# Public Roads

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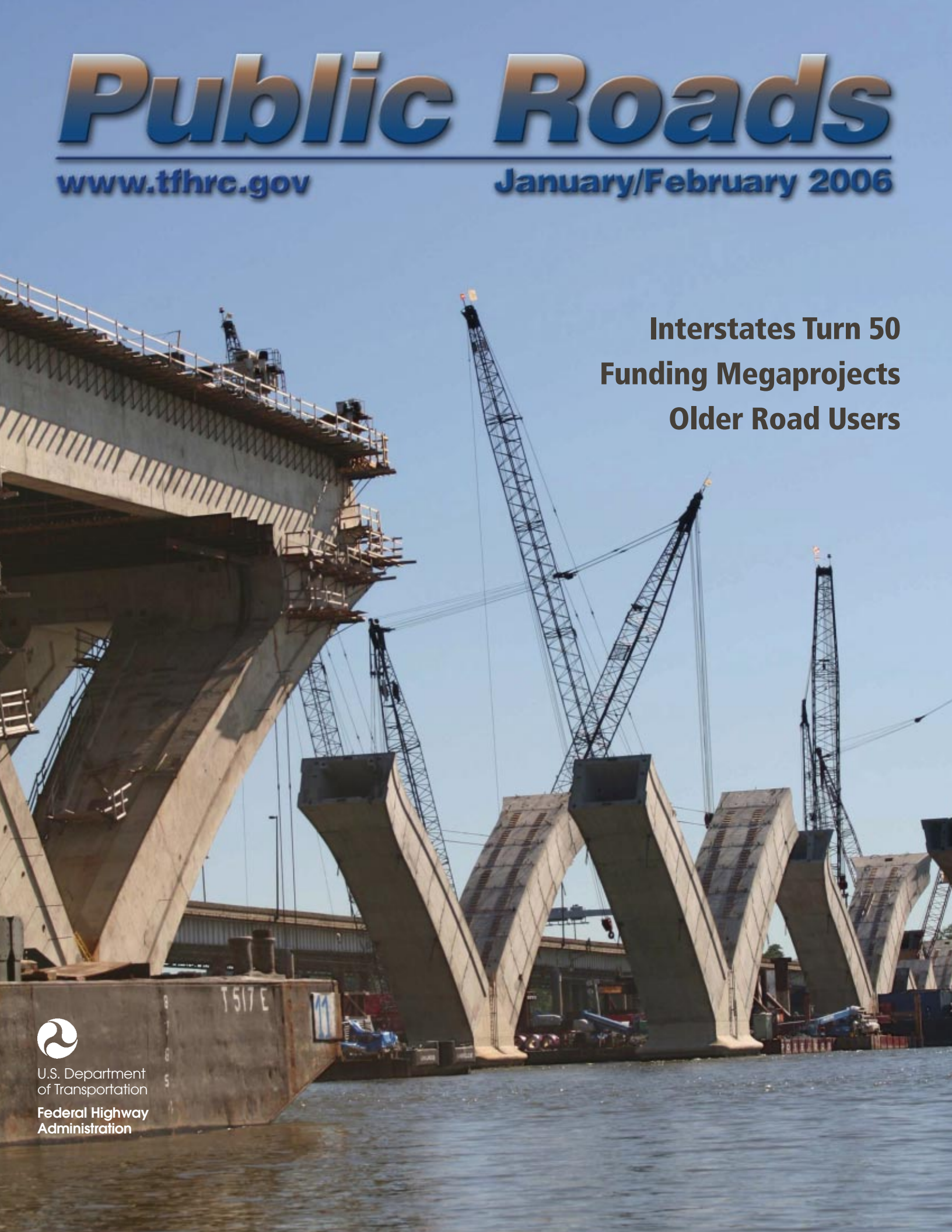
January/February 2006

## Interstates Turn 50
## Funding Megaprojects
## Older Road Users




U.S. Department of Transportation

Federal Highway Administration

# Public Roads

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

January/February 2006 www.tfhrc.gov Vol. 69, No.4

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**Front cover**—Cranes tower over the V-shaped concrete piers of the new Woodrow Wilson Bridge that will connect Maryland and Virginia just south of Washington, DC. The new structure, with eight general purpose lanes and an express lane configuration, will replace an existing bridge built in 1961 to handle 75,000 vehicles per day, but which now carries three times its design load and is burdened with 7 hours of congestion daily and traffic backups stretching several kilometers. *Photo: John McCracken, FHWA.*

**Back cover**—When completed in 2011, the new, double-span Woodrow Wilson Bridge will stitch together I–95/I–495, I–295, U.S. Route 1, and MD–210. Despite the size of the project with its massive concrete piers and superstructure, shown here from a kayaker's perspective, significant steps were taken to protect the natural environment, including habitat preservation, stream restoration, reforestation, and wetland creation, enhancement, and preservation. The $2.45 billion project is cofunded by the Federal Government, the States of Maryland and Virginia, and the District of Columbia. *Photo: John McCracken, FHWA.*

U.S. Department of Transportation
**Federal Highway Administration**

**U.S. Department of Transportation**
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# Guest Editorial

## Ensuring Safe Mobility for America's Seniors

The Eisenhower Interstate System, which celebrates its 50th anniversary in 2006, has brought about dramatic changes in the lives of all Americans. Yet in the coming years, the Nation's transportation system is likely to undergo further significant changes in order to accommodate the growing number of older Americans.

By 2030, the number of Americans 65 years or older is projected to double to about 70 million, or one in five Americans. The ranks of our most senior citizens, those 85 years and older, are expected to quadruple in the next 50 years. The aging of the U.S. population has important implications for the Nation's transportation system. Although recent efforts to improve safety and mobility for seniors are certainly beginning to show results, much more must be done to address the consequences of this significant demographic shift.

The Nation can take some measure of satisfaction from the reduced number of highway fatalities in recent years among those younger than age 65. The data over the last decade for older road users do not paint such a rosy picture. And looking ahead is not much better: Without improvement in the current fatality rate, highway deaths for those age 65 and above are projected to double or even triple by 2020 due to the rapid growth in the size of the older population.

Without additional attention to the needs of older citizens, the United States faces critical national impacts not only in terms of transportation safety, but also for the independence and mobility of the senior population. The specialized needs of older road and transit users will place new demands and strains on America's transportation system.

This edition of PUBLIC ROADS introduces the first in a series of articles describing the variety of efforts already underway to improve transportation safety and mobility for older Americans. Over the next several issues, the older driver and pedestrian series will highlight how highway and traffic engineers, safety researchers, professionals in aging services agencies, vehicle manufacturers, medical groups, and many others are helping to ensure that America's senior population continues to enjoy safe transportation and mobility throughout their later years.

Through these creative approaches, we have many opportunities to help make the roadway environment work well for America's seniors. Considering these issues in highway design and operational practices can make it easier and safer for older road users to extend their safe driving years as well as improve safety for road users of all ages.

Responding to this challenge will require the combined actions of local, State, and Federal transportation agencies, but the benefits are well worth the effort. A mobile senior population will allow this growing part of American society to remain active and independent as contributing members of their communities.

When you read these articles, I hope you will find inspiration for the many ways that you too can contribute. There is much that highway and traffic engineers can do to provide the physical links that allow America's seniors to enjoy rich, fully productive lives. Creating a safe roadway environment often requires considerable lead time, and with the rapid aging of the U.S. population, the time to act is now. I hope you will join me in supporting these efforts that are so important to the safety and independence of America's seniors.

Norman Y. Mineta
Secretary of Transportation

*In 2006, the 50th anniversary of "the greatest public works project in history" calls for a celebration—and an appeal for a searching look at the future of transportation.*

*by Richard F. Weingroff*

# The Year of the Interstate

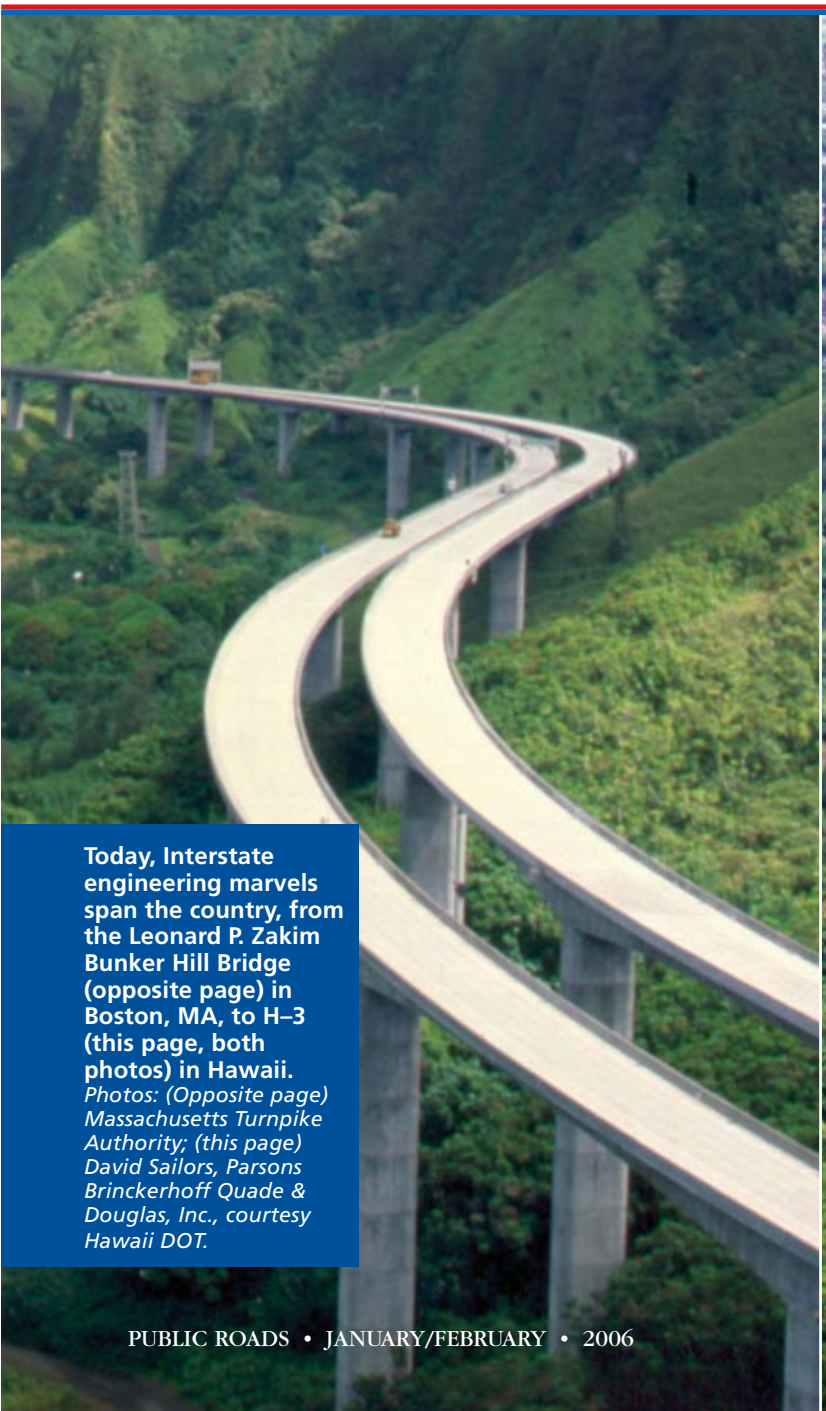
One mark of the overwhelming success of the Eisenhower Interstate System is that the American people take it for granted, as if has always been there, like the Mississippi River or the Rocky Mountains. The Interstates are so much a part of the daily life of Americans that most people do not realize that the system they use to get to work, to school, to the mall, and to their vacation destination could be considered one of the "wonders of the world."

In 2006, the Federal Highway Administration (FHWA), State departments of transportation (DOTs), and transportation partners in the private sector will have the opportunity to remind the American people that the Interstate System is not a natural phenomenon, but rather the result of dedicated men and women working for five decades to enhance the mobility that has always been part of the American dream. Those years of challenge and controversy were also a period of technological evolution, environmental stewardship, and, most of all, commitment to the goal of building the Dwight D. Eisenhower National System of Interstate and Defense Highways.

## In the National Interest

The origins of the Interstate System go back to studies in the late 1930s and early 1940s. Section 7 of the Federal-Aid Highway Act of 1944 authorized designation of a 65,000-kilometer (40,000-mile) "National System of Interstate Highways." Within that original mileage limitation, the routes were designated in 1947 and 1955, but in the absence of a national program and a Federal commitment to build the roadways, little was accomplished.

President Dwight D. Eisenhower is rightly called the "Father of the Interstate System." Despite all the challenges that faced him at the height of the Cold War, the highway network was his personal mission. He fought for it in public and behind the scenes. In 1955, when



**Today, Interstate engineering marvels span the country, from the Leonard P. Zakim Bunker Hill Bridge (opposite page) in Boston, MA, to H–3 (this page, both photos) in Hawaii.** *Photos: (Opposite page) Massachusetts Turnpike Authority; (this page) David Sailors, Parsons Brinckerhoff Quade & Douglas, Inc., courtesy Hawaii DOT.*

**Shown here is one of the country's main Interstate highways of an earlier era: U.S. 40 (Atlantic City, NJ, to San Francisco, CA) in 1953 at its intersection with Ingleside Avenue west of Baltimore, MD.**

disputes over financing caused the U.S. Congress to reject the bills that would have funded the system, his frustration was evident when he declined to hold a special session to consider the bills, saying, "Well, the special session might be necessary—but calling it could be at the cost of the sanity of one man named Eisenhower."

In 1956 the pieces finally fell into place. Although the Federal-Aid Highway Act of 1956 contained many provisions affecting the Interstate System, the key legislative phrase in section 108 is breathtakingly simple and direct: "It is hereby declared to be essential to the national interest to provide for the early completion of the 'National System of Interstate Highways,' as authorized and designated in accordance with section 7 of the Federal-Aid Highway Act of 1944."

That simple phrase—"the national interest"—is all the justification the legislators who created the bill thought was needed, perhaps because they believed the interest was obvious, widely understood, and


**The standard road sign for the Dwight D. Eisenhower National System of Interstate and Defense Highways, designed by FHWA and the American Association of State Highway and Transportation Officials, was unveiled in a ceremony on Capitol Hill on July 29, 1993. Left to right: Chairman Nick J. Rahall (D–WV) of the House Surface Transportation Subcommittee, John Eisenhower (President Eisenhower's son), Federal Highway Administrator Rodney E. Slater, and Chairman Norman Y. Mineta (D–CA) of the House Committee on Public Works and Transportation.**

shared. They added only that one component of the national interest was "national defense," so section 108 also changed the name of the new network to the "National System of Interstate and Defense Highways." (In 1990, President George H. W. Bush signed legislation changing the name of the Interstate System to honor President Eisenhower.)

Of all the bills that President Eisenhower signed during his 8 years in office, he probably put as much of himself into the one that created the Interstate System as any other, and more than most. Unfortunately, he did not have an opportunity to celebrate the occasion with a formal ceremony. The bill was among a stack that he signed on June 29, 1956, his last day at Walter Reed Army Medical Center following surgery on June 7. He made no recorded comment, issued no statement, had no celebratory photo taken. He was said to be "highly pleased."

One might wonder what his thoughts were as he signed the new law. Perhaps he was just relieved that the job was done, or worried that the job was just beginning. History does not say whether he worried that the men and women who would have the job of carrying out his vision in "the national interest" might falter, but it does reveal, 50 years later, that they did carry out the vision and did so triumphantly.

Dwight Eisenhower Library

**President Dwight D. Eisenhower, the "Father of the Interstate System," was convinced the highway network would "change the face of America."**

## Adapting to a Different World

If Eisenhower was the visionary promoter behind the Interstate System, Francis C. "Frank" Turner was its spirit. He joined the U.S. Bureau of Public Roads (BPR) in


**Frank Turner speaks at the dedication of the Francis C. Turner Building at the Turner-Fairbank Highway Research Center in McLean, VA, on May 5, 1983. Turner was honored as "a man who thrived on change, believed in innovation based on facts gathered through research, and played a significant role in implementing research results in the United States and the world."**

## The Way It Was in 1956

How much the Nation has changed since that June day in 1956! Television was black and white, every kid in America could sing the theme to "Davy Crockett," and everyone loved Lucy and all the other TV characters who were the era's role models. Cars had fins, an Oldsmobile 88 deluxe sedan cost $2,688, and traffic was increasing every year, but passenger rail was still the preferred choice for long distance travel.

Elvis Presley topped the charts with "Don't Be Cruel," and other performers in the Top 10 included the Platters, Gogi Grant, Doris Day, and Nelson Riddle. Playwright Arthur Miller married actress Marilyn Monroe on the same day that President Eisenhower signed the Interstate bill. "Around the World in 80 Days" won the Academy Award for Best Picture, the New York Yankees beat the Brooklyn Dodgers in the World Series, and President Eisenhower defeated Illinois Governor Adlai Stevenson in a landslide.

Over the decade, the number of children ages 5–14 grew from 24.6 million in 1949 to 40.0 million in 1960, while U.S. homeowners increased from 23.6 million to 32.8 million. Americans were moving to the suburbs in increasing numbers. The Nation's schools were adjusting to the Supreme Court's landmark 1954 decision in *Brown v. Board of Education of Topeka*, and society began to adapt to a revolution in civil rights.

Still years off were the copy and fax machines, cable television, microwave ovens, personal computers on every desk, e-mail and e-commerce, a man on the moon, recycling, the Beatles, Spider-Man, the assassination of a President, "The Sixties," iPods® and BlackBerries™, compact discs and DVDs, the Vietnam War, dependence on foreign oil, the collapse of the Soviet Union, and 9/11 and the war on terrorism. Betty Friedan's *The Feminine Mystique*, Ralph Nader's *Unsafe at Any Speed*, and Rachel Carson's *Silent Spring* had not yet initiated movements that would change America.

1929, and by the 1950s was in position to serve as executive secretary of the committee the President formed, under retired General Lucius D. Clay, to develop a plan for a National Highway Program. He also was the liaison between the BPR and the House and Senate committees as they developed the 1956 Act. Once it went into effect, Turner worked with State highway officials on many of the location and design decisions prior to construction of Interstate highways around the country. He would serve as Federal Highway Administrator (1969–1972), the only career employee to head the agency.

Turner was a transitional figure, helping the agency adapt to changing demands on the Interstate System as it developed in the context of the eras it passed through. The early Interstates were the best roads built to that date, the product of an evolutionary design process that can be traced through Germany's autobahn (1930s), the Pennsylvania Turnpike and Arroyo Seco Parkway in Los Angeles (both 1940), and the turnpike boom of the late 1940s and early 1950s. Opponents said the early Interstates were produced from a "cookie-cutter" design. However, the design was never static. The public and private partners who created the Interstate System adapted the highways to operational

**Shortly after President Dwight D. Eisenhower signed the Federal-Aid Highway Act of 1956 on June 29, Secretary of Commerce Sinclair Weeks apportioned FY 1957 Interstate Construction funds. Two days later, on August 1, cameras snapped as Secretary Weeks (center) signed the FY 1958 apportionment, with Commissioner of Public Roads Charles D. "Cap" Curtiss (left) and Under Secretary of Commerce for Transportation Lewis Rothschild looking on.**

and safety experience, criticism from the environmental community and safety advocates, and advances in bridge, pavement, and tunnel technologies. Each generation of Interstate engineers topped its predecessors, so that today, engineering marvels span the country, from the Leonard P. Zakim Bunker Hill Bridge in Boston, MA, to H–3 in Hawaii.

An example of that evolution was the Papago Freeway in Phoenix—the final segment of transcontinental I–10 (Jacksonville, FL, to Santa Monica, CA). When the Interstate first appeared on the drawing boards, it was to be an elevated highway that would soar 10 stories above Phoenix's Central Avenue. "Helicoil" interchange ramps provided "safe, easy" access to the structure, according to a promotional brochure. Twenty years of controversy later, on August 10, 1990, the Arizona Department of Transportation (ADOT) opened the "missing link" in I–10—below ground through a tunnel topped by a long grassy strip called the Margaret T. Hance Park, which links the communities on either side of the highway.

William Ordway, director of ADOT from the mid-1970s to the

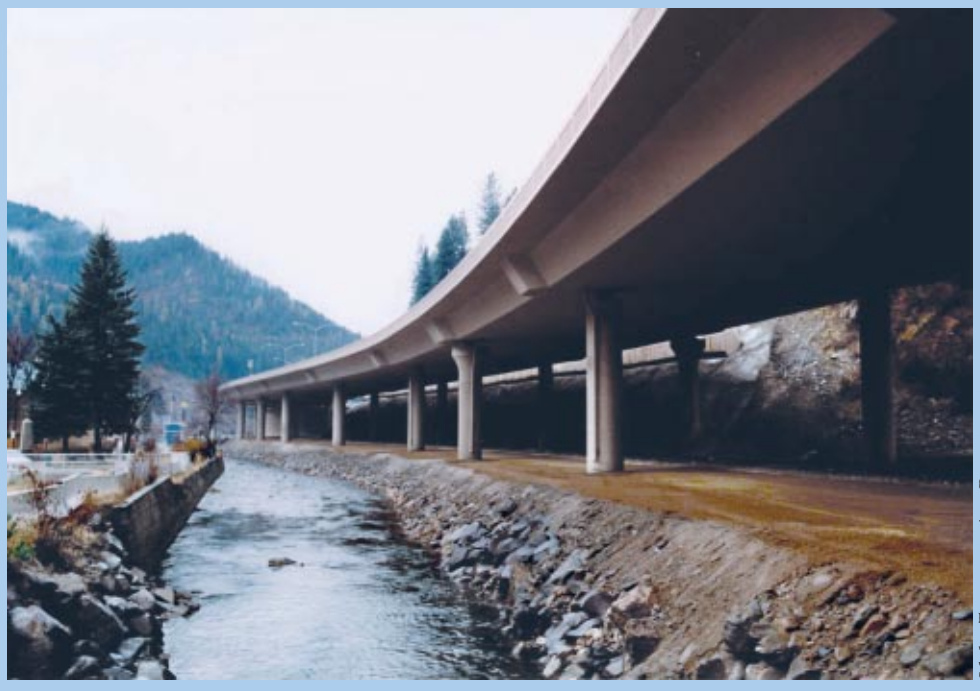
**Design of the Interstate System evolved from earlier freeways, such as the Pennsylvania Turnpike (above) and the Arroyo Seco Parkway (below, now the Pasadena Freeway) in Los Angeles, both of which opened in 1940.**

ADOT

**In the original 1960s design for an elevated I–10 Papago Freeway, the Arizona Highway Department proposed a new interchange design called a "helicoil" that would require traffic to take a 280-degree loop to the ground. The elevated freeway and helicoil interchanges were abandoned in favor of construction below ground with a deck carrying the Margaret T. Hance Park linking the communities on either side of the highway.**

**The opening of the Leif Erickson Tunnel in Duluth, MN, on October 28, 1992, completed I–35 (Duluth to Laredo, TX). The Duluth segment began as a conventional freeway that would have cut off access to the shoreline and eliminated historic properties. With the help of a Citizens Advisory Committee, the Minnesota Department of Transportation (Mn/DOT) redesigned I–35 to include cut and cover tunnels, architectural design treatments, and extensive landscaping. Mn/DOT spokesman John Bray said, "The great thing is that this . . . was Duluthians deciding what was best for Duluth and then all working together to make it happen."** *Photo: Mn/DOT.*

**Years of controversy delayed construction of I–90 through Wallace, ID, the final segment of the route (Boston, MA, to Seattle, WA). On September 12, 1991, the $40 million I–90 viaduct bypass opened, putting an end to the widely publicized "last stoplight on I–90." Two days later the town held a "Last Stop Celebration" to bury the stoplight. With tongue in cheek, City Councilman Mike Aldredge told a crowd of more than 1,000, "Cruel progress has eliminated the need for the services of our old friend."**



*Idaho Transportation Department*

mid-1980s, during the peak of the Papago struggles, probably put it best: "Painful and costly as were the delays, there's no question that we got a better freeway, friendlier toward the city, with high-occupancy vehicle lanes, and built-in beautification. The combined expertise of all of America's freeway building was available for the Papago."

He could have been describing the evolution of countless Interstate System highways.

## Changing the Cookie-Cutter

One of the most important features of the Interstate System is uniformity in design and signage to eliminate surprises that could result in safety and operational problems. These standards would be necessary as the Interstate expanded across the Nation and made cross-country commerce and travel possible.

The close partnership between Federal and State agencies played an important role in establishing standards in design, operations, and safety. Design guidelines issued by the American Association of State Highway and Transportation Officials (AASHTO) are adopted by FHWA as national standards, and likewise, FHWA is responsible for standards such as those in the *Manual on Uniform Traffic Control Devices*. Standards are updated when necessary as innovations and new solutions to problems are developed.

From the early years, highway engineers across the country built Interstates to match geographic and other challenges. Through creativity, sensitivity, and engineering expertise, each State built highways that, while uniform in some respects, were unique to their settings. Even in the late 1950s, the U.S. Bureau of Public Roads was referring to "the broad sweep, the varied facets of accomplishments" that were part of the Interstate story. Given the diversity of the United States, this part of the history should not be surprising. But it is a part of the story that has been lost, in part because the Interstate System has had its share of opponents.

Author and social scientist Lewis Mumford was a harsh observer of the Interstate System from the start, particularly its impacts on U.S. cities. He said that in passing the 1956 Act, Congress "hadn't the faintest notion of what they were doing." Looking back, perhaps he was right. Maybe no one fully understood that the legislation would not simply create better highways, but would "change the face of America," as President Eisenhower put it in his 1963 memoir *Mandate for Change*.

The Interstates have never been able to shake the cookie-cutter image, the idea that traveling the Interstates involves the "mind-numbing monotony" of traveling on "brain-deadening" roads in an "effortless, rolling trance." (These quotes are real, by the way, from various travel writers of the 1990s.) The Interstates have been blamed for many perceived ills of the American society, from sprawl to air pollution to a lack of sense of place, from racial tensions to alienation to dependence on foreign oil. And those involved in building an Interstate highway over the past 50 years have learned about the determined individuals and organizations who fought Interstates from start to finish.

The challengers have been persistent, but perhaps the men and women who built the Interstate System should be thankful that their feet have been held to the fire all these years; the Interstates and other roads are the better for it. It is likely that the transportation community would not have made as much progress in the conception and design of the Interstates and other highways. Similarly, much less effort would have been devoted to historic preservation and development of context-sensitive designs such as noise barriers, aesthetic treatments, and other environmentally sensitive solutions to help fit roadways into the surrounding environment. As illustrated by the transformation of the I–10 Papago Freeway, I–66 inside the Capital Beltway, I–70 through Glenwood Canyon in Colorado, the I–476/Blue Route in Philadelphia, the I–105 Glenn Anderson Freeway/Transitway in Los Angeles, and countless other Interstates, the transportation community was challenged to create


Marshall H. Cohen

**During the 40th anniversary of the Interstate System, the Federal Highway Administration developed a "Men of Vision" display featuring the Interstate System founding fathers: (left to right) Representative Hale Boggs (D–LA), former Federal Highway Administrator Francis C. "Frank" Turner, Representative George H. Fallon (D–MD), President Dwight D. Eisenhower, and Senator Albert Gore, Sr. (D–TN).**

highways that better fit the environment and communities that surround them. Instead of trying to overcome the environment, as in the early years, highway engineers learned to team up with experts from other disciplines, particularly planners and environmental specialists, historic preservationists, and with citizens to accomplish their objectives in ways that are consistent with their responsibilities for environmental stewardship.

The struggles are part of the history of the Interstate System. So are the engineering marvels stretched across the country like gems scattered by a giant's hand. As are the Federal, State, and industry leaders, as well as the thousands of anonymous men and women who helped to build the Interstate System. And another part of history is the laws that extended and transformed the program over the years, from the National Environmental Policy Act of 1969 that provided a framework for resolving the controversies to the Intermodal Surface Transportation Efficiency Act of 1991, which authorized the final funding for the Interstate construction program and launched the post-Interstate era. Observers may debate whether the Interstates' impacts are more positive or negative, but not, as President Eisenhower predicted, whether they have transformed the Nation.

## The Year of the Interstate

With the 50th anniversary of the Interstates falling on June 29, 2006, FHWA will join its partners in the State DOTs and the private sector to tell the story of the Dwight D. Eisenhower National System of Interstate and Defense Highways. This is not an "inside-the-Beltway" story (a phrase that did not exist before construction of I–495 encircling Washington, DC). It is a story that has a unique variation in each State and in the District of Columbia. It is a story that affects U.S. economic competitiveness in a world marketplace, national defense from the Cold War to the war on terrorism, and the daily life of every

Administrator Slater at the start of the tour in San Francisco, CA.

