled for use or further crushing and screening to make smaller aggregate sizes for use in construction.

of transportation asset management. In the State's three regions—northern, central, and southeastern—there are approximately 2,800 material sites on the road system, of which about one-third are active, Stanley says. Another 250 or so material sites are located at rural airports and have not been inventoried to date.

Alaska faces a number of challenges related to its aggregate supply, including limited transportation systems to deliver materials, material sites converted to other uses, and right-of-way and land use issues. The program will include development of a searchable database of material sites, an overview of available gravel sources, and justification to regulatory agencies for obtaining and retaining sites. Ultimately, Hardcastle says, the program "will help avoid planning conflicts such as with megaprojects and provide continuity despite personnel turnover. The system will be portable, easy to use, and designed to survive future program interruptions."

The Alaska Department of Transportation & Public Facilities has assigned each site an availability classification and documented detailed information about location and material quality and quantity for use in various applications. "The asset management data will be useful to help ensure sufficient material for the future and protect sources for materials mining operations and sharing sites with other agencies," Stanley says. "The data also will support better practices, including buffers between sites and adjacent private properties, correction of problems with land status plats and records, and meeting of environmental requirements such as storm water runoff rules."

Other objectives of Alaska's program include development of performance standards that the department can apply to material sites and to facilitate geotechnical asset management to drive long-term decisionmaking concerning these material assets.

Public Issues Related to Supply and Transportation

In addition to efforts to reuse existing material and catalog the location of aggregate sites, States are faced with issues that arise at the crossroads of supply, materials transportation, and public policy. Highways provide reliable corridors for accessing natural resources, transporting products to markets, and facilitating convenient mobility for communities. Once constructed, highways in rural or remote areas that provide access to mines, agriculture, forests, and recreation areas generally require fewer aggregates for maintenance and upgrades. However, those that serve the Nation's urban and suburban markets and intermodal hubs require greater quantities of aggregates for maintenance and rehabilitation. But, often, aggregate mines and other sources are not available near these high-demand areas.

According to Mark Krumenacher, an industry consultant with GZA

Aaron Banks, R&M Consultants, Inc.

Shown here is a sand and gravel material site on Holden Creek on the north side of the Brooks Range, just south of Galbraith Lake in Alaska. At this location, crews crush gravel aggregates for road construction.

GeoEnvironmental, a number of issues surround permitting for aggregate sources. In addition to land use and environmental regulations, in more populated areas, continued development and population growth encroach on current and potential aggregate mining sources. "It is increasingly difficult to expand sources horizontally or open new sites unless there is an ample land buffer," Krumenacher says. "Aggregate producers can sometimes mine their deposits deeper if material of sufficient quality exists, but this is often expensive, with significant engineering challenges."

In *Mineral Commodity Summaries 2011*, the U.S. Department of the Interior and USGS point to the effect of public and permitting issues on the availability of crushed stone, sand, and gravel, stating that the "[m]ovement of sand and gravel operations away from densely populated centers was expected to continue where environmental, land development, and local zoning regulations discouraged them."

For crushed stone, the report says, "Shortages in some urban and industrialized areas are expected to continue to increase, owing to local zoning regulations and land development alternatives. These issues are expected to continue and to cause new crushed stone quarries to locate away from large population centers." In terms of recycled aggregates, the report acknowledges that, "Increasingly, recycled asphalt and portland cement concretes are being substituted for virgin aggregate, although the percentage of total aggregate supplied by recycled materials remained very small in 2010."

Bottom line: Much of the natural aggregate needs for highways in more populated areas will need to come from further away with increased cost, congestion, and energy use. That is, unless State, local, and municipal organizations plan for the long term to optimize the use of existing closer-in aggregate resources and to facilitate rail and water movement of aggregates when available.

Uses of Aggregates and Relative Level of Quality Needed

Lower Quality	Backfill and Bedding
	Subbase, Select Material, and Subgrade Improvement
	Base Course (Unbound and Stabilized) • Stabilized (Asphalt, Portland Cement, and Lime-Fly Ash) • Dense Graded • Open Graded
	Aggregate Surfaced Roads (Gravel Roads)
	Chip Seal, Cover Material
	Portland Cement Concrete • Lean Concrete Base (Dense or Open Graded) • Structural Concrete • Concrete Pavement
	Hot-Mix Asphalt and Warm-Mix Asphalt • Dense Graded • Open Graded
Higher Quality	Drainage and Riprap
	Filter Aggregates

Aggregates and FHWA

Recognizing the importance of a sustainable supply of quality aggregates for road building and maintenance activities at the national level, FHWA is collaborating with the International Center for Aggregates Research at the University of Texas and Texas A&M University to sponsor research projects involving both concrete and asphalt. The partnership established a technical working group with Federal, State, university, and industry experts participating in a peer review of ongoing aggregate research and to examine research needs in the highway and transportation areas.

The group provides updates to the TRB Committee on Mineral

Richard Meininger, FHWA

For asphalt pavements, the frictional properties of the coarse aggregate are important because they are exposed at the pavement surface. Shown here are three polished coarse aggregate samples sitting on an asphalt pavement surface.

Richard Meininger, FHWA

FHWA researchers are using a falling weight deflectometer, towed behind this van, to test the compacted granular base on a section of research pavement in in Loudoun County, VA. This research project was developed through collaboration involving FHWA, State DOTs, university researchers, and industry.

Aggregates and is working on a roadmap for aggregate research to identify technological and sustainability innovations needed for aggregate granular bases, concrete technology (especially use of manufactured sand), and asphalt pavement mixtures. Matching future regional needs with availability is an important element of that discussion. Balancing land use and resource availability is part of a complex matrix that involves the public at many levels, including consideration at the State and metropolitan planning organization levels.

