

CALIFORNIA TRANSPORTATION

# Journal

January-March 2003 Volume 3 Issue 4

INNOVATION ISSUE:

## Cutting Through the Soup p. 2

**Quick Strike Teams** p. 6

**The Big Sur Coast Highway Management Plan** p. 14

**Keeping It Cool** p. 18

**Zero Emission Bus Demonstration Project** p. 29



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**Jeff Morales**

## Happy New Year!

An innovative spirit has been the hallmark of the organization that is known today as Caltrans ever since it started life as the California Bureau of Highways with three newly appointed officials and a buckboard in 1895. Much of what is now national transportation policy stems from policies and procedures that were developed here in California. In good times and bad, the spirit driving that innovation has never flagged. For that reason, it is my pleasure to introduce you to **11 innovations** that, over the year 2003, will make our agency more efficient, more effective, safer—and a better place to work. These have come about as a result of creative thought by Caltrans people; I have no doubt that in the years after 2003, many of them will enter use nationwide and become the standards and policies for America's transportation systems of the future.

Because of the current budget restrictions throughout State government, the California Transportation Journal will return to publication of four issues annually and restrict its overall size in order to save money. We will continue to emphasize information about processes and procedures that save funds and improve the department's overall effectiveness.

CALIFORNIA TRANSPORTATION

# Journal

JANUARY-MARCH 2003 • VOLUME 3 • ISSUE 4

**2 Cutting Through the Soup**  
Innovation in Fog Warning

**6 Quick Strike Teams**  
Innovation in Incident Clearance

**10 Airborne GPS for Photogrammetric Control**  
Innovation in Photogrammetry

**14 The Big Sur Coast Highway Management Plan**  
Innovation in Managing a Changing Landscape

**18 Keeping It Cool**  
Innovation in High-Volume Concrete Placement

**22 GPS for Travel Surveys**  
Innovation in Household Travel Surveys

**26 Kids n' Trains**  
Innovation in Rail Marketing

**29 Zero Emission Bus Demonstration Project**  
Innovation in Bus Propulsion

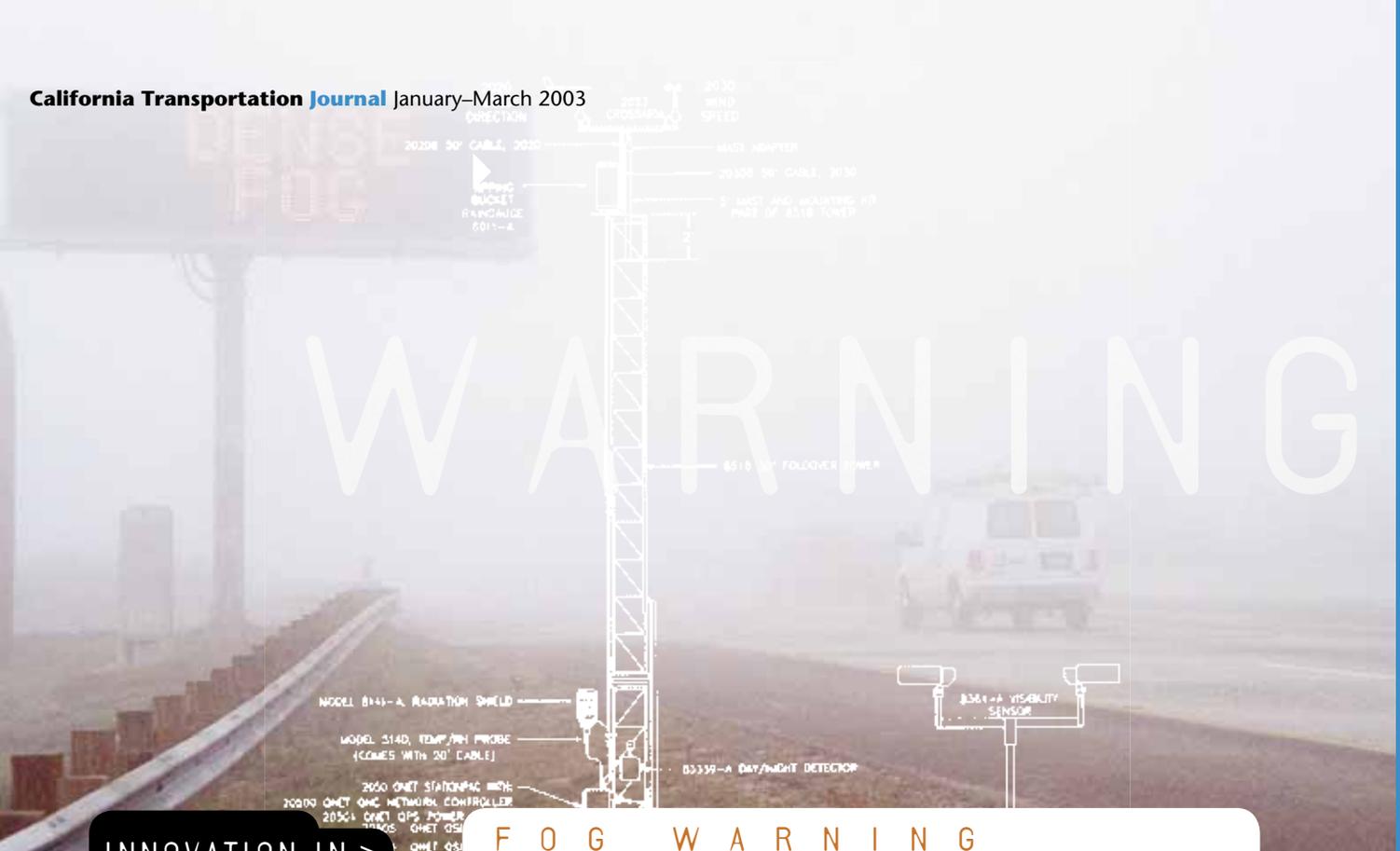
**34 Sound Engineering**  
Innovation in Pavements