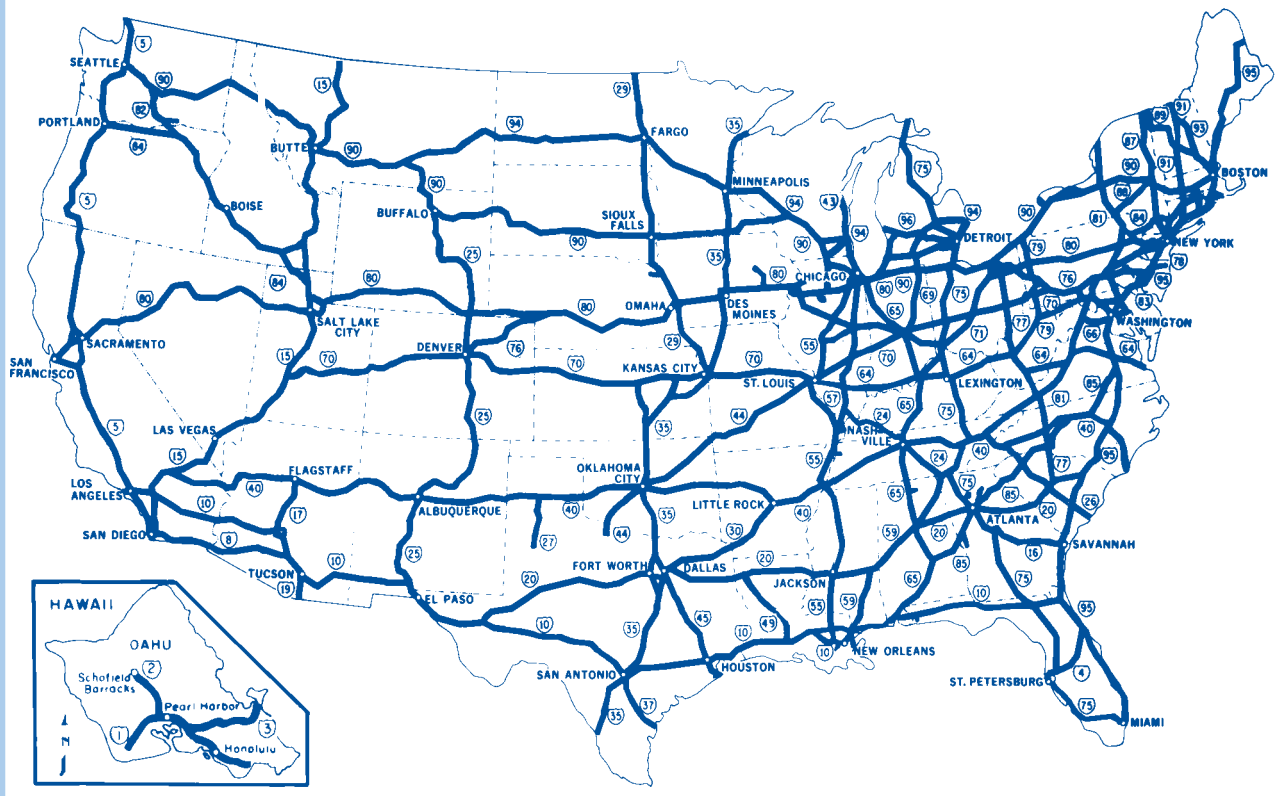

Stan Smith (right), commissioner of the Indiana Department of Transportation, introduced Administrator Slater at a happy 40th birthday ceremony in Indianapolis.


# 1996 Cross-Country Interstate Anniversary Road Tour

To commemorate the 40th anniversary of the Interstate System, Federal Highway Administrator Rodney E. Slater embarked on a cross-country tour paralleling the U.S. Army's 1919 transcontinental convoy (from the Zero Milestone in Washington, DC, to Golden Gate Park in San Francisco, CA) that gave future President Dwight D. Eisenhower an understanding of the need for better roads. The tour proceeded in reverse, California to Washington, from June 17 to June 26, 1996.

The cross-country tour ended where the 1919 convoy began—at the site of the Zero Milestone on the Ellipse south of the White House.

## THE DWIGHT D. EISENHOWER SYSTEM OF INTERSTATE AND DEFENSE HIGHWAYS




*Source: U.S. Department of Transportation, Federal Highway Administration.*

American. It is a story about agreeing on a national goal and achieving it through a Federal-State transportation partnership forged over the years, starting with the creation of the Federal-Aid Highway Program in 1916.

The 50th anniversary is an opportunity for the transportation community to tell a big story about the past. But it is also an opportunity to focus public attention on the future. The Interstates will remain a vital part of the transportation network for as far into the future as anyone might dare predict. Although the formal program initiated under the 1956 Act is at an end, more Interstates are on the drawing boards or under construction, while older routes are being upgraded to meet future needs, reflecting the vitality of the concept 50 years after it was put into law. How will the Interstates evolve? How will the Nation find the resources so these highways can continue to provide the vital service they have from the start? Could anything replace them, that is, carry the people and goods represented by 703 billion vehicle miles of Interstate travel annually?

This celebration of the past is an opportunity to explore a future where the Dwight D. Eisenhower National System of Interstate and Defense Highways will continue to serve the American people in "the national interest," and continue to be instrumental in keeping the Nation's economy moving.

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**Richard F. Weingroff** is the information liaison specialist in FHWA's Office of Infrastructure. He wrote about the origins of the Interstate System in the Summer 1996 issue of PUBLIC ROADS and took a comprehensive look at President Eisenhower's role in that history in the March/April and May/June 2003 issues of PUBLIC ROADS ("The Man Who Changed America, Part I" and "The Man Who Changed America, Part II"). He also wrote a prequel, "The Man Who Loved Roads," about President Harry S. Truman's contribution, in the May/June 2002 issue of the magazine.

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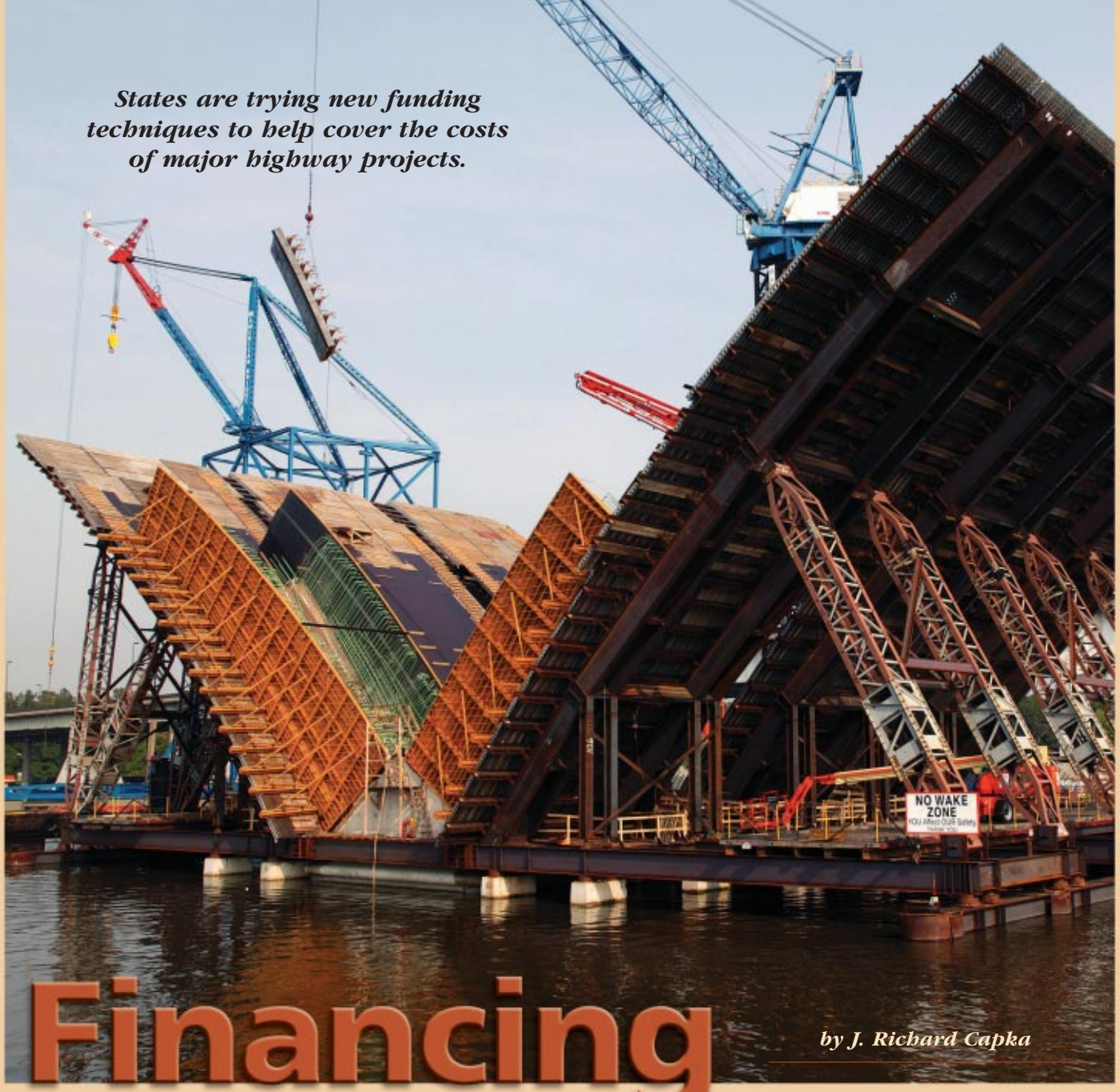
*States are trying new funding techniques to help cover the costs of major highway projects.*




# Financing MEGAPROJECTS

*by J. Richard Capka*

Megaprojects—$500 million-plus major infrastructure projects designed to meet the Nation's growing needs—are critical to increasing the capacity of the transportation infrastructure and improving mobility. Unfortunately, the associated megacosts of the projects make it a challenge to finance these behemoths. States and localities already have their plates full meeting the requirements of operating, maintaining, and rehabilitating existing highway systems.

In addition, the size and scope of megaprojects make it difficult to use traditional pay-as-you-go financing methods. The amount of transportation funding available to an agency in a fiscal year may not be enough to cover the cost of advancing a major project, but waiting until the money is available may result in increased congestion and further deterioration of the infrastructure, making delays unacceptable to the driving public. And the costs of project delay or extending the project timeline increase over time in terms of disruption to public mobility, the value of money, and project overhead.

**(Above) The Woodrow Wilson Bridge, shown here under construction over the Potomac River near Washington, DC, is a megaproject that relies exclusively on public financing.** *Photo: Virginia DOT.*

"There's simply not enough public-sector capital to undertake the backlog of transportation infrastructure work that needs to be done," says Robert Prieto, senior vice president of Fluor Corp., an engineering and construction firm. "The only option is to find new delivery mechanisms and sources of capital."

To address the challenges of financing megaprojects, transportation agencies are looking at new financing tools and techniques to pay for these huge undertakings and ways to start projects sooner. Agencies also are considering new models of financing that bring private-sector dollars into public projects to deliver the maximum infrastructure at the lowest cost to taxpayers and users in terms of time and money.

Most of today's megaprojects still rely exclusively on traditional public financing. A case in point is the Woodrow Wilson Bridge project near Washington, DC, which is designed to unclog a significant traffic bottleneck on the I–95 corridor. Federal funding participation for the Woodrow Wilson Bridge Project is approximately 85 percent, with the remainder of the funding coming from Maryland, Virginia, and Washington, DC.

An emerging trend in the transportation community is to use private-sector dollars to partially or totally finance megaprojects. For example, the Trans-Texas Corridor, a statewide network of transportation routes, is a public-private partnership that has attracted $7.2 billion in private investment. The Channel Tunnel (Chunnel) between London and Paris is wholly funded through private investors in a joint English and French venture managed by a private company under a long-term concession.

"Public-private partnerships provide new delivery mechanisms by allowing acceleration of what the public sector might be able to do. And they open access to sources of funds that are otherwise unavailable to the public sector," says Prieto.

## Megaproject Beginnings

A growing need to rehabilitate the Nation's aging infrastructure made major projects part of the construction project mix in the United States in the 1990s. Major projects completed during the decade include the $2.4 billion Alameda Corridor, an express rail line for freight linking the ports of Los Angeles and Long Beach, CA, and the $1.6 billion reconstruction of 27 kilometers (17 miles) of I–15 before the 2002 Winter Olympic Games in Salt Lake City, UT.

**The Central Artery/Tunnel project replaced an elevated highway with an underground expressway, shown here, to ease traffic congestion in Boston. The State and local governments are covering 42 percent of project costs.**

*Massachusetts Turnpike Authority*

Among the 1990s megaprojects still underway is the $1.3 billion Miami Intermodal Center, designed to improve access to Miami International Airport. Another is the $1.1 billion Foothill Freeway project to construct 45 kilometers (28 miles) of freeway between Los Angeles County and San Bernardino County, CA.

Most megaprojects are designed to enhance the existing infrastructure in busy urban areas, presenting the challenge of keeping traffic moving while the project is underway and increasing the complexity and cost of construction. As transportation agencies gained experience in developing megaprojects, they found that long-term cost projections, attrition of project staff, complex construction requirements, and unique engineering and design problems could make it difficult to keep cost overruns within bounds.

The Central Artery/Tunnel project, which replaced an elevated highway with an underground expressway and new bridge to ease traffic congestion in Boston, MA, has projected costs of more than $14.6 billion. Today the monumental cost involved in megaprojects such as this raises serious concerns about the public's ability to bear the financial burden using *only* public dollars.

Lessons learned from 1990s megaprojects led Congress to include a requirement in the Transportation Equity Act for the 21st Century (TEA-21) that every megaproject of $1 billion or more receiving Federal funds for construction have a financial plan that is updated annually. The recently enacted Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) redefined a megaproject to include projects of $500 million or more. The focus of the financial plan is to compare

## Current Major Highway Infrastructure Projects

- I–80/San Francisco-Oakland Bay Bridge (East Span), CA
- S.R. 210/Foothill Freeway, Los Angeles, CA
- I–25/I–225 Southeast Corridor (T-REX), Denver, CO
- I–95/New Haven Harbor Crossing Corridor Improvement Program, CT
- I–4, Orlando, FL
- Miami Intermodal Center, FL
- Tampa Interstate System (TIS), FL
- CREATE, Chicago, IL
- New Mississippi River Bridge (St. Louis), IL-MO
- New Ohio River Bridges (Louisville), KY-IN
- Central Artery/Ted Williams Tunnel, Boston, MA
- Intercounty Connector, MD
- I–94/Edsel Ford Freeway, Detroit, MI
- Mon/Fayette Expressway Toll Facility, Pittsburgh, PA
- Central Texas Turnpike, Austin, TX
- I–10/Katy Freeway, Houston, TX
- Trans-Texas Corridor, TX
- I–64/Hampton Roads Third Crossing, VA
- I–95/I–395/I–495/Springfield Interchange, VA
- I–95/Woodrow Wilson Bridge, MD-VA-DC
- I–43/I–94/I–794/Marquette Interchange, Milwaukee, WI

**Federal dollars are financing 95 percent of the Springfield Interchange, a project to reconstruct the intersection of Interstates 95, 395, and 495 near Washington, DC. This aerial photograph shows ongoing work on the megaproject.**

original cost estimates to actual costs and project completion schedules, as well as to provide reasonable assurance that sufficient resources are available to complete the project as planned.

As the Nation's infrastructure rehabilitation needs continue, so will the need to develop and finance megaprojects. At the end of fiscal year 2005, twenty-one active megaprojects receiving Federal funding were underway, ranging from projects in the final stages of environmental review to those under construction. The Federal Highway Administration (FHWA) anticipates the number of major projects to increase substantially over the next several years, especially with the new, lower threshold for defining a megaproject. (See "Current Major Highway Infrastructure Projects" on page 13.)

## Funding Variations

Historically FHWA has financed highways through the Federal-Aid Highway Program, which generally covers up to 80 percent of project costs (90 percent on interstate projects), with States and localities providing the remaining funds. Federal funding participation in today's megaprojects, however, varies significantly.

Of the major projects under construction, four are being financed under a Federal funding ratio of 80 to 95 percent, with States and localities providing the remainder. The four projects under this funding structure include the Washington, DC-area Woodrow Wilson Bridge, the Springfield Interchange in Virginia, the Tampa Interstate System in Florida, and the New Haven Harbor Crossing Corridor Improvement Program in Connecticut.

Projects with less-than-traditional Federal funding participation include Boston's Central Artery/Tunnel, at 58 percent; California's Foothill Freeway, at 55 percent; the Miami Intermodal Center, at 5 percent; Denver's Southeast Corridor (T-REX) project, at 53 percent; the San Francisco-Oakland Bay Bridge, at 5 percent; the Central Texas Turnpike, at 28 percent; Houston's Katy Freeway, at 61 percent; and Milwaukee's Marquette Interchange, at 54 percent.

State transportation agencies have compelling reasons to look to sources other than Federal funds to pay for megaprojects. Federal dollars apportioned to the States do not cover all of the projects eligible for Federal funding, so States must make hard decisions on how they will use the funds they do receive. In many cases, smaller projects that have captured the interest of local or political stakeholders use up the available Federal funding in a given fiscal year.

In addition, many megaprojects are so large and the need for them is so critical that pay-as-you-go is not a viable option. Instead, States are stepping up with higher contributions and using innovative financing techniques—including Federal loans, State bonding initiatives, and public-private partnerships—to secure funds sooner so they can get these projects underway.

## GARVEE and TIFIA Programs

The Federal Government and some States have introduced innovative tools to help State and local agencies finance transportation projects. Two programs that agencies are using to finance megaprojects are the Grant Anticipation Revenue Vehicle

(GARVEE) Program and the Transportation Infrastructure Finance and Innovation Act (TIFIA). Although the programs differ, they share the concept of financing projects by leveraging Federal assistance and accessing capital markets.

The GARVEE program enables States and other public authorities to issue debt-financing instruments, such as bonds, to pay for current expenditures on transportation construction projects and repay the debt using future Federal apportionments. In general, projects funded with the proceeds of a GARVEE debt instrument are subject to the same requirements as other Federal-aid projects with the exception of the reimbursement process. Instead of reimbursing construction costs as they are incurred, the reimbursement of GARVEE project costs occurs when debt service is due.

The benefit of the GARVEE financing mechanism is that it generates upfront capital to keep major highway projects moving forward at tax-exempt rates and enables a State to construct a project earlier than is possible with traditional pay-as-you-go financing. With projects completed sooner, costs are lower because of inflation savings, and the public realizes safety and economic benefits. By paying with future Federal highway reimbursements, the cost of the infrastructure is spread over its useful life rather than just over the construction period.

Without the ability to issue GARVEE bonds to provide upfront capital, the Colorado Department of Transportation (CDOT) would have been unable to bridge the funding gap on the $1.7 billion T-REX project to reconstruct sections of I–25 and I–225 and build a light transit line in Denver. With pay-as-you-go financing, T-REX would not be finished until 2017 instead of its anticipated 2006 completion date.

The GARVEE program along with other financing options is being considered to partly finance the proposed Intercounty Connector, a new highway that would link major travel corridors in Montgomery and Prince George's Counties, MD, north of Washington, DC. The Maryland General Assembly passed legislation giving the Maryland Transportation Authority, an agency under the Maryland Department of Transportation (MDOT), permission to issue up to $750 million in GARVEE bonds specifically for the project.

While GARVEE bonds help States obtain funding that will be repayable from future Federal-aid streams, the TIFIA program provides assistance to projects with their own repayment streams, such as tolls or other dedicated funding sources. Under TIFIA, the U.S. Department of Transportation (USDOT) provides direct credit assistance—up to 33 percent of eligible project costs—to sponsors of major transportation projects. Credit assistance can take the form of a loan, loan guarantee, or line of credit.

TIFIA assistance provides a number of benefits to project sponsors, including improved access to capital markets, flexible repayment terms, and potentially more favorable interest rates than can be found in private capital markets for similar instruments. TIFIA can help advance large, capital-intensive projects that otherwise might be delayed or not be built at all because of their size, complexity, and the market's uncertainty over the timing of revenues.

TIFIA has helped accelerate the Miami Intermodal Center, which involves construction of a multimodal transportation center for car rental, transit, commuter rail, Amtrak®, and intercity bus services. The Florida Department of Transportation (FDOT) is using a $433 million TIFIA loan package to finance part of the first phase of the project, which includes construction of the rental car facility and central station, right-of-way acquisitions, and roadway improvements. State fuel tax revenues and rental car fees secure the loans.

Another project using TIFIA financing is the Central Texas

**Using GARVEE bonds to provide upfront capital enabled CDOT to accelerate reconstruction of the I–225/I-25 interchange near Denver, CO. The photo shows I–25 running horizontally as I–225 connects from the bottom left.**

*Gregg Gargan, CDOT*

FDOT, District 6 and Earth Tech Consulting, Inc.

**In Florida, a TIFIA loan package is helping FDOT finance part of the construction of the Miami Intermodal Center. Fees generated by the car rental facility, shown here in an artist's rendering, will help pay off the loans. Features shown in the rendering include the customer lobby in the background, metal screens on the exterior of the garage, and the glazed wall of the ramp structure.**

Turnpike, a 196-kilometer (122-mile) toll facility in the Austin–San Antonio corridor designed to relieve congestion, improve safety, and enhance freight movement through central Texas. A $917 million TIFIA loan will finance nearly one third of the cost of phase one of the project. The Texas Turnpike Authority will repay the loan using toll revenues.

## Public-Private Partnerships

New developments in megaproject financing involve more than differences in the split between Federal and State dollars. Although innovative financing tools are making public dollars more available for project financing, they are not enough to meet the Nation's transportation infrastructure needs. Agencies are looking beyond public dollars and exploring public-private partnerships to help share the costs of major projects.

These partnerships enable transportation agencies to tap private-sector financial, technical, and management resources to achieve public objectives such as greater cost and schedule certainty, innovative technology applications, specialized expertise, and access to private capital.

"The single most important thing the public sector gains in a public-private partnership is certainty in terms of funding, cost, and schedule for the project—it's not subject to annual appropriations," says Fluor's Prieto. "The taxpayer benefits from that certainty, but he also gets a new or upgraded facility earlier than he might under a traditional financing approach. And from a public policy standpoint, there is a better match between who bears the costs and who accrues the benefits of projects because many will be toll facilities."

Risk transfer is another significant benefit of public-private partnerships, according to Robert Poole, director of transportation studies and founder of the Reason Foundation.

"Public-private partnerships shift some of the risks involved from taxpayers to the private capital markets and large global companies that can afford and are willing to take those risks under the right kinds of agreements," he says. "The challenge is to develop public-private partnerships that are genuinely partnerships and have benefits for both sides."

An example of this new breed of public-private megaproject is the Trans-Texas Corridor. As part of the financing arrangement for the proposed Oklahoma-to-Mexico element of the Trans-Texas Corridor (TTC–35), a private consortium has agreed to invest $6.0 billion in a toll road between Dallas and San Antonio and give the State $1.2 billion for additional transportation improvements between Oklahoma and Mexico. In return, the firm plans to negotiate a 50-year contract to maintain and operate the toll road.

The result is that the Texas Department of Transportation (TxDOT) will have more money for roadbuilding than it would otherwise. Additional public-private partnerships may play a key role in financing the corridor project. Based on the *Crossroads of the Americas: Trans Texas Corridor Plan*, the 6,440-kilometer (4,000-mile) corridor is estimated to cost $31.4 million per centerline mile, not including right-of-way or miscellaneous costs.

TxDOT

**The Texas Turnpike Authority will use toll revenues from the Central Texas Turnpike to repay the TIFIA loan used to finance part of the cost of the project. This aerial shot shows the Loop 1/State Highway 45 interchange of the toll road under construction.**

The Chicago Region Environmental and Transportation Efficiency Program (CREATE) is a first-of-its-kind partnership involving the State and city departments of transportation (DOTs), Chicago-area commuter rail system, and six private railroads. The need to work together to solve common transportation problems led the railroads to partner with the transportation agencies on CREATE, according to Illinois Department of Transportation (IDOT) Secretary Timothy Martin.

"If everybody waited around for the other person to do it, it would never get done," Martin says. "That's what brought everybody to the table—shared pain and shared gain."

CREATE will invest $1.5 billion—including $212 million from the railroads—in capital improvements in the Chicago region's railroad infrastructure, including 25 new roadway overpasses and underpasses to eliminate traffic crossing tracks at grade level and six overpasses and underpasses to separate passenger and freight train tracks.

"We think this could be one of the models for the future," says Martin. "We're getting away from the traditional 80-20 percent split of Federal and State funding and bringing private partners into the process. We're figuring out what we can learn from each other. It's a matter of putting aside the idea that we've never done it that way and asking ourselves 'Why can't we do it that way?'"

## Developing Valid Estimates

No matter how a megaproject is financed, a critical component of success is an initial cost estimate that stands up over time. Aside from supplying Congress and the public with valid data on which to make informed decisions, a true representation of costs is necessary to determine the most appropriate financing mechanism.

"Part of the problem has been an incentive to underestimate the cost because of the fear that people wouldn't approve a project if they knew the true cost," says the Reason Foundation's Poole. "Ultimately, that's a mistake. It's important to develop a realistic initial cost estimate."

Underestimation of megaproject costs is a concern overseas as well. In a study of 258 transportation infrastructure projects worldwide, Professor Bent Flyvbjerg of Aalborg University in Denmark found that costs were underestimated in 9 out of 10 projects, actual costs of all types of projects were on average 28 percent higher than estimated costs, and actual costs of road projects were 20.4 percent higher.

"Underestimation of costs at the time of the decision to build is the rule rather than the exception for transportation infrastructure projects," Flyvbjerg writes in "Underestimating Costs in Public Works Projects" in the *Journal of the American Planning Association*. "Frequent and substantial cost escalation is the result."

FHWA encourages project sponsors to evaluate risks and include appropriate contingencies when developing both cost and revenue estimates. "One of the virtues of going with a private arrangement is that once you get the project costed out and the financing plan approved and turn it over to the private sector, they have to keep costs within what they can finance based on project revenues," Poole says. "The private team has strong incentives to resist further add-ons [increases in project scope] that would make the project more costly."

Even with realistic cost estimates, projects can fail to meet revenue expectations. When the Dulles Greenway, a privately owned toll road in the Washington, DC, area, did not meet its initial traffic and toll revenue projections because of a slowdown in real estate development, the owner was forced to restructure its debt. Since then, a development spurt has led to increased traffic and toll revenues that led to the owner investing in expanding and improving the road.

**A private consortium has agreed to invest in the proposed Oklahoma-to-Mexico element of the Trans-Texas Corridor (TTC–35), shown here in an artist's rendering, in return for negotiating a 50-year contract to maintain and operate the section as a toll road.**

*TxDOT*

"If the Dulles Greenway had been a public-sector project, the taxpayers of Virginia would have been at risk [instead of the private sector]," says Poole. "That's the advantage of risk transfer."

The objective of setting up a public-private partnership, however, should not be to take advantage of private organizations. The best public-private partnership is a win-win relationship, with risk shared between the public and private sectors. From the public viewpoint, the objective is an infrastructure gain, while the private-sector priority is a return on investment. When both public and private sectors win, it enhances the possibility for future private-sector investments in the transportation system.

## New Skills for a New Era

As public dollars continue to fall short of what is needed to address transportation infrastructure challenges, public-private partnerships and private-only investment arrangements have the potential to play a significant role in how major projects are financed in the future.

The public-sector decisionmakers responsible for developing megaprojects need to become adept at negotiating and working financial logistics with the private sector. But IDOT's Martin cautions that public-private partnerships cannot be one-size-fits-all endeavors.

"Public-private partnerships will have to be developed specifically for each State and each challenge," he says. "What may work for the railroads and the city of Chicago and the State of Illinois may not work for

California Department of Transportation, District 4

**A TIFIA loan has been approved for use on the San Francisco-Oakland Bay Bridge project, shown here in a computer rendering. Toll surcharges on seven bay area bridges will be used to repay the loan.**

the airlines and the city of Fort Worth and the State of Texas."

To accommodate this new world of megaproject financing, public agencies will need new skills to ensure that they make the best use of the resources available. The risk management, financial management, traffic modeling, and business development skills needed to evaluate public-private partnerships are different from those needed to evaluate more traditional transportation projects.

"These skills exist in the United States, but they have not traditionally been applied to projects like these," says Fluor's Prieto. "It's a matter of drawing these skills into the transportation sector."

Public agencies need the capability to evaluate the overall economic benefits of competing proposals, not just the ability to conduct a purely financial evaluation of which offers the best rate of return. "When agencies are looking at proposals, they need the skills to compare an apple to an orange and determine which is better for the State and the taxpayer," Prieto says. "That's not something DOTs traditionally have been called on to do."

One way to be successful, according to IDOT's Martin, is to find experts who can look out for the State's best interest. In most cases that means hiring outside specialists—such as law firms expert on U.S. tax laws and financial service firms knowledgeable about the international markets—to advise the State DOT as it negotiates a public-private partnership.

"When you hold a competition to select the best-qualified private-sector team to do a megaproject, you can be sure that the private sector will have world-class legal and financial expertise on their side of the table," says the Reason Foundation's Poole. "Public-sector agencies need to have the same kind of expertise."

## Financing for the Future

For nearly 100 years, highway construction in the United States has been financed almost entirely by the public sector, but that is changing. Today's highway agencies have a spectrum of financing options available, from traditional public-sector funding sources to innovative tools that leverage public dollars to new models that bring private-sector investment into the mix.

Because of their size, complexity, and high cost, transportation megaprojects present a particular challenge to agencies trying to balance the dollars available for construction projects with the need to rehabilitate and enhance the transportation infrastructure. As the number of megaprojects grows, the transportation community will need to be both innovative and strategic in putting together the resources to build these huge undertakings.

That process already is underway in State DOTs across the country. The Indiana Department of Transportation (INDOT), for example, is considering a range of options as it crafts a financing strategy for the proposed Evansville-Indianapolis corridor of I–69. The options under consideration include TIFIA loans and public-private partnerships.