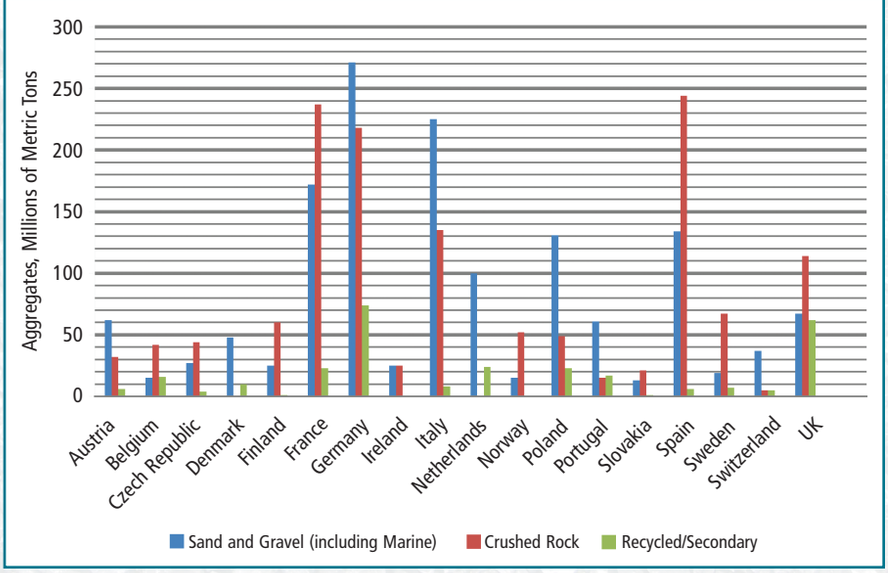
European Experience And Perspectives

The Europeans too are concerned about the sustainability of local aggregate supplies, as reported by Andrew Dawson, associate professor at the University of Nottingham in the United Kingdom, who studies European aggregate supply issues. Since 1987, the European Aggregates Association has promoted the interests of the European aggregates industry by representing member associations on economic, technical, environmental, and health and safety policies. The association's *Annual Review 2009–2010* highlights production and use data from 2008. According to the report, Europe extracts approximately 3.3 billion tons (3 billion metric tons) per year overall, which exceeds current U.S. aggregate production. Of this total, 2 percent is natural sand and gravel dredged from marine seabed sources, and 6 percent is supplied by recycling.

Over the next 5 to 10 years, European production could rise to as much as 4.4 billion tons (4 billion metric tons). The top three countries in terms of recycling percentage (with about 20 percent of total production coming from recycled sources) are Belgium, the Netherlands, and the United Kingdom, which now recycle nearly all available construction and demolition materials. Citing a report by the University of Leoben, Austria, Dawson notes that across Europe a value of 15 percent would represent total recycling, and that in the medium term recycling is unlikely to grow beyond 10 percent of production due to demolition material limitations and the economics of transport.

Dawson reports that permitted aggregate reserves are dropping in Europe due to competing land use, lack of strategic policy and planning, a political drive toward localization of decisionmaking, environmental restrictions, and the complexity and uncertainty of the permissions system. As an example of the lack of planning, Dawson says that data collection on aggregates in Europe is inconsistent and incomplete. "Much of it is industry collected, and many governments do not evaluate aggregate resources. It is therefore difficult to establish policy.

Aggregate Production in Europe (2008)



Source: Plot created based on data from European Aggregates Association. www.uepg.eu/uploads /documents/pub-31_en-en-uepg_ar2009-2010.pdf.

Planning authorities need to conduct minerals mapping. In addition, planning is seldom strategic and often reactionary. In many cases, land use decisions are pushed to local authorities who do not have a broad enough view, thus hindering national and regional policy development."

But, he says, the European Commission's EU Raw Materials Initiative, launched in 2008, could be a step in the right direction. The initiative aims to build a strategy for dealing with raw materials issues and underpin the strategy with legislation. "Aggregates are well represented in the plans," Dawson says, "which is critical, because the availability of aggregates from regional and local sources is essential for economic development in view of logistical constraints and transport costs."

Looking to the Future

The future of public roads depends on a reliable, sustainable supply of aggregates with the quality levels needed to build and maintain long-lasting, durable pavements and transportation structures. State and local DOTs need access to good-quality sources of virgin aggregates—sand, gravel, crushed gravel, and crushed stone—reclaimed asphalt pavement, recycled concrete aggregate, crushed rubble, reworked/rebound aggregates from pavement rehabilitation and full-depth reconstruction, and other alternative byproduct materials to support their highway programs.

Although the use of recycled aggregate is growing, many industry experts doubt the supply will meet the demand. Aggregate mining, therefore, remains a necessity, and needs to be done in an environmentally sound and sustainable way. As individual quarries and mines are depleted and no longer able to supply aggregates, agencies and landowners will need to follow through with reclamation plans to reuse the land for other purposes approved by planning agencies, such as lakes, fish habitat, parks, greenways, groundwater recharge, mixed-use residential and commercial sites, recreation, and wildlife preserves.

As is the case with energy resources, viable solutions for aggregate supplies will vary by location and local circumstances. The TRB workshop presentations and ongoing discussions among industry experts underscore the need for attention to this critical issue: ensuring sustainable sources of mineral aggregates and recycled aggregate materials for tomorrow's transportation system.

Selected Solutions to Ensure a Sustainable Supply of Aggregates

1. Compile geologic knowledge of where potential aggregate resources are located and their characteristics. This effort will help in strategic planning and project development to optimize use of regional resources.
2. Develop project designs to best use local marginal and recycled materials for appropriate base layers, and reserve higher quality materials for pavement wearing courses.
3. Recognize that some high-spec materials might have to be imported to meet project objectives. For example, Delaware has abundant natural sand sources, but crushed stone must be imported from other States.
4. Consider expanding specification options and whether the agency can employ blended materials or performance specifications.
5. Use recycled materials where available and consider stockpiling surplus materials for use on future projects.
6. Consider backhaul trucking options, such as hauling corn from Nebraska to Colorado for feedlots and backhauling crushed stone aggregate. About 90 percent of aggregate transport is by truck, and, generally, transporting aggregate with haul distances of 30 to 50 miles (48 to 80 kilometers) can double the cost of the aggregate, as reported by Gilpin R. Robinson, Jr., and William M. Brown in the USGS publication *Sociocultural Dimensions of Supply and Demand for Natural Aggregate—Examples from the Mid-Atlantic Region, United States*.
7. Consider rail and waterway transportation options. Some States have sufficient rail networks or access to major rivers, the Great Lakes, canals, and seaports. Truck transportation costs are rising because of higher fuel prices and are higher in congested traffic or on mountainous hauls. Efficient unit trains can reduce the cost per ton-mile significantly; barge waterway transportation is less; and ocean bulk carrier is even less. Materials suppliers are moving aggregates to coastal areas, such as in California and along the Gulf of Mexico and Florida, because coarse aggregates are in short supply. For example, the majority of aggregates used in Louisiana are shipped via barge from Arkansas, Illinois, Kentucky, and Missouri, and via bulk ship from Mexico.
8. Plan strategically for aggregate resources in growth areas. Aggregate extraction is often a transitional land use, and the ultimate use of the land can be planned for implementation in later development phases.

—Bill Langer, USGS

Richard C. Meininger, P.E., is a highway research civil engineer on the Pavement Materials Team at the FHWA Office of Infrastructure Research and Development. Based at the Turner-Fairbank Highway Research Center in McLean, VA, Meininger's primary responsibilities include managing research projects related to concrete and aggregates in the center's laboratories and projects by outside researchers as well. He has M.S. and B.S. degrees in civil engineering from the University of Maryland, College Park.

Steven J. Stokowski, P.G., is an aggregate technologist and petrographic laboratory expert with SES Group & Associates, LLC, a contractor for FHWA at the Turner-Fairbank Highway Research Center. He has an M.S. in geology from the South Dakota School of Mines & Technology in Rapid City, SD, and a B.S. in geology from The George Washington University in Washington, DC.