**38 Innovations in Noise Protection & Public Outreach**

**40 Caltrans People**  
Getting involved in exciting, rewarding activities

**45 Editor's Notebook**  
Mark Balsi

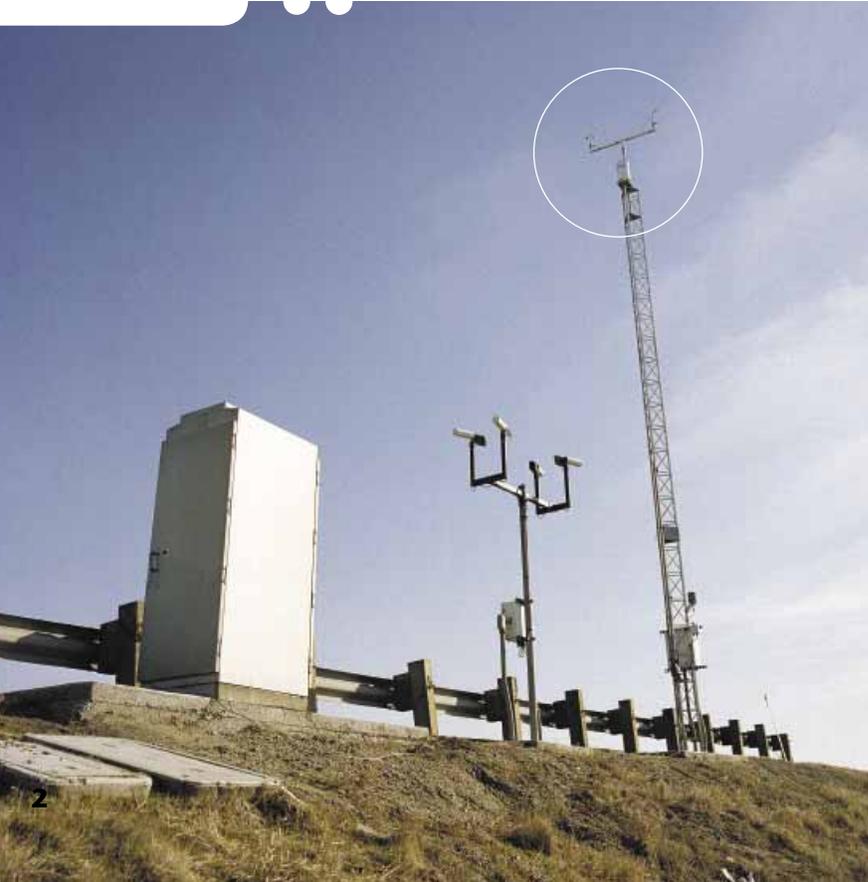




INNOVATION IN >

FOG WARNING

# CUTTING THROUGH THE SOUP



IN

California's Central Valley between November and February, the air regularly cools to 4–5° C overnight, dropping its capacity to hold water to about half a percent. In the period after a storm and regularly near major waterways, the air's actual water content is well above that, and some of the water condenses as fog. The higher the water content, the thicker the fog. And that can be a nightmare for Caltrans traffic operators and for drivers.

It doesn't help any that the worst fog almost always arrives early in the morning when it is still dark and when drivers are getting a good run at their morning commute.

"We have observed speeds of more than 100 km/h on Interstate 5 when the visibility was as low as 30 meters," says Dinah Bortner, District 10 Deputy Director for Maintenance and Operations.

"Under these conditions, when the visibility is that low, we believe drivers lose their depth perception and don't understand how fast they're going."

That's the stuff of 100-car pileups.

Legal action related to the construction of State Route 120 between State Route 99 and Interstate 5 is what set Caltrans on a course that has resulted today in the most advanced fog warning system on any highway in the world. As part of an agreement that work could begin on the highway, in 1993, Caltrans began work on a fog warning system that was defined, then, only as "state of the art."

The fog warning system that has since evolved and is now operated by the Caltrans Valley districts—Districts 2, 3, 6 and 10—consists of three main elements: driver education, enforcement and an advanced system of weather sensors and driver messaging.

Today, according to Diana Gomez, a Senior Electrical Engineer with Caltrans District 6, Caltrans is embarking on a new educational program. "The media has tended to characterize the fog itself as what does the damage to motorists, but it's not that. It's what's out there that you can't see."

So District 6, along with an advisory group that consists of Ted Eichman and Pete Parker of the California Highway Patrol's Central Division and staff from other Caltrans districts, has come up with a new slogan: "What you can't see could kill you."

The marketing campaign featuring the slogan uses a revised brochure that is being distributed widely, even being mailed by insurance companies in their monthly statements. The district is also working with the Department of Motor Vehicles to change the drivers' handbook to include information about the danger of driving in fog.

The California Trucker's Association has agreed to develop mudflaps with the message, "What you can't see could kill you," so that the thousands of drivers who end up in traffic behind a truck will have a good view of the free advertisement. Also being developed are videos, a brochure and fog driving tips as part of a

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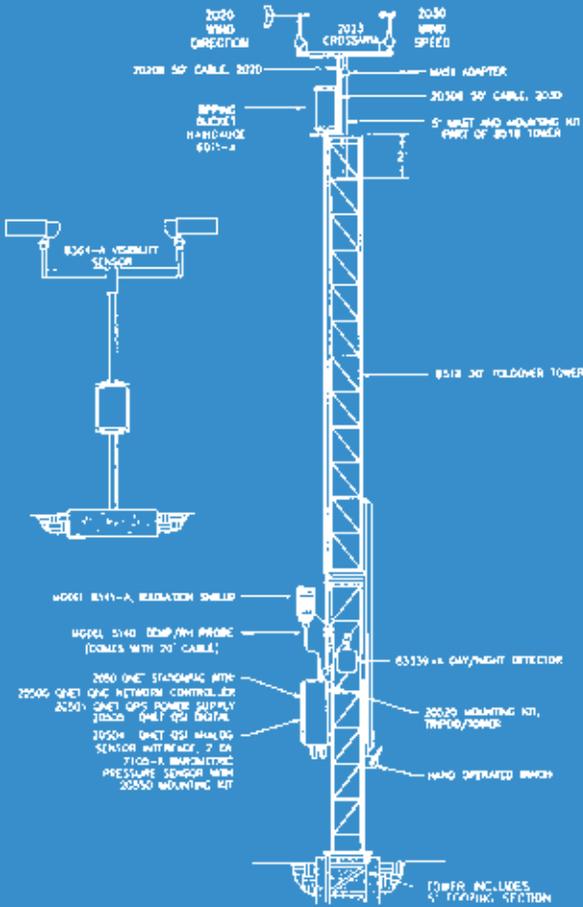


INNOVATOR

DIANA GOMEZ,  
SENIOR ELECTRICAL ENGINEER,  
DISTRICT 6

*Operators are constantly in touch with monitoring equipment on the highways to assure that incidents are cleaned up as quickly as possible, reducing the possibility of wider involvement.*





THE WEATHER INSTALLATIONS MEASURE VISIBILITY BY AIMING A BEAM OF LIGHT AT A RECEPTOR FROM A DISTANCE OF ABOUT TWO METERS. AS FOGGY CONDITIONS DEGRADE THE AMOUNT OF LIGHT HITTING THE RECEPTOR, THE SIGHT DISTANCE IS CALCULATED AND TRANSMITTED TO A TRANSPORTATION MANAGEMENT CENTER.

program for high school driver education classes. Caltrans and the CHP recently kicked off the campaign with a joint press conference.