If traditional funding mechanisms were used to finance the $1.78 billion project, the State would not be able to start construction until 2016, and the project would take 14 years to complete.

"That's not acceptable," says Robert Tally, administrator of FHWA's Indiana Division, which is working with INDOT to develop a financing strategy for the I–69 project. "Our challenge is to work in cooperation with INDOT to find innovative ways to finance and construct this important project in a more accelerated timeframe."

By combining the various tools and techniques available, highway agencies will have more options to deliver innovation, cost savings, and quality improvements. And by exploring ways to stretch public dollars with private investment, agencies will be able to get construction of megaprojects underway sooner and ultimately provide the maximum infrastructure at the lowest cost to users and taxpayers.

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Acting Federal Highway Administrator **J. Richard Capka** is responsible for shaping the management of highway megaprojects across the country and developing other FHWA programs and initiatives. Before joining FHWA, Capka was executive director and chief executive officer of the Massachusetts Turnpike Authority, where he directed oversight of the Central Artery/Tunnel project. He spent three decades in the U.S. Army Corps of Engineers and retired as a brigadier general after serving as commander of the Corps' activities in the West/Southwest and Southeast regions of the United States and the Central/South America region.

*To learn more about FHWA's major projects, visit www.fhwa.dot.gov/programadmin/mega. For more information on public-private partnerships, visit www.fhwa.dot.gov/ppp.*


*by Tracy Scriba and Jennifer Seplow*

# RULE on WORK ZONE Safety and Mobility

***FHWA and States offer guidance and share best practices to facilitate implementation of the regulation.***

**(Above) Construction has the potential to affect safety and mobility for motorists using the road under repair and nearby roads as well. The updated Rule on Work Zone Safety and Mobility contains provisions to help transportation agencies manage those impacts. Here, motorists wait in traffic as they approach a construction zone.**

Work zone safety is a major concern in the United States, with 1,065 fatalities and more than 40,000 injuries resulting from work zone crashes in 2004 alone. In addition to the human toll, consider the following: Traffic volumes and congestion are increasing, but little corresponding growth in road miles is happening. Many of the Nation's highways are approaching middle age, requiring additional construction and repair, and thus more work zones. Increasingly, construction is taking place while traffic continues to flow on the facility undergoing repair, which applies greater pressure on contractors to compress schedules, finish projects early, and perform work at night while maintaining safety and quality. Mobility, often referred to as "travel time reliability," is also a key factor associated with

Oregon Department of Transportation

**The Rule encourages agencies to use innovative construction strategies, such as full road closures, to enhance safety and mobility for workers and drivers. The use of full road closure, as was done here on I–84 in Portland, OR, reduces safety risks to workers and significantly reduces construction time.**

work zones, with travelers reporting being frustrated with the delays and unexpected road conditions caused by work zones. This is particularly an issue for road users when a project is in progress but no work appears to be going on for days at a time, yet congestion and delays continue to occur.

These trends underscored a strong case for updating the Federal regulations governing safety and mobility in work zones. After soliciting input from transportation agencies and organizations across the country, the Federal Highway Administration (FHWA) updated 23 CFR 630 Subpart J, the Rule on Work Zone Safety and Mobility (the Rule), on September 9, 2004.

Published in the *Federal Register* (69 FR 54562), the Rule updates the former regulation, "Traffic Safety in Highway and Street Work Zones," to address the challenges of today and those likely to be faced in the future. The updated Rule provides a decision-making framework for considering the broader safety and mobility impacts of work zones across all stages of a project. The updated regulation also will facilitate the implementation of appropriate strategies to help manage those impacts.

The broader context takes into consideration that the impacts of work zones may extend beyond the physical location of the construction itself to affect safety and mobility miles away. Not only can work zones affect traffic on the roadway being worked on, but also on other highway corridors and even other modes of transportation.

All State and local governments that receive Federal-aid highway funding must implement the Rule by October 12, 2007. Updating the regulations is just one part of the solution. Ongoing outreach and development of detailed guidance are two methods FHWA is using to disseminate information. The other part of making work zones work better is for State and local transportation agencies to adopt and implement the updated Rule. Highlights follow from some of the States that are using innovative strategies to improve safety and mobility in work zones.

## Overview of the Rule

Some of the questions that State and local agencies are asking as they begin implementation include the following: "We know this new Rule exists, but what do we need to do to implement it?" "Does the Rule mean a lot of additional work for my agency?" "How does the Rule differ from what we are already doing?"

The level of effort needed to implement the Rule will vary from agency to agency. Some agencies already are adopting aspects of the Rule and may need only to formalize and institutionalize those steps. Others will find they need to change the way they do business. But modifying their procedures promises to yield positive results.

"We are working with FHWA and looking at all the information that has been gathered to help craft the Rule," says Jacqui Yuke Ghezzi, chief of the traffic management branch at the California Department of Transportation (Caltrans). "Any time we can borrow information from other States, it's very welcome and helpful."

The updated regulation emphasizes partnerships between FHWA and the States, valuing adaptability and elasticity so that agencies can

**Work zones, such as this one near Kalamazoo, MI, have the potential to cause substantial traffic impacts, as can be seen in this photo.**

apply the provisions appropriately to their respective operating circumstances and serve the needs of various kinds of projects. "[FHWA] left the States with the flexibility to address their particular issues," says Dave Holstein, administrator of the Office of Traffic Engineering for the Ohio Department of Transportation (ODOT). "Ohio's needs may be very different from those of a more rural State, for example."

The Rule contains three primary components:

- Implementation of an overall, agency-level policy on work zone safety and mobility to institutionalize the consideration and management of work zone impacts
- Development and implementation of agency-level processes and procedures to support policy implementation, including procedures for assessing the impacts of work zones, analyzing data, conducting training, and reviewing processes
- Development and implementation of project-level procedures to assess and manage the impacts of individual projects, including the creation of transportation management plans (TMPs)

For each component, the Rule includes provisions and guidance to help transportation agencies address work zone considerations early in the planning stages of a project, which is crucial for successfully developing and managing work zones, and throughout the project design, implementation, and performance assessment stages.

## Ohio's Work Zone Policy

The Ohio Department of Transportation (ODOT) developed and adopted a policy that limits the number of lanes that may be closed for construction and maintenance activities on interstate highways and other freeways. The policy requires sufficient mainline capacity during construction and maintenance and provides for allowable queue thresholds.

ODOT provides training for implementing its work zone policy. The training addresses topics such as the use of traffic modeling software, work zone traffic control, and inspection requirements. The training class is one of several required for approximately 2,500 ODOT highway workers, project inspectors, and others. As part of their prequalifications, consultants also are required to attend a class on work zone design. Testing and certification are required for both ODOT and consultant staff.


ODOT

**In accordance with its policy on lane closures, ODOT uses this Web-based system to determine the number of lanes that can be closed on interstates and other freeways and when they can be closed. The system is accessible at https://dotaw100.dot.state.oh.us/plcm/plcm_web.jsp.**

For Dave Holstein, administrator of ODOT's Office of Traffic Engineering, the overarching principle of work zone safety and mobility is early planning. "It is absolutely critical to identify potential work zone impacts early enough in the project development process to be able to include an engineering solution in the subsequent plan development," he says. "You don't want to get too far into a project and then realize you needed wider bridges, more right-of-way, or a different environmental footprint to mitigate a work zone impact. When an impact cannot be completely designed out of the project, innovative contracting or innovative construction techniques can be used to minimize the time an impact is present."

## Defining and Implementing a Policy

A new component in the Rule requires development and implementation of an overall agency-level policy for work zone safety and mobility. The policy is the first step necessary for State and local agencies to institutionalize planning, design, and operational strategies that reduce congestion (or delay) and crashes due to work zones. Because of the high rates of retirement and turnover within departments of transportation (DOTs) and the increasing use of consultants to do what traditionally was in-house work, formalizing processes and practices will help ensure a consistent way of doing business across projects. Formalized processes also will lead to a greater degree of consistency and uniformity for highway users traveling through work zones. Although the policy must apply to all Federal-aid highway projects, agencies may benefit from applying it to other projects as well.

Agencies are responsible for developing their own work zone policies, but it is recommended that States use a multidisciplinary team and coordinate with counterparts in the FHWA division offices. Although the Rule does not require the inclusion of specific elements, the policy should be customized as appropriate to individual agency needs and should be sensitive to varying project characteristics and the expected impacts of different types of projects. Many agencies already have policy statements that reflect their commitments to managing the safety and mobility impacts of work zones.

To help implement the policy, the Rule requires developing and implementing agency-level processes and procedures. This includes procedures for data collection and analysis, training, and process reviews. Agencies also are encouraged to implement the policy through the development and implementation of systematic procedures to assess and manage work zone impacts.

## Assessing Potential Work Zone Impacts

Existing procedures can be adapted to assess and manage work zone impacts systematically during project development and implementation. For example, the systematic review

## California's Policy on Transportation Management Plans

California is one of the few States that has a specific policy on transportation management plans (TMPs). Since the policy's inception in 1993, it has evolved and improved the TMP guidelines for using the most effective mitigation strategies. In July 2001, Caltrans published the most recent version of the "Transportation Management Plan Guidelines," with addenda on bicycle and pedestrian mitigation strategies added in May 2004.

California's policy states that TMPs, "including contingency plans, are required for all construction, maintenance, encroachment permit, planned emergency restoration, locally or specially funded, or other activities on the State highway system. Where several consecutive or linking projects or activities within a region or corridor create a cumulative need for a TMP, Caltrans coordinates individual TMPs or develops a single interregional TMP."

The plans are considered early during the project initiation or planning stage, and the level of detail differs based on project characteristics. The project team includes a district traffic manager or a TMP manager to investigate the level of TMP needed.

of road segments by multidisciplinary teams as part of road safety audits (RSAs) can be adapted for work zone situations. To address work zone impacts, agencies can modify RSA procedures by adding safety considerations and operational aspects specific to work zones. Some agencies have used concepts such as lane rentals, where a contractor must pay to rent a lane in order to close it, to minimize operational impacts. Agencies also can use road user cost as a way to assess potential work zone impacts. Determining road user cost provides the agencies with a method to quantify user costs based on operating and time delays. These and other procedures could be employed more often and even enhanced with minimal effort.

Several States offer examples of procedures currently in use:

- The New York State Department of Transportation (NYSDOT) considers mobility and safety impacts in the initial phases of project development, called scoping. NYSDOT's scoping process identifies mobility needs that may influence the selection of a preferred design alternative.
- In its policy guidance, Caltrans defines work zone-related delay as follows: "Significant traffic impact is 30 minutes above normal recurring traffic delay on the existing facility or the delay threshold set by the District Traffic Manager, whichever is less."
- For each of its projects, the Washington State Department of Transportation (WSDOT) develops a design strategy with a qualitative analysis. The design strategies vary in size, content, and format for different projects and from region to region, as they are developed at the district level with advice from the central office. The central office then reviews the projects. Presently, some regions list all the possible work zone impacts and develop a work zone impact statement. WSDOT currently is trying to implement this approach statewide.
- In Ohio, ODOT staff analyzes work zone impacts before submitting the first detailed plans, using a process called Maintenance of Traffic Alternative Analysis. The analysis is intended to be a comparison of the benefits and problems related to various alternatives, and the result yields the design team's recommendation. "We can engineer solutions to the problems into the design phase in the first place," says ODOT's Holstein. ODOT completes the analysis early enough to facilitate selecting alternatives and identifying right-of-way and environmental impacts in time to address them.

Developing and implementing procedures to assess the impacts of work zones can streamline the process of identifying significant projects and developing and implementing TMP strategies to mitigate work zone impacts, both of which are new requirements of the updated Rule.

## Identifying Significant Projects

Recognizing that not all road projects cause the same level of impact, the updated work zone Rule establishes a category for "significant" projects. A significant project is one that by itself or in combination with other nearby projects is anticipated to cause sustained impacts that are greater than considered tolerable, according to State policy and/or engineering judgment. In addition, under the updated Rule, all projects on the interstate system within the boundaries of a designated Transportation Management Area are deemed significant projects if they occupy a location for more than 3 days with either intermittent or continuous lane closures.

The classification of significant projects is intended to help States think through project coordination and scheduling and focus their resources where they are needed most. The classification also will

**Radio stations, project telephone hotlines, and Web sites, ideally in a short, easily remembered format, are effective strategies for providing drivers with work zone information. This sign was located near a road project south of Flagstaff, AZ.**

determine which requirements in the TMP apply to the project.

## Transportation Management Plans

A TMP consists of strategies to manage the impacts of work zones. A TMP's scope, content, and level of detail will vary based on each State's work zone policies and the anticipated impacts of individual projects.

The requirement for developing and implementing TMPs builds on the former Rule's requirement for traffic control plans. For all projects, TMPs must contain traditional temporary traffic control plans that address traffic safety and control in work zones. If a project is identified as a significant project, the TMP also must contain both transportation operations and public information components. The operations component addresses management of the transportation system in the region affected by the work zone. The public information component outlines communication with the public and stakeholders—both before and during the project—about what to expect in and around the work zone and about travel alternatives.

Some agencies already are using these strategies to great benefit in managing the impacts of work zones. "Based on our experience, public information is the TMP mitigation strategy that gives us the biggest bang for the buck," says Robert Copp, chief of the Division of Transportation System Information with Caltrans. "Its effectiveness is greater in urban areas but still holds true in rural areas."

The Illinois Department of Transportation (IDOT) also reports success with public information efforts, including the campaign for the Upgrade I–74 project. Because IDOT used consistent messages in all of its marketing materials to detail the importance of the project to future safety, the project has been well received by the public. Similar messages were shared through various outreach mechanisms, including the Web, radio announcements, brochures, and at community events.

Similarly, by partnering with the news media throughout the I–65/I–70 Hyperfix reconstruction project, the Indiana Department of Transportation (INDOT) obviated the gridlock that many feared would shut down Indianapolis. Instead, people changed their travel behaviors, and INDOT officials deemed the overall project a success. INDOT's outreach tactics included media interviews and notices, public meetings, advertising, displays at local rest stops, and distribution of 250,000 maps showing recommended alternative routes. INDOT even created a logo, which shows a running construction worker, and matching signage for Hyperfix 65/70.


IDOT

**A project logo, such as this one used for the Upgrade 74 project in Illinois, can be an effective component of a public outreach campaign. Once people become familiar with the logo they will begin to identify information and materials associated with the project.**

In terms of transportation operations strategies, the New Mexico Department of Transportation (NMDOT) deployed a variety of intelligent transportation system (ITS) technologies to manage traffic through the work zone at its Big I construction project (I–40/I–25) in

**Several States use ITS technologies in the form of mobile traffic monitoring and management systems to help move vehicles through construction areas. This image shows some of the ITS equipment deployed by IDOT to monitor traffic flow in a work zone on I–64 in September 2005.**

## Additional Tools

- **QuickZone**—A tool that road owners and contractors can use to estimate work zone delays and analyze and compare project alternatives, such as performing highway work at night instead of during the day or diverting traffic to alternate roads at various stages of construction. For more information, visit www.tfhrc.gov/its/quickzon.htm.
- **Full Road Closure for Work Zone Operations**—A series of documents describing how several State DOTs used a full closure approach to reduce the impacts of road rehabilitation and reconstruction projects. For more information, visit www.ops.fhwa.dot.gov/wz/construction/full_rd_closures.htm.
- **Innovative Contracting Guidance**—Resources for innovative contracting methods, including a link to an online knowledge exchange. For more information, visit www.ops.fhwa.dot.gov/wz/contracting/index.htm.
- **ITS in Work Zones**—A series of documents that raise awareness among maintenance and construction engineers and managers of the applications and benefits of ITS in work zones. For more information, visit www.ops.fhwa.dot.gov/wz/its/index.htm.
- **Work Zone Training Courses**—A new National Highway Institute (NHI) course, Advanced Work Zone Management and Design (#380072A), provides planners, designers, construction managers, and other transportation professionals with additional knowledge of technical and nontechnical aspects of work zone design and traffic management practices. For more information, visit www.nhi.fhwa.dot.gov.
- **Road Safety Audits**—Guidance on performing audits to assess a project's crash potential and safety performance. For more information, visit http://safety.fhwa.dot.gov/state_program/rsa.

Albuquerque. The high volume of traffic moving through the Big I created the potential for congestion. Incidents would cause further congestion and require rapid response to avoid additional delays. A system was needed to provide accurate information, support quick identification of incidents, and help manage traffic through the area. NMDOT used a mobile traffic monitoring and management system during the project to help maintain traffic flow and facilitate rapid responses to crashes.

## Resources for Implementation

A number of resources are available to help State and local agencies implement the updated Rule and improve the effectiveness and safety of their work zones. Several guidance documents offer advice and suggestions that can help agencies that already are implementing aspects of the Rule and need to enhance their progress, as well as those that may have to change some of the ways they do business.

*Implementing the Rule on Work Zone Safety and Mobility* (FHWA-HOP-05-065). This guidance document covers each element of the Rule and provides suggestions for implementation. The guide provides a general overview and examples of strategies, best practices, resources, and tools for implementing the Rule's provisions. For example, one section on developing and implementing an overall policy covers the systematic consideration of the work zone impacts of road projects. The guide suggests elements to include in the policy and lays out suggested steps for implementation. Other topics include tips on identifying significant projects, developing TMPs, and using work zone safety and operational data.

*Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects* (FHWA-HOP-05-068). This document offers some guiding principles and a general approach for assessing and managing the potential impacts of road projects. The work zone Rule does not prescribe a specific approach to establishing procedures to assess the impacts, but rather the intent of the guide is to help agencies develop their own procedures. FHWA used a variety of methods to illustrate recommended activities and decision-making factors, including process diagrams, workflow explanations, real-world examples, and links to more detailed information about each example.


**Changeable message signs such as this one can assist with public information and outreach efforts by alerting drivers that they are approaching work zones and offering information about alternative routes. The *Manual on Uniform Traffic Control Devices* (Section 6F.55) contains provisions on the use of changeable message signs.**

The approach used in the guide is structured to mirror the program delivery process commonly used by State DOTs. The guide presents the assessment process activities for work zone impacts organized according to the program delivery stages as follows:

- Developing and implementing an overall work zone safety and mobility policy at the policy level
- Conducting a first-cut work zone impacts assessment at the systems-planning level
- Conducting a project-level assessment of work zone impacts during preliminary engineering
- Conducting a detailed project-level assessment of work zone impacts during design
- Monitoring and managing work zone impacts during construction
- Conducting post-construction work zone performance assessments
- Incorporating work zone impacts assessment procedures in ongoing management, operations, and maintenance

*Developing and Implementing Transportation Management Plans for Work Zones* (FHWA-HOP-05-066). This guide can help agencies develop, implement, and monitor TMPs. The document takes into consideration the variety of objectives, needs, and issues by project. However, agencies ultimately need to establish and implement plans that most effectively serve the mobility and safety needs of the motoring public, construction workers, businesses, and community.

The guide highlights the benefits of TMPs and offers recommendations on how and when to develop them. A comprehensive list of possible components and a checklist for developing TMPs also are included to help agencies develop their own guidelines. Another feature is a matrix of strategies for managing work zone impacts, such as traffic control devices, project coordination, motorist information, incident management, and enforcement. The matrix briefly mentions benefits or effects of certain strategies, such as whether a given measure is intended to improve safety or reduce delays. It also outlines project characteristics that could qualify certain strategies for consideration. Other important features in the TMP guide include Web links to sample plans, policies, and procedures; related references and literature; and an overview of findings on current practices drawn from a literature review and interviews with State DOT personnel.

*Work Zone Public Information and Outreach Strategies Guide* (FHWA-HOP-05-067). To help States communicate better with stakeholders, the guide presents information based on a review of approximately 30 project-specific outreach campaigns for work zones located across the country. The campaigns represent projects that run the gamut in size and complexity from a major multiyear interstate reconstruction project to an interstate rehabilitation project completed over 2 weekends to a street widening project in the downtown of a small city. A variety of information, including notes on practices used and materials developed, the use of outside public relations consultants, and approximate budget size, was collected from officials associated with each project.

The underlying theme is that successful public information and outreach campaigns are typically well thought out by project partners and planned well before construction. For highway officials planning a public information and outreach campaign, the guide provides tips, examples, and practices on a range of topics, including the following:

- Information needed to plan and evaluate a campaign
- Details that need to be conveyed to the public, such as project duration, details of lane closures, up-to-the-minute information on traffic delays, and alternative routes or methods of transportation
- Methods of communication, such as newspaper advertisements, brochures, interactive Web pages, and dynamic message signs
- Suggestions on when to begin a public outreach campaign
- Target audiences that need to be reached
- Use of the mass media to spread the message

All of the aforementioned documents are available online at www.ops.fhwa.dot.gov/wz/resources/final_rule.htm. Requests for hardcopies should be e-mailed to: workzonepubs@fhwa.dot.gov. See "Additional Tools" for more information about courses, publications, and tools available to help agencies implement the Rule.

## Taking the Plunge

The implementation guidance documents provide a jumping-off point for information on the nuances of the updated Rule, tried-and-true State practices, and opportunities for modifying existing policies and practices to meet the new requirements. As transportation agencies move forward with implementation, representatives from FHWA headquarters, division offices, and the Resource Center will be available to assist them on the road to compliance.

The updated Rule fosters customer-focused project delivery that considers both the safety and mobility impacts of work zones, from initial systems planning through construction and maintenance. In implementing the provisions of the Rule, agencies will be building on their current efforts to manage work zones. The end result is that work zones will work better, and safety and mobility will increase.

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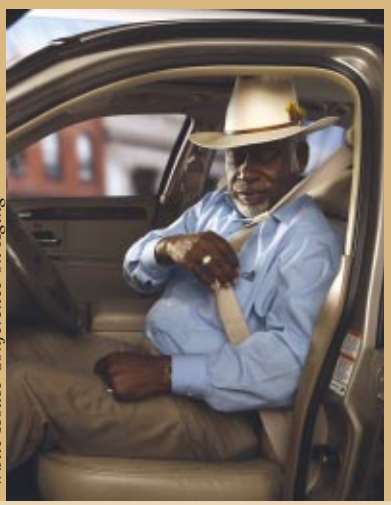
**Jennifer Seplow** is a research analyst with Science Applications International Corporation in McLean, VA. She currently supports FHWA's Work Zone Mobility and Safety Program, primarily assisting with outreach efforts for the updated Rule on work zone safety and mobility. She holds a B.S. in commerce from the University of Virginia.

*For more information, please visit the FHWA "Work Zone Mobility and Safety Program" Web site at www.fhwa.dot.gov/workzones. The full text of the Rule is available at www.ops.fhwa.dot.gov/wz/docs/wz_final_rule.pdf.*


AAA Foundation for Traffic Safety


White House Conference on Aging


White House Conference on Aging

# The Older Driver Comes of Age

*by Thomas M. Granda and Shirley Thompson*

***As the senior citizen population increases, activities around the country are addressing transportation and mobility challenges.***

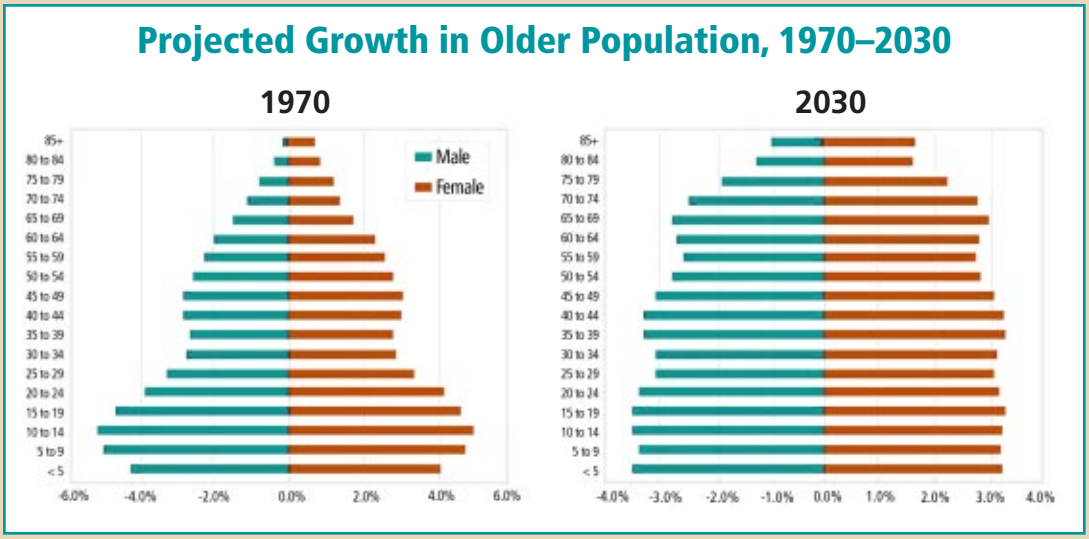
Aging is a fact of life. However, the number of seniors in the United States will reach an apex over the next 20 years. According to census data in 2000, the U.S. population included approximately 35 million people who are aged 65 years and older, making up 12.4 percent of the total population. Baby boomers born between 1946 and 1964 will reach the age of 65 beginning in the year 2011. Projections indicate that the population of older Americans in the United States will more than double by 2030.

Along with this large population shift also will come a shift in vulnerabilities: because of their fragility, older people are more easily injured and killed in crashes, and are more prone to trauma resulting from crashes. In 2003, the National Highway Traffic Safety Administration (NHTSA) indicated that older citizens accounted for 12 percent of all traffic fatalities and 16 percent of all pedestrian fatalities.

"This aging population increases the challenges and responsibilities of numerous organizations, including those in the transportation community," says Michael Trentacoste, director of the Office of Safety Research and Development at the Federal Highway Administration (FHWA).

The burgeoning of the Nation's senior population is driving government at all levels to reexamine

**(Right) U.S. Secretary of Transportation Norman Y. Mineta watches while occupational therapist Elin Schold-Davis demonstrates the CarFit program at the White House Conference on Aging, held December 11–14, 2005.**




*Source: U.S. Census.*

services such as Social Security, health care, and transportation. Professionals who help shape transportation policy and programs have been at work for some time to address one of seniors' greatest needs: retaining their safety and mobility in later years.

The transportation community is looking at safety improvements in a number of areas that address some of the challenges facing the Nation—including highway and vehicle design. For example, highway design alternatives might incorporate safer and easier methods for senior usage because perceiving and judging the dynamics of traffic movement may be among the limitations experienced by some older drivers. Safer, easier-to-use automobiles, as well as roadways and walkways designed to accommodate the special needs and functional requirements of older drivers and pedestrians can greatly reduce both the number and severity of crashes. Safe, well-designed, and well-lighted pedestrian facilities encourage walking, which is the second most widely used mode of travel by those 65 and older. Design standards that meet the needs of all road users—drivers, passengers, pedestrians, and bicyclists—will provide a safer transportation system for all.

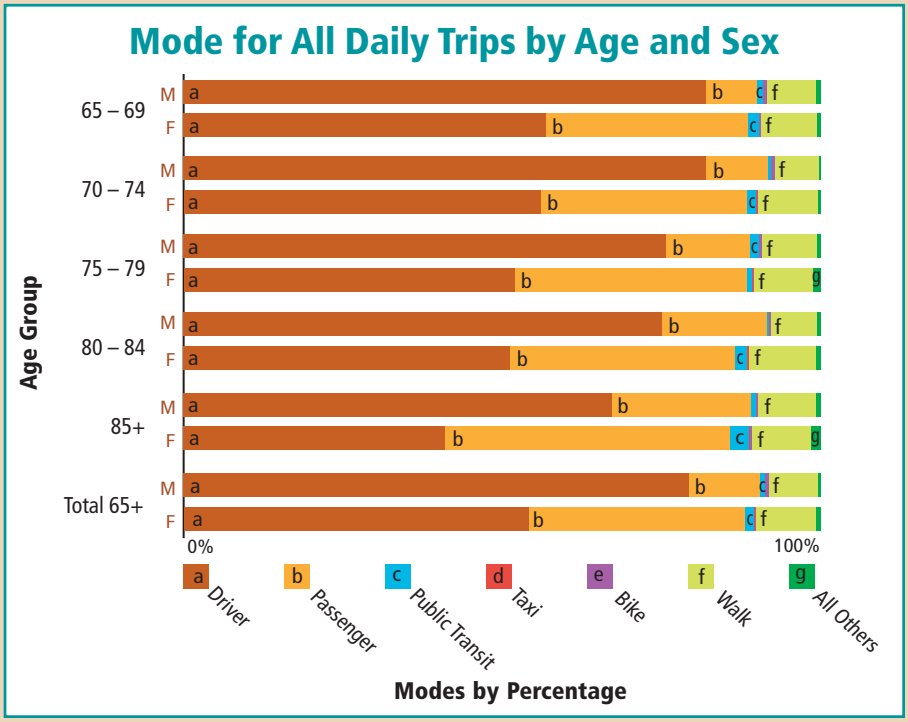
This article is the first in a PUBLIC ROADS series that will look at how various groups across the country are managing issues related to the older road user, including program development, projects, and activities.