For more information, contact Richard Meininger at 202-493-3191 or richard.meininger@dot.gov, or Steven Stokowski at 202-493-3403 or steven.stokowski.CTR@dot.gov. See also Aggregate Resource Availability in the Conterminous United States, Including Suggestions for Addressing Shortages, Quality, and Environmental Concerns *(Open-File Report 2011-1119), available at http://pubs.usgs.gov/of/2011/1119.*

The authors would like to acknowledge the contributions of the following TRB committees that organized the workshop: Low-Volume Roads (AFB30), Exploration and Classification of Earth Materials (AFP20), and Mineral Aggregates (AFP70).

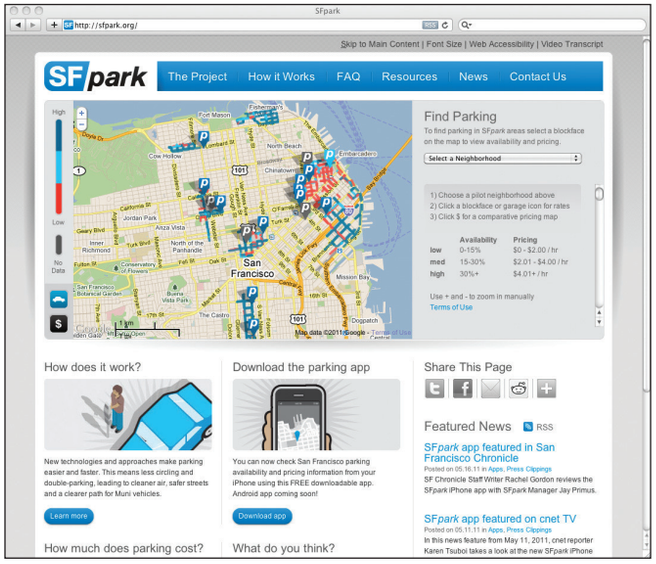
Along the Road

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 (USDOT) sources unless otherwise indicated. Your suggestions and input are welcome. Let's meet along the road.

Management and Administration

San Francisco Launches Real-Time Parking System

Federal Highway Administration (FHWA) Deputy Administrator Greg Nadeau recently joined transportation officials in San Francisco, CA, to unveil SF*park*, a new system that provides real-time information on parking availability and pricing. The system combines various intelligent transportation systems and will help San Francisco drivers spend less time searching for parking.



The San Francisco Municipal Transportation Agency is using a $19.4 million grant from FHWA for SF*park*. The system will apply to 6,000 metered onstreet parking spaces, about one-quarter of the city's total, and 12,500 spaces in more than 14 garages and lots. Eight areas of the city will have SF*park*: the Civic Center, the Fillmore, Financial District, Fisherman's Wharf, Hayes Valley, the Marina, the Mission, and SoMa.

SF*park* also offers important safety benefits. City officials expect the new service to unclog slow traffic lanes, making it easier for emergency vehicles to make their way. Also, instead of drivers focusing on finding open parking spaces, they can focus on the road.

"This innovative system will save drivers time, fuel, and frustration," says Nadeau. "It's also good for the economy because it will make it easier to shop and do business within the city."

The system collects real-time information through intelligent transportation systems, including sensors and data feed technology, and distributes it to drivers via the SF*park* Web site and smartphone applications. SF*park* also will use dynamic message signs to inform drivers of parking availability. Parking space prices will fluctuate according to availability.

For more information, visit http://sfpark.org.

Technical News

FHWA Develops Design Software for Soil Nail Walls

The Federal Lands Highway Division (FLH) of FHWA recently released a software program for evaluating and analyzing soil nail walls for temporary cut excavations and permanent slope stabilizations. Although software programs for soil nailing are available to design nail size and length, they lack the capability to design temporary or permanent wall-facing elements or check the stability of the overall soil nail wall system. To fill this need, FHWA's FLH, through its Technology Development Program, produced the Soil Nail Analysis Program (SNAP) as a basic state-of-the-art package.

Workers are constructing the facing for a permanent soil nail wall on a project in Guanella Pass near Georgetown, CO.

Features include the ability to conduct analysis of both internal (wall-facing and uniform and nonuniform nail length and inclination) and external failure modes for static and seismic loading conditions including global stability, sliding, and bearing capacity. SNAP also can evaluate maximum nail loading along the entire length of each nail, evaluate verification and proof field test results, and generate a comprehensive summary report. To run the program, users enter information about the wall, back-slope, and fore-slope geometries; retained single-layer slope material properties, such as friction angle, unit weight, and cohesion; ground water elevation; seismic loading; uniform or varying nail size, length, and inclination; and temporary and permanent facing support elements.

For more information, contact Khamis Haramy at khamis.haramy@dot.gov. To download the

SNAP software and user's manual (FHWA-CFL/TD-10-004) at no cost, visit www.cflhd.gov/programs/techDevelopment/geotech/SNAP.

USDOT to Test Connected Vehicle Technologies

USDOT recently selected six cities where it will hold clinics for drivers to test automobiles outfitted with new vehicle-to-vehicle communications technologies. The clinics will help the Department learn more about how drivers respond to these technologies, which have the potential to help reduce traffic crashes and save lives, according to USDOT officials.

The clinics are part of the Connected Vehicle Safety Pilot, a USDOT program conducted by the Research and Innovative Technology Administration and the National Highway Traffic Safety Administration. The Department is working with the Crash Avoidance Metrics Partnership, a research consortium of eight automobile manufacturers, to develop technology to help cars, trucks, buses, and other vehicles avoid crashes by communicating with nearby vehicles and roadway infrastructure such as traffic signals and grade crossings. The in-car systems send safety warnings to alert drivers when there is a risk of a crash or other driving hazard.

The clinics will be held between August 2011 and January 2012 in Blacksburg, VA; Brooklyn, MI; Dallas, TX; Brainerd, MN; Orlando, FL; and San Francisco, CA. Each city will recruit approximately 100 local motorists to drive vehicles equipped with Dedicated Short Range Communication, a wireless safety technology. In a controlled environment, researchers will assess the drivers' responses to the in-car collision warnings, "do not pass" alerts, warnings that a vehicle ahead has stopped suddenly, and similar safety messages.

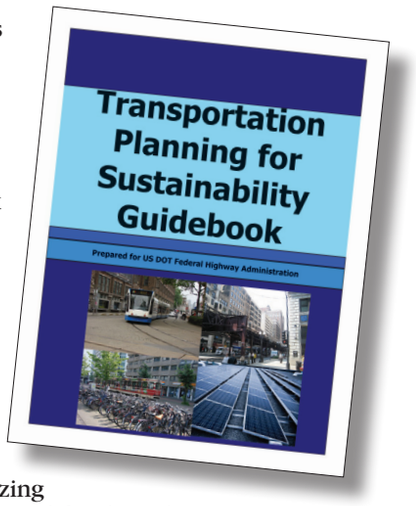
At the conclusion of the driver clinics, USDOT will deploy thousands of wirelessly connected vehicles to test how the technology performs in a real-world driving environment. The model deployment is scheduled to begin in fall 2012.

For more information, visit www.its.dot.gov/research/safety_pilot_overview.htm or contact Mike Schagrin at 202-366-2180 or mike.schagrin@dot.gov.