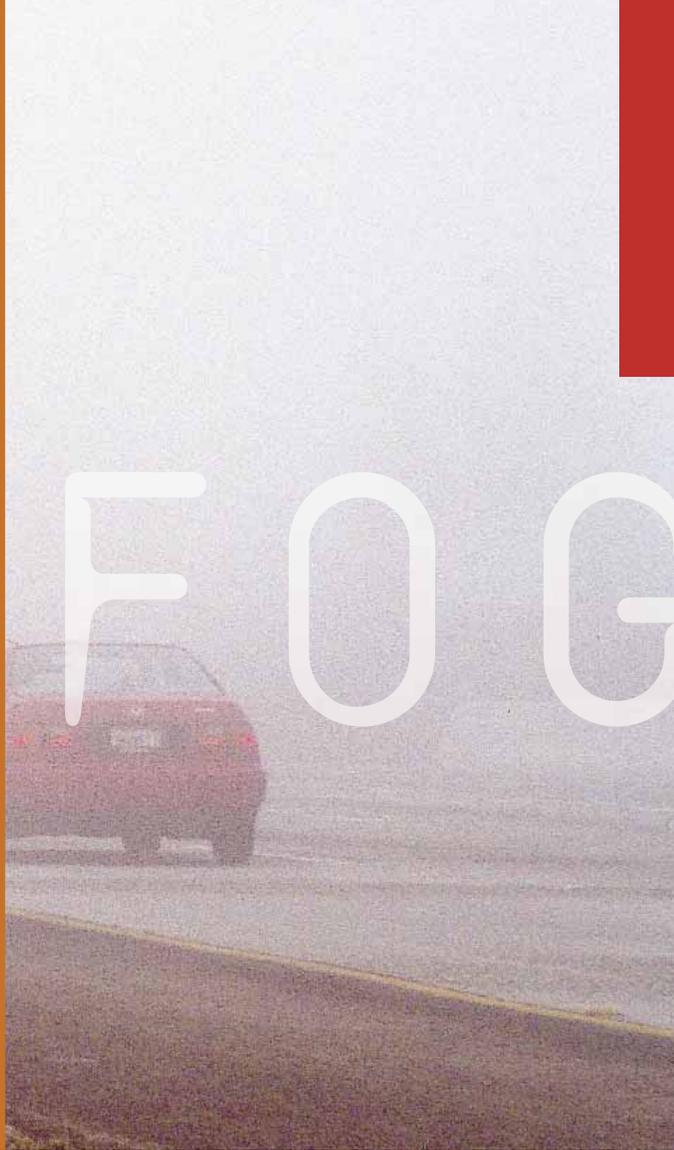
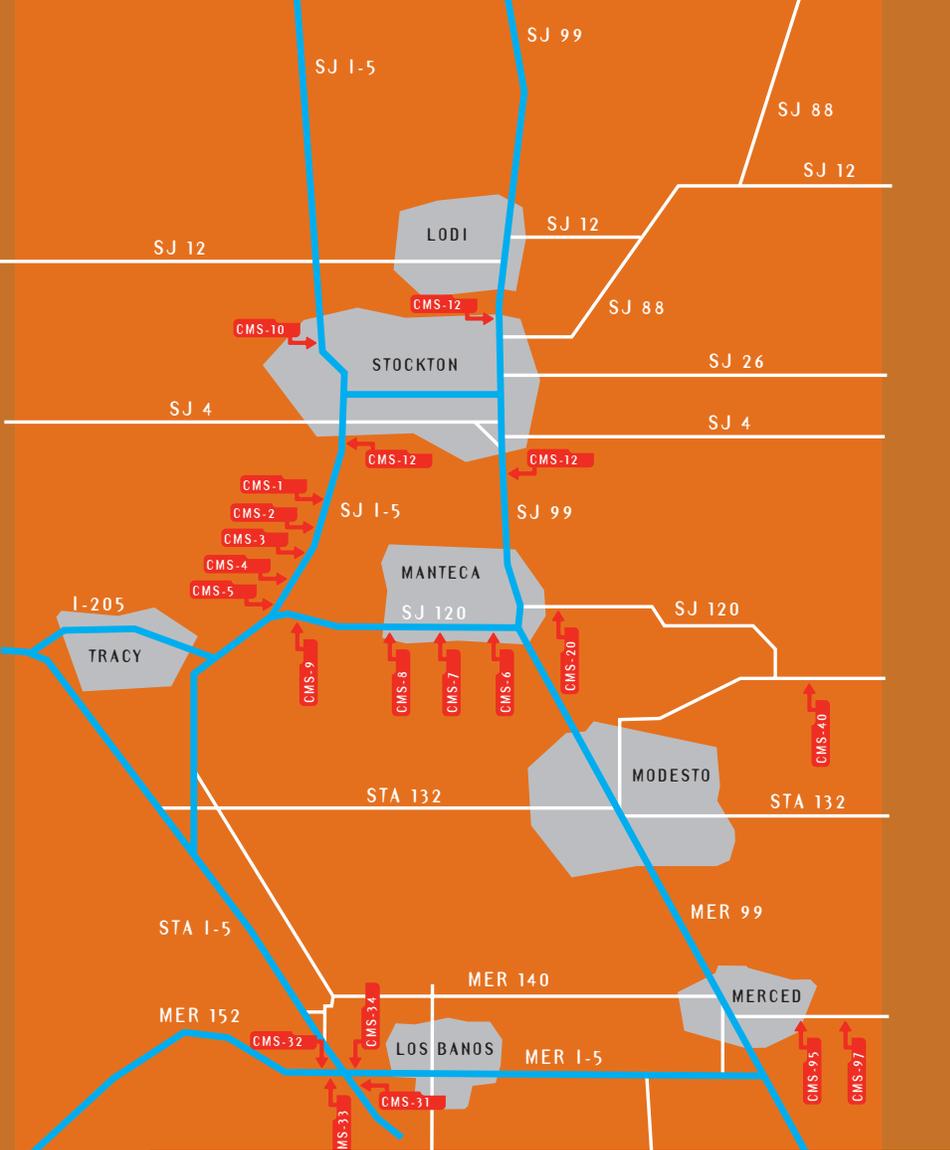
The California Highway Patrol is a full partner in all of these efforts, providing advice on all measures and enforcement along Valley highways. When visibility is reduced to 150 m, Highway Patrol officers “pace” the traffic by turning on warning lights and weaving across highway lanes at lowered speeds.

The third element is the warning system itself, and this is what that judge must have been talking about when he used the term “state of the art.” Sensors—really, weather stations that measure wind speed, humidity and visibility—are placed at locations where fog occurs regularly. In District 6 this is near the San Joaquin and Kings Rivers, about 50 km apart. In District 10, the foggiest conditions

tend to occur near the junction of Interstate 5 and State Route 120—the so-called Mossdale Y, near the San Joaquin River.

The weather installations measure visibility by aiming a beam of light at a receptor from a distance of about two meters. As foggy conditions degrade the amount of light hitting the receptor, the sight distance is calculated and transmitted to a transportation management center.

The weather installations work in conjunction with loop detectors that measure freeway speeds. “The transportation management centers thus know both the sight distance and the freeway speeds,” Bortner says. “If either the sight distance drops too low or stopped traffic is detected, caution messages are placed on pertinent ones of the 80 or so changeable message signs in District 6 and the 32 in District 10, warning of dense fog ahead.”



*The fog warning system in District 10 senses visibility and freeway speeds, and when either drops below acceptable thresholds, automatically places warning text on changeable message signs.*

“The other condition is freeway speed,” Diana Gomez says. “If the speed drops below 55 kilometers per hour, drivers get a warning of slow traffic ahead. If it drops below 15 km/h, they are warned of stopped traffic.”

In District 6, warnings are activated on the signs manually by staff in the transportation management center. But in District 10 near the Mossdale Y, warnings to changeable message signs upstream of the weather station are triggered automatically (the system contains nine such signs). “If the pavement sensors or weather stations pick up either of the two conditions—dense fog or dramatically slowed traffic—the warnings are automatically placed on the signs and eliminated when the condition no longer exists,” Bortner says.

Caltrans is now developing a pilot project to place speed advisories on the signs. When the visibility drops to

150 m, they will advise 70 km/h. At 60 m of visibility, they will advise 50 km/h.

The warning system, which constantly is being upgraded, has been an enormous success. “In 1991, 23 collisions occurred in the two districts,” Gomez says. “Since the program started, we generally have only one fog-related accident a year. Last year a 40-car accident in which there were three fatalities was an anomaly.”

“A small accident started it, and it grew into a chain reaction,” says Gomez. Dinah Bortner agrees, “If we can keep people moving at uniform, reasonable speeds, then the chances of one of these chain reaction accidents is vastly reduced. That is the whole point of the education program, the enforcement program and the warning system.—Gene Berthelsen

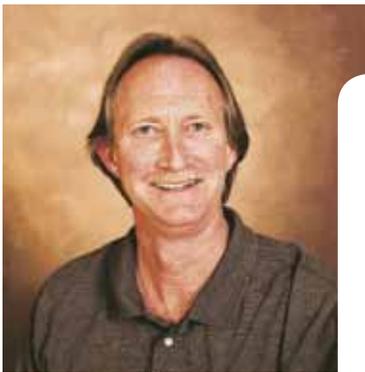
## INNOVATION IN > INCIDENT CLEARANCE

**R**ecently when a beekeeper's truck overturned and let loose 10 000 bees on US 50, Ron LeCroix, Maintenance Superintendent for the Sunrise Region in District 3, dispatched a quick-acting team that scooped up the bees and got the road open. That left LeCroix with a sticky issue. The beehives were taken to the maintenance yard and the bees followed.