## The Demographics of Older Road Users

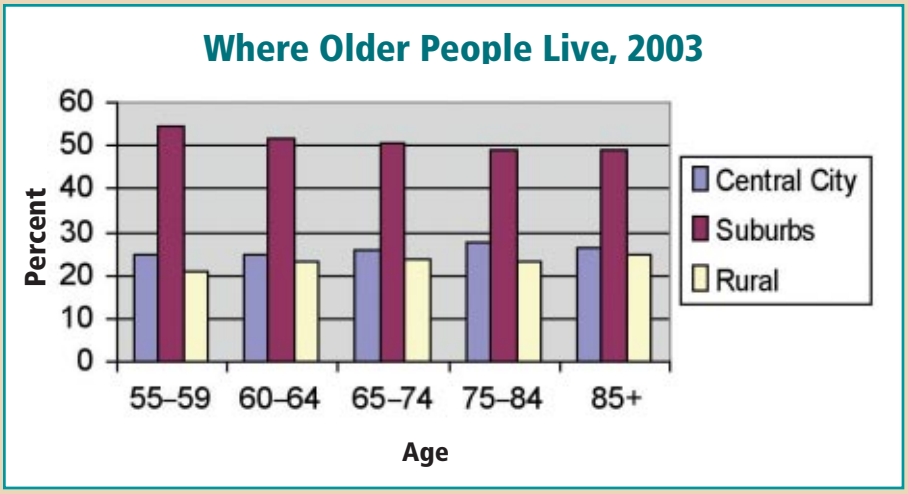
Aging is an individual process that affects each person differently, at different ages and at different rates. Aging may bring maturity with seasoned judgment and reduced risk-taking behavior, but it also may bring varying degrees of reduced functional abilities from multiple, chronic illnesses. Physical and cognitive abilities may decline. Physical functions such as strength, flexibility, and range of motion may be reduced. Visual limitations are often, but not always, noted in acuity and contrast sensitivity. Cognitive capabilities may slow in terms of the speed of processing information and ability to address multiple claims on attention. On the other hand, over time many older road users learn to compensate successfully for at least some of their functional limitations.

FHWA and NHTSA, agencies that maintain the national transportation data on this subject, define "older" to mean people 65 or more years of age. Members of the older population, like everyone else, largely depend on the automobile for the bulk of their travel. Although this varies from rural to suburban to urban regions, overall people over 65 years of age make roughly 90 percent of their trips by car, more than 65 percent as drivers, and another 22 percent as passengers in a vehicle.

Data from the National Household Travel Survey indicate that compared to younger people, older adults make a greater percentage of their trips as drivers. Sandra




*Source: Sandra Rosenbloom, "Is the Driving Experience of Older Women Changing? Safety and Mobility Consequences Over Time," Transportation Research Record, 2006 (forthcoming).*



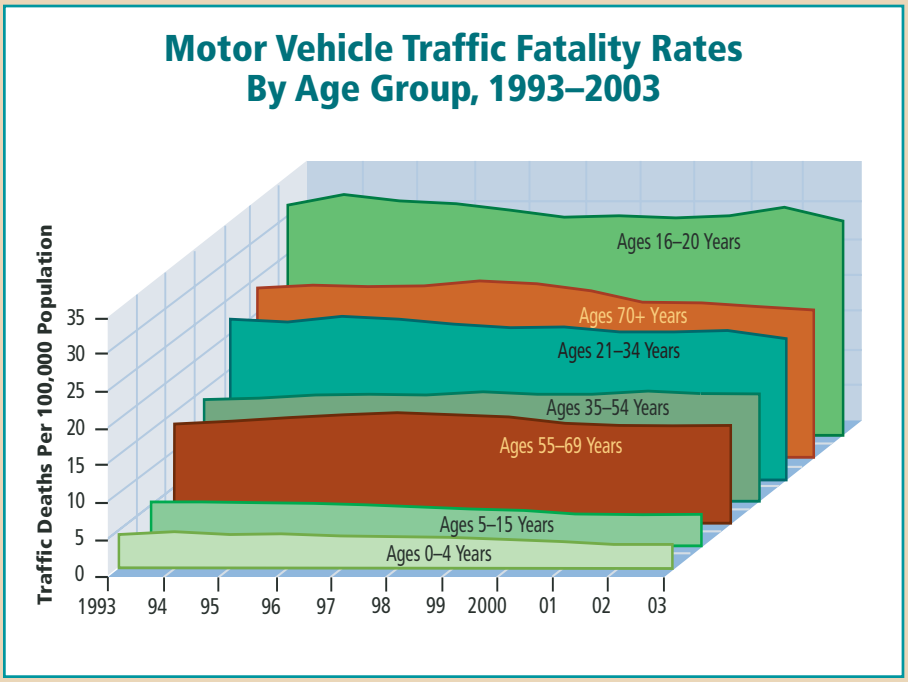

*Source: Sandra Rosenbloom, "Understanding Women and Men's Travel Patterns: The Research Challenge," in Transportation Research Board (ed) Research on Women's Travel Issues, Vol. I, Plenary Papers, Washington, DC: The National Academy Press, 2006 (forthcoming).*

Rosenbloom, professor of planning and adjunct professor of gerontology at the University of Arizona, Tucson, says, "Regardless of where they live, most older people are extremely dependent on the private car, either as a passenger or a driver, and increasingly the latter."

In 2002 there were 19.9 million older licensed drivers; a 29 percent increase from 1992. During that same period, the number of drivers of all ages increased just 12 percent.

Maintaining safe mobility through the latter years is one of the highest priorities for many Americans and has obvious impacts on health and well being. According to a U.S. Department of Transportation (USDOT) report, *Safe Mobility for a Maturing Society: Challenges and Opportunities*, most older adults continue to live in the same homes or localities where they lived before they retired, close to family and friends, leading active lives, and aging in familiar surroundings. More than three-fourths of the older population live in the suburbs and rural areas, where automobiles are the primary mode of transportation.

Although the data show that many older drivers are quite responsible (high safety belt usage and low rates for both alcohol-related crashes and speeding), fatality rates per 100,000 populations for older road users parallel the high rates for teens.




*Source: NHTSA.*

The Insurance Institute for Highway Safety conducted a study of the present and future impacts of older drivers and predicted that by the year 2030 drivers 65 and older will account for 16 percent of all crashes and 25 percent of all fatal crashes. According to the Institute's study, *Older Driver Involvements in Police-Reported Crashes and Fatal Crashes: Trends and Projections*, "The annual number of older driver fatal crashes is expected to more than double."

An effective transportation system will offer safe mobility to users and enable older persons to remain independent and "age in place" (grow older without relocating) if they so desire. Medical and social service workers, transportation managers, motor vehicle administrators, caregivers, and others interested in the safety of seniors can work together to promote safe driving and to ensure that other convenient, affordable, and safe transportation options are available when driving or walking must be curtailed. Public and private organizations can form new partnerships to enable all citizens to enjoy safe mobility for life. Safer roadways, safer automobiles, better transportation options, and improved competency of older drivers will lead to a safer transportation system for everyone.

## Selected National Activities Related to the Older Road User

The changing demographics of the United States have immense national implications. As early as 1988 the Transportation Research Board (TRB) documented the problem in TRB Special Report 218, *Transportation in an Aging Society*, and warned that transportation practitioners would face a wide range of design issues related to older road users. It should be strongly noted that changes that might be needed in road infrastructure or operations to accommodate seniors, would also benefit other transportation users.

Selected examples illustrate how Government, industry, associations, and academia are addressing these concerns. The examples are not necessarily mutually exclusive; a Government entity and an association group could be working on the same effort.

## Government Efforts

At the Federal level, the surface transportation legislation, Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), enacted in August 2005 contains provisions specifically emphasizing the transportation needs of older people. One such provision, "Roadway Safety Improvements for Older Drivers and Pedestrians" (Section 1405) authorizes a program to improve traffic signs and pavement markings in all States consistent with the recommendations in the FHWA 2001 publication, *Guidelines and Recommendations to Accommodate Older Drivers and Pedestrians* (FHWA-RD-01-051) available at www.tfhrc.gov/humanfac/01105/cover.htm.

Another Federal effort is the White House Conference on Aging (WHCoA), which is just a once-in-a-decade event. Held in December 2005, its purpose is to develop policy recommendations for Congress and the White House on the range of issues that will affect seniors for the coming 10 years. Delegates to the WHCoA voted on a number of recommendations, including some that were devoted to continued safe senior mobility.

Also at the Federal level, USDOT published a report in November 2003, *Safe Mobility for a Maturing Society: Challenges and Opportunities*, which identified priorities including roadway designs that take into account the needs and limitations of older road users, vehicle designs that protect fragile older occupants, and effective assessments of older-driver competencies.

FHWA has had a broad involvement with older road users. During the 1980s and 1990s, FHWA's dedicated research program on older road users culminated in publication of the *Highway Design Handbook for Older Drivers and Pedestrians* (FHWA-RD-01-103), first published in 1998 and revised in 2001 (www.tfhrc.gov/humanfac/01103/coverfront.htm). The handbook's recommendations and supporting evidence focus on at-grade intersections, grade-separation interchanges, roadway curvature and passing zones, construction work zones, and highway-rail passive grade crossings. Elizabeth Alicandri, FHWA's director of the Office of Safety Programs, says, "These design changes make it safer not only for older users of the highway system, but for all users." Since the handbook's publication, FHWA has conducted workshops across the country to educate practitioners about the needs and limitations of older road users.

Today, FHWA is continuing the workshops and initiating studies that focus on intersections, visibility, pedestrians and bicyclists, speed management, and various operational topics, such as experiments on traffic control devices that can assist older drivers and pedestrians. In the research, the performance of older road users is measured and considered in design and operational recommendations.

In other Federal efforts, NHTSA has several programs underway with partner organizations to improve safety for older road users. Programs include activities that assist law enforcement officers to better identify older persons' physical and mental changes related to driving and help licensing and allied health professionals to assess drivers' abilities. Additional efforts have involved research and production of a range of printed materials that help older drivers and their families make sound choices about safe driving. These printed materials and research reports may be downloaded from the NHTSA Web site at www.nhtsa.dot.gov.

At the State level, one of the primary interests relates to driver testing and licensing. States are considering questions such as: Should older drivers be required to undergo more frequent testing? If so, what should the testing cover? Should certain older people have restricted drivers' licenses? If so, who should determine the type of restrictions and the conditions? Should older drivers be required to renew in person rather than by mail or online? Should older drivers be subjected to evaluation after being involved in a crash? If so, who should conduct the evaluation? In looking at these questions, States are attempting to strike a proper balance between the safety needs of older drivers and other road users, as well as to ensure continued mobility for seniors.

## White House Conference on Aging

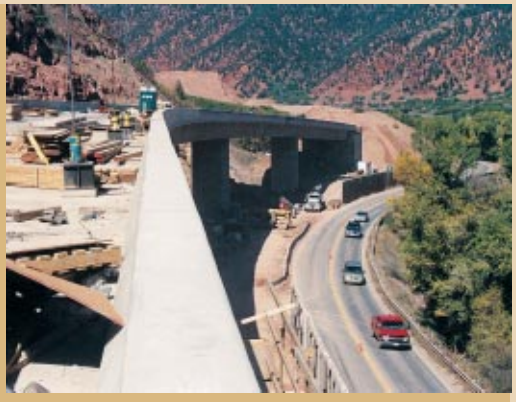
The 2005 White House Conference on Aging (WHCoA) was held in December, which was just the fifth time the conference convened in its nearly 50-year history. Underscoring the importance of transportation to seniors, Secretary of Transportation Norman Y. Mineta was invited to address the conference in the opening ceremonies. He delivered the Administration's message about the importance of safe mobility in latter years, and urged delegates to include recommendations on transportation solutions in the list of recommendations they forwarded to the U.S. President and Congress.

Attendees at the WHCoA included about 1,200 voting delegates who were appointed by the governors in their States, their senators, or their congressional representatives. Other attendees participated but were not eligible to vote on recommendations. These included cabinet secretaries, invited international observers, congressional staff, and other dignitaries.

The format for the WHCoA called for a large number of independent preconference events to be held in the year leading up to the 2005 conference. At these events, attendees were asked to provide input to WHCoA about those recommendations they believed were important to seniors. Each event could only forward a maximum of five recommendations to the WHCoA. Although approximately 400 preconference events were held on topics from housing to mental health to technology, only 5 were devoted exclusively to transportation. Despite the breadth of topics, in about half of all the events attendees nonetheless raised transportation as among the top five issues of concern to seniors.

The conference was organized so that the delegates voted for their top recommendations just after the opening ceremonies. That left the bulk of the conference time for devising implementation strategies for the top recommendations.

Recommendations specifically addressing transportation included those devoted to finding ways to keep older drivers on the road safely and for longer periods, and ways to ensure that sufficient alternative forms of transportation are available when driving or walking must be curtailed. The final recommendations selected by the delegates and their implementation strategies are posted on the WHCoA Web site at www.whcoa.gov.



Steve Moler

**Construction work zones like these (left and right) and curves like this one (below) on State Road 168 in Indiana can create extra challenges for older drivers.**

National Asphalt Pavement Association

Through the American Association of Motor Vehicle Administrators (AAMVA), in 2003 State motor vehicle administrators and their departments or divisions of motor vehicles (DMVs) initiated a pilot public awareness campaign for older drivers in the Washington, DC, metropolitan area. Known as the GrandDriver® program, the 6-month public relations and advertising effort encouraged older drivers and those who care about them to learn more about aging and driving by calling a toll free number or visiting the program's Web site at www.granddriver.info. Following statistically sound postcampaign research, AAMVA tweaked the public relations elements and fashioned a turnkey kit for State DMVs and State patrols. Today, Arizona, Florida, Maryland, Nebraska, and Virginia all have adopted portions of the GrandDriver program.

In June 2002, Iowa held an NHTSA-sponsored Older Driver Conference to identify problems and solutions for the older driver. Among the actions identified for support were safer and easier-to-use infrastructure, safer and easier-to-use automobiles, and improvement of older driver competencies.

In 2004 the Michigan Governor's Traffic Safety Advisory Commission partnered with a host of Michigan State agencies and other entities such as FHWA, TRB, AARP®, and AAA to host the North American Conference on Elderly Mobility: Best Practices from Around the World. The practices discussed were national in scope for the advancement of safe, considerate, and effective senior mobility.

Many States, such as California, Florida, Iowa, Maryland, and Virginia, have established joint task forces with aging and licensing communities working together to address safety and mobility for older people. Currently three States are demonstrating and evaluating the effectiveness of the older road user guidelines contained in the *Highway Design Handbook for Older Drivers and Pedestrians.* Washington State is addressing pedestrian safety. Arizona is looking at signs, signals, and pavement markings. And the Commonwealth of Massachusetts' Governor's Safety Bureau is studying work zone safety.

## Industry Activities

Car manufacturers and after-market vendors worldwide are designing products to appeal to the needs and desires of older drivers. To support those efforts, Ford Motor Company developed a Third Age Suit that, when worn, permits young designers to gain first-hand knowledge of some of the physical difficulties experienced by older road users. The designers also employ a simulator to conduct research on performance by older drivers. In addition, the company is looking into technologies that help compensate for age-related limitations and help protect older drivers and passengers in crashes.

General Motors developed and evaluated an older driver program intended to identify driving problems and increase self-awareness and driving knowledge. The program was described in a 2003 article in the *Journal of Safety Research*, "Improving Older Driver Knowledge and Self-Awareness Through Self-Assessment: The Driving Decisions Workbook."

In another example, Motorola and DaimlerChrysler are developing in-vehicle driving aids that may assist older drivers. The Driver Advocate™ system presents information in a way designed to help prevent excessive cognitive overload. The intent of the other system, Driving Coach, is to help older people maintain their driving skills. Both products are still in development phases and have yet to be fully tested.

## Organizations and Associations

Professional organizations such as TRB and associations such as AARP that serve both industry and consumers are looking at ways to help older road users.

The TRB Committee on the Safe Mobility of Older Persons focuses on cognitive impairment, driving performance, and driver self-awareness; older road user needs and capabilities; alcohol and other drug use among older road users; and engineering solutions to improve older driver and pedestrian mobility and safety (www.eyes.uab.edu/safemobility).

The TRB Committee for a Future Strategic Highway Research Program responded to a directive in the 1998 Transportation Equity Act for the 21st Century (TEA–21) calling for a focus on the older road user as one of the key emphases of a new strategic highway research program. Committee interests include older road users and perception/decision/reaction times during the yellow phase of intersection signals, left turns and gap size, lane-keeping and age, and intersection maneuvers and age (www4.trb.org/trb/newshrp.nsf/web/committee?OpenDocument).

In addition to the two committees, TRB is involved with older road user issues via the National Cooperative Highway Research Program (NCHRP). The recently completed *NCHRP Report 500, Volume 9: A Guide for Reducing Collisions Involving Older Drivers* offers strategies for accommodating older drivers on the roadway and sustaining their proficiency (www.trb.org/news/blurb_detail.asp?id=3844). And TRB's *Improving the Safety of Older Road Users: A Synthesis of Highway Practice* documents the range of strategies and programs available at the national, State, and local levels to improve the safety and mobility of older road users (http://trb.org/news/blurb_detail.asp?id=5479).

Another association effort is a CD-ROM developed by AAA and transportation safety researchers. Roadwise Review™: A Tool to Help Seniors Drive Safely Longer is an interactive computer-based screening tool that enables seniors to measure their driving skills in the privacy of their own homes. Eight functional abilities shown to be the strongest predictors of crash risk among older drivers are assessed, including leg strength and general mobility, head/neck flexibility, high- and low-contrast visual acuity, working memory, visualization of missing information, visual search, and visual information processing speed. The CD-ROM is available from www.aaapublicaffairs.com or most local AAA clubs.

**Intersections are particular challenges for older drivers, but extra turn lanes can help, as with this intersection on State Road 436 in Florida.**

*National Asphalt Pavement Association*

The consumer organization AARP offers a driver safety course designed to increase road safety for motorists aged 50 and older. Taken by more than 9 million older drivers, the course aims to improve driving skills, update attendees on rules of the road, and reduce crashes and associated injuries and fatalities. The National Safety Council and other organizations also offer older driver skill refresher courses similar to that offered by AARP.

In addition, AARP recently established a National Older Driver Safety Advisory Council to serve as an independent voice on current developments and research in mobility, safety, and aging and to provide other services for seniors. (http://mit.edu/agelab/driver-safety/overview.shtml).

A number of health-oriented organizations are addressing older road user concerns. The American Medical Association (AMA) views the safety of older road users as a public health issue and encourages physicians to be proactive in addressing road safety with their older patients. In that regard, AMA and NHTSA developed the *Physician's Guide to Assessing and Counseling Older Drivers*, which assists physicians in such areas as assessing the medical fitness of older people for driving, offers information on medical conditions and medications that may affect driving, and recommends rehabilitation options (www.ama-assn.org/ama/pub/category/10791.html).

The American Occupational Therapy Association (AOTA) also is engaged in evaluating the ability of older people to drive safely. Specially trained occupational therapists conduct behind-the-wheel driver assessments and remediations in a variety of outpatient settings around the country. AOTA provides training and information for their members to help them strengthen driving skills related to various physical, visual,

## NACEM—Best Practices From Around the World Conference

In September 2004, experts from 17 States and 7 countries gathered in Detroit, MI, to attend the North American Conference on Elderly Mobility (NACEM). Sponsored by the Michigan Governor's Traffic Safety Advisory Commission, this meeting marked one of the first times a conference took a strong interdisciplinary approach to help improve the mobility of older people in the United States.

In planning the conference, NACEM committee members launched a nationwide search for best practices in the areas of roadway design, alternative transportation, education and training, housing and land use, and driver screening and assessment.

As an engineering highlight of the conference, the Michigan Department of Transportation, in collaboration with AAA Michigan, developed a "senior driver showcase roadway" in which signs, signals, and markings were modified on a nearby freeway and arterial road system. Improved treatments, better crafted for use by an aging driving population, were on display—including new Clearview font for signs, freeway diagrammatic sign design, increased letter height, brighter sign sheeting, wider pavement markings, brighter traffic signal lenses, back plates on signals and selected signs, pedestrian countdown signals, and painted curb islands. To the extent possible, all of these treatments were placed side-by-side with existing standard treatments for comparison viewing by the conference participants.

"This was a conference in which the participants emerged having more energy than they started with," says David Morena, safety and traffic operations engineer, FHWA Michigan Division Office. "Everyone left excited about what their discipline can do and what is going on in other disciplines. The common feeling was—'I can do more.'"

*Frank Cardimen*
*Chair, NACEM*

and cognitive driving tasks (www.aota.org/olderdriver).

### Academia

Academic institutions across the country are engaged in studies and research projects concerning older drivers and road users. The following list of higher education institutions, although not a comprehensive list, features some of the programs available across the Nation.

The Massachusetts Institute of Technology (MIT) created the AgeLab to bridge the gap between technology and support for older road users (http://web.mit.edu/agelab). The AgeLab uses a multidisciplinary approach including cognitive psychology, gerontology, medicine, engineering, and planning to conduct research related to older drivers. Research topics include driver decisionmaking, the effects of in-vehicle technologies on older drivers, and the politics and policy of older driver licensing and retesting. The lab's projects include a Driving and Personal Mobility Program and a National Older Driver Safety Advisory Council, created by MIT and AARP.

At the University of Iowa, researchers are using a National Advanced Driving Simulator to conduct validation research on simulated driving performance by older drivers and other motorists.

The University of Florida established the National Older Driver Research and Training Center (http://driving.phhp.ufl.edu) to help older citizens stay independent as long as possible. To accomplish this, the university developed a multifaceted program that evaluates fitness for driving, age-related physical and cognitive decline and driving performance, driver risk factors associated with unsafe driving, and driving performance at night and during inclement weather.

And the Center for Research on Applied Gerontology at the University of Alabama at Birmingham focuses on development and evaluation of interventions, which will allow seniors to remain independent and to experience a high quality of life. The center's programs cover areas that include enhancing driving performance through cognitive training, glaucoma and driving in older adults, safety and mobility assessment in older drivers, advanced cognitive training for independent and vital elderly, knowledge that enhances safety, and improvement of visual processing in older adults.

### Subsequent Articles in the Senior Mobility Series

Additional articles are currently planned for this series in PUBLIC ROADS magazine. The next article will discuss age-related physical and cognitive changes, including reductions in peripheral vision, loss of visual acuity, and yellowing of the cornea; physical changes, such as restricted neck movement; and cognitive changes, including selective and divided attention, plus slower response time. It will discuss how these changes affect specific driving tasks from a human factors perspective. This article also will include a discussion of how FHWA's human factors researchers are using their knowledge of age-related ability changes to investigate ways to modify or develop infrastructure to be more understandable and easier to use for the older road user.

Another article will discuss the American Association of State Highway and Transportation Officials' guide for reducing collisions. It will highlight key strategies for improving highway infrastructure to safely accommodate older road users, implementing a comprehensive approach to improving older road user safety, and assessing the feasibility of Advanced Traveler Information Systems and Advanced Vehicle Control Systems for sustaining mobility and enhancing proficiency.

The best infrastructure practices from around the Nation and their associated benefits will be described in yet another article in the series. The practices, which include signing, marking, and signaling practices for highways and roadways, were gathered during a series of conversations with engineers in 40 States and 10 cities and towns. It is anticipated that the practices already employed in these locations will benefit older road users and other motorists.

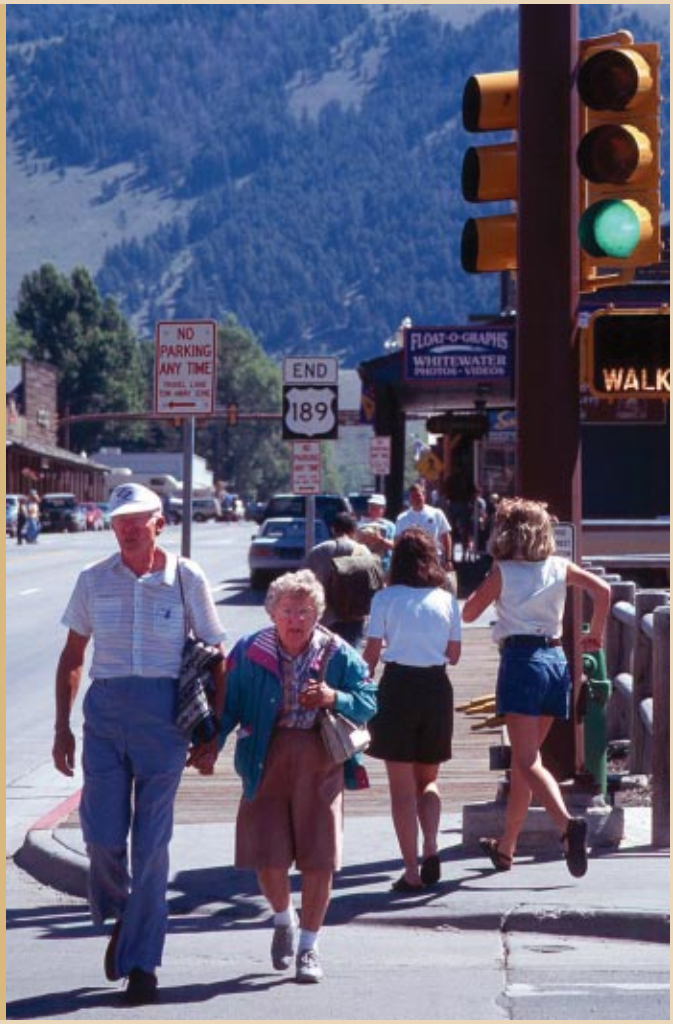
The overall thesis of another future article will be that almost any countermeasure used by engineers

to reduce cognitive and visual demands at intersections will benefit not only older motorists but also the driving public at large. Specific examples of operational improvements that will be discussed include four-lane to three-lane conversions, addition of left-turn lanes and left-turn phasing, removal of the left turn from the intersection proper to an indirect turn location, and roundabouts.

Another article will focus on some of the problems and issues experienced by the international community and solutions that are being developed to address them.

The integration of older pedestrian needs with planning will also be looked at in a future article. The successful and widespread use of pedestrian lead countdown signals and leading pedestrian intervals, which allow pedestrians to begin crossing prior to the release of turning vehicles, at many locations in the city will be described.

Another article shows how in-vehicle navigation and collision avoidance technologies may help counter some of the performance changes associated with aging. The authors will discuss research findings related to older drivers' acceptance of in-vehicle enhancements for systems involving collision avoidance, navigation, and vision enhancement.




**These older pedestrians may need extra time to cross this signalized intersection.**

## Moving Forward . . .

It is widely known that Americans today are living longer than past generations. What is not always known is how to make sure those additional years of life are productive and enjoyable. A major factor continually cited by seniors themselves is their need for continued safety and mobility as they age. The vast majority of seniors prefer to age in place, to grow old in the communities where they raised their families, where they have roots. Transportation that enables seniors to remain in their homes, to remain engaged in community life as active and contributing members, has been cited as the critical link that makes all else in life possible.

Although many segments of Government, industry, community organizations, professional associations, and academia already are exploring and studying a variety of approaches that aim to make those later years fruitful, there is far more that the engineering community can do to make the road environment safer for senior users. The remaining articles in this series will provide more detailed information on how the transportation community and others are making and can make that goal become a reality.

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*This article is the first in a series on older drivers and road users that will run in upcoming issues of PUBLIC ROADS.*

# Mimicking Mother Nature

*by Megan Hall and Steve Moler*

***Washington State constructed an engineered logjam to help safeguard a vital roadway from chronic flooding and at the same time improved fish habitat.***

For the better part of two decades, a remote two-lane stretch of U.S. Highway 101 in western Washington State took a recurring beating from the floodwaters of the Hoh River, which flows to the Pacific Ocean from the glaciers and rainforest of the Olympic Mountains. Major floods in 1981, 1997, 2001, and 2003 inflicted heavy damage on a particularly vulnerable road section where the Hoh takes a 90-degree turn and slams head-on into the highway embankment and then flows along it for about 366 meters (1,200 feet) before turning away. The vulnerable segment, at the highway's Milepost (MP) 174, is about 24 kilometers (15 miles) south of Forks, WA, in Jefferson County.

**WSDOT built this engineered logjam on the bank of the Hoh River to help prevent erosion of U.S. Highway 101. The person in the center of this picture provides perspective on the magnitude of the structure.** *Photo: Herrera Environmental Consultants, Inc.*

The Washington State Department of Transportation (WSDOT) spent $2.2 million over a 12-year period on emergency repairs, mostly placing rock groins and riprap revetments extending from the roadway shoulder to the river below. However, significant erosion of the riverbank and shoulder continued. Highway 101 remained in danger of severe undercutting and possible loss of the entire roadway section from catastrophic failure of the unstable slope.

The battered highway, in addition to being one of the State's most scenic routes, is a critical economic lifeline to Washington's northwestern coast, because it is the only route on the Olympic Peninsula capable of carrying commercial truck traffic. A lengthy closure was not feasible.

## Innovation Needed

The WSDOT engineers urgently needed to find a long-term solution that would not only protect the highway infrastructure, but also would minimize environmental impacts. With the help of the Federal Highway Administration (FHWA), WSDOT was able to implement an innovative strategy consisting of an emerging technology called "engineered logjams" (ELJs).

These manmade logjams mimic those found in nature. In a natural

river system, logjams typically form when a large tree falls into the water and becomes embedded in the river bottom, creating a snag that captures additional logs and debris moving downstream. Such logjams are capable of redirecting the channel and slowing the water's destructive forces. As an additional benefit, the logs and debris can create or enhance fish habitat.