Public Information and Information Exchange

Now Available: Transportation Planning For Sustainability Guidebook

A sustainable transportation system generally is one that contributes to the sustainable development of the community that owns and uses it. Individual States and metropolitan areas have begun developing policies, programs, and methodologies for improving the sustainability of the transportation system. This FHWA-sponsored publication, *Transportation Planning for Sustainability Guidebook*, examines how agencies can better incorporate sustainability considerations into transportation planning. The document includes case studies highlighting sustainability planning practices culled from experiences at State departments of transportation (DOTs) and at the national and international levels.



Divided into six chapters, the guidebook focuses on practices that refine, enhance, or redefine steps in the planning process. The guidebook begins by presenting critical issues involved in planning for sustainable transportation systems, such as prioritizing initiatives to best use limited funds and measuring and monitoring progress, and then reviews current practices that address these issues. Later chapters cover potential data sources and examples of how agencies are using data in sustainability-related initiatives, case studies of sustainability practices, and cutting-edge evaluation methods.

For more information, visit www.fhwa.dot.gov/hep/climate/resources.htm.

MoDOT Introduces New Spokesperson For Work Zone Safety

The Missouri Department of Transportation (MoDOT) recently introduced its new face of work zone safety: Barrel Bob. Made from recycled orange and white barrels and standing 11 feet (3.3 meters) tall, Barrel Bob personifies MoDOT's current theme for work zone safety: "Don't Barrel Through Work Zones."

According to MoDOT, Barrel Bob has been popular in the Kansas City area in recent years, his roadside presence serving as a reminder to motorists to pay attention and slow down in work zones. During National

MoDOT

Barrel Bob, MoDOT's safety mascot, stands at the entrance to a work zone as a reminder for drivers to slow down and use caution.

Work Zone Awareness Week in April 2011, Barrel Bob brought his safety messages regarding the dangers of speeding and the importance of staying alert to a series of radio public service announcements. The radio advertisements are part of a larger statewide campaign that reminds motorists to drive safely in work zones and includes Internet banner ads, safety ads on fuel pump tops, and information on electronic message boards.

Fifteen people were killed in Missouri work zones in 2010, and 1,033 people were injured, up from 13 deaths and 676 injuries in 2009—an increase of almost 53 percent in injuries. Since 2000, 15 MoDOT employees have been killed in the line of duty. The top contributing circumstances for work zone crashes in 2010 were motorists following too closely, inattention, improper lane usage/change, driving too fast, and failure to yield.

For more information on the campaign, visit www.modot.mo.gov/workzones/multimedia.htm.

MoDOT

Utah DOT Completes Longest Span Bridge Move

The Utah Department of Transportation (UDOT) and its contractor recently completed a project to transport the longest two-span bridge ever moved in the Western Hemisphere to a new location. Overnight, workers transported the 354-foot (108-meter)-long Sam White Bridge to its new location over I–15 in American Fork, UT. Despite cold temperatures, more than 1,000 spectators came to watch the move, including 200 State officials, delegates from FHWA and other DOTs, and transportation professionals from as far away as Europe.

UDOT

UDOT's I–15 Corridor Expansion crew members prepare to move the Sam White Bridge, shown here lifted on the hydraulic self-propelled modular transporters.

Using accelerated bridge construction techniques, workers constructed the overpass beam bridge from reinforced concrete and steel about 500 feet (152 meters) from its final destination. The bridge was then lifted 21 feet (6.4 meters) in the air, moved across eight freeway lanes, and lowered into place. Workers moved both spans simultaneously using two sets of self-propelled modular transporters—essentially hydraulic jacks on wheels. By using accelerated bridge construction, UDOT eliminated the need for as many as six full freeway closures, thereby reducing traffic delays and keeping people, goods, and services moving.

The Sam White Bridge was the fourth of six bridges moved by self-propelled modular transporters on UDOT's Utah County I–15 Corridor Expansion, and the department's 23rd time moving a bridge under its accelerated bridge construction program—nearly double the number moved by all other States combined. FHWA designated the move as a "showcase" event for this technology and how it can be applied to other transportation projects across the United States.

For more information, visit www.udot.utah.gov/i15core/bridge.

UDOT

Eleven Communities Designated "Walk Friendly"

The Pedestrian and Bicycle Information Center (PBIC) recently announced its inaugural round of Walk Friendly Communities designations as part of its efforts to recognize cities and towns with a demonstrated commitment to improving walkability and pedestrian safety.

After evaluating applicant communities in several categories related to walking, including safety, mobility, access, and comfort, PBIC recognized 11 municipalities: Ann Arbor, MI; Arlington, VA; Austin, TX; Charlotte, NC; Charlottesville, VA; Decatur, GA; Flagstaff, AZ; Hoboken, NJ; Santa Barbara, CA; Seattle, WA; and Wilsonville, OR.

Drew Strauss

Sidewalks and other amenities shown here promote pedestrian activity in Decatur, GA, one of eleven cities designated as a Walk Friendly Community.

"The Walk Friendly Communities designation recognizes communities that help set the bar in fostering and accommodating walking," says Carl Sundstrom, program manager for Walk Friendly Communities.

According to PBIC, pedestrian injury and fatality levels remain high in the United States, despite a groundswell of support for active transportation. Communities are channeling this support for livability and taking advantage of the many benefits of walking, including environmental and personal health, reduced traffic congestion, enhanced quality of life, and economic rewards. The Walk Friendly Communities program empowers communities to make a long-lasting social impact by providing the tools to assess their own walkability and create plans for change.

For more information, visit www.walkfriendly.org.

PBIC

New Organization Works to Measure Infrastructure Sustainability

A newly established, independent nonprofit organization, the Institute for Sustainable Infrastructure (ISI), is working to develop and administer a sustainability rating system for North American infrastructure. ISI was founded by the American Council of Engineering Companies, the American Public Works Association, and the American Society of Civil Engineers.

The ISI rating system, called envision™ Sustainability Rating System, includes environmental, economic, and social considerations, and is designed to identify the benefits of sustainable practices for infrastructure owners, regulators, designers, and managers. The rating system, inspired by the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) Green Building Rating Systems™, is the only comprehensive assessment system that strives to measure a project's social and environmental performance, while also accounting for economic benefits.

ISI is aiming to launch the rating system in late summer 2011 as a voluntary, Web-based product. The ISI system will be performance-based and adaptable to project size and complexity. The system also will be applicable to a wide range of infrastructure projects, from roads and bridges to energy and water systems. Agencies that use the system will have options for self-assessment or third-party certification.

Through its rating system, ISI aims to promote community and policy acceptance of sustainable solutions and encourage knowledge sharing, innovation, and collaboration in the design, construction, and maintenance of infrastructure.

Visit www.sustainableinfrastructure.org for more information.