"We couldn't find a beekeeper to remove them, so the only way to deal with the situation was to take the damaged hives to the dump in the cool of the morning. I'm not sure where the bees went then," LeCroix says. "Next time, we won't store them at the maintenance yard."

LeCroix's team's quick action was characteristic of a team that regularly meets its goal for clearing major incidents within 90 minutes. With so many things outside Caltrans' control, this may seem impossible. The right equipment may not be available, other emergency responders may be delayed or may block traffic, or hazardous material cleanup may require a detailed police investigation or a specialized contractor that is not readily available.

Southwest Airlines CEO Herb Kelleher had a concept of quick turnaround of planes, hub airports, a fun work environment and a willingness to experiment. No one believed you could clean, restock, fuel and safety-inspect a plane in 20 minutes, but at Southwest all the employees—the pilots, the flight attendants and the ground crew—work together to make it happen.



RON LECROIX,  
AREA  
SUPERINTENDENT,  
DISTRICT 3  
MAINTENANCE,  
SUNRISE REGION

INNOVATOR

Caltrans' customers—travelers—deserve a similar strategic focus on major incident clearance. LeCroix's Quick Strike incident management concept fits that bill. For the past several months, LeCroix has served as a member of an Incident Management Task Team, composed of Traffic Operations, Maintenance and CHP staff, to improve incident response. Now he will work to implement the concept statewide.

LeCroix joined the department in Oakland in 1971 at age 17. Later, in San Jose where he responded to several spills without adequate resources, he resolved to improve incident response if he ever got the chance. In 1999, promoted to Area Superintendent, he now had the authority and staff to do it.

In 2000, Deputy Directive DD-60 was circulated, saying that 30-minute or longer delays were unacceptable in construction and maintenance work zones. "I realized that this could apply to responding to and clearing incidents," LeCroix says.

The biggest problem he saw was the inability to pull staff in. Many supervisors lived more than 30 minutes away from work, some more than an hour. Response times after hours and on weekends could be very slow because of this. In the 1980s, Caltrans Maintenance Supervisors had been required to live within 30 minutes of the area in which they worked, but this requirement had been lifted.

To deal with this, LeCroix established a voluntary after-hour response program configured around how far his staff lived from their work areas. In implementing the concept, he received support from Larry Orcutt, Maintenance Division Chief, who required all districts to be able to respond to incidents in 30 minutes. "I wanted not just to meet this goal but exceed it," LeCroix says.

LeCroix began rolling two supervisors to the scene of any incident that was expected to delay drivers by 30 minutes or more. "Mostly," he says, "these were multi-vehicle collisions, truck overturns (many of them on freeway-to-freeway connectors) and especially those occurring before the morning commute."

*continued*



# QUICK STRIKE TEAMS

By Robert Copp, Division of Traffic Operations



One supervisor would arrive at the scene with basic equipment, then call a second one for other needed supplies and equipment. One supervisor would shadow the CHP scene commander and provide improved communications while the other would take charge of equipment, supplies and personnel.

The Quick Strike teams have put the CHP and Caltrans on a fast pace to get the people and equipment on scene for early clearance of the roadway," says CHP Lieutenant Otto Knorr.

LeCroix's teams were now available to meet with the CHP in the field for early strategy sessions to develop improved incident clearance plans.

Although LeCroix explained his process to other Maintenance Deputy District Directors and staff, his concept was slow to catch on. "Many supervisors wanted to be the first called to incidents in their areas," he says. "Some saw the idea as unfairly distributing limited overtime. Additional home storage permits were needed for leadworkers and other employees who had not qualified under the tightly managed policy. Getting basic equipment to the scene immediately, instead of waiting for a detailed description of the incident, created concern about rolling unneeded equipment."

As response times improved LeCroix gave his staff recognition, but noted when a response was slower than the 30-minute goal and asked his supervisors for ideas on how they might have shortened the response time. He developed a tracking system for overtime that showed clearly that all personnel were being treated fairly. He requested additional home storage permits, then worked to sell his managers on the need. He continued to require that a full complement of equipment and personnel arrive at the scene before fully analyzing what was needed.

"I expect all supervisors to have their sand trucks fully loaded at the end of every shift in case it is needed, and to know at all times where the area's equipment is. To improve efficiency, the department has regionalized equipment, so at times supervisors are able to borrow what they need with only a moment's notice."

"Every little improvement adds up," LeCroix says. "Better training, a new piece of equipment and having supplies ready may individually save only five minutes, but 12 innovative ideas will save an hour." He found halogen bag lights that were simple to install, use, take down and transport. "The better you can see, the quicker the response." he says.

LeCroix ordered a chain saw with a metal-cutting wheel to allow responders to remove a damaged hitch quickly,

"One innovation may reduce the duration of an incident by only five minutes," says Ron LeCroix. "But a dozen of them will get the incident off the highway an hour earlier."



TOM PARKER



TOM PARKER

# RESPONSE ACTION

# QUICK

separate two vehicles or to cut up a burned or crumbled tractor-trailer. He purchased nylon straps and shrink-wrap to secure loads and get them off the road more quickly, and kerosene heaters to keep workers warm. A coffeepot was made available. A cable was packed to replace a damaged bridge rail until a bridge crew could make a permanent repair. He obtained cell phones with two-way radio features so that in a major incident, as travelers tied up cell phone frequencies, his crews could communicate via the radio.

Protecting the environment was also a priority. LeCroix purchased a light, inexpensive product to be placed on a diesel spill, allowing it to be swept off the roadway quickly and transported to a handling facility. In the Caltrans warehouse, he found large trash bags to put under a leaking tanker to collect the fuel before it could run into the drainage system and contaminate stormwater. "You can block the drains," he says, "but if you can catch it at the source you can open the roadway that much faster."

LeCroix's crews clear incidents 33 percent faster than the statewide average; he believes his teams to be the fastest

in the state. This confidence drives him to try new tools and never to stop innovating.