Similarly, in the right situations, the construction of ELJs can have beneficial effects on the natural environment by improving fish habitat, while protecting critical transportation infrastructure by stabilizing and taming river channels during flooding.

"Despite seeming counterintuitive, placing woody debris in rivers as stable logjams can provide an effective means of managing unstable woody debris that poses a risk to infrastructure," says geomorphologist and leading ELJ expert Tim Abbe of Herrera Environmental Consultants, Inc. WSDOT hired Abbe as a consultant on the Hoh River project.

The project is believed to be the first nationally significant application of ELJs for infrastructure protection, and experts at WSDOT and elsewhere are keeping a watchful, hopeful eye.

"Many methods have been used routinely in the past to prevent erosion—rocks, car bodies, dikes, walls—all of which have had temporary success," says John Hart, the lead WSDOT engineer on the Hoh logjam project. "But ELJs may give us the long-term, environmentally friendly method we've been looking for to protect property and infrastructure."

## Why Use Logjams?

"Expanding the use of ELJs for infrastructure protection is what separates this project from other logjam projects," says Hart. Prior to the Hoh River solution, most ELJ projects in the past were constructed for habitat enhancement and relatively small-scale bank protection.

So what prompted WSDOT to try ELJs, something so new and different?

After the 2001 flood inflicted heavy damage on MP 174, WSDOT conducted a reach analysis (a detailed site investigation) of the river along a 13-kilometer (8-mile) section upstream and downstream from MP 174. The reach analysis provided WSDOT with a full understanding of the problem, based on sound science and engineering, and a thorough assessment of long-term solutions for protecting Highway 101 in an environmentally friendly way.

Data from the analysis suggested that the area's relatively unstable glacial geology may have caused large quantities of sediment to be deposited in the water. Over thousands of years, these sediments accumulated in large bars that, over time, caused the river to migrate back and forth across the valley. During the past 50 years, erosion from extensive logging in the valley led to increased sediment deposits. Also, during major floods, the river's accelerated side-to-side movements increased erosion and destructive forces at MP 174 and other problem areas.

The reach analysis found that doing nothing would leave the highway vulnerable to continued flood damage and, possibly, catastrophic failure. Options for action included moving the highway away from the river, which would have involved carving a massive roadcut into a landslide hazard zone, at an estimated cost of $40 million, or constructing a bridge structure at an estimated cost of up to $20 million. Alternatively, the construction of ELJs provided a potentially long-term solution that incorporated habitat-forming elements, at an estimated cost of about $7 million. The study concluded that ELJs were the best option.

## Enhancing Fish Habitat With Logjams

According to geomorphologist Tim Abbe, woody debris in rivers is a positive and necessary natural process in many situations. Woody material helps create diverse fish habitat, protect endangered species, enhance water quality, and sustain complex ecosystems. Specifically, currents that flow through the logs scour deep pools where fish, particularly salmon, can rest, find refuge from predators, and reproduce. Logjams also shade the water so that it remains at a cool temperature suitable for spawning, and the decaying logs serve as a source of nutrients for plants and fish.

Studies have shown that fish living around structures of woody debris are healthier than those living around rock structures, according to Roger Peters, a fisheries biologist with the U.S. Fish and Wildlife Service. In an April 6, 2005, article in *Environmental Science & Technology Online News* regarding the Hoh River logjams, Peters wrote: "Rock is just not that good because it does not allow the development of diverse habitats."

*Herrera Environmental Consultants, Inc.*

**(Above) As shown in this aerial shot, the Hoh River takes an abrupt turn and slams head-on into Highway 101 along a quarter-mile section in the area of MP 174, leaving the highway vulnerable to erosion during the rainy season.**

*WSDOT*

**(Left) Floodwaters in March 1997 jumped the highway embankment and took out a portion of the southbound lane of Highway 101 near MP 174, prompting WSDOT to close the highway temporarily and make costly emergency repairs.**

After the 2003 flood, during which the river chewed up most of a 214-meter (700-foot)-long riprap revetment and required $500,000 of additional riprap for emergency temporary stabilization, WSDOT asked FHWA for help. After reviewing the reach analysis, design, past history, and cost data, FHWA determined that the site qualified for funding under the Emergency Relief (ER) program and approved $7 million to implement the ELJ alternative. The logjam approach was approved as a "betterment involving added protective features" under the provisions of the ER program.

"Band-aid recurring repairs were no longer considered cost beneficial, and a long-term solution was in order," says Gary Hughes, operations team leader in FHWA's Washington Division. Other regulatory agencies agreed. The U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service strongly endorsed the project and issued the appropriate emergency approvals.

"When we reviewed WSDOT's proposal, we really liked what we saw," says Dan Mathis, FHWA's division administrator for the State of Washington. "We were impressed with how their solutions dealt so well with balancing both engineering and environmental issues. Instead of the same old solution of rock revetments, they came to us with an innovative plan."

The novel approach to solving chronic flooding problems excited engineers at WSDOT as well. "Everyone involved in this project was ready for something new," says WSDOT hydrologist Jim Park. "This project showed that we can think 'outside the box,' that we're willing and able to develop innovative new approaches and get out of situations where we keep doing the same old things over and over again."

## Engineering the Right Logjam

The Hoh River ELJ project near MP 174 included construction of four logjam structures in the main channel to divert the river into side channels and help dissipate and redirect the destructive energy. The project also included six bank ELJs extending 15 meters (50 feet) into the channel along the roadbank, plus two smaller bank ELJs, to prevent the river from eroding the highway embankment.

Prior to construction of the logjams, a risk assessment was conducted to estimate the maximum scour depths during a 100-year flood.

## The Inspiration Behind the Engineered Logjam

Before European settlers came to North America, logjams littered rivers and streams in heavily forested areas, helping tame the rivers and creating vast and complex networks of wetlands rich in fish and wildlife. But early pioneers considered logjams and other woody debris a safety hazard and an impediment to river transportation and hence to agricultural and industrial development. Pioneers cleared many rivers and streams of snags, jams, and old-growth trees, and transformed the waterways into simple channels, thereby reducing the wood supplies needed to create natural logjams.

Geomorphologist Tim Abbe conceived the idea of engineering logjams to protect human infrastructure during a hike in 1991. "I came upon a natural logjam and noticed that the logjam was directly influencing the hydraulics and morphology of the stream," Abbe recalls. "Here was this deposit of wood affecting where the stream went and how it behaved."

This observation inspired Abbe to begin considering the idea of building manmade logjams to return rivers to their natural state, to the extent possible for any given situation. In 1995, he supervised construction of what is believed to be the first ELJ project in the United States—and possibly the world—to provide emergency bank protection for private land along the Upper Cowlitz River near Packwood, WA. For this project, Abbe designed three logjam structures using trees found onsite, already fallen over and still retaining their root-balls.

He found that the root-ball is a critical factor in the stability of a river snag, as it acts as both a plow and an anchor. As flow hits the root-ball, it scours the riverbed, and the root-ball sinks further into the substrate to create a snag that can resist even the most formidable floods. This self-strengthening process is what gives natural logjams some of their structural integrity and durability.

When conducting additional research, Abbe found that, in at least one Washington river, natural logjams had lasted for more than 1,000 years. The ELJs constructed on the Cowlitz River withstood a 25-year flood only 6 weeks after being constructed, and the landowner has actually regained some of the previously eroded land, as a result of sedimentation behind the logjams.

Since 1995, more than 50 ELJ projects have been constructed in the Pacific Northwest and 15 in Australia. All are functioning today as intended.

"Reintroducing wood into streams and rivers is not a passing fad," says Abbe. "It's a scientifically recognized component of restoring Pacific Northwest river ecosystems and is also essential to salmon recovery."

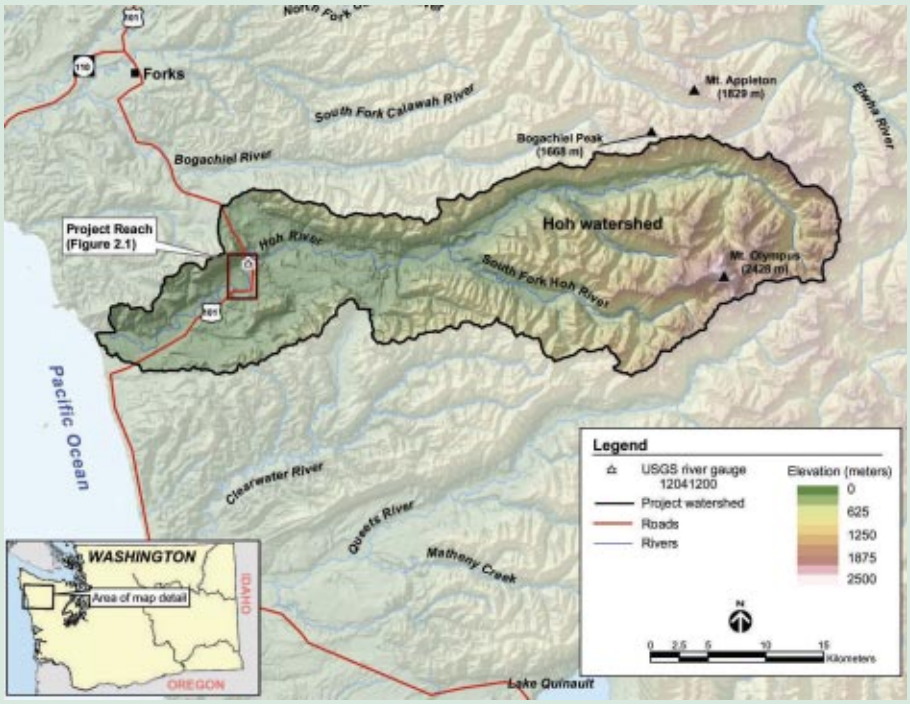

Herrera Environ. Consultants, Inc.

**This image of the Hoh River site was taken in the spring of 2004 prior to construction.**


Herrera Environ. Consultants, Inc.

**This aerial photo shows the Hoh River site as it was predicted that it would look in 2005.**

**(Right) The Hoh River project map.**




*Herrera Environmental Consultants, Inc.*

Designing and building for a 100-year flood is the current engineering standard because building for more than that would entail great additional cost. The WSDOT design team calculated contraction scour, abutment scour, and local pier scour to estimate total scour for all the ELJ structures based on an equivalent bridge pier width. It was found that during a 100-year flood, scour could possibly extend 9 meters (30 feet) below the river bottom. Therefore, the WSDOT design team and contractor considered several alternatives to prevent undercutting, such as extending the ELJs deeper, constructing a scour apron of large rock beyond the perimeter of the ELJs, or extending a scour curtain of steel sheet piles beneath the perimeter of the ELJs to create a continuous rigid barrier that would prevent undercutting of the structure. The WSDOT designers chose the sheet pile scour curtain, deciding that it would create the least disturbance and highest level of protection for the cost.

The construction crew installed the scour curtain at each of the four midchannel logjams in the shape of a U, with the open ends downstream. To stabilize the scour curtain, the sheet pile extends below the depth of maximum expected scour and upward into the base of the ELJ structure. The curtain is three-sided and interlocking, so if the river undercuts the ELJs to expose the scour curtain, racked logs in the ELJs are expected to settle into the scour hole, thereby providing further protection to the scour curtain.

The design team used one-dimensional (depth- and width-averaged flow) and two-dimensional (depth-averaged flow) numerical models to estimate the hydraulic conditions the ELJs would be subjected to during flood events. The models helped in determining critical design factors such as the location and size of the ELJs, pile size and depth, the size and number of logs, and backfill material. Modeling also was a key tool in evaluating the river's response to the proposed structures, particularly with regard to erosion and flood hazards. The ELJs were ultimately designed to handle flows exceeding a 100-year flood of 2,067 cubic meters (73,000 cubic feet) of water per second.

"These logjams were designed to last a long, long time," says Abbe, the geomorphologist. "We engineered them with the same considerations and detail we would apply to designing a bridge with a design life of 75–100 years. They have to be built using sound engineering standards and factors of safety to protect human life and property."

The design team conducted an extensive analysis of historical channel migration patterns to predict future changes in the river and the implications for the project. The analyses indicated that the river would continue to shift throughout its channel migration zone, so the ELJ structures were designed to accommodate changes in the river's location, including a 180-degree change in the channel approach. The designers also estimated the sediment transport likely to result from the proposed design, particularly the new diversion channel and its potential downstream effects.

Ensuring minimal backwater impacts was another concern. The design team predicted a maximum change in the backwater level of 0.46 meter (1.5 feet) directly upstream of the midchannel structures, diminishing to zero 305 meters (1,000 feet) upstream of the midchannel ELJs. The localized backwater effect was essential to meet the project goal of redirecting a portion of the river's flow through the diversion channel and away from the highway. The designers expected the diversion channel to enlarge (which

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**The construction crew stacked and interlaced a 9-meter (30-foot)-high matrix of large logs with the H-pile grid at the core of each midchannel ELJ. More than 100 smaller logs were tightly packed into a pile of debris at the upstream end of the structures. Large rocks and river gravel then were backfilled into voids in the log matrix, which further increased the ELJs strength to a safety factor of more than 2, meaning the structures are more than twice as strong as the maximum forces expected to be exerted during a 100-year flood.**

## A Systematic Protocol for Designing and Constructing ELJs

In recent years, scientists and engineers from the Pacific Northwest have developed standard construction practices for ELJs to ensure that they are built to high standards. To this end, geomorphologist Tim Abbe developed the following logjam design protocol:

1. *Reach Analysis*—attempt to answer such questions as: Why is the road or infrastructure at risk? What are the processes causing the damage? Are things getting worse or better? The analysis should document historic changes in the river, sediment transport and deposition, bank materials and stability, hydrology and hydraulics, ecological and biological conditions and opportunities, riparian conditions, and infrastructure constraints. The reach analysis should provide sufficient information to make predictions on the river's future under various scenarios, so that sustainable logjam designs can be developed that emulate natural conditions and processes.
2. *Feasibility Study*—evaluate actions that should be considered and assess solutions that are realistic, from a cost and constructability perspective. The feasibility study should help answer such questions as: Can the threatened infrastructure be moved out of harm's way? How can environmental impacts be minimized in the channel migration zone? Can habitat be enhanced as part of solving traditional problems, such as bank erosion and flooding? Are construction materials available locally? Will partnerships with other stakeholders benefit the project?
3. *Risk Assessment*—evaluate and predict how the project will perform under both normal and adverse conditions, and evaluate the accuracy of the scientific data to be used in the project's design. The study also should determine the potential effects on changes in the river channel (including flood levels, scour, sedimentation, and bank erosion) and should evaluate potential short- and long-term impacts on humans, infrastructure, and natural habitat. The assessment should include appropriate public outreach and involvement to educate project stakeholders and affected groups and individuals and to provide project managers and experts with public feedback, insights, and ideas.
4. *Design*—build in "factors of safety" equivalent to those applied to any other civil engineering project. In doing this, engineers should determine the type, size, location, and strength of the structures needed to withstand maximum forces and achieve the highest level of public protection.
5. *Construction*—prepare the site and sequence the construction to include access, flow diversions and dewatering, major excavation and grading, careful placement of structural elements, fish removal and protection, water quality and erosion control, and revegetation. Construction of ELJs can range from relatively simple placement of large woody debris directly into a stream or river to more complex structures, like the Hoh River logjams. Construction can be done in many different ways and can have a significant effect on cost, regulatory compliance, and final outcome.
6. *Monitoring and Maintenance*—monitor the structures to evaluate structural integrity, scour, drift accumulation, and ecological effects, and include surveys of fish utilization similar to those conducted by the U.S. Fish and Wildlife Service. Periodic maintenance can include culling, repairing any structural damage, and revegetating, as needed.

it did) after the project was implemented, which in turn diminished the backwater effect. A thorough analysis showed that backwater would not impact developed areas nor change the Federal Emergency Management Agency's floodway delineations.

The engineers selected H-piles with a 1.4 factor of safety to resist bending and overturning, which would compromise the ELJs. According to WSDOT's Hart, the addition of logs, large woody debris, and river sediments increased the strength of the ELJs to a safety factor of about 2—meaning the structures were twice as strong as the maximum forces expected to be exerted on them during a 100-year flood.

In preparing for construction, the construction crew first had to dewater the site by excavating a 610-meter (2,000-foot)-long diversion channel through the floodplain. Next, crews constructed an upstream diversion dam and a downstream backwater dam. Under the supervision of State, Federal, and tribal wildlife experts, as many as 2,000 fish were moved in buckets to the diversion channel. Once the structures were completed, workers slowly reintroduced the river water back into the main channel to minimize disturbing sediments that might redeposit downstream and damage fish habitat.

Each ELJ structure was set up to 18 meters (60 feet) deep into the riverbed and contains a core matrix of 30 or more large spruce trees with the root-balls still intact and most large branches cut off. To meet WSDOT's high safety standards, each logjam has a core of 9 to 14 steel H-piles, covered with dozens of racked logs, then backfilled with loose rock and river sediment, and planted with trees.

The construction crews had just 3 months, from July through September 2004, to complete the project prior to the onset of the rainy season, despite the complex design and the need to temporarily divert the river around the site. They succeeded on time and within budget.

**Megan Hall, area engineer with FHWA's Washington Division, offers perspective on the size of the logs used for the ELJs shown behind her. The larger spruce logs are 91 to 122 centimeters (36 to 48 inches) in diameter, with many still holding their root-balls, as is the case with the logs shown in the background.**

### Logjams as a Panacea?

Initial results of the Hoh River Highway 101 bank protection project have been positive. Although the winter of 2004–2005 was unusually mild for the Olympic Peninsula, there were two peak river flows equivalent to a 2-year flood. Thus far, the ELJs have met or exceeded expectations, successfully diverting the

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**(Above) The H-piles of the midchannel ELJs, such as this one shown under construction, were driven deep into the underlying riverbed. Deep excavation required shoring depicted in the photograph. Steel sheet piling was driven below the lowest log layers on three sides of the structure's core to prevent scour from undercutting the structures. (This piling extends below the logs in the photograph and is not visible.)**

**(Below) Construction crews placed these large spruce trees in interlocking layers around the core of H-piles. The crews then added large rocks and river gravel to fill the interior log matrix to resist buoyancy and increase structural stability. Smaller logs were tightly packed into the upstream portion of the structure to decrease interstitial flow and provide valuable habitat and biological productivity.**

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river's erosive power away from Highway 101.

Still, WSDOT and other project stakeholders, including FHWA, are reserving final judgment for the day a major flood puts the ELJs to the test. In a region that routinely receives 508 centimeters (200 inches) of annual rainfall, that day could come at any time.

"We're watching this project carefully to see how it works during a major flood event," says FHWA's Mathis. "If it does, I think this type of technology can be applied in appropriate situations elsewhere in the country."

Whether logjams prove to be the right answer for MP 174 and similar highways or bridges threatened by flooding rivers, wood removal continues to be part of current river management practice. For example, the Ohio Department of Natural Resources, in its online "Stream Debris and Obstruction Removal Guide," instructs landowners how to remove logjams and other woody debris, noting that, "[i]n-stream debris often gets lodged behind bridge and culvert openings, which can cause higher flood levels and result in additional land inundation and property damage."

Indeed, geomorphologists like Abbe maintain that reintroducing wood is not appropriate for all sites, particularly those where wood accumulations would not have formed naturally, in highly constrained channel segments, or where wood placements would increase risks to public safety or property.

The opportunity exists, however, to improve current river management practices through the reintroduction of wood. The type and size of an ELJ can be adapted to comply with site constraints and achieve the desired factor of safety in most situations.

In the appropriate settings, well-designed ELJs can provide bank protection that emulates the natural character of the river, increases channel complexity, dissipates energy, and creates quality habitat with improved fish passage over a range of flow conditions. Moreover, the use of ELJs is consistent with the principles and practices of context-sensitive design.

Conversely, traditional hardened revetments, like the ones used in previous emergency repairs of Highway 101, are not considered desirable solutions for bank protection on many Pacific Northwest alluvial rivers.

"Rock revetments simplify the morphology and habitat of alluvial rivers by reducing the complexity found along natural banks, disconnecting floodplains, and limiting wood recruitment," says Abbe. According to him, constructing one rock revetment after another has a cumulative effect of concentrating a river's energy, limiting the development of logjams and side channels, and promoting channel incision—all the while reducing the quantity and quality of aquatic and riparian habitat.

Looking forward, only time will tell whether the ELJs are the perfect solution to WSDOT's washout problems along Highway 101. But whatever the case, this project will go a long way to test the waters of this technology, which was originally engineered by Mother Nature.

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**Steve Moler** is a public affairs specialist at FHWA's Resource Center office in San Francisco, CA. He has been with FHWA for 5 years, providing the agency's field offices and partners with support in media relations, public relations, and public involvement communications.

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# Improving Freight Transportation

*by Joanne Sedor*


***Industry leaders help define the role of a State-level coordinator.***

**(Above) Air cargo is a fast-growing sector of the U.S. freight industry. An important role of a State-level freight coordinator will involve promoting and facilitating freight issues across multiple modes of transportation. Here, a plane is being loaded with cargo.** *Photo: American Trucking Associations Foundation.*

Freight haulers face increasing challenges moving goods across the Nation's highways. According to the Federal Highway Administration (FHWA), the volume of freight traffic on the U.S. road system will increase 70 percent by 2020. Though this increase represents a positive trend and reflects a healthy national economy, it does present significant challenges for the freight transportation industry and State departments of transportation (DOTs) across the country.

No one has to peer into a crystal ball to realize that roadblocks lie ahead if the transportation system's highway capacity continues to lag

behind the growth in freight movement. Data from FHWA's *Highway Statistics* series indicate that truck vehicle-miles logged on U.S. highways nearly doubled between 1980 and 2003, while roadway lane-miles increased by only 5 percent. As demand for freight service increases, so does concern about how an even greater number of trucks on the road will affect congestion, safety, and the environment.

Fortunately, some State DOTs and metropolitan planning organizations (MPOs) already are taking steps to manage freight growth by seeking to understand the dynamics of freight movement in their jurisdictions. And their efforts are paving the way for solutions to ease short- and long-term problems.

As heavy volumes continue to strain roadways around the country, freight movement issues must be a top priority in planning and operations decisionmaking. Moving forward, the challenge will be to bring all levels of Government, the driving public, and private organizations into the fold to help solve problems and keep shippers and carriers moving goods safely and efficiently.

Recognizing the important role that Federal, State, local, and industry stakeholders will play in balancing freight and passenger transportation needs, the FHWA Office of Freight Management and Operations (HOFM) conducted extensive outreach, including a survey, to representatives from these groups between 2000 and 2002. The goal was to gain their insights on freight transportation issues and determine how best to prioritize and fund freight-related transportation projects.

Responses by participants to the survey emphasized the need for better coordination and cooperation between the public and private sectors. Innovative mechanisms for financing projects, better research data, and improved data analysis also ranked highly in participants' minds. In the realm of human resources, the respondents highlighted a need for transportation professionals to have greater access to knowledge of data sources and freight trends and issues. They also cited a need for new skills, such as freight forecasting techniques using different data sources and analytical tools and creating Freight Advisory Committees to develop cooperation between the public and private sector on freight issues. Finally, one key finding proved almost universal among respondents: State DOT and MPO officials clearly voiced a common belief that one or several specially designated people need to serve as focal points for freight interests at the State level.

## The Surveys Say . . .

Based on survey results from State DOT and FHWA division office personnel, the following steps are critical in addressing the rapidly increasing volume of freight traffic on the Nation's roadways and establishing State-level freight coordinator positions to develop and implement necessary solutions:

- Setting transportation priorities, promoting the issues, educating members of the public and private sectors, and improving the knowledge of freight professionals
- Connecting with the private sector through transportation councils or other institutional means, such as advisory boards
- Connecting jurisdictions to improve communications and planning between States
- Integrating transportation efforts between institutions
- Integrating transportation modes
- Improving data analysis and planning
- Creating a better understanding of funding and financing issues
- Improving understanding of the planning process
- Thinking globally and locally to solve transportation problems

## On the Road to Coordination

Research and prior surveys have shown that the potential to advance freight-related transportation projects is significantly improved if public- and private-sector collaboration is fostered and projects are

**Estimated Average Annual Daily Truck Traffic, 1998**


**Estimated Average Annual Daily Truck Traffic, 2020**


**By 2020, the volume of freight traffic on the U.S. road system will increase by 70 percent compared to 1998 levels, according to FHWA's 1998 Freight Analysis Framework, a database that integrates information from various sources to estimate freight transportation activity domestically and at major international gateways. The heavy red areas on the maps show where the increased volume will have the greatest impact.** ***Source:*** *FHWA, Freight Analysis Framework, 2002.*

## Identifying the Need

States must understand their freight transportation issues before they can address them. The Minnesota Department of Transportation (Mn/DOT) is in the early stages of this process, according to Cecil Selness, director of Mn/DOT's Office of Freight and Commercial Vehicle Operations.

"The freight office in Minnesota has just completed the first State freight plan in which we identify the challenges of accommodating a 70-percent increase in freight traffic on the basic transportation system that is already in place," says Selness. "We are seeking to better understand the essential transportation needs that must be in place to support the businesses and industries that make our State's economy prosper. Because our resources are very limited, we are learning to focus those resources where they can be most effective."

While Mn/DOT looks toward improved freight movement in the near future, the Maine Department of Transportation's (MaineDOT) Office of Freight Transportation (OFT) is reaping the benefits of changes implemented nearly 9 years ago. Organized in 1996, OFT is responsible for developing policies, programs, and projects that strive to transform the State's freight transportation network into a cohesive system. The office combines various pre-existing MaineDOT functions in rail, port, and truck regulatory management into one office.

Since its inception, OFT has delivered many dividends, most notably a coordinated management and communications center that deals with the State's present and future freight transportation needs. Within that structure, the director participates in top management discussions along with directors of more traditional planning and maintenance offices. Likewise, OFT personnel interact with other MaineDOT units, other Federal and Maine State Government agencies, and private-sector stakeholders. In addition, OFT proposes and coordinates projects that promote freight transportation efficiency. The result is an ongoing exchange of information among all parties.

"Without OFT, those initiatives would have been nearly impossible to accomplish," says Tim Bolton, a policy development specialist with OFT. "Our goal is to move goods through the State safely and efficiently, and this organizational structure has allowed us to coordinate a multimodal approach toward achieving that goal," he says. "We have coordinated several freight studies for the department, as well as for the Northeast Association of State Transportation Officials. Our office also is involved with ITS [intelligent transportation systems] development in commercial vehicle operations, and we coordinate a freight advisory council of private-sector freight stakeholders. These initiatives would have been far more difficult without an organized freight transportation office arrangement."

*For more information about the* Minnesota Statewide Freight Plan*, visit www.dot.state.mn.us/ofrw/statewide_plan.htm. For more about the MaineDOT's Office of Freight Transportation, visit www.maine.gov/mdot/freight/freight-home.php.*

coordinated by an office or a person dedicated to this activity at the State level. Collaboration is key to identifying and implementing complex regional solutions to freight transportation problems. A coordinator also can advance freight capacity-building programs for the State.

Many States are taking the initiative to establish State-level freight coordinators. FHWA and the American Association of State Highway and Transportation Officials (AASHTO) agreed on the need to tap into existing capabilities, inform others, and build consensus on the role of State-level freight coordinators.

With the understanding that the needs of each State differ, FHWA and AASHTO set out to create a position description for a State-level freight coordinator. The effort involved two key components. The first involved conducting a survey of State DOTs and FHWA division offices to learn their perspectives on freight transportation priorities and needs. The second entailed holding a national conference for State DOTs, FHWA, and private-sector representatives to further identify and define the roles, responsibilities, and skills necessary for a State-level freight coordinator. The conference also sought to resolve the institutional issues that would prevent coordinators from operating with maximum effectiveness. A sample position description for a State freight coordinator is posted at www.ops.fhwa.dot.gov/freight/fpd.

### Focusing on Freight Perspectives and Needs

In February 2005, FHWA surveyed its division offices, while AASHTO surveyed State DOTs. The following were among the questions posed to participants:

- How high a priority is freight transportation in your State?
- What hot freight issues do you foresee in the next 5 to 10 years?
- What are the roles and responsibilities of a State-level freight coordinator?
- What organizational and institutional changes are needed to improve planning for freight transportation?

The results of this survey, shared with FHWA and State DOT staffs through two Web conferences, indicate that the two groups concur on some issues but differ on others. For example, although more than 40 percent of State DOT respondents said freight transportation was an extremely important priority in their States, the majority of FHWA respondents were neutral on this question, considering freight neither a high nor low priority.

The FHWA division offices and State DOTs agreed, however, that the State-level coordinator function requires a core set of skills, roles, and responsibilities to advance freight-related transportation projects. Both groups also agreed that one of the more important roles and responsibilities is developing partnerships and cooperating with other stakeholders. This includes coordination among transportation modes, between the public and private sectors, within institutions, and among jurisdictions. Likewise, both surveys showed that the following institutional barriers affect the implementation of freight initiatives:

- Limited management support for freight projects
- Competing priorities that push freight to the back burner
- Lack of coordination with the private sector

In addition, FHWA and State DOT staff agreed that educating stakehold-

ers, including the public, about key issues is crucial to developing solutions to freight transportation issues.