American Society of Civil Engineers

Toolkit Helps Advance RSAs on Federal and Tribal Lands

To increase implementation of road safety audits (RSAs), the FHWA Office of Federal Lands Highway and Office of Safety recently released a toolkit designed specifically for tribes and Federal land management agencies. The toolkit provides information about partnerships needed to build support, available funding sources for the program and improvements, tools to conduct RSAs, and resources to identify safety issues and select countermeasures.

Dan Nabors, Vanasse Hangen Brustlin, Inc.

A multidisciplinary RSA team reviews crash records and conditions in the field to determine road safety issues in the Navajo Nation.

RSAs are a proven technology for improving safety on and along roadways. For several years, FHWA has helped tribal governments and Federal land management agencies implement RSAs by leading the audits and providing training and technical assistance. However, these stakeholders often face challenges such as staffing and funding constraints that limit the use of RSAs. FHWA created the toolkit to help agencies and tribes overcome these obstacles by guiding them in establishing the necessary support and securing needed resources.

The toolkit includes worksheets and sample materials designed to aid in the eight-step RSA process, including requesting assistance, scheduling the audits, analyzing data, conducting field reviews, and documenting issues and suggestions. The toolkit also includes case studies.

For more information, visit http://flh.fhwa.dot.gov/programs/irr/safety/audits.htm#toolkit.

Now Available: Pavement Management Roadmap

FHWA recently released a publication on the long-term vision for pavement management. *Pavement Management Roadmap* (FHWA-HIF-11-011) discusses the research, development, and technology transfer initiatives needed to help agencies use pavement management to support broader asset management strategies and preserve valuable investments in the Nation's roads.

An increased emphasis on asset management to better allocate resources and to base decisions on system performance objectives means a shift for agencies to more fully utilize their pavement management systems. Traditionally, agencies used pavement management tools and techniques to assess and report pavement conditions, prioritize capital improvements, and estimate

funding needs. But today, pavement management supports broader asset management strategies by enabling agencies to manage infrastructure assets over the course of their entire life cycles.

To help make this shift, the *Roadmap* identifies the steps needed to address current gaps in pavement management and establish research and development priorities and initiatives. The publication discusses short- and long-term needs as identified by participants in three regional workshops. Needs are grouped under four main themes: use of existing tools and technologies; institutional and organizational issues; the broad role of pavement management; and new tools, methodologies, and technology. For example, short-term needs include communicating pavement management information and benefits, while long-term needs include using these data to support design activities and developing performance models that consider a series of preservation treatments.

For more information, visit the FHWA Asset Management site at www.fhwa.dot.gov/infrastructure/asstmgmt/index.cfm.

FHWA Road Safety Workshop Targets Local Governments

FHWA's Office of Safety has developed a 1-day workshop focused on improving the physical factors of local and rural roadways that may contribute to crashes. Developed in cooperation with Federal, State, and local stakeholders, Road Safety 365: A Safety Workshop for Local Governments provides transportation agencies that manage local and rural roads with effective ways to incorporate safety into daily activities.

Using examples, case studies, and hands-on activities, the course demonstrates how to integrate safety solutions into transportation projects at all stages of the project development process—planning, design, construction, implementation, operations, and maintenance. The course provides practical guidance for identifying road safety issues and implementing low-cost countermeasures. Workshop participants also will learn about the benefits and potential cost savings associated with integrating safety improvements into daily operations and maintenance activities.

FHWA developed the workshop for Local Technical Assistance Program and Tribal Technical Assistance Program centers to deliver to local practitioners. The workshop is divided into nine modules that cover all aspects of improving safety on rural roadways—from understanding the need for safety to planning and paying for safety improvements. Upon completion, participants will have an understanding of how adopting a culture of safety can help make roadways safer.

For more information, contact Rosemarie Anderson at 202-366-5007 or rosemarie.anderson@dot.gov.

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, Paula Magoulas, via email (paula.magoulas@dot.gov), telephone (202–493–3398), or mail (Paula Magoulas, PUBLIC ROADS Distribution Manager (HRTM), Federal Highway Administration, 6300 Georgetown Pike, McLean, VA, 22101-2296).

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Internet Watch

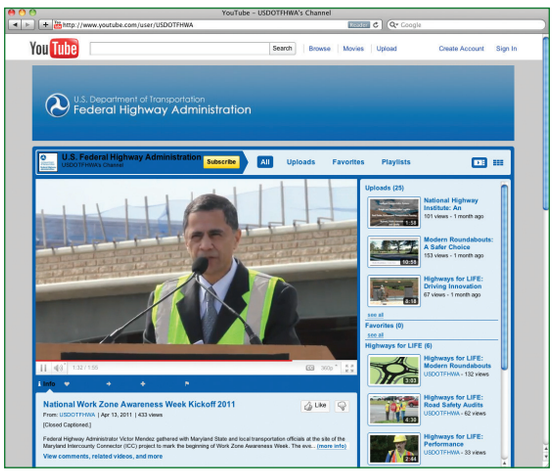
by Tom White

FHWA Launches Facebook And YouTube Presence

Social networking and media Web sites have evolved into powerful marketing tools. Arguably, two of the most prominent of these sites are Facebook and YouTube. Since its creation 7 years ago, Facebook has gained more than 500 million active users worldwide, making it the number one social networking site on the Internet. YouTube hosts more than 80 million videos. With such extended networks, these sites can serve as major communication channels through which transportation agencies can reach both targeted and broad audiences in a timely manner.

Recognizing these potential benefits, the Federal Highway Administration (FHWA) officially launched a Facebook page and a YouTube channel in March 2011. The pages are accessible from the home page of the FHWA Web site at www.fhwa.dot.gov. FHWA will use these new media to supplement the agency's traditional public communication channels such as newsletters, news releases, and other print media.

"Facebook and YouTube offer the opportunity to share a wide range of information with diverse audiences in a consistent and timely fashion," says FHWA Executive Director Jeff Paniati. "We realize the potential impact of social media and are excited about its communications benefits."



Communicating Via Facebook

Among other things, Facebook enables individuals to share articles, photographs, and videos. The site also serves as a sort of news ticker service for its users. For example, a registered Facebook user can link to FHWA's Facebook page simply by clicking "Like." The user then will be notified each time FHWA posts something new on its Facebook page, including news items, information on new technologies, or other hot topics.

FHWA uses Facebook to inform multiple audiences about current and completed projects and initiatives. Other uses include recruiting potential employees, promoting events, and sharing photographs and video clips from recent events and speaking engagements. The site is a channel through which FHWA officials hope to engage readers, build interest, and seek public feedback and input.

"In today's fast-paced, mobile world, many people use Facebook as more than a social networking tool," Paniati says. "They also use it as a news source and a way to stay informed about topics that are important to them. Now that can include FHWA."

Connecting Via YouTube

YouTube offers an opportunity for FHWA to share videos with both broad and targeted audiences. The FHWA YouTube channel has more than 25 videos covering topics such as National Work Zone Awareness Week, modern roundabouts, and road safety audits. Users have the option to subscribe to the channel to receive notification when FHWA posts new videos.