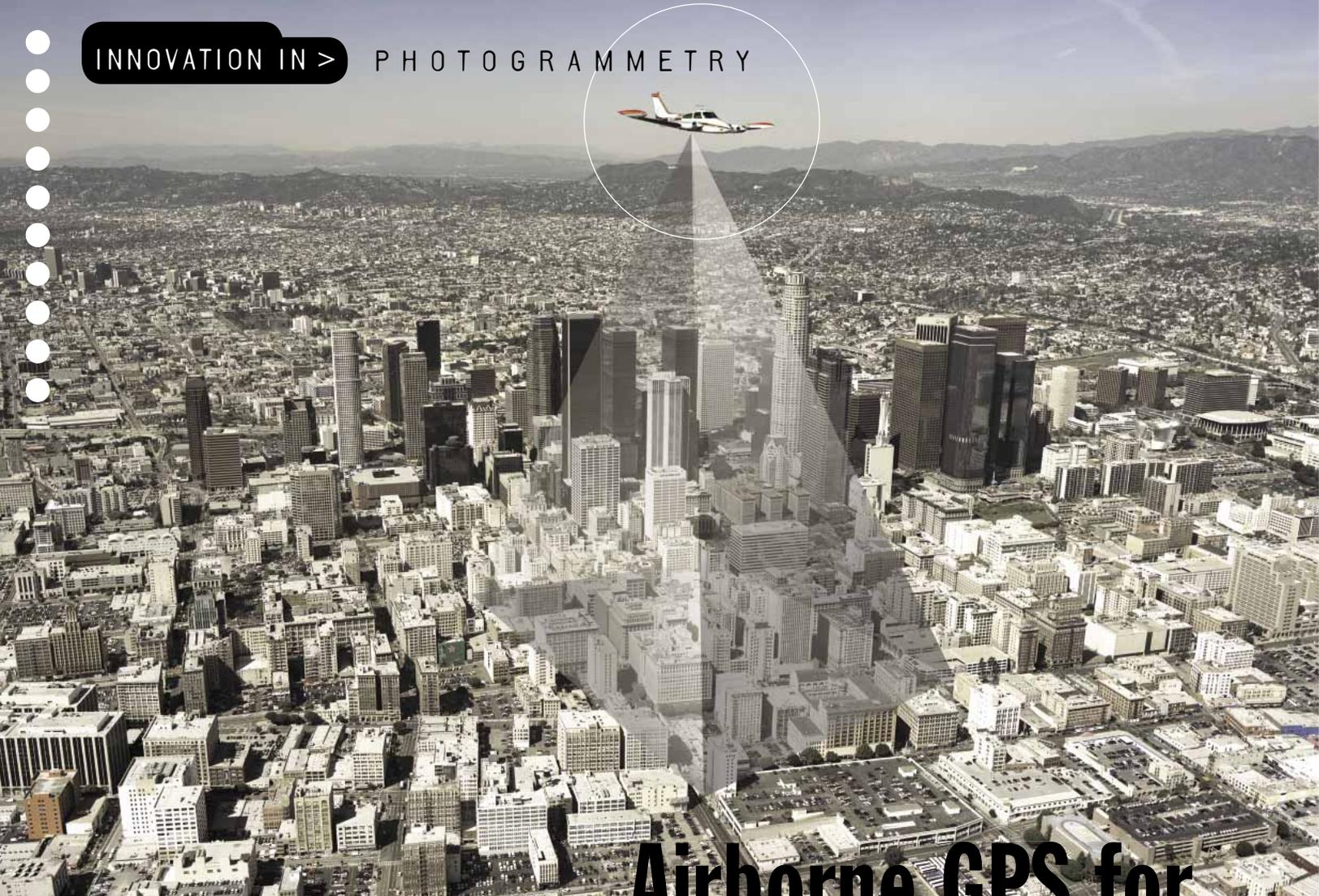
"You innovate through planning," he says, "but sometimes you have to innovate on the fly and then put in new procedures as you learn."

When concrete slabs on Route 160 and the Capital City Freeway blew up in the hot weather in the middle of the afternoon commute last summer, LeCroix found the paving plants closed. Now, he has the plants' phone numbers and pagers so they can be contacted after hours.

Over his 31-year career, LeCroix has never given up on a good idea. Asked what one thing still needs to be fixed, he responds, "Get the right tow truck to the scene. Too often the tow operator comes unprepared, has the wrong equipment or just can't do the job. I think, working with CHP and the Incident Management Task Force, we can resolve this one too."

With patience and persistence, he says, all things are possible.

INNOVATION IN > PHOTOGRAMMETRY



# Airborne GPS for PHOTOGRAMMETRIC CONTROL

On July 29, 1992, Callie "Joel" Buser, Jr., a Caltrans surveyor, was struck and killed by an impaired driver while painting targets for photogrammetric control on the shoulder of the Antelope Valley Freeway (State Route 14) near Acton. (See sidebar article)

That tragic accident spurred a Caltrans-wide safety stand-down, called by then-director James Van Loben Sels. At their safety brainstorming session, managers and staff in the Caltrans Office of Geometronics resolved to find a way to keep the department's 500 field surveyors out of harm's way when performing this task.

That effort, today, is bearing fruit as the Office of Photogrammetry begins its first AirBorne Global Positioning

System (AB-GPS)-controlled production project on State Route 76 near Oceanside in San Diego County. Use of AB-GPS on this project will reduce the field control survey effort by 80 percent and eliminate the need for painting control targets within the right of way, thus removing surveyors from exposure to high-speed traffic.

AB-GPS implementation is the result of a multi-year research effort between the Office of Photogrammetry, the Division of Research and Innovation, the Caltrans-AHMCT (Advanced Highway Maintenance and Construction Technology) partnership and the CSU Fresno Geomatics Engineering Program. Critical support for field trials was provided by the Surveys function in several districts and staff from the Office of Geometronics.

"After that stand-down, we got in touch with the Division of Research and Innovation," says Jim Appleton, Chief of the Office of Photogrammetry in the Division of Engineering Services. "We asked them to assist us in a search for a safer, more efficient way."

The first efforts were directed at developing a robotic device to paint the targets on the highway. Research and Innovation, through its AHMCT partnership, began a two-year effort that resulted in a trailer containing equipment that could, in fact, robotically paint the targets on highways with wide shoulders.

Meanwhile, a second effort focused on emerging technologies to eliminate the need for photogrammetric ground control altogether, an ambitious goal. When early results showed promise, Appleton halted the robotic trailer project. "It could not be used on a significant percentage of State highways—those with narrow shoulders," Appleton says. "While the trailer operator was more protected than Mr. Buser was, the trailer itself created a new traffic safety issue."

Photogrammetric ground control targets have been necessary because aerial photographers have not been able to directly record the position (X, Y, Z) and attitude (the rotation about each of the X, Y, Z axes) of the camera at the instant each photograph was taken. Photogrammetrists plan an aerial photography mission by choosing the approximate location of each exposure and selecting the locations for ground control targets. Surveyors then place each target and determine its exact ground position.

The photogrammetrists then make a series of precise measurements on the aerial photographs that allow them mathematically to determine the camera's position and attitude for every exposure. Thus, if the position and attitude could be known with absolute accuracy, all ground control could be eliminated; if only the position were known, most of the ground control could be eliminated.

"A photogrammetric camera costs about \$500 000," Appleton says. "Adding an Inertial Measurement Unit (IMU) to determine both attitude and position would have added another \$300 000 to each contractor's equip-

# SAFETY



THE PLACEMENT OF SURVEY TARGETS ON ROADSIDES, A HAZARDOUS JOB IN TRAFFIC, HAS BEEN MOSTLY ELIMINATED AS A RESULT OF AIRBORNE GPS.

ment cost. But we found that AB-GPS gave us enough to eliminate 80 percent of the ground control, and for just an additional \$50 000 in Caltrans-owned equipment. It is critical that the solution be practical for our contractors; they are small businesses and most are DBEs as well. An IMU would be beyond their reach, whereas AB-GPS is not."

"The GPS receiver on the airplane looks at a constellation of at least five satellites, fixing the camera's position at a minimum rate of twice per second," Appleton says. "This is not likely to occur at the precise moment the camera is shooting a photograph. Thus the system has to calculate its position by recording the GPS time of each exposure and interpolating between the twice-per-second GPS position fixes. The real challenge is that an aircraft is a dynamic platform traveling at about 60 meters per second while being buffeted about. AB-GPS, for the type of work Caltrans

*continued*



INNOVATOR

JIM APPLETON,  
CHIEF OF THE OFFICE OF PHOTOGRAMMETRY,  
DIVISION OF ENGINEERING SERVICES



THE SUCCESS OF THE AB-GPS RESEARCH EFFORT IS  
MANIFOLD, ENHANCING SAFETY FOR SURVEYORS AND  
TRAVELERS, SAVING BOTH TIME AND MONEY, AND  
PROMULGATING A STANDARD FOR ENGINEERING MAP-  
PING LONG SOUGHT BY INDUSTRY.

does for engineering design, is pushing the envelope of what the industry has considered practical.”