## A Meeting of Like Minds

Following the Web casts, State DOT officials, FHWA division office staff and headquarters personnel, and private-sector representatives gathered in Columbus, OH, on April 26–27, 2005. Their plan was to identify and define the roles and responsibilities of a State-level freight transportation coordinator, the skill sets and resources required for the position, and the organizational and institutional issues that will need to be addressed to advance freight transportation projects effectively. In addition, participants had the opportunity to listen to a panel of private-sector representatives who shared their thoughts on the duties of the coordinator position.

As the conference progressed, participants identified two roles that a coordinator must assume. One involves having a thorough working knowledge of the freight industry, related policies, and emerging trends. Attendees agreed that a coordinator must have a grassroots connection to freight stakeholders and the ability to understand, analyze, and transform data into useful information. The other role involves working at a higher level as a spokesperson for freight in the State and serving as an advocate for transportation improvements that benefit freight movement. These two roles were termed "coordinator" and "champion," respectively.

Although there is a continuum of activity between the two roles, they are separate functions. Certain roles, responsibilities, and skill sets may apply to one role or the other, or both. However, a coordinator most likely will need a champion at a higher level who can help influence decisions and bring about changes within the State.

Throughout the conference, attendees participated in a constructive give-and-take that served to form a common understanding of the requirements. David Ganovski, director of the Maryland DOT's Office of Freight Logistics, summed up the meeting's many benefits. "This conference definitely exceeded our premeeting expectations," Ganovski says. "The well-facilitated, 'out-of-the-box' brainstorming sessions, including high-level industry shipper representatives, significantly added to the 2-day session. Although more refinements are required, this effort directionally defined what a State freight coordinator should be. Succinctly, the results call for this position to be a champion, advocate, and facilitator of freight issues."


AASHTO

**The logo for the AASHTO-FHWA Freight Partnership Conference.**

## Shaping Roles and Responsibilities

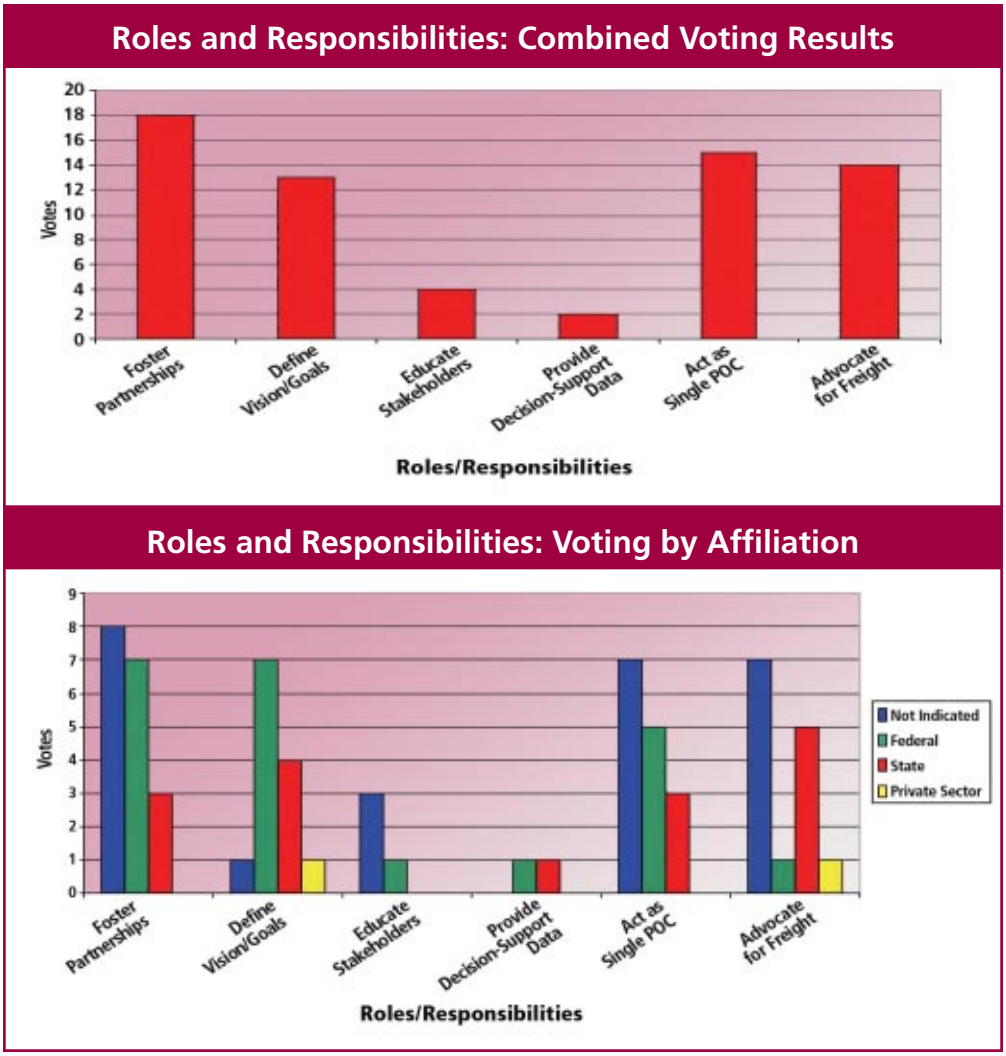
Together, the surveys and conference highlighted a half dozen roles and responsibilities of the State-level freight coordinator. In their order of importance, the six key functions are as follows:

- *Fostering cross-state, cross-agency, cross-sector, and cross-modal partnerships.* These partnerships are necessary to achieve joint planning and operations for efficient freight transportation and to obtain needed funding for projects. When developing the partnerships, the coordinator will need to think regionally and corridor-wide. The coordinator also will need to review current partnerships to see where gaps exist and identify solutions to help bridge those gaps.
- *Acting as single point of contact (POC) to all stakeholders.* This role entails coordinating with all relevant stakeholders and creating a forum in which all parties can come together to work on freight transportation improvements. This would involve participation in multijurisdictional activities.
- *Serving as an advocate for the State's freight interests.* This will require an understanding of the various audiences involved in freight projects and how to best reach those audiences to promote freight interests. It also will require an awareness of all freight projects in the State and those in other areas that involve multijurisdictional coordination. The coordinator will need to track progress to understand when issues occur, how they are resolved, and what changes need to be made within the State to better support project development and implementation.
- *Determining the State's freight vision and goals.* The vision and goals need to connect freight

**Introduced in 1956, overseas container shipping (shown here) is the leading component of increased global trade. Shipments to the United States doubled over the past 10 years and are expected to double again every 10 to 15 years. Once they reach port, many of those containers will travel along U.S. roadways to reach their inland destinations, adding to the growing volume of freight traffic on the Nation's highways.**

movement needs with other State interests such as economic development, land use, and environmental compliance.

- *Educating all stakeholders on the importance of freight.* This includes educating the public and private sectors about freight movement through the State and its relationship with their interests. FHWA and State DOT respondents also agreed that FHWA should develop and provide educational opportunities such as workshops and training courses for State DOTs and MPOs. In addition, they said that FHWA should continue to provide the tools and resources to educate stakeholders. The coordinator will be a vital link to FHWA to identify necessary training.
- *Identifying data sources and providing technical data.* The coordinator will be the primary point of contact for freight data within the State and will need to understand what data is required to support decisionmaking that involves freight-related transportation projects. The coordinator will be the connection point for integrating local (State and MPO) data with larger national or regional databases on freight movement.




**These two figures show how participants at the freight mobility conference in Columbus, OH, ranked the importance of the roles and responsibilities of a State-level freight coordinator. Above (top) are the voting results representing the general consensus of all attendees. Directly above, the results are broken down by group affiliation.** *Source: The AASHTO-FHWA Freight Transportation Partnership—Synthesis Report.*

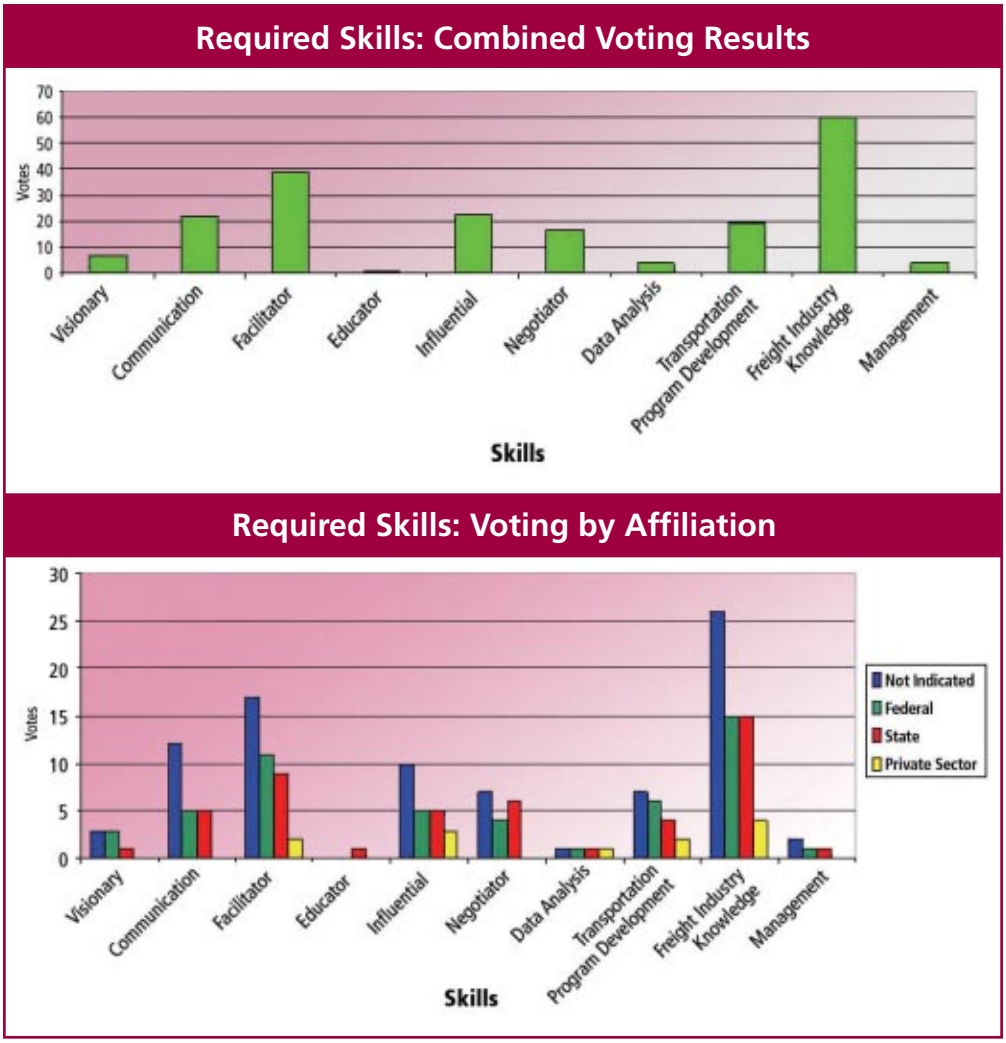
## Skill Set for Coordinators

After defining the coordinator's roles and responsibilities, survey respondents and conference attendees identified a core set of skills needed by freight transportation professionals and offices to advance freight-related projects. Listed according to top priority, these skills include the following:

- Knowledge and understanding of the freight industry and freight movement to deal effectively with private-sector logistics, the goods movement industry, infrastructure for the various modes, and Federal, State, and local government roles in freight movement
- Organizational knowledge and expertise to bring all stakeholders together and facilitate a dialogue that identifies mutual interests, shares ideas, and advances continued collaboration
- Persuasive communication capabilities to articulate needs and influence stakeholders to advance freight interests and improvements
- Public speaking and interpersonal communication capabilities to build relationships and speak to people at all different levels, from State Governors to the public, in a language that resonates with them
- Understanding of transportation programming, project development, and design and funding processes and mechanisms to comprehend all elements of freight transportation projects from development through design and implementation; understanding of current funding and financing options
- Negotiation capabilities to facilitate agreement between potentially disparate interests and enable them to work together for the advancement of freight transportation within the State
- Visionary thinking to help set State goals for freight that encompass present dynamics and improvements for the future
- Capability to analyze and interpret data and then draw meaningful conclusions to provide decisionmakers with useful information; the ability to identify missing data and recommend strategies to bridge those gaps

- Project management expertise to track freight projects within the State and monitor plans and timelines
- Educational expertise to understand options and opportunities to educate freight professions, such as universities, FHWA's Freight Professional Development Program, National Highway Institute, and AASHTO's professional development series

This rather exhaustive list encompasses the breadth of skills necessary to perform the roles and responsibilities outlined for the freight coordinator position. It is important to keep in mind, however, that these skill sets are scalable, as are the roles and responsibilities, depending on the level of freight activity in the State. In States with a high level of freight activity, or in States that wish to attract the economic development that comes with freight activity, these functions may be performed by an office rather than by a single freight coordinator.




**These graphs summarize how conference participants ranked the importance of skills required by a State-level freight coordinator. The top graph represents the general consensus of all attendees, and the lower graph breaks down the voting by group affiliation.** *Source: The AASHTO-FHWA Freight Transportation Partnership—Synthesis Report.*

## Organizational and Institutional Issues

On the second day of the conference, State DOT and MPO personnel and FHWA division office representatives met separately to discuss organizational and institutional issues related to their respective administrative and operational environments. Specifically, they discussed the changes necessary to enable coordinators to assume the roles and responsibilities that were identified during the conference's first day.

The State DOT and MPO representatives identified several issues that hampered the effective development and implementation of projects to improve freight transportation, such as shortages of dedicated funding for freight projects, difficulty in getting the right stakeholders to the table and keeping them there, scarcity of data regarding freight issues, insufficient multistate and multiregional coordination, limited recognition of freight in the political process, and lack of understanding of freight transportation's role in economic development.

To address these barriers, the State DOT and MPO representatives recommended a number of changes, including integrating freight awareness into all planning, developing and implementing a national freight transportation policy, and creating three types of corridors—those with national, multistate, and regional significance—and identifying common issues for those corridors at the national and State levels. In addition, representatives agreed that solutions that provide positive results in one State should be analyzed so that other States can apply those benefits.

Another needed change is to provide a mechanism for overcoming highway-specific funding processes. A flexible funding source is necessary to expedite freight projects that do not fall into highway project guidelines. Other State DOT and MPO recommendations included addressing freight issues proactively and using economic benefit analyses to illustrate the positive results of action and the consequences of inaction.

Meanwhile, during their session the FHWA division office participants identified the following challenges: (1) integrating the modal activities of USDOT and FHWA to promote freight planning; (2) emphasizing that organizations—from the top down—must buy into the belief that freight is a transportation planning priority; (3) promoting the importance of national-level freight goals and objectives; (4) advocating that the FHWA division-level freight coordinator

WSDOT

**Along with a healthy domestic economy, international trade, which accounted for 25 percent of the Nation's economy in 2004, has contributed to the dramatic growth in freight moving along U.S. highways. During that year, nearly 6.9 million trucks crossed the U.S.-Canadian border, creating delays and congestion such as in the photograph above.**

needs the same training and skills that were identified for State-level freight coordinators, and recognizing that the coordinator must *want* to do the job; and (5) increasing knowledge and appreciation of other modes among FHWA staff.

The FHWA representatives recommended the following changes to address these challenges: (1) urging USDOT to develop a national-level freight policy with other stakeholders; (2) encouraging parties to integrate all modes at the State and regional levels through the FHWA State freight coordinator, establishing a freight point of contact through each modal administration, and inviting other modes to attend advanced planning workshops to discuss their modes; (3) engaging FHWA division administrators in understanding and resolving freight issues; (4) providing ongoing data on national freight growth to help inform how this issue can be addressed; (5) encouraging FHWA to develop a set of core competencies for State freight coordinators; and (6) considering creating rotational opportunities for FHWA personnel to improve their understanding of freight issues.

One change that both the State DOT and FHWA division office representatives suggested was establishing a national-level freight transportation policy. Although a policy cannot overcome all institutional issues, it can reinforce the importance of efficient freight movement and help elevate freight transportation needs to a more visible level.

"The Columbus conference was an excellent opportunity to talk about how the States and FHWA should address freight needs that are going to continue to grow rapidly over the next 20 years," says Cecil Selness, director of the Minnesota Department of Transportation's Office of Freight and Commercial Vehicle Operations. "Every State has a little different situation but realizes that the health of its economy and its economic growth require [efficient] access for its businesses to their customers and suppliers." Selness adds, "More and more, we find ourselves in an international environment where the quality of transportation beyond our borders is essential to our success. We are seeing the need to work together and for the Federal Government to have a coherent national [freight] transportation policy."

## Ready Resources

The survey and conference highlighted four essential resources needed to plan and execute freight initiatives effectively:

- *Funding*. Money to fund projects may be obtained through traditional and innovative financing mechanisms.
- *Training and Educational Opportunities*. These opportunities are needed to create a group of future freight transportation professionals.
- *Internal and External Support*. Buy-in from senior management within State DOTs and FHWA

## Educationally Speaking

The FHWA Freight Professional Development (FPD) Program educates professionals through training, technical assistance, and a Web-based resource library. By working with the academic community, the program encourages changes in degree programs in transportation planning and logistics that better enable public- and private-sector transportation professionals to understand each other's roles and responsibilities.

The program provides technical assistance to States and MPOs through efforts such as the "Talking Freight" Web-based videoconference series, a no-cost way for freight transportation professionals to broaden their knowledge and develop skills. Information on the monthly seminars is available at http://talkingfreight.webex.com.

The FHWA "Freight Planning Peer Exchange Listserv" at www.fhwa.dot.gov/freightplanning provides a forum to share information on freight with more than 500 subscribers from the public and private sectors. In addition, the new Freight Peer-to-Peer Program puts freight experts in touch with practitioners who need assistance. This program includes a database of freight experts in various disciplines and offers travel assistance to support the peer exchange.

*For more information on the FPD Program, visit www.ops.fhwa.dot.gov/freight/fpd.*

## Stateside Report

Many State DOTs already have implemented aspects of the suggested freight coordinator guidelines within their existing freight offices. In fact, some States, including Washington and Oregon, shared some of their lessons learned with participants at the freight conference in Columbus, OH.

Through its Office of Freight Strategy and Policy, the Washington State Department of Transportation (WSDOT) is working to improve freight transportation through enhanced data collection and by working with the private sector to better understand customer needs.

"WSDOT is committed to fact-based decisionmaking," says Barbara Ivanov, director of the WSDOT Freight Strategy and Policy Office. "The primary task of the [WSDOT] Freight Strategy and Policy Office is to provide quality freight information to our State's leaders so we can make better decisions today than we did yesterday, and better decisions tomorrow than we did today."

In addition, the WSDOT freight office stresses the importance of communicating and working with the private sector to understand and resolve freight transportation issues. Ivanov says that improving the State's freight system starts with clearly defining customers' problems.

"Although the WSDOT Freight Strategy and Policy Office has two managers, and our current staff has been in place for just 18 months," she explains, "we've completed more than 200 one-on-one interviews with high-volume shippers and carriers across the State. We're constantly in the field with customers to determine their requirements of the State's freight system, observe freight system flow at their plants, ask detailed questions at industry association meetings, and listen to their issues. There are a thousand demands on their time, and we do everything possible to make giving us information convenient and easy."

Meanwhile, in fall 2004, the Oregon Department of Transportation (ODOT) established a Freight Mobility Section with the mission to raise the visibility and effectiveness of planning and delivering freight infrastructure and policy improvements in all modes across the State. The section's purpose is to promote, coordinate, and facilitate freight issues. It coordinates public-private, State-local, and State-Federal decisions on freight transportation infrastructure and activities on a statewide and State-to-State basis. The office is responsible for encouraging all ODOT divisions to integrate freight mobility considerations into their day-to-day business practices. Training and education on freight issues are provided to all levels of ODOT staff.

"We staff the statewide Oregon Freight Advisory Committee (OFAC)," says Julie Rodwell, freight mobility section manager at ODOT. "This committee, which reports directly to the Oregon Transportation Commission (OTC), is composed of high-level industry and government representatives and has been making freight policy recommendations to the OTC, the governor, and to the [State] legislature since 1998."

According to Rodwell, the Freight Mobility Section, working through the OFAC, not only provides a central focus for freight-related activities and information within ODOT, but also collaborates with other freight stakeholders in Oregon, such as local freight advisory committees, area committees on transportation, metropolitan planning organizations, the public, and other State and Federal agencies.

Rodwell's group also is playing a growing educational role. For example, the annual Oregon Planning Institute meeting held September 15–16, 2005, at the University of Oregon, now has a freight planning session each year thanks to the efforts of the Freight Mobility Section. In October 2005, the section sponsored a 3-day National Highway Institute course on freight planning. The group also is providing stakeholders with data on freight issues, such as commodity flow data developed by subareas of the State to assist with freight planning.

*For information about the WSDOT Freight Strategy and Policy Office, visit www.wsdot.wa.gov/freight. For more information about ODOT's Freight Mobility Section, visit http://egov.oregon.gov/ODOT/TD/FREIGHT or contact the office at 503–986–3520.*

division offices is essential, as is support from industry and the private sector.

- *Data and Information*. Useful freight data are needed, including freight flow data and the analytical tools to understand the information. Additional freight research is necessary, along with a knowledge base of successful practices, lessons learned, and existing multimodal issues.

Although some resources, such as buy-in from senior management, will need to come from changes and actions at the institutional level, others can be provided through existing education and training. A gap analysis will need to be completed to compare what additional resources are needed to augment current resources and training. The FHWA Freight Professional Development Program, for example, already provides seminars, courses, workshops, and informational materials. The seminar Freight Data Made Simple addresses the major types of freight data, their sources, and limitations. It also discusses the use of freight data in the transportation planning process, including their use in forecasting, and highlights examples of national, State, and local applications. Further, the seminar identifies key resources and references to help guide State and metropolitan planners in their freight planning efforts.

Similarly, the workshop Engaging the Private Sector in Freight Planning teaches participants how to establish a relationship with the private sector. Another existing

WSDOT

**By 2020, more trucks carrying more tons of freight will combine with an increasing human population to strain the U.S. highway system, which is already struggling to keep pace. Consequently, congestion like that shown here will spread to more major urban areas and intercity links.**

## The I–10 Corridor: The Road More Traveled

As the Nation's southernmost, coast-to-coast Interstate, I–10 travels 3,959 kilometers (2,460 miles) across California, Arizona, New Mexico, Texas, Louisiana, Mississippi, Alabama, and Florida. With more than $1 trillion in trade annually moving along this roadway, the corridor is of significance not only in those States, but also on a national level.

Approximately 5 years ago, the State transportation agencies that I–10 crosses joined together to conduct a comprehensive evaluation of the overall corridor system. Their goal was to assess the need for and feasibility of new options to facilitate goods movement along the corridor. The Federal Highway Administration also played a role in this study, by joining the eight State DOTs as a funding partner, as well as by attending the meetings of the Technical Advisory Committee (TAC).

In a presentation given during a December 2005 Talking Freight Seminar, Dilara Rodriguez of Caltrans, who serves as the technical project manager for the study, as well as chair of the TAC, noted that there was a great degree of willing cooperation among the State DOTs.

"What was unique about this effort is that the State DOTs came on their own," Rodriguez says. "They were not prompted by any private sector entities or even Federal entities to begin this partnership. We sat together and said we have a common issue. We decided to look at our needs and what can we do as eight States together, to move freight along the I–10."

The study began in 2001 and focused on pinpointing I–10's problems and identifying strategic solutions to meet the ongoing growth in freight movement along the route. A Memorandum of Understanding (MOU) was developed, and a Steering Committee and a TAC, with officials from each State, were formed to oversee the study. With the understanding that freight movement differs within their borders, each State had the opportunity to choose which elements (that is, border crossings, rail systems, intermodal connectors, etc.) along the corridor would be analyzed in the study.

Upon its completion in 2003, the study yielded results that included options for improving I–10 in specific locations, along with overall solutions such as utilizing technology to enhance truck movement, communicating with motorists, and speeding up emergency response times. The partnership is now assessing the results and beginning to implement the recommended solutions. It also is focused on short-term, State-specific operational solutions, which should be in place by 2008. Mid- to long-term solutions will be implemented between 2008 and 2025 and include more strategic, corridorwide solutions, many involving the use of innovative technologies, such as intelligent transportation systems.

*More information about the I–10 National Freight Study is available at www.i10freightstudy.org.*

resource is the recently implemented Freight Peer-to-Peer Program, which is meant to help States share knowledge and best practices. More information about these existing resources is available on the "Freight Professional Development" Web site at www.ops.fhwa.dot.gov/freight/fpd.

### Insights from the Private Sector

To supplement the information gathered from Federal and State personnel, a panel of representatives from the private sector also provided their perspectives on the roles, responsibilities, and skills required for the freight coordinator position. The panel, consisting of representatives from Limited Brands; Owens Corning; Pacer Cartage; Edwards & Drew, Inc.; Jacobson Distribution; ODW Logistics; and BNSF Railway, stressed the importance of collaborating with the private sector, as well as all freight stakeholders, and understanding supply chain logistics.

According to John A. Gentle, chairman of the National Industrial Transportation League Highway Transportation Committee and global leader of transportation affairs for Owens Corning, the freight coordinator should not be a political appointment. "The most desirable characteristic is a seasoned person who has an indepth and practical understanding of how the supply chains operate," he says.

The panelists also highlighted the need for the coordinator to understand and integrate State and national perspectives on freight transportation into planning decisions. "The freight coordinator is a strategist, a goal setter, someone who plans for the future," says David Holsclaw, regional operations manager of Jacobson Distribution.

The private-sector participants also indicated that they rely on the public sector to serve as educators, informing the public about the importance of freight and educating upcoming transportation professionals about freight transportation and logistics. "There is a need to educate the public on the importance of freight," says John Joseph, senior transportation manager with Limited Brands. "This is a very tough thing to do, and sometimes it takes situations like the congestion in southern California for people to wake up and see that we have a major problem on our hands."

Members of the private-sector panel further noted that solving freight transportation issues is not the sole responsibility of the public sector. They stated their willingness to work with the public sector, namely the freight coordinators, to help nurture the partnerships needed to resolve freight issues. As one panel member put it: "We can be available. In this conference, there has been a lot of talk about education and awareness. There is a willingness on our part to help solve the problem. We don't want to say that this is the Government's entire problem. We can help with education and invite and embrace the coordinator into some of our dialogs and discussions."

### Taking the Next Step

The conference enabled a diversified group of individuals to participate in defining the key elements of the

State-level freight coordinator position and went a long way toward identifying issues and scoping potential solutions to advance freight transportation planning and operations. At the conclusion, attendees were asked to identify followup activities to help FHWA and AASHTO move forward. Here are highlights from their responses:

1. Develop a national USDOT freight policy.
2. Establish a formal way for States to work together on regional and interregional projects.
3. Identify legal flexibility within existing funding mechanisms.
4. Establish a freight committee in AASHTO.
5. Promote the importance of freight within State DOTs and Federal leadership.
6. Educate shippers through the National Industrial Transportation League.

FHWA and AASHTO intend to vet the results of the survey and conference with FHWA division administrators and State DOT chief executive officers to solicit their input and buy-in. The FHWA Freight Council and AASHTO have formed subcommittees to act on a number of the next steps and develop a template position description for the State-level freight coordinator. To help develop the template, FHWA and AASHTO will compare position descriptions used by State DOTs to operating practices already in place in freight offices. Aspects of these descriptions, along with the results of the conference, will be used to create the template.

FHWA and AASHTO will continue to collaborate in support of activities that advance the freight coordinator effort as well as freight transportation overall. Now that the survey and conference are complete, the goals are to continue working toward better integration of freight projects into the planning process and to ensure that America's freight keeps on trucking.

## A New Way to CREATE

The Chicago Regional Environmental and Transportation Efficiency (CREATE) Program is a shining example of how public and private partnerships can work. For this program, the State of Illinois and the city of Chicago joined with passenger and freight railroads serving the region to identify a set of critically needed improvements to the Chicago region's rail and highway transportation infrastructure.

Partners in this project are the Illinois Department of Transportation, the Chicago Department of Transportation, and members of the Association of American Railroads, including BNSF Railway, Canadian Pacific Railway, Canadian National Railway, CSX Transportation, Norfolk Southern Corporation, Union Pacific Railroad, and Metra.

With freight demand in Chicago expected to double in the next 20 years, CREATE will develop options to provide increased rail infrastructure and capacity. CREATE will invest $1.5 billion to improve rail freight flow and will bring public benefits in the form of new jobs, economic development, air quality improvements, reductions in shipping costs, improved passenger rail service, and reductions in highway usage for freight movements.

According to Division Administrator Norman Stoner with the FHWA Illinois Division Office, "Within the CREATE program there is much promise and great expectations for remarkable improvements in the way freight moves through the Chicago region and on to the Nation. FHWA's role has been and continues to be one of preparing the way so that CREATE does fulfill its promise and realize its expectations."

CREATE is funded by public and private contributions. In addition, the six railroad partners will provide $212 million, an amount equal to the potential economic benefits of the improvements to the rail industry. The remaining funds will come from Federal, State, and local governments. The CREATE improvements will be implemented over the next 6 to 10 years.

*For more information, visit www.createprogram.org.*


SAIC

**These shipping containers are stacked up, waiting to be loaded for transportation to their final destination.**

**Joanne Sedor** is a transportation specialist in FHWA's Office of Freight Management and Operations. As a member of the Freight Policy and Communications teams, she analyzes freight issues and trends and writes about them in publications. Prior to joining the Freight Office in 2001, Sedor was a senior analyst and project manager at the Congressional Office of Technology Assessment.