YouTube is easy to use. From FHWA's YouTube page, users can watch and rate videos, leave feedback, and share or embed links on their Web sites to the videos. In addition, YouTube videos are playable on an estimated 99 percent of the computers linked to the Internet. Users do not have to download video playback software to view the videos. And, all YouTube content is compliant with Section 508 of the Rehabilitation Act (that is, captioned for the hearing impaired).

Facebook and YouTube are interconnected—extending FHWA's reach to even broader audiences. From YouTube, FHWA can embed videos to Facebook, enabling anyone viewing a video on the Facebook page to double-click the video and go directly to the YouTube channel. The Facebook page also displays a YouTube tab, which shows the most recent videos. Likewise, the FHWA YouTube page includes a link to the FHWA Facebook page.

"FHWA is a proponent of innovation and embraces new and emerging technologies," says Paniati. "And although FHWA's YouTube and Facebook pages are in their infancy, we see them growing into useful, popular tools for communicating with large audiences."

Tom White is the social media and Web content coordinator in the FHWA Office of Public Affairs.

by Lilly Pinto

Supporting Local Public Agencies to Meet Uniform Act Requirements

Many cities and counties, also known as Local Public Agencies (LPAs), receive Federal-aid highway funds to help support their transportation programs and projects. In some cases, Federal-aid projects undertaken by LPAs require the acquisition of real property. When this happens, LPAs must ensure the accurate implementation and administration of the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, known as the Uniform Act.

The purpose of the Uniform Act is twofold: (1) to provide for equitable treatment of persons displaced from their homes, businesses, or farms by Federal and federally assisted programs, and (2) to establish uniform and equitable land acquisition policies for these programs. If an LPA needs to acquire real property, its right-of-way acquisition must comply with the Uniform Act and the act's implementing regulations outlined in 49 Code of Federal Regulations Part 24. Compliance is necessary if Federal funding contributes to any phase of the project, from planning to right-of-way and construction.

FHWA Review Reveals Need for Training

A national review, led by FHWA, of the LPA-administered projects in 2006 identified several risk factors associated with LPAs' implementation of Federal-aid projects. The review, in part, suggests that FHWA may need to provide more oversight and training to ensure that LPAs meet Federal-aid requirements for projects they administer.

"As a result of these findings, FHWA has implemented several strategic objectives aimed at improving the integrity of the LPA program through risk-based oversight," says Carolyn James, a realty specialist in the FHWA Office of Real Estate Services. "To support these objectives, FHWA outlined a national initiative to develop procedures, training, and oversight guidance for the delivery of LPA projects."

To assist with meeting the strategic objectives for increasing LPA training, the National Highway Institute (NHI) created the course Introduction to Federal-Aid Right-of-Way Requirements for LPAs (FHWA-NHI-141050). The goal of the course is to support local agencies in their knowledge of Federal-aid requirements regarding real property acquisition, specifically those laid out in the Uniform Act. The course consists of information from existing NHI training materials, information culled from the Office of Real Estate Services, and up-to-date guidance on complying with the Uniform Act. NHI also is assisting in the development of a Web site for LPAs, which will provide information, guidance, and resources related to the requirements for using Federal-aid highway funding in locally administered projects.

Robert Merryman, an NHI course instructor, provides details of a case study during a right-of-way training session.

O. R. Colan Associates

About the Course

Introduction to Federal-Aid Right-of-Way Requirements for LPAs is designed to provide participants with a working knowledge of Federal requirements and procedures for acquiring property for federally assisted transportation projects. The course is hands-on and highly interactive. For example, course instructors present case studies of agencies acquiring real properties and encourage participants to comment and share ideas relative to the acquisition, valuation, and relocation processes. In addition, the instructors facilitate role-playing exercises to demonstrate real-life interactions between landowners and LPAs.

Participants learn how to explain the legal basis for land acquisition by a governmental entity, assess the impact of a roadway project as it relates to the Uniform Act, sequence the right-of-way process within the overall project development process, determine the appropriate valuation process for right-of-way acquisition, apply the Uniform Act requirements for right-of-way acquisition and relocation assistance, and determine their agency's responsibilities for managing real property. For participants with limited knowledge of right-of-way requirements, NHI provides a free Web-based overview course, Real Estate Acquisition Under the Uniform Act: An Overview (FHWA-NHI-141045). Participants can take the Web-based course for a basic overview of the Uniform Act before attending the Instructor-led session.

The course is relevant for LPAs and those individuals responsible for overseeing LPAs' Federal-aid projects. However, the course content also is appropriate for any Federal, State, and local personnel responsible for acquiring rights-of-way for transportation projects using Federal funds.

"This course emphasizes coordination and communication between the State department of transportation and LPAs, and provides a forum for the exchange of ideas between them facilitated by a qualified instructor," says Lisa Barnes, vice president of O. R. Colan Associates, and project manager for the Course Development Team.

For a full course description, visit NHI's Web site at www.nhi.fhwa.dot.gov.

Lilly Pinto is a contractor for NHI.

Communication Product Updates

Compiled by Zachary Ellis 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 (FHWA) 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: 703–605–6000
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).

Field-Cast UHPC Connections for Modular Bridge Deck Elements (TechBrief) Publication No. FHWA-HRT-11-022

The use of modular bridge deck components has the potential to produce higher quality, more durable bridge decks. However, the materials used to connect the precast bridge deck components often prove lacking, resulting in less than desirable overall system performance. Advanced cementitious composite materials, such as ultra-high performance concrete (UHPC), present an opportunity to enhance the performance of field-cast connections significantly. This TechBrief highlights the results of an FHWA study to evaluate the performance of field-cast UHPC connections linking precast concrete bridge deck components.

Through its Structural Concrete Research Program, FHWA recently completed an experimental study focused on the performance of field-cast UHPC deck-level connections between precast modular bridge components. Researchers fabricated and tested bridge deck components simulating both longitudinal and transverse connections, and then subjected them to repeated traffic loadings.

During the loadings, the researchers assessed three critical behaviors. First, cyclic loading below the cracking load enabled researchers to assess the cracking performance of the field-cast UHPC and its bonding to the precast concrete. Second, cyclic loading that generated stresses above the static cracking stress on the specimen enabled researchers to evaluate whether any uncontrolled, progressive cracking or interface debonding occurred between the UHPC and precast concrete. Finally, the researchers assessed the static overload performance of the system.

The results of the study, in combination with experience gained through deployments of field-cast UHPC-filled connections, have demonstrated the viability of this connection system.

The document is available at www.fhwa.dot.gov/publications/research/infrastructure/structures/11022/index.cfm. Printed copies are available from the PDC.