Caltrans began its first experiments with AB-GPS on a conventionally-mapped project on State Route 113 in Dixon in 1996. “We didn’t get everything we wanted in that test, but we got enough to know that GPS would be a successful technology for us,” Appleton says.

Subsequent field trials in District 11 in January and August of 2000 essentially perfected the technology, Appleton

says. “We actually got better results than we had anticipated with those tests.” A fourth trial in District 4 on US 101 near Novato in April of 2001 established that AB-GPS was ready for production.

The tests demonstrated that the number of field-surveyed control points could be reduced to a pair of control points at six “model” intervals along the flight line. The GPS hardware and software technology could provide airborne antenna positions with accuracy from 50-100 mm—well within the 200-300 mm required.

Before airborne GPS, each “model”—actually a composite of two successive overlapping aerial photographs—required a set of targets painted on the highway. Surveyors had to go out and manually paint the crosses on the highway approximately every 120 m. “The job that we are starting in District 11, for instance, would have required about 130 of them, and at least half of those carried the potential for an accident similar to what happened to Callie Buser,” Appleton says.

# BUSER MEMORIAL SCHOLARSHIPS

"With AB-GPS, the Route 76 project will require 28 points, all chosen with the safety and convenience of the surveyors in mind. We have eliminated the need for the targets in the right of way."

"We have had the best of all possible worlds in terms of cooperation on this project. Mike Jenkinson in the Division of Research and Innovation took all the administrative load off our shoulders in dealing with consultants and quarterly reporting as well as securing funds for the research, leaving us free to focus on the technical aspects of the problem," Appleton says.

"The district Surveys staffs provided tremendous support for the field trials; this research could not have been successful without their efforts. Photogrammetry's aerial photography contractors also were key participants. Caltrans is fortunate to have the CSU-Fresno Geomatics Engineering Program in our back yard. In addition to providing us with highly skilled graduates, members of its faculty have worldwide reputations in the surveying and mapping community. It was a pleasure and an education to work closely with the lead researchers, Dr. Munjy and Dr. Husain, on this project. Their reputations, along with that of Caltrans, has made it easy to get industry buy-in on the recommendations resulting from this research."

"The success of the AB-GPS research effort is manifold," Appleton says. "It fulfilled the primary goal of enhancing safety for surveyors as well as the traveling public; it reduced the requirement for field control surveys, saving both time and money, promogulated a standard for AB-GPS use for engineering mapping long sought by industry and was a model interdivisional and university cooperative effort.

"Another benefit is that aerial photography is best obtained during the spring, summer and fall. Reducing the number of targets means that the surveyors can be freed up to provide services for construction and other work during their peak workload season."—*Gene Berthelsen*

On July 29, 1992, Callie "Joel" Buser, a District 7 Field Survey Party Chief, was struck and killed by a driver under the influence of the drug PCP. Buser was working at the rear of his survey vehicle along State Highway 14 in Los Angeles County when the errant driver swerved from the center divide to the shoulder at about 100 km/h, striking him and pinning him against his vehicle. The driver was subsequently sentenced to 10 years in prison for gross vehicular manslaughter.

In a program inaugurated in 1991, Caltrans surveyors have awarded scholarships to deserving geomatics engineering students CSU Fresno. In 1993, this program was renamed to honor the memory of Mr. Buser. Objectives of the program are to help outstanding geomatics students realize their educational goals and to instill a spirit of safety consciousness among students and surveyors alike.



This scholarship program is supported by annual contributions from Caltrans surveyors statewide. In addition, the California Transportation Foundation underwrites 25 percent of all scholarships that are awarded. From an initial \$600 award in 1991, the program has expanded to the four \$1000 awards presented in 2002. In addition, a deserving freshman student entering the Geomatics program is awarded a \$1000 per semester endowment through his or her sophomore year.

Since its inception in 1991, this program has provided 37 scholarships and supported two freshman honors students. A total of \$42 600 has been awarded, made possible by Caltrans surveyors and the generous support of the foundation.

In January 2003, the Caltrans surveyors, along with the foundation, plan to award four Buser scholarships at the 42nd annual CSU Fresno geomatics conference. In addition, \$4000 will be encumbered for the freshman honors award.

If you are interested in the Buser scholarship program, please contact Mark Turner or Edward Zimmerman at the Office of Geomaterials in Sacramento: (916) 227-7681, or Calnet 498-7681.



INNOVATION IN >

MANAGING A CHANGING LANDSCAPE

# THE BIG SUR COAST HIGHWAY MANAGEMENT PLAN



A good El Niño storm can dump as much as 300 mm of rain on the California coast at Big Sur. Combine that with geologic forces that seem bent on pushing Big Sur off the continental table into the ocean, and you have a monumental headache: keeping California's primary coastal route open while preserving one of America's most beautiful scenic vistas.

That is a primary aim of the Big Sur Coast Highway Management Plan, perhaps the most comprehensive highway management plan ever developed.

“We started developing the Big Sur plan in 1998, after El Niño storms closed portions of State Route 1 for three and one half months,” says Aileen Loe, the plan’s manager. “We were looking for a coordinated management framework to preserve the unique qualities along this 120 km corridor.”

Caltrans began by seeking the cooperation of key stakeholders, such as the Monterey Bay National Marine Sanctuary, US Forest Service, California Coastal Commission, Monterey County Planning and Building, the Monterey County Travel and Tourism Alliance, local land use advisory committees and locally-elected officials including Monterey County Supervisorial District 5 and the office of Congressman Sam Farr.

That group, representing 19 organizations, crafted direction for the critical activities of storm damage response and repair and, in addition, for maintenance practices, scenic and habitat conservation and public access and recreation.

The group first catalogued Big Sur’s natural, scenic, historical, archaeological, cultural and recreational qualities. It assembled a geographic information system database—the most comprehensive resource inventory ever compiled for a rural California highway corridor—to provide information about sensitive resources in the vicinity of a project or storm damage and to support actions to avoid, minimize or mitigate for impacts on them.

The next task was to assemble the outline of the Big Sur Coast Highway Management Plan. “The plan will be a living document, not just a list of ways to address issues as we understand them now,” Loe says. “Implementing it will involve scanning for new patterns of travel, natural processes and responses to change, new technology and the interests of stakeholders. An organization and structure for implementation is outlined to ensure that the plan adapts to changing needs.”



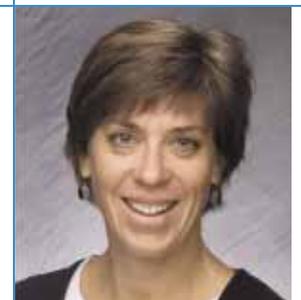
ONE OF THE MAJOR ISSUES ADDRESSED BY THE BIG SUR MANAGEMENT PLAN IS THE DISPOSITION OF MATERIAL BROUGHT DOWN BY LANDSLIDES.

The plan’s chapters describe the region’s natural, cultural, historic and recreational attributes, identify major issues and concerns about storm damage response, and address maintenance practices, scenic and habitat conservation, public access and recreation and implementation.

Because Route 1 provides crucial access to homes, schools and businesses, closures are very disruptive for those who depend on it. No suitable detour exists between the east-west connections to Route 101 via Routes 46 (south of Cambria to Paso Robles) and 68 (Monterey to Salinas), a distance of more than 160 km.

Caltrans manages Route 1 by dewatering slopes and controlling runoff, constructing retaining walls and excavating slopes

*continued*



INNOVATOR

AILEEN LOE,  
BIG SUR COAST HIGHWAY  
MANAGEMENT PLAN MANAGER



CORRIDOR AESTHETICS GUIDELINES DIRECT THE MANAGEMENT OF THE HIGHWAY AND ROADSIDE ENVIRONMENT IN A WAY THAT HONORS ITS NATURAL AND CULTURAL QUALITIES.

that incorporate room for rock catchment. A large part of this effort also involves keeping waterways under the highway clear.