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# Energy Losses in Storm Drain Access Holes

*by Kornel Kerenyi and J. Sterling Jones*

***FHWA studies new techniques that may be used to estimate head losses through manholes.***

Anyone who resides in an urban area in the United States probably lives over an elaborate network of underground pipes that comprise a storm drain system. The system collects storm runoff from streets, parking lots, and other development and conveys it to an outfall.

Approximately every 92 to 183 meters (300 to 600 feet) and at every junction where several pipes intersect, an access hole, commonly referred to as a manhole, is installed for joining pipes with different base elevations, alignments, and/or diameters, and for inspection, maintenance, and repair. Typically the access hole is simply a concrete pipe or box set on its end, with openings for joining pipes into the system, a ladder anchored on one side, and a cast iron cover large enough for a person to enter.

**(Above) A typical access hole (manhole).**

Energy losses in these systems due to friction in the pipes reduce water flows, creating such potential hazards as flooded basements and blown access covers during major floods. Designers analyze these energy losses to select appropriate pipe sizes, set base elevations, and evaluate potential hazards. Estimating energy losses is relatively straightforward, but estimating the losses in the access holes tends to be a challenge because the flow in the junction is so chaotic.

"Most of the energy lost in storm drains is within the pipes themselves, but the energy lost at junctions is not at all insignificant," says Joe Krolak, senior hydraulics engineer with the Federal Highway Administration's (FHWA) Office of Bridge Technology. Ultimately, once the dynamics are better understood, engineers at State departments of transportation, highway planners, and others in the field will be able to apply new methodologies and build improved storm drains with greater cost savings, he adds.

## The Original Study

Between 1986 and 1992, FHWA conducted a lab study of energy losses through junction access holes, using relatively large-scale (one-quarter scale) physical models. A preliminary method for determining such losses, based on early results from that study, was published in FHWA's Hydraulics Engineering Circular 22 (HEC 22), *Urban Drainage Design Manual* (NHI-01-021).

A revised method, based on the final results, was coded in the highway drainage HYDRAIN software system.

Practitioners questioned both of these methods when they encountered situations beyond the range of the experimental parameters tested in the lab study. Both methods had limitations when applied to junctions with plunging inflow or with outflow pipes that carry supercritical flow. In addition, both methods are relatively complex and necessitate solutions that may require repeating over time. FHWA plans to update HEC 22 and further develop computer software for storm drain design. The need for consistent technology in FHWA publications and software applications on this subject is urgent. To accommodate that need and overcome some of the difficulties in estimating energy loss in access holes, Krolak initiated an effort to reanalyze the data from the 1986–1992 study.

## The Followup Study

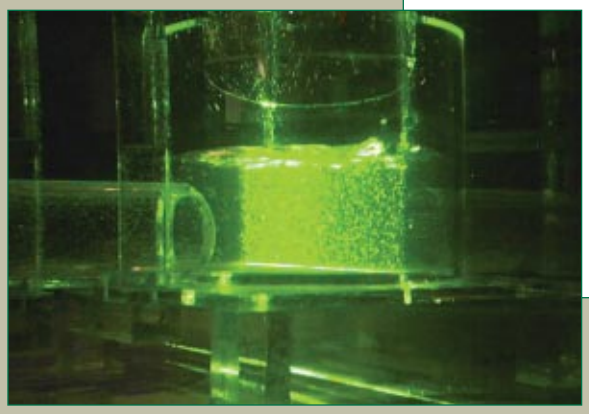
Roger Kilgore, principal of Kilgore Consulting and Management in Denver, completed that effort for FHWA in 2005. "The 1986–1992 work improved the methodology for people to improve storm drains," Kilgore says. But Kilgore, who was the principal investigator during part of the 1986–1992 study, subsequently, as a practitioner, has seen the limitations of the existing methods.

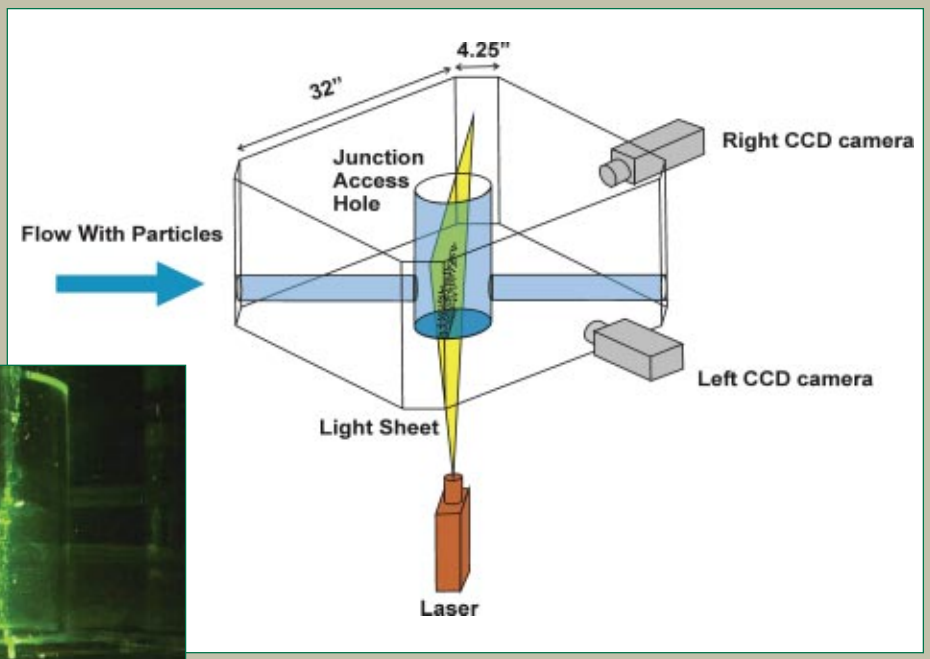
The new FHWA study separated the 1986–1992 data into two groups. The first group consisted of "base runs" with the simplest configurations (one inflow and one outflow pipe with the same base elevations) to establish first approximations of access hole energy loss. The second group included the more complex configurations used to derive adjustments to the first approximations. The result is a new method, which is somewhat simpler than the existing methods and might improve handling of plunging flow and supercritical flow situations. Concurrently, Krolak requested additional, independent lab experiments to collect data and evaluate the proposed new method.

The original 1986–1992 FHWA lab study used a large-scale model of an access hole with a diameter of 0.6 meters (2.0 feet), which is near prototype for some applications. That original study included 755 test runs. For the current study, researchers decided to use a much smaller scale, easier-to-operate, experimental setup with higher precision instrumentation to investigate a wider range of parameters and study energy inside the access hole itself. In particular, researchers chose to use a particle image velocimetry (PIV) technique to visualize and measure flow patterns. This technique requires special tracer particles to be induced into the flow, which makes the use of a smaller experimental environment much more practical. It also requires transparent models for flow visualization.

**(Right) An old, large-scale junction loss model is shown here at the FHWA Hydraulics Laboratory.**

**(Below) This small-scale junction loss model, used in the new study, has attached standpipes that measure the hydraulic grade line using vertically mounted contact image sensors.**






**This diagram shows a pair of digital cameras in an angular imaging arrangement and a laser light sheet in the center plane of the access hole. The photo (below) shows an image captured by one of the laser light cameras.** *Source: FHWA.*

The current study has two objectives. The first is to evaluate the proposed procedure, which requires conducting some of the same types of tests that were run in the previous study. But the new tests include a wider range of parameters, such as greater plunge height ratios and steeper pipe slopes. Previous research was limited in that it was applicable to storm drain systems located only in relatively flat areas; the research would not hold up for systems in hilly and mountainous regions of the country, where steep pipe slopes are the norm. Researchers shared data with Kilgore during the study that resulted in several modifications in his proposed procedure.

The second and more challenging objective is to characterize the energy level in an access hole with various inflow and outflow pipe configurations. If that can be accomplished, then the familiar culvert hydraulics analyses can be applied to the access hole that serves as the tail box where inflow pipes enter, and to the head box for outflow pipes where the water exits. Researchers have attempted numerous analyses of PIV data and three-dimensional (3–D) numerical model data, with uneven results. Characterizing energy in the access hole is highly problematic because the flow is so chaotic, and arbitrary assumptions have to be made to obtain results that fall between intuitive limits.

## Experimental Setup

The new test apparatus for junction energy loss includes three water tanks: a head box, main tank, and tail box. The purpose of the head-box tank is to control the pressure head for the experiments and to allow injection of seeding particles. The junction loss models are mounted inside the main tank, where they are surrounded by still water to minimize distortions for the 3–D and stereoscopic PIV recordings. The main tank also supports a carriage system for two laser distance sensors. These sensors measure the flow depth in standpipes attached to the sides of the inflow and outflow pipes of the junction access hole. This setup is automated to maintain constant flow depth in the access hole during the test run. The water column in the standpipes represents the hydraulic grade line in the inflow and outflow pipes. The tail-box tank is designed to control the tail water.

To accomplish the first objective of evaluating the proposed new method, the researchers performed tests to measure the total loss through the access hole; it was not necessary to measure energy inside the access hole to meet this objective.

The researchers applied two techniques to measure the flow depth. One method used laser displacement sensors pointed at a floating disk in the standpipes. Another method, recently developed at the FHWA Hydraulics Laboratory, uses contact image sensors (CIS) mounted on the sides of the standpipes to scan the water columns. The big advantage of the CIS system is that it can measure all water columns in the standpipes simultaneously, which results in a more precise loss coefficient computation.

Three flow meters provide discharge readings and are used to compute velocity head. CIS sensors pointed at four locations in the access hole measure an average water surface elevation. The models are fabricated from Plexiglas® with a 15-centimeter (6-inch) access hole diameter and 3.8-centimeter (1.5-inch) inflow and outflow pipe diameters, resulting in a relative access hole

diameter equal to 4, which is the access hole diameter divided by the outflow pipe diameter.

To meet the second objective of characterizing the energy inside the access hole, the researchers employed 3-D and stereo PIV techniques and 3-D numerical models. The PIV technique is an optical flow diagnostic based on the interaction of light refraction and scattering using nonhomogeneous media. The fluid motion is made visible by tracking the locations of small tracer particles at two instances of time. The particle displacement as a function of time then is used to infer the velocity flow field. The 3-D PIV makes it possible to measure instantaneous velocity flow fields.

A stereo PIV camera system is based on a pair of digital cameras in an angular imaging arrangement. A special geometry is necessary to reconstruct the 3-D field from the two projected, planar displacement fields. Therefore, knowing the precise distance between the two camera lenses and the distance between the cameras and the light sheet is important. The laser system and cameras are mounted on a movable carriage frame to keep the distance constant between cameras and light sheet.

## Test Results

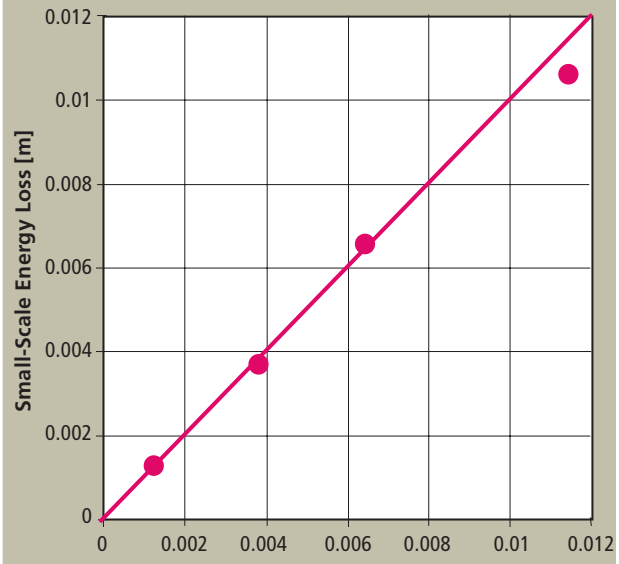
The first set of tests, using the new junction loss setup and corresponding small-scale models, was intended to verify scale effects. A subset of the base runs (one inflow and one outflow pipe) was used to analyze scaling issues. The dimensions of the apparatus for the base runs were scaled down by a scaling ratio factor of 1 to 4, and total energy loss across the access hole was measured. Those energy losses, scaled back up to the dimensions of the original apparatus, agreed quite well with the corresponding energy losses from the larger scale experiments. Based on that observation, researchers were confident to proceed with the small-scale models to evaluate the proposed procedures.

Comparing the proposed methodology to the base run tests shows that the new method predicts total losses for the simple one inflow and one outflow pipe very well.

One of the biggest limitations of the existing methods for estimating junction losses was that they did not apply to supercritical flow, where the losses were greatest. Kilgore attempted to solve this problem, but there were no data in the original large-scale experiments to use as a basis for this part of his methodology.

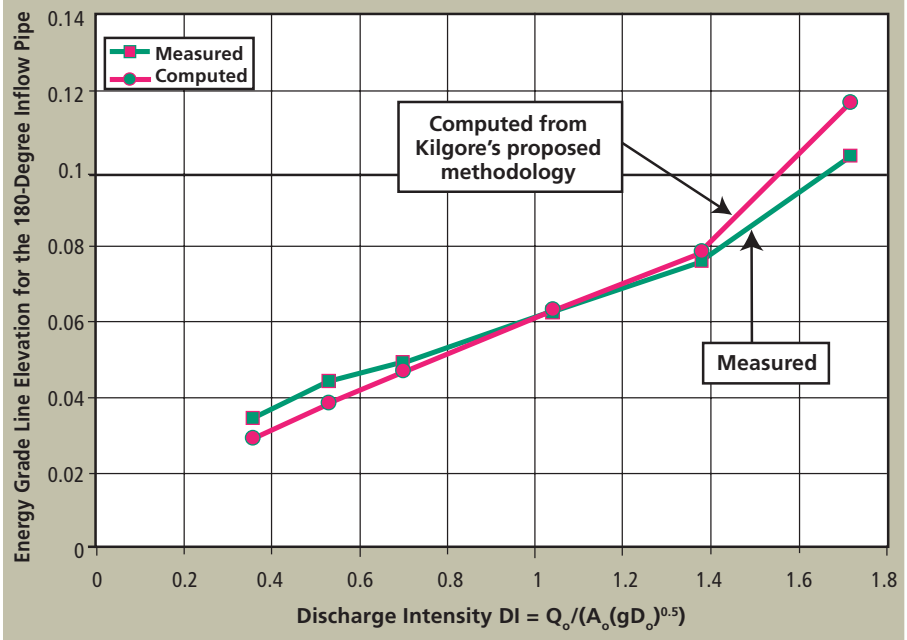
The FHWA lab performed 18 runs in the small-scale experiments, with supercritical flow in the outflow pipe and two inflow pipe configurations at 180 degrees and 90 degrees. The outflow pipe for these runs had a slope of 3 percent. A surprising result of the tests was an almost constant depth in the center of the

### Verification of Scale Effects



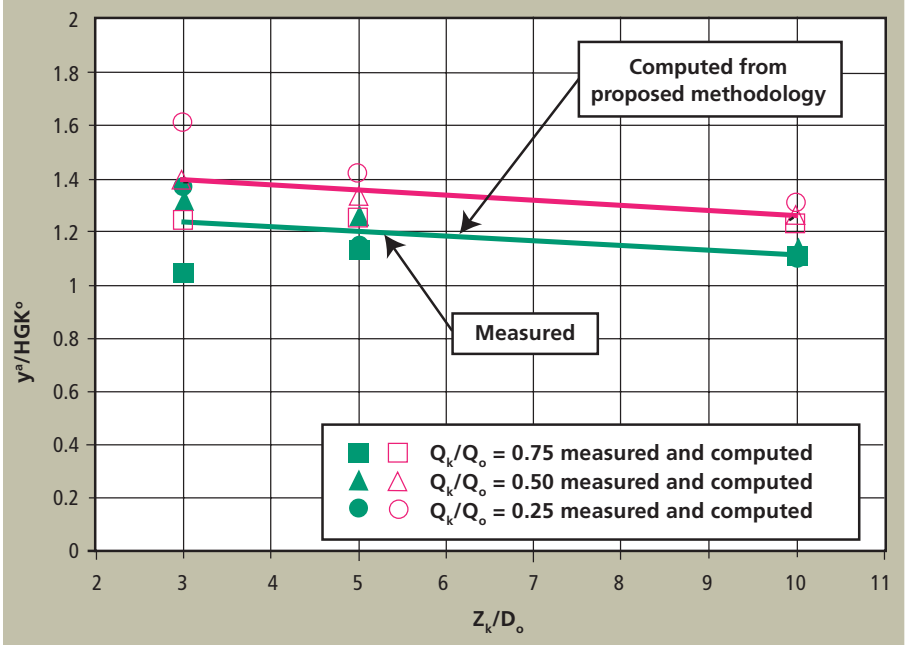

**This chart compares energy losses from previous junction loss experiments with new small-scale tests and shows a good agreement comparing old and new data, which indicates negligible scale effects.** *Source: FHWA.*

### Inflow Pipe Energy Grade Line Elevation For Supercritical Flow in the Outflow Pipe




**This graph shows the measured inflow energy grade line elevation superimposed on the proposed Kilgore's method as a function of discharge intensity for one inflow pipe at 180 degrees and supercritical flow in the outflow pipe. Measured and predicted data are in agreement.** *Source: FHWA.*

## Plunging Flow Tests




**This graph shows the measured and computed access hole depth normalized by the hydraulic grade line elevation for the outflow pipe as a function of relative plunge height, using various fractions of flow coming from the inlet.** *Source: FHWA.*

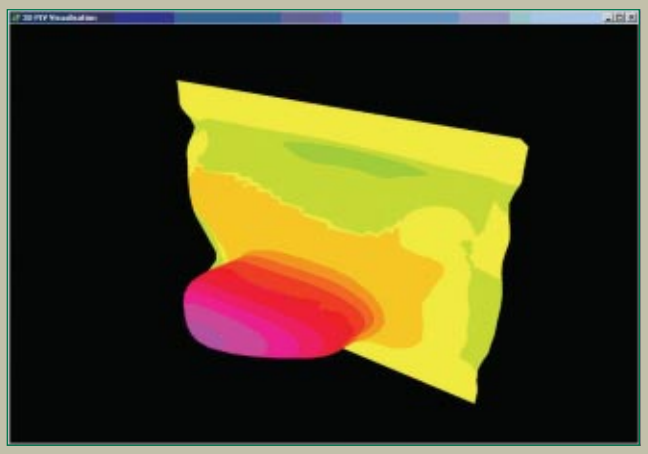
access hole for a fairly wide range of discharge intensities. Kilgore's methodology does an average job of estimating that depth in the access hole; but it does a good job of estimating the energy grade line elevations for the inflow pipes for supercritical flow situations. Kilgore mentions in his publication that his proposed methodology may not be appropriate for high discharge intensities when flow is into a supercritical outflow pipe, because water might shoot across the access hole in a jet and not expand and contract as expected.

The FHWA researchers conducted 18 runs to model plunge flow conditions. They varied the drop elevation for the inlet between 3 and 10 times the outflow pipe diameter. Kilgore's methodology does a reasonably good job of predicting the influence of plunging flow on the depth in the access hole and estimating the energy grade line elevations for the 180 degree inflow pipe.

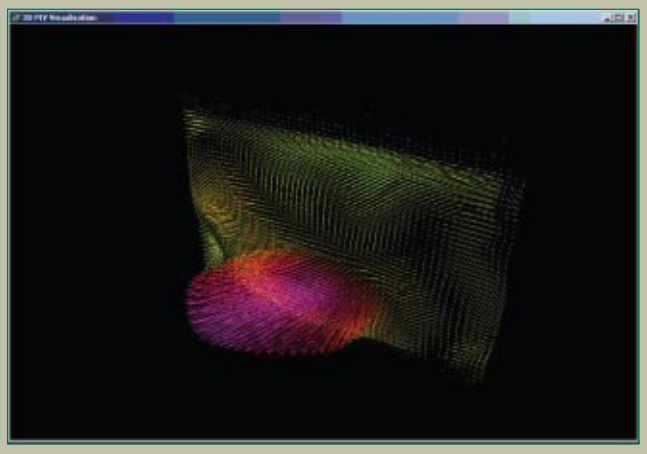
The FHWA lab also used Kilgore's base runs to explore the kinetic energy distribution in the access hole using PIV. When this aspect of the study is successful, there will be a valid basis for adjusting Kilgore's coefficients even if it does not lead to a full culvert analogy for the energy loss analysis for access holes. The researchers used 3-D numerical model results, as well as PIV physical model results, for the kinetic energy investigation. With the numerical model, depth-averaged kinetic energy could be computed at the very center of the access hole—or integrated over a selected plane or over the entire matrix of vertical node points used in the simulation.

For the PIV technique, local velocities in three planes perpendicular to the inflow and outflow centerline were recorded in the access hole. Knowing the total energy loss led to the question of how to separate it into entrance and exit losses. An average kinetic energy was determined in each of the three planes. Regressing these values over the access hole diameter allowed a distribution of the total loss.

The results are very sensitive to the averaging technique used. Depth-averaged kinetic energy generally leads to low numbers because it includes large, ineffective flow areas. To obtain reasonable kinetic energy



**This photo shows an averaged velocity distribution contour plot in the center plane perpendicular to the main inflow direction in the access hole.**



**This photo shows an averaged velocity distribution vector plot in the center plane perpendicular to the main inflow direction in the access hole.**

values from the PIV results, an effective area has to be determined arbitrarily, which is not necessarily transferable to more complex pipe configurations. An attempt using this technique to determine the kinetic energy distribution for a more complicated inflow pipe configuration (pipe at 90 degrees) failed because the flow in the access hole is extremely unorganized, and no zones of effective flow could be detected.

Similarly, the 3-D numerical model gave unexpectedly low kinetic energy values for two of the four base run tests, which would suggest the impossible conclusion that there was a gain in energy as the flow passed from access hole to outflow pipe. One advantage of the numerical model simulation was that no area was arbitrarily disregarded, and if the center point were to be used as the representative energy for the access hole, the simulation might apply to any pipe configuration.

Based on these complications, FHWA is taking a different approach to a methodology for estimating the kinetic energy distribution. The approach will be to relate the contraction loss, as flow goes from the access hole into the outflow pipe, to the contracted area (vena contracta) in the outflow pipe. The 3-D PIV technique can be used to measure the contraction zone in the outflow pipe.

Although it is difficult to measure the kinetic energy in the access hole, it is relatively easy to compute the energy line for the outflow pipe and measure the vena contracta in the pipe using PIV techniques. If the vena contracta is an indirect measure of the contraction loss for the outflow pipe, it would lead to an indirect measure of the total energy in the access hole, regardless of the inflow pipe configuration.

## Significant Findings

One concern when starting the new small-scale experiments was the scaling issue. Using base runs confirmed that the small-scale results with precise instrumentation can be used with reasonable confidence to evaluate and develop enhancements to Kilgore's proposed methodology. Small-scale tests allow a much more efficient testing procedure and reduce physical and geometrical constraints.

## For Further Information

- HYDRAIN (version 6) uses the methods developed in the research report, *Energy Losses Through Junction Manholes*, FHWA-RD-94-080, November 1994.
- Kilgore, Roger T., "A Proposed Storm Drain Energy Loss Methodology for Access Holes," Transportation Research Board 84th Annual Meeting, January 9–13, 2005, Washington, DC.
- *Urban Drainage Design Manual* (HEC 22, November 1996) uses a methodology reportedly based on an earlier report by Chang and Kilgore (1989).
- www.fhwa.dot.gov/engineering/hydraulics/library_arc.cfm?pub_number=22.

The proposed new methodology addresses the problem of supercritical flows in outflow pipes. The use of inlet control culvert equations to estimate the initial depth in the access hole for these situations does appear to work very well.

Kilgore proposed a relatively simple equation to compute additional energy loss for plunging flows that accounts for the proportion of the flow that is plunging and the drop height. The proposed procedure is applicable to plunge height ratios, plunge height divided by outlet pipe diameter, up to 10 using the small-scale experimental setup.

Understanding the kinetic energy characterization in the access hole remains the most rational procedure for estimating energy losses in access holes and distributing those losses among several inflow pipes. The two approaches using 3-D PIV and 3-D numerical modeling to analyze the energy level in the access hole did not give satisfactory numbers, due to extremely unorganized flow inside the access hole. Researchers at the FHWA lab now are investigating the more organized flow in the contracted area of the outflow pipe, using the contraction ratio as an indirect measure of the contraction loss in the flow from the access hole to the outflow pipe to back-calculate the energy loss in the access hole.

"It's very worthwhile research," Kilgore says, referring to the recent research at the FHWA lab. "They employed a lot of innovative techniques and newer technology to reduce the scale of the experiments and the time it takes to do them."

That view is bolstered by Krolak, who says that "current methods for estimating the energy loss are unwieldy and overly complicated; some assumptions maybe are too conservative or not conservative enough." The FHWA lab was able to apply new technology to improve the older studies, and "validated some of the old data while making new strides," he adds. The older studies used large-scale physical models. Their size limited what configurations could be considered, Krolak explains. The new technology allows use of much smaller scale models while maintaining (or improving) the accuracy of results, and allowing testing of different configurations and junction types.

**Kornel Kerenyi** is a hydraulics research engineer in the FHWA Office of Infrastructure Research and Development (R&D). He coordinates hydraulic and hydrological research activities with State and local agencies, academia, and various partners and customers, and co-manages the FHWA Hydraulics Laboratory. He was previously a research engineer at a private company and supervised support staff in the data collection and analysis for this study. Dr. Kerenyi holds a Ph.D. in fluid mechanics and hydraulic steel structures from the Vienna University of Technology in Austria.

**J. Sterling Jones** is a hydraulics research engineer in the FHWA Office of Infrastructure R&D. He manages the FHWA research program in hydrology and hydraulics and comanages the Hydraulics Laboratory. He provided oversight during the data collection, analysis, and results reporting for this study. He is a registered professional engineer in the Commonwealth of Virginia.

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# 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.*

## Technical News

### New Report Evaluates Effectiveness Of Red-Light Cameras

During the 6-year period from 1997 to 2002, nearly 6,000 people died in red-light running (RLR) crashes in the United States. Another 1.2 million people were injured. An emerging method for enforcing compliance with red lights is red-light cameras (RLCs), which detect vehicles that pass over pavement sensors after a traffic signal has turned red. The sensors are connected to computers in high-speed cameras, which take two photographs of the violation. The first photo shows the front of the vehicle when it enters the intersection, and the second captures a shot of the vehicle in the intersection. Law enforcement officials then review the photographs, and in many localities mail a citation to the registered owner of the vehicle. To evaluate the safety and economic effectiveness of RLC systems, the Federal Highway Administration (FHWA) recently completed a research study, *Safety Evaluation of Red-Light Cameras* (FHWA-HRT-05-048).

The FHWA researchers compiled data from several jurisdictions, including El Cajon, San Diego, and San Francisco, CA; Howard County, Montgomery County, and Baltimore, MD; and Charlotte, NC. The researchers analyzed the total number of right-angle and rear-end crashes at 132 signalized intersections in those jurisdictions, both before and after the installation of RLCs. In addition, they analyzed crashes at 296 unsignalized intersections to serve as a comparison group.

The results showed that RLCs reduced the total number of right-angle crashes by nearly 25 percent and decreased the number of injuries resulting from right-angle crashes by 16 percent. The total number of rear-end crashes, however, increased by 15 percent, and the number of injuries resulting from rear-end crashes increased by 24 percent. The study included an economic cost analysis to determine whether the increase in rear-end crashes at intersections with RLCs negates the economic benefits of fewer right-angle crashes. The combined results from the seven jurisdictions indicated a positive aggregate economic benefit of approximately $39,000 to $50,000 per site per year. Therefore, the increase in rear-end crashes does not appear to negate the benefits derived from the decrease in right-angle crashes.

The study also revealed that the use of RLC technology is especially advantageous when placed at locations with a high ratio of right-angle to rear-end crashes. Public awareness and appropriate signage also improve the effectiveness of RLC programs.

*The final report is available at www.tfhrc.gov/safety/pubs/05048/index.htm. To obtain hard copies, contact the FHWA Report Center at report.center@fhwa.dot.gov. For more information, contact Michael Griffith at 202-493-3316 or mike.griffith@fhwa.dot.gov.*

## Policy and Legislation

### New Rules Regulate Work and Sleep Schedules For Commercial Truck Drivers

USDOT's Federal Motor Carrier Safety Administration (FMCSA) issued a new hours-of-service (HOS) rule that details the length of time commercial drivers can operate trucks before they are required to take a break. The new rule, effective in October 2005, is the product of years of research meant to keep drivers healthy and make highways safer, officials said.

Announced on August 19, 2005, the rule replaces HOS regulations that were last updated in 2003. Parts of the rule, including the maximum driving time and minimum rest limits, remain the same. However, it now includes changes affecting short-haul operators and longer distance drivers who use in-cab sleeper berths for their rest.

As in the 2003 regulations, the new rule prohibits truckers from driving more than 11 hours in a row, working longer than 14 hours in a shift, and driving more than 60 hours over a 7-day period or 70 hours over an 8-day period, FMCSA Administrator Annette M. Sandberg said. In addition, the rule requires truckers to rest for at least 10 hours between shifts and provides a 34-hour period to recover from cumulative fatigue.