Ultra-High Performance Concrete (TechNote) Publication No. FHWA-HRT-11-038

The exceptional mechanical and durability properties of UHPC present potential solutions to highway infrastructure deterioration, repair, and replacement issues. This TechNote provides an introduction to UHPC and discusses practical considerations. The document includes information on UHPC applications; availability; mixing and casting; curing procedures; testing

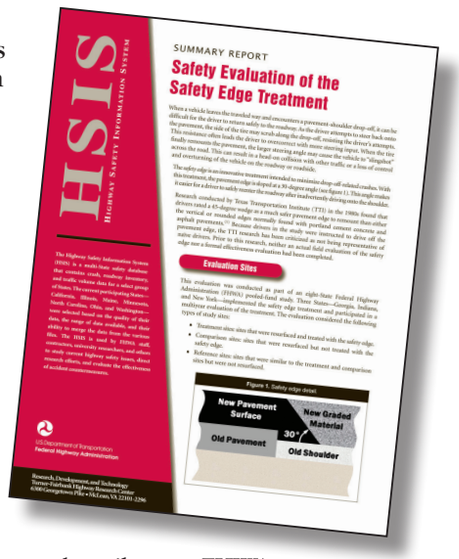
procedures; sample preparation and extraction; structural design, analysis, and modeling; and inspection information.

Since it became commercially available in 2000, UHPC has been used in three prestressed concrete girder simple span bridges in the United States. Many more departments of transportation are considering using UHPC for a wide variety of highway infrastructure applications. The concrete's high compressive and tensile strengths enable the redesign and optimization of structural elements, while its enhanced durability properties can extend design life. Enhanced durability also enables potential use as thin overlays, claddings, or shells.

Researchers have determined that UHPC can facilitate the development of innovative solutions to existing challenges, for example, advancing accelerated construction, lengthening span ranges, and rehabilitating substandard infrastructure. According to the TechNote, a decade of research and deployment efforts demonstrates that UHPC is a material both capable of and poised for future deployment in infrastructure-scale applications.

The document is available at www.fhwa.dot.gov/publications/research/infrastructure/structures/11038/index.cfm. Printed copies are available from the PDC.

Safety Evaluation of the Safety Edge℠ Treatment (Summary Report) Publication No. FHWA-HRT-11-025



Pavement-shoulder dropoffs can pose challenges to drivers attempting to return their vehicles safely to the road when recovering from a roadway departure. This report, *Safety Evaluation of the Safety Edge Treatment*, examines the effectiveness of a pavement edge sloped at a 30-degree angle to minimize the impacts on vehicles entering and exiting the shoulder. The document describes an FHWA evaluation of the Safety Edge treatment in three States, safety effectiveness analysis and results, treatment costs, benefit-cost analysis and results, and recommendations.

Using data from Georgia, Indiana, and New York, researchers completed a 3-year study of sites that were resurfaced and treated with the Safety Edge (treatment sites), sites that were resurfaced but not treated with the Safety Edge (comparison sites), and sites that were similar to the treatment and comparison sites but were not resurfaced (reference sites).

Researchers found that for all two-lane highway sites in Georgia and Indiana, the effectiveness of the Safety Edge treatment is a reduction in total crashes of approximately 5.7 percent. While this result is not statistically significant, the Safety Edge treatment is so inexpensive that its application under most conditions appears to be highly cost effective. The report concludes that the treatment is suitable for use by highway agencies under a broad range of conditions on two-lane highways.

The document is available at www.fhwa.dot.gov/publications/research/safety/hsis/11025/index.cfm. Printed copies are available from the PDC.

Highway Safety Information System: The Essential Information System for Making Informed Decisions About Highway Safety (Brochure) Publication No. FHWA-HRT-11-031

The Highway Safety Information System (HSIS), developed and maintained by FHWA, is a roadway-based system that houses quality data on a large number of crash, roadway, and traffic variables collected from State departments of transportation. HSIS aims to bolster the FHWA safety research program and provides input for policy decisions. This brochure, *HSIS: The Essential Information System for Making Informed Decisions About Highway Safety*, highlights key information about HSIS, including participating States, available data, a related laboratory, a Web site, and related tools including guidebooks, data element tables, and summary reports.

The HSIS database contains basic files on crashes, roadway inventories, and traffic volumes from California, Illinois, Maine, Michigan, Minnesota, North Carolina, Ohio, Utah, and Washington. Information also is available on supplemental data such as intersections, interchanges, horizontal curves, and vertical grades from some of the States. Safety analysts, researchers, and other highway safety professionals can request and receive data in various formats such as Microsoft® Excel® and Access®, dBase™, SAS®, American Standard Code for Information Interchange (ASCII), or convert the data to a format for sharing and for use in a statistical analysis system.

The HSIS Web site is accessible at www.hsisinfo.org. The brochure is available at www.fhwa.dot.gov/publications/research/safety/hsis/11031/index.cfm. Printed copies are available from the PDC.

Geosynthetic Reinforced Soil Integrated Bridge System Synthesis Report Publication No. FHWA-HRT-11-027

Geosynthetic Reinforced Soil (GRS) technology consists of closely spaced layers of geosynthetic reinforcement and compacted granular fill material. The GRS Integrated Bridge System is a fast, cost-effective method of bridge support that blends the roadway into a superstructure to create a jointless interface between the bridge and the approach. This report is the second in a two-part series to provide engineers with basic knowledge of GRS

technology and its fundamental characteristics as an alternative to other construction methods.

The application of the Integrated Bridge System has several advantages. According to the report, the system is easy to design and economical to construct. It can be built in variable weather conditions and can easily be modified in the field. FHWA found that this method has significant value when employed for small, single-span structures. Further, FHWA selected the technology for promotion under the Every Day Counts Initiative (www.fhwa.dot.gov/everydaycounts), which aims to accelerate implementation of proven, market-ready technologies.

The *Geosynthetic Reinforced Soil Integrated Bridge System Synthesis Report* is available at www.fhwa.dot.gov/publications/research/infrastructure/structures/11027/index.cfm. Printed copies are available from the PDC.

Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide
Publication No. FHWA-HRT-11-026

The *Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide* outlines the state of the art and recommended practice for designing and constructing GRS technology for the application of the Integrated Bridge System. The procedures presented in the manual are based on 40 years of State and Federal research focused on GRS technology as applied to abutments and walls. FHWA developed the interim implementation guide to assist deployment of this technology as part of the Every Day Counts Initiative.

FHWA developed the implementation manual to provide engineers with background knowledge of GRS technology and its fundamental characteristics as an alternative to other construction methods. The manual presents step-by-step guidance on the design of GRS Integrated Bridge Systems and provides analytical and empirical design methodologies in both the Allowable Stress Design and Load and Resistance Factor Design formats. The guide also provides material specifications and detailed construction guidance along with methods for the inspection, performance monitoring, maintenance, and repair of GRS Integrated Bridge Systems. Quality assurance and quality control procedures also are covered.