Culverts and bridges carry more than just water. Heavy rains trigger erosion and landslides from steep watersheds above the highway. With intense storms, massive amounts of debris can block culvert inlets. Once they become plugged, flows build up behind the highway embankment and the water runs over the road, creating a waterfall that eats away the embankment, eventually causing it to collapse.

Preventing these conditions is a high priority for District 5. Caltrans is upgrading its culvert inventory along the highway, updating information on size, type, condition and remaining service life. This Geographic Information System database assists crews in locating culvert inlets buried by storms, aiding in a more rapid response to restore or prevent loss of the highway.

In recent years, Caltrans has shifted its emphasis from fixing landslides to living with them. In the era of grand engineering projects, Caltrans sought long-term stability of a landslide, often by completely excavating it. Today, the department uses frequent inspections, storm patrols, rock scaling and state-of-the-art management and technology for excavation and stabilization. This acknowledges that temporary road closures may occur during intense storms from localized failures. While this may lead to some inconveniences, the result is fewer impacts from repairs. In some situations, the most desirable option is to separate the highway from the instability, allowing natural processes to occur without affecting the highway. These options generally involve realignments or structures such as bridges and viaducts.

The shift to a less aggressive approach to repair is illustrated by comparing Caltrans' response to damage in the 1983 and 1998 El Niño storms. After the storms of 1983, when about 2.3 million m<sup>3</sup> of earth moved during the Julia Pfeiffer Burns or McWay landslide, Caltrans removed 3.1 million m<sup>3</sup> of earth—150 percent of what had been displaced naturally—during a one-year closure.

By contrast, after the 1998 storms, repair of four large landslides resulted in the natural displacement of nearly 3 million m<sup>3</sup>; Caltrans removed only 700 000 m<sup>3</sup>—25 percent—during a three and a half month road closure.

Even with the evolution in repair techniques, excess earthen material still must be removed from the immediate construction site. Impacts to upland habitats may be well understood, but those on the marine environment are not. As research and policy discussions continue, Caltrans is seeking coastal development permits to place the excess material at four upland disposal sites.

The Big Sur Coast Highway Management Plan will contain three sets of guidelines. Guidelines for **landslide management and storm damage response** will outline preventive and reactive strategies in this dynamic geological context. **Corridor aesthetics** guidelines direct the management of the highway and roadside environment in a way that honors its natural and cultural qualities. **Vegetation management** guidelines will outline best practices for weed control and site restoration after disturbance.

The strategies and actions presented in the plan are consistent with Caltrans' authority and responsibility to operate the highway; they do not alter its obligation to comply with environmental laws and regulations. It is suitable for implementation without an accompanying environmental document.

An important objective is to streamline environmental decisions when work is required to prevent an imminent failure or reopen the highway after a storm. Although CEQA and NEPA provide for exemptions from formal environmental review during an emergency, Caltrans must still comply with requirements for permits after the fact, often a costly and inefficient process. If prior agreement on mitigation requirements can be achieved, decision-making in response to major events can be improved and crisis-driven negotiations avoided.

Caltrans will seek programmatic agreements from agencies such as the California Coastal Commission, Los Padres National Forest, US Army Corps of Engineers, California Department of Fish and Game and others. These agreements are expected to streamline regulatory pre-authorization to expedite emergency repairs and regular maintenance.

One objective of the planning process is to form partnerships and share ownership over decisions about resources and facilities that are held in the public trust. And while Caltrans initiated the planning effort, changing basic management practices will require the help of others. The steering committee is exploring the development of a lasting organization to ensure its longevity and success.

The Steering Committee currently favors forming an organization by Interagency Agreement or MOU together with a nonprofit as the fiscal agent. This novel arrangement is expected to provide proper care and feeding for the living, collaborative process that the Coast Highway Management Plan has initiated.—*Gene Berthelsen*

# THE BIG SUR COAST HIGHWAY



INNOVATION IN > HIGH-VOLUME CONCRETE PLACEMENT

AS Caltrans began to consider design features for the replacement span of the San Francisco-Oakland Bay Bridge, it became apparent that several of the structural features of the new bridge would be so massive that measures would have to be taken to control the heat generated by hydration of the cement.

The piles, pile cap structural concrete, pier columns and pier tables were likely to meet the American Concrete Institute's definition of mass concrete, some of them with a concrete compressive strength requirement of 56–70 Mpa.

The process that allows concrete to harden is a chemical process, one whose byproduct is heat.

As concrete hardens, all concrete structures produce this heat; however, Caltrans had produced relatively few structures whose strength requirement was so critical. It had previously controlled the heat by varying the concrete mix design or initial placement temperature.

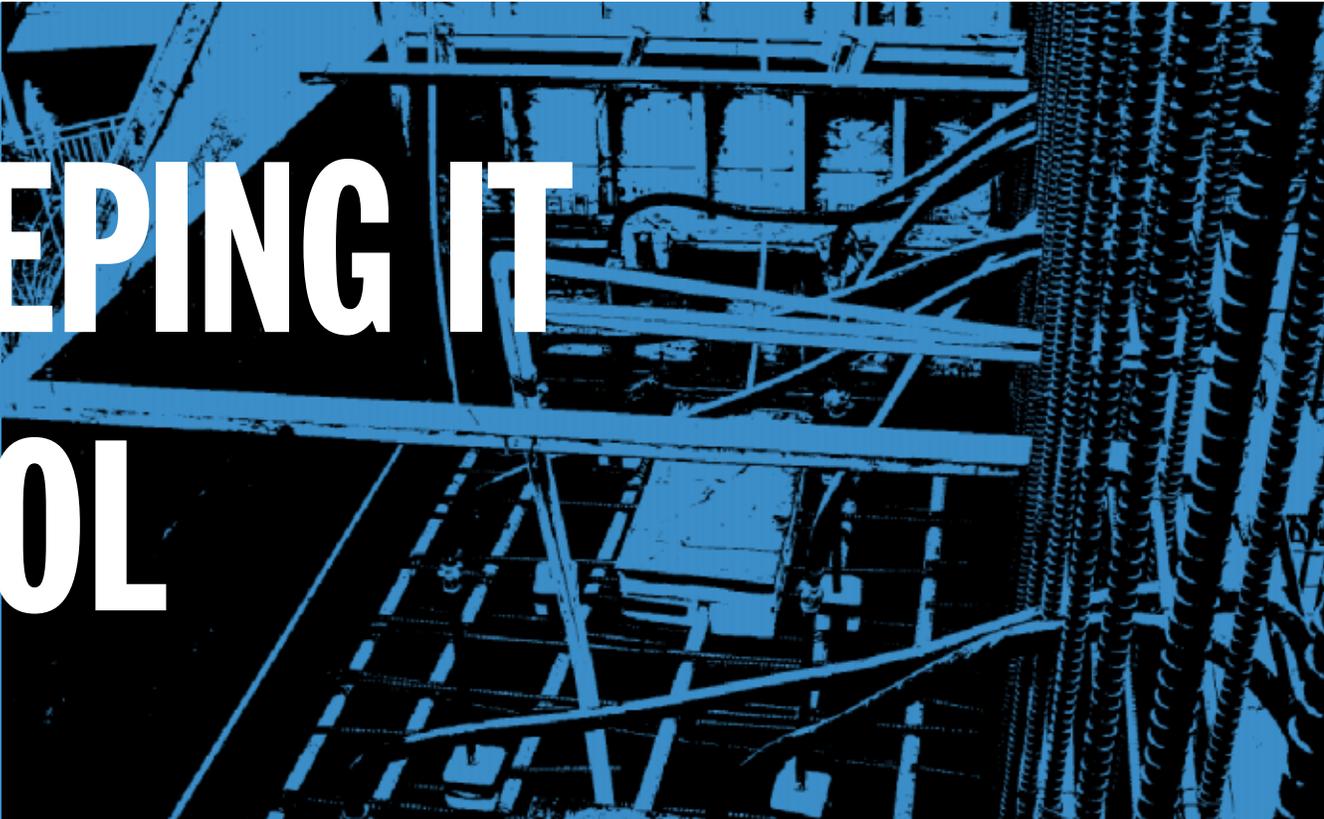
The principle measures to control the heat for the more typical Caltrans structures included keeping the cemen-

tious content at 350 kg per cubic meter, replacing Portland cement with fly ash and disallowing use of high performance pozzolans. Initial placement temperature was controlled by adding mix water as ice.