The most important change under the new rule allows short-haul operators not required to hold a commercial drivers license, such as landscape crews and delivery drivers who work within a 240-kilometer (150-mile) radius of their starting point, to extend their work day twice a week. They also will no longer have to maintain logbooks. The change was prompted by safety data that show short-haul drivers make up more than half the commercial fleet, yet are involved in less than 7 percent of the Nation's fatigue-related fatal truck crashes, Administrator Sandberg said.

Administrator Sandberg pledged to work with States and the trucking community for the first 3 months that the rule is in effect, allowing them time to update educational materials, train employees, and reprogram driving schedules. During this transition period, FMCSA and State law enforcement officials will monitor carriers for egregious violations and pursue enforcement action where necessary.

*For more information or to review the new HOS rule, please go to www.fmcsa.dot.gov.*

### FHWA Helps Evaluate State Pavement Preservation Programs

To help State highway agencies develop and enhance their pavement preservation programs, the FHWA Office of Asset Management recently launched a Pavement Preservation Technical Assistance Program. The National Center for Pavement Preservation (NCPP) at Michigan State University in Okemos, MI, under contract to FHWA, will facilitate an assessment team consisting of a representative from either FHWA headquarters or one of the Technical Service

Wolf Boehnke, Boehnke Studios

**A worker is sealing cracks in this roadway.**

Centers, the local FHWA division office, and the local State departments of transportation (DOTs). This team will evaluate each State's procedures, policies, and programs for preserving pavements. The goal is to help States assess their progress and identify best practices, and then provide recommendations on how to enhance their programs.

Pavement preservation is a proactive, long-term network strategy to improve pavement performance using a variety of tools consisting of cost-effective, thin-surface treatments that extend the life of a road, such as crack and joint sealing, chip seals, slurry seals, microsurfacing, and thin and ultrathin hot-mix asphalt overlays for flexible pavements and partial- and full-depth repairs, dowel-bar retrofits, and surface grinding of rigid pavements. To be effective, these treatments must be selected carefully and applied before the pavement sustains any structural damage.

For each review, NCPP staff will spend approximately 80 hours assessing the State DOT's program and interviewing key personnel involved in developing, implementing, and managing the pavement maintenance, evaluation, and preservation efforts. The assessment team will tailor its review to the highway agency's existing programs, policies, specifications, and organizational structure to identify sound engineering practices and pinpoint those that could be refined or improved to provide a more effective program. At the end of each review, the assessment team will meet with the participants to discuss observations and make recommendations.

FHWA and NCPP will use information gathered during the reviews to create a database of preservation practices and trends. The database will serve as a long-term tool for sharing best practices and assessing the success of preservation programs throughout the United States. This tool also will help FHWA and NCPP examine variables that can adversely affect pavement preservation treatments, such as application timing, environmental factors, and traffic loads. In addition, the database may be useful in determining the degree to which various treatments will increase a pavement's service life.

*For more information, contact Tom Deddens at 202-366-1557 or tom.deddens@fhwa.dot.gov.*

## Public Information and Information Exchange

### Library of Access Management Resources Available on Two-Disc Set

With traffic congestion growing and fewer new arterials being built, the need to manage roadway access effectively is increasingly important. Access management is the systematic control of the location, spacing, design, and operation of driveways, median openings, interchanges, and street connections to direct where motorists enter and exit roadways. It also encompasses design treatments of medians and auxiliary lanes, and the appropriate spacing of traffic signals. By managing roadway access, government agencies can reduce traffic congestion, increase safety, extend the lives of major roadways, and support alternative transportation modes such as bicycling.

To help transportation specialists obtain the latest resources on access management, FHWA is offering free copies of the new *Access Management DVD/CD-ROM Library*. The two-disc set, which includes one DVD and one CD, is a 28,000-page compendium of all the resources presented at the six National Access Management Conferences held since 1993. FHWA, which helps fund the biennial meetings, compiled the DVD/CD library after the most recent conference in August 2004 in Kansas City, MO, and is distributing the set in partnership with the conference host, the Transportation Research Board (TRB) Committee ADA70 on Access Management.

Among the other resources on the DVD and CD are the proceedings from the Sixth National Conference on Access Management in 2004, including 11 audio-visual presentations delivered at the conference. The set also contains brochures, handbooks, and reports, including eight National Cooperative Highway Research Program reports on access management topics.

**The *Access Management DVD/CD-ROM Library* features a 28,000-page compendium of all the resources presented at the six National Access Management Conferences held since 1993.**

The DVD also features the proceedings from the first five TRB access management conferences and eight short videos on access management topics produced by FHWA, the Missouri and Florida DOTs, and other organizations. Both discs feature interactive search menus that enable users to look for resources by title, author, and subject.

*For information on the Seventh National Conference on Access Management, scheduled for August 13-16, 2006, in Park City, UT, visit www.accessmanagement.gov. For more information on the* Access Management DVD/CD-ROM Library *and the* 2003 TRB Access Management Manual, *contact Neil Spiller at 202-366-2188 or neil.spiller@fhwa.dot.gov.* *(Continued on page 61)*

# Internet Watch

*By Joanne Sedor*

## New Web Site Streamlines Reporting of Truck Weight and Size Data

To preserve the Nation's transportation infrastructure and keep trucks and buses moving efficiently, States must ensure that commercial motor vehicles comply with Federal size and weight standards. The Federal Highway Administration (FHWA) is the agency responsible for certifying State compliance with these standards. Until recently, the certification process was conducted manually, with States mailing reports to FHWA. However, the use of paper and pen soon will be a thing of the past.

In late 2005, FHWA's Office of Freight Management and Operations unveiled a new online reporting system and Web site for use by preauthorized freight personnel at State departments of transportation and FHWA division offices. The new system will automate the historically paper-based reporting process for managing truck size and weight certifications.

### New System, Same Requirements

Under the old system, each State had until July 1 to submit an annual State Enforcement Plan (SEP) to its local FHWA division office for approval. The SEPs described the procedures, resources, and facilities that the State intended to devote to the enforcement of its vehicle size and weight laws in the next fiscal year. In addition, each State had until January 1 to certify that it was enforcing all applicable size and weight laws and that it was fulfilling the commitments set forth in its SEP. States completed this step by sending FHWA a report with data on the activities carried out and the resources invested during the preceding fiscal year.

To streamline the process for developing SEPs and certification reports, FHWA is replacing its manual reporting system with an online system accessible only by the Federal and State employees responsible for administering the truck size and weight program. The new system enables State enforcement personnel to submit electronically the data and narrative explanations required for each section of the SEP and certification report.

After each State submits its information, staff from the State's FHWA division office reviews the submissions. Should a section fail to meet the reporting requirements or to offer an effective explanation of changes that occurred within the State's program, FHWA staff can use the new system to add comments and remands to the State's online report, including requiring the State to make corrections to its submission. Once the division office is satisfied and has approved the SEP and certification report, the documents are submitted electronically to FHWA headquarters in Washington, DC, for review and use in analyzing State trends and needs.

### User-Friendly System Makes Life Easier

The newly automated process eases some of the burden of reporting annual data by providing States with an easy-to-use format for submitting information. For personnel trying the system for the first time, a handy user's guide is available to walk them through the process and provide information on how to upload documents to the site and complete each section. In addition, FHWA established a toll-free number (1–800–VSW–FHWA) that authorized users can call with questions or concerns.

Although the new reporting system intended to help State-level personnel with their duties, it also will assist Federal employees. The new system follows Federal regulations promoting uniformity, so all State submissions will be in the same format, making enforcement and analysis of State trends easier for staff at the Federal level.

In addition to the new reporting system, FHWA developed a question-and-answer section on the new site. Accessible by both system users and the public, this section answers many of the most commonly asked questions and offers guidance on some of the more complex interpretative issues regarding commercial motor vehicle size and weight. And to ease navigation, FHWA created a search function that enables users to locate information based on various keywords.

### Already Out There

In addition to the new online reporting system, FHWA's Office of Freight Management and Operations operates


**FHWA recently launched a new Web site, shown here, that will streamline the submission and analysis of data on truck weight and size.**

other Web sites that provide information on vehicle size and weight programs and enforcement activities. For example, at www.ops.fhwa.dot.gov/freight/size_weight.htm, users can access and download historical, statistical, and informational articles on vehicle size and weight requirements. These resources include the U.S. Department of Transportation's *Comprehensive Truck Size and Weight Study* (FHWA-PL-00-029), *Pilot Car Escort Best Practices Guidelines* (FHWA-HOP-04-026), and several brochures and other documents.

Also available is State information on the permits issued for oversized and overweight vehicles, citations for excessive weight, the number of vehicles required by enforcement officials to offload or shift loads to be in compliance with size and weight regulations, and the number of vehicles weighed on portable, semiportable, and fixed scales and on weigh-in-motion equipment.

Further, the site provides links to sections of the Code of Federal Regulations that relate to truck size and weight, and lists contact information for FHWA staff throughout the country, as well as staff at the Federal Motor Carrier Safety Administration, National Highway Traffic Safety Administration, Surface Transportation Board, State permitting offices, State departments of transportation, and other government agencies.

*For more information, contact Julie Strawhorn in FHWA's Office of Freight Management and Operations at 202-366-4415 or julie.strawhorn@fhwa.dot.gov.*


**FHWA's Freight Management and Operations site offers the public information on vehicle size and weight.**

**Joanne Sedor** is a transportation specialist in FHWA's Office of Freight Management and Operations.

# Communication Product Updates

*Compiled by Zac Ellis of FHWA's Office of Research and Technology Services*

*Below are brief descriptions of products recently published online by the Federal Highway Administration's (FHWA) Office of Research, Development, and Technology. Some of the publications also may be available from the National Technical Information Service (NTIS). In some cases, limited copies are available from the Research and Technology (R&T) Product Distribution Center.*

*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**
**5285 Port Royal Road**
**Springfield, VA 22161**
**Telephone: 703–605–6000**
**Toll-free number: 800–553–NTIS (6847)**

*Address requests for items available from the R&T Product Distribution Center to:*

**R&T Product Distribution Center, HRTS-03**
**Federal Highway Administration**
**9701 Philadelphia Court, Unit Q**
**Lanham, MD 20706**
**Telephone: 301–577–0818**
**Fax: 301–577–1421**

*For more information on research and technology publications from FHWA, visit the Turner-Fairbank Highway Research Center's (TFHRC) Web site at www.tfhrc.gov, FHWA's Web site at www.fhwa.dot.gov, the National Transportation Library's Web site at http://ntl.bts.gov, or the OneDOT information network at http://dotlibrary.dot.gov.*

### Computer-Based Guidelines for Concrete Pavements, Volume I: Project Summary Publication No. FHWA-HRT-04-121

This report documents enhancements incorporated into the HIPERPAV® (HIgh PERformance PAVing) II software. The enhancements include the addition of two major modules: one to predict the performance of jointed plain concrete pavement (JPCP) as affected by early-age factors, and one to predict the early-age (first 72 hours) and early life (up to 1 year) behavior of continuously reinforced concrete pavement (CRCP). Two additional FHWA studies also were incorporated. One predicts dowel bearing stresses as a function of environmental loading during the early age, and the other involves optimizing concrete paving mixes as a function of 3-day strength, 28-day strength, and cost. The researchers also incorporated additional functionality into the software by reviewing and prioritizing feedback provided by users of the first generation of the software, HIPERPAV I.


To complete the project, the researchers conducted an extensive literature search on the mechanistic and mechanistic-empirical models that could be used for this purpose. They used a systems approach for incorporating additional developments in the software following the same methodology used during development of HIPERPAV I. A panel of technical experts helped evaluate the enhancements. Likewise, the model predictions were validated by employing existing databases and by investigating pavements during construction as well as those already in service.

This report summarizes the work conducted to enhance the HIPERPAV concrete pavement design guidelines. This is the first in a series of three volumes that document the tasks carried out to accomplish the objectives of this project.

The NTIS publication order number is PB2005-105417.

### Computer-Based Guidelines for Concrete Pavements, Volume II: Design and Construction Guidelines and HIPERPAV II User's Manual Publication No. FHWA-HRT-04-122

This volume provides a comprehensive set of guidelines useful in designing and constructing both JPCP and CRCP. It also provides sample case studies that illustrate the proper use of HIPERPAV II to optimize the behavior of concrete pavements. Further, the document contains a user's manual for HIPERPAV II. This is the second volume in a series of three that documents the tasks carried out to accomplish the objectives of this project. The third document is *Technical Appendices, Volume III* (FHWA-HRT-04-127).


The NTIS publication order number for Volume II is PB2005-108228.

### Field Observations and Evaluations Of Streambed Scour at Bridges Publication No. FHWA-RD-03-052

The variability and complexity of site conditions make it difficult to develop a methodology for predicting scour at bridges. Laboratory investigations often oversimplify or ignore many complexities common in the field. The


U.S. Geological Survey, in cooperation with FHWA and many State highway agencies, has collected and compiled field data on scour at bridges at 79 sites in 17 States. Researchers analyzed the data to isolate pier, contraction, and abutment scour. The national database contains 493 local pier scour measurements, 18 contraction measurements, and 12 abutment measurements. The pier measurements were used to evaluate 26 published pier scour equations.

The Froehlich Design, HEC–18, HEC–18–K4, HEC–18–K4Mu, HEC–18–K4Mo (>2 millimeter), and Mississippi equations proved to be better than the other equations for predicting pier scour for design purposes. However, comparison of the scour predicted from these equations with the observed scour clearly shows that the equations do not account for the variability in the field data. Relations between dimensionless variables developed from laboratory experiments did not compare well with the field data. Analysis of the pier scour data indicated the importance of bed material characteristics as a variable in the predictive equations. A new $K_4$ term for the HEC–18 pier scour equation was developed based on the relative bed material size ($b/D_{50}$), where $b$ = pier width and $D_{50}$ is the median bed material.

A review of published literature revealed 29 references to abutment and contraction scour data; however, only a few provided complete datasets. Published comparisons of observed versus computed scour were inconclusive. A detailed comparison of computed contraction and abutment scour with field observations for two sites in Minnesota also was inconclusive. The current methodology for computing scour depth provides reasonable estimates of the maximum total scour, but the individual estimates of contraction and abutment scour did not compare well with the observed data. The accuracy of the contraction and abutment scour equations may depend on the degree of contraction, the flow distribution in and configuration of the approach, and how well the hydraulic model represents the true flow distribution.

The NTIS publication order number is PB2005-106540.

### Freight Facts and Figures 2005
### Publication No. FHWA-HOP-05-071

*Freight Facts and Figures 2005* provides a snapshot of the volume and value of freight flows in the United States, the physical network over which freight moves, the economic conditions that generate freight movements, the industry that carries freight, and the safety, energy, and environmental effects of freight transportation. This snapshot helps planners, decisionmakers, and the public understand the magnitude and importance of freight transportation in the global economy. An electronic version of the publication is available at www.ops.fhwa.dot.gov/freight.

## Along the Road *(Continued from page 57)*

## Personnel

### Peters Joins Consulting Firm HDR

Former FHWA Administrator Mary E. Peters has joined the consulting firm HDR as national director for transportation policy and consulting. She will be based in HDR's Phoenix office where she will be responsible for building a management consulting practice and formulating public policy initiatives for the firm's transportation program.

### Secretary Mineta Names Jacqueline Glassman As Deputy Administrator of NHTSA

In August 2005, U.S. Secretary of Transportation Norman Y. Mineta announced that Jacqueline Glassman will serve as the deputy administrator of the Department's National Highway Traffic Safety Administration (NHTSA).

In her new post, Glassman will help administer the agency responsible for preventing injury and death from motor vehicles on the Nation's highways. She will leave her current position as NHTSA's chief counsel to take the new job.

*For more information, visit www.nhtsa.dot.gov.*

### James D. Cooper, Internationally Respected Bridge Engineer

James D. Cooper, an internationally recognized expert and leader in the field of bridge engineering, passed away on November 23, 2005. As FHWA's Director of the Office of Bridge Technology, he worked to improve the condition of the Nation's bridges and their life-cycle performance by ensuring that advanced technologies were developed and implemented into practice. During his career, Cooper authored numerous research and practice papers on bridge and earthquake engineering, and was involved with scientific and professional societies.

Following his 2003 retirement, Cooper consulted with bridge engineering clients, and continued to serve as a director and steering committee member of several prestigious bridge engineering organizations and societies. He earned the highly prestigious Charles Martin Duke award, which the American Society of Civil Engineers presented to him in 2004 for his lifelong contributions and achievements in the field of lifeline earthquake engineering.

## New Course Addresses Design and Construction of Micropiles

Micropiles, which are often used in foundations to resist static and seismic loading in highway infrastructure, are a relatively new technology for which design and construction methodologies have only recently been fully developed. Also used as in situ reinforcements for slope and excavation stability, micropile technology is particularly applicable in situations where access is difficult or overhead clearance is limited.

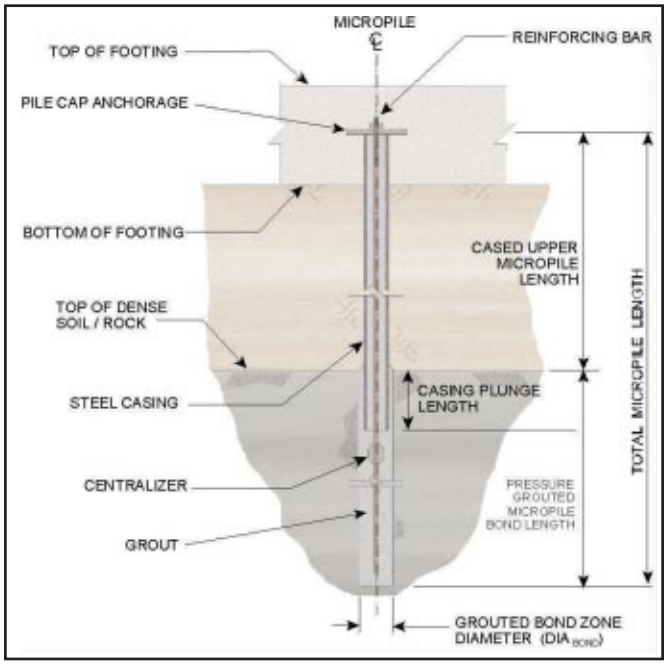
To offer training in this emerging technology, the Federal Highway Administration's (FHWA) National Highway Institute (NHI), the International Association of Foundation Drilling, and the International Society on Micropiles recently teamed up to develop a new course, Micropile Design and Construction (#132078A). Neither NHI nor any other associated organization has offered a similar course before.

"The purpose for developing and delivering this course and the accompanying Federal Highway Administration *Micropile Design and Construction Guidelines* [FHWA-NHI-05-039] is to provide 'practitioner-oriented' technical guidance," says Barry D. Siel, P.E., senior geotechnical engineer with the FHWA Resource Center.

The course targets practicing geotechnical, foundation, construction, and bridge/structural engineers who have knowledge and experience in the design and construction of driven piles and drilled shaft foundations. Further, the course builds upon the basic concepts presented in the NHI Soils and Foundations Workshop (#132012A), Drilled Shafts (#132014A), and Driven Pile Foundations—Design and Construction (#132021A) courses. Note that the Soils and Foundations Workshop is a recommended prerequisite.

Upon completion of this course, participants will be able to briefly describe the history and current status of the micropile industry; identify potential micropile applications; explain construction constraints, techniques, and performance; assess the feasibility of micropiles for a given application; prepare conceptual and basic designs and evaluate contractor-submitted designs; select appropriate specifications and contracting methods and prepare contract documents; and describe requirements for construction monitoring and inspection.

*For course scheduling, contact the NHI Training Team at 703-235-0528 or NHITraining@fhwa.dot.gov. For more information, visit NHI's Web site at www.nhi.fhwa.dot.gov.*




**This figure shows a typical micropile in cross section with a hypothetical footing and subsurface profile. The micropile components are labeled, including the reinforcing bar, casing, centralizer, grout, and pile cap anchorage. Also shown are design dimensions including bond length, plunge length, and bond zone diameter.** *Source:* Micropile Design and Construction Guidelines*, FHWA-NHI-05-039.*

## Reporting Changes Of Address

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Free copies are distributed to offices of the Federal Highway Administration, State highway agencies, technology transfer centers, and selected leaders who have a 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, Martha Soneira, via e-mail (martha.soneira@fhwa.dot.gov), telephone (202–493–3468), or mail (Martha Soneira, PUBLIC ROADS Distribution Manager (HRTS), Federal Highway Administration, 6300 Georgetown Pike, McLean, VA, 22101-2296).

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# Conferences/Special Events Calendar

| Date | Conference | Sponsor | Location | Contact |
|---|---|---|---|---|
| March 13–16, 2006 | World of Asphalt 2006 Show and Conference | Association of Equipment Manufacturers; National Asphalt Pavement Association; and National Stone, Sand, and Gravel Association | Orlando, FL | Megan Tanel<br>800-867-6060<br>mtanel@aem.org<br>www.worldofasphalt.com |
| March 19–22, 2006 | ITE 2006 Technical Conference and Exhibit, Transportation Solutions for the Real World | Institute of Transportation Engineers (ITE) | San Antonio, TX | Donna Ford<br>202-289-0222 ext. 140<br>dford@ite.org<br>www.ite.org/conference |
| March 28–30, 2006 | Conference on Transportation and Economic Development (TED 2006) | Transportation Research Board (TRB), University of Arkansas at Little Rock Institute for Economic Advancement, Federal Reserve Bank of St. Louis, Federal Highway Administration (FHWA), Federal Reserve Bank of Dallas, Federal Transit Administration, Appalachian Regional Commission, and Nick J. Rahall, II Appalachian Transportation Institute | Little Rock, AR | Vincent W. Yao<br>501-569-8453<br>wxyao@ualr.edu<br>www.ted2006-littlerock.org |
| May 7–10, 2006 | 2006 Concrete Bridge Conference | FHWA, National Concrete Bridge Council, Nevada Department of Transportation, and American Concrete Institute | Reno, NV | Shri Bhidé<br>847-972-9100<br>sbhide@cement.org<br>www.nationalconcretebridge.org/cbc |
| May 14–20, 2006 | National Transportation Week | U.S. Department of Transportation (USDOT) and other organizations | Nationwide | Joe Toole<br>703-235-0500<br>joe.toole@fhwa.dot.gov<br>www.ntweek.org |
| June 4–7, 2006 | North American Travel Monitoring Exhibition and Conference | TRB, FHWA, American Association of State Highway and Transportation Officials (AASHTO), Minnesota Department of Transportation, City Engineers Association of Minnesota, Minnesota County Engineers Association, Institute of Transportation Engineers, and ITS/Management and Operations Council | Minneapolis, MN | Tom Palmerlee<br>202-334-2907<br>tpalmerlee@nas.edu<br>www.natmec.org |
| July 16–19, 2006 | 3rd International Conference on Bridge Maintenance, Safety, and Management (IABMAS 2006) | International Association for Bridge Maintenance and Safety (IABMAS) | Porto, Portugal | Sandra Pereira<br>(+351) 253-51-0489<br>secretariat@iabmas06.com<br>www.iabmas06.com |
| July 23–26, 2006 | 45th Annual Workshop on Transportation Law | TRB | Chicago, IL | James McDaniel<br>202-334-3209<br>jmcdaniel@nas.edu<br>www.trb.org/conferences/law |
| July 25–29, 2006 | 5th International Symposium on Highway Capacity | TRB Committee on Highway Capacity and Quality of Service, Nagoya University, University of Tokyo, Tottori University, Toyo University, Yokohama National University, Tokyo Metropolitan University, Kyoto University | Yokohama, Japan | Richard Cunard<br>202-334-2965<br>rcunard@nas.edu<br>www.itr.genv.nagoya-u.ac.jp |
| July 30–August 2, 2006 | 2006 Pipelines Conference | American Society of Civil Engineers (ASCE) | Chicago, IL | Leonore Jordan<br>703-295-6110<br>ljordan@asce.org<br>www.asce.org/conferences/pipelines2006 |

| Date | Conference | Sponsor | Location | Contact |
|---|---|---|---|---|
| August 6–9, 2006 | First International Conference on Fatigue and Fracture in the Infrastructure: Bridges and Structures of the 21st Century | Pennsylvania Infrastructure Technology Alliance, FHWA, TRB, The Port Authority of New York & New Jersey, and New Jersey Department of Transportation | Philadelphia, PA | Alyssa Clapp<br>610-758-3535<br>alcb@lehigh.edu<br>http://ffconf.atlss.lehigh.edu |
| August 6–9, 2006 | ITE 2006 Annual Meeting & Exhibit | ITE | Milwaukee, WI | Lisa Petty<br>202-289-0222, ext. 136<br>lpetty@ite.org<br>Christina Denekas<br>202-289-0222, ext. 128<br>cdenekas@ite.org<br>www.ite.org |
| August 13–16, 2006 | Applications of Advanced Technology in Transportation | Transportation and Development Institute's Committees on Advanced Technology and Infrastructure Systems, and University of Illinois at Chicago | Chicago, IL | Kelvin Wang<br>479-575-8425<br>kcw@engr.uark.edu<br>www.asce.org/conferences/AATT2006 |
| August 23–25, 2006 | 7th International Conference on Short and Medium Span Bridges | Canadian Society for Civil Engineering | Montreal, Québec, Canada | Amin Khouday<br>514-393-1000 ext. 7715<br>bridgeconference2006@snclavalin.com<br>www.bridgeconference2006.com |
| October 2–5, 2006 | Plastics Pipes XIII Conference | TRB, American Gas Association, Plastic Pipes Institute, PVC4Pipes, PE 100+ Association, The European Plastic Pipes and Fittings Association | Washington, DC | Tim Ball<br>202-320-3950<br>PPXIII@everettreed.com<br>www.plasticspipes.com |

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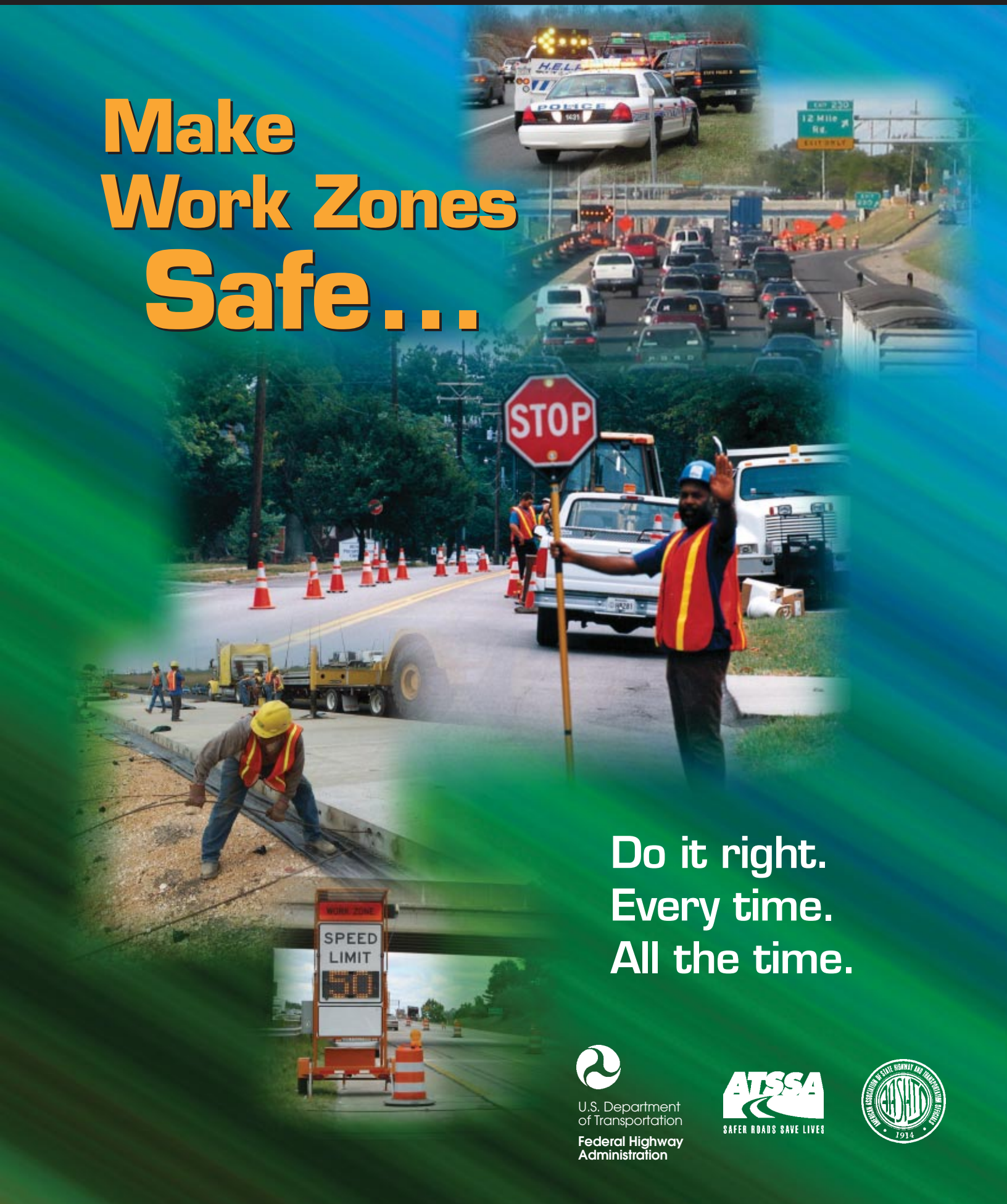


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