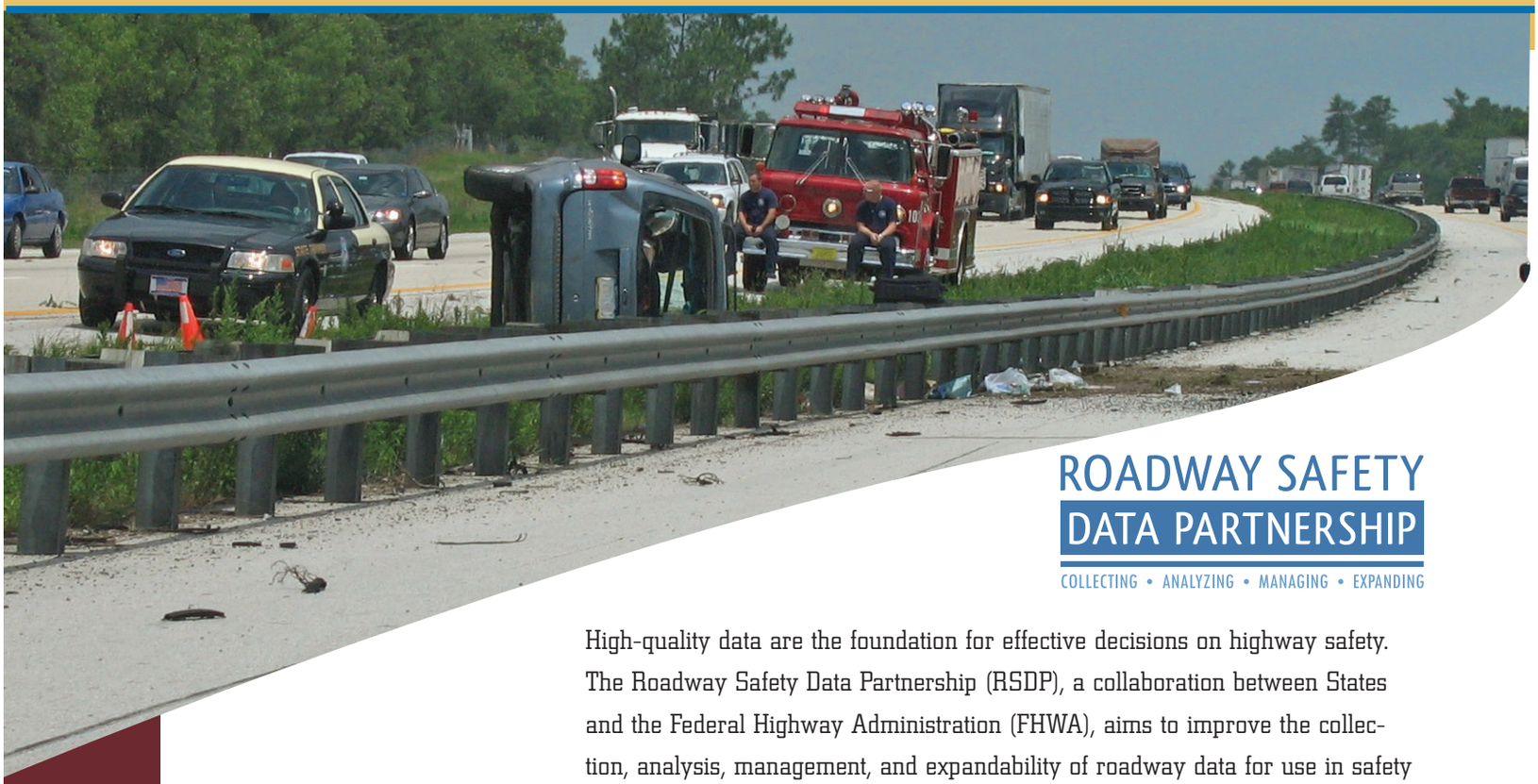
The document is available at www.fhwa.dot.gov/publications/research/infrastructure/structures/11026. Printed copies are available from the PDC. Copies are also available from NTIS under order number PB2011107390.

Conferences/Special Events Calendar

Date	Conference	Sponsors	Location	Contact
November 3–4, 2011	5th Rubber Modified Asphalt Conference	See conference Web site for a list of hosts and sponsors.	Austin, TX	Patricia Hahn 202-682-4883 phahn@rma.org Michael Blumental 202-682-4882 mblumenthal@rma.org www.rma.org
November 9–11, 2011	New York Public Transit Industry Fall Conference and Trade Show	New York Public Transit Association	Saratoga Springs, NY	Megan Tangjerd 518-434-9060 info@nytransit.org www.nytransit.org
November 9–12, 2011	Congress of Cities & Exposition	National League of Cities	Phoenix, AZ	Michelle Lynch 202-626-3105 lynch@nlc.org www.NLCCongressofCities.org
November 14–17, 2011	14th Annual National Tribal Transportation Conference	Tribal Technical Assistance Program, Federal Highway Administration, U.S. Department of the Interior Bureau of Indian Affairs	Nashville, TN	Dottie Fucetola or Ron Hall 800-262-7623 or 970-491-1007 dottie.fucetola@business.colostate.edu or ron.hall@business.colostate.edu http://ttap.colostate.edu
November 29–December 2, 2011	ACPA 48th Annual Meeting	American Concrete Pavement Association (ACPA)	Indian Wells, CA	ACPA Meetings & Events 847-966-2272 acpa@acpa.org www.acpa.org
November 29–December 2, 2011	Ground Water Expo and Annual Meeting	National Ground Water Association (NGWA)	Las Vegas, NV	NGWA Customer Service Department 800-551-7379 customerservice@ngwa.org www.ngwa.org/expo
December 5–9, 2011	Ecobuild® America 2011	National Institute of Building Sciences and AEC Science & Technology, LLC	Washington, DC	Ivett Ortiz 800-996-3863 ivett.ortiz@aecst.com www.aececobuild.com
January 22–26, 2012	TRB 91st Annual Meeting	Transportation Research Board (TRB)	Washington, DC	TRB Meetings Department TRBMeetings@nas.edu www.TRB.org/AnnualMeeting
January 24–27, 2012	World of Concrete	See show Web site for a list of cosponsoring organizations.	Las Vegas, NV	Jackie James 972-536-6379 jjames@hanleywood.com www.worldofconcrete.com

Have you scheduled your assessment yet?

Helping States benchmark and improve State roadway safety data capabilities



ROADWAY SAFETY
DATA PARTNERSHIP
COLLECTING • ANALYZING • MANAGING • EXPANDING

High-quality data are the foundation for effective decisions on highway safety. The Roadway Safety Data Partnership (RSDP), a collaboration between States and the Federal Highway Administration (FHWA), aims to improve the collection, analysis, management, and expandability of roadway data for use in safety programs and decisionmaking.

The State roadway safety data capability assessment is key to helping each State understand its existing capabilities and the steps to reach its self-identified goals. The process will help States identify actions to overcome gaps and integrate improvements into their safety plans.

For more information, visit http://safety.fhwa.dot.gov/rsdp. To schedule your State's assessment, contact Heather Rothenberg at 202–366–2193 or heather.rothenberg2@dot.gov.

The Assessment Process

Review Existing Sources → **Complete Preassessment Survey** → **Conduct Assessinar or Site Visit with FHWA Concurrence** → **Document Findings** → **Create Roadway Safety Action Plan**

U.S. Department of Transportation
Federal Highway Administration

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