But limiting cementitious material to 350 kg per cubic meter and restricting pozzolan could not be done when the ultimate strength needed was as high as that required for the new bridge's massive structures.

"Heat can potentially compromise the durability of concrete due to temperature-induced stresses and possible chemical alteration of cement paste," says Ric Maggenti, a Senior Materials and Research Engineer in the Caltrans District 4 Bay Toll Bridge Program. "If the temperature is not adequately controlled, temperature-induced stresses may cause thermal cracking because of uncontrolled volume changes. Chemical alteration from too-high a peak curing temperature can cause delayed or secondary ettringite formations years later."

(Ettringite is a calcium sulfinate mineral that forms as a precipitate from hydrothermal solutions with hexagonal prisms that are topped by a hexagonal pyramid.)



# KEEPING IT COOL

"Ettringite forms while the concrete is setting," Maggenti says. "The problem is that when the paste gets overheated, the sulfate that usually reacts dissolves instead and sits in the system unreacted until a later time. Then later the crystals form and grow, displacing the material that is already there, and cracks develop."

In general, the higher the curing temperature, the lower the ultimate strength of the concrete. Caltrans specifies that curing temperatures should not be higher than 65° C.

"Caltrans had taken note of the damage caused by high curing temperatures years ago," Maggenti says, "and generally we were able to deal with it in less massive structures through limiting the cementitious content, use of more fly ash than the normal practice, eliminating high performance pozzolans and using courser aggregate."

"For larger structural elements requiring higher strengths, sometimes called 'medium mass concrete,' we reviewed national and international literature and found that artificial temperature control was indispensable and that inter-

nal cooling by pipe-borne water was the most effective way of doing it. The technology had been used for years in dams, including the Hoover Dam."

In 1999, during a meeting with industry representatives to discuss mass concrete and also through Caltrans' own research, Maggenti proposed to test the use of pipe-borne water on one of the footings being built as part of the construction of the interchange of Interstates 580 and 680 in Dublin, in the San Francisco Bay Area. Maggenti, who was at METS (Office of Materials and Testing Services) at the time, was already in the process of collecting temperature data from the construction of the mass concrete footings at this site.

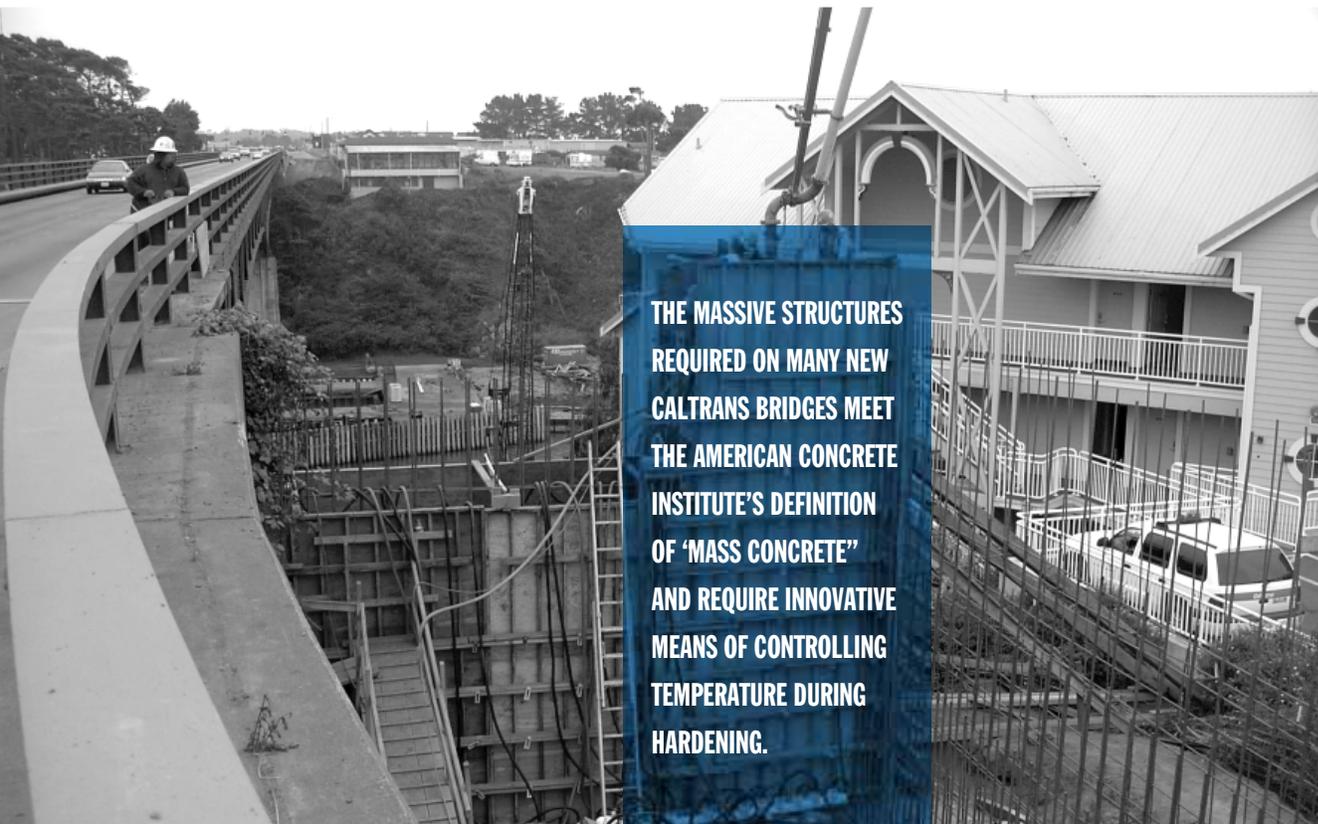
"Five of the footings with dimensions about three meters thick and lengths from eight to 13 meters, were constructed using conventional six-sack concrete. The mix designs



INNOVATOR

RIC MAGGENTI,  
SENIOR RESEARCH  
AND MATERIALS  
ENGINEER,  
BAY TOLL BRIDGE  
PROGRAM

*continued*



THE MASSIVE STRUCTURES  
REQUIRED ON MANY NEW  
CALTRANS BRIDGES MEET  
THE AMERICAN CONCRETE  
INSTITUTE'S DEFINITION  
OF 'MASS CONCRETE'  
AND REQUIRE INNOVATIVE  
MEANS OF CONTROLLING  
TEMPERATURE DURING  
HARDENING.

## HIGH-VOLUME CONCRETE PLACEMENT

had 25 and 35 percent replacement of the Portland cement with fly ash. The 35 percent replacement reached a 28-day compressive strength of 5 kps.

For the sixth footing, measuring 10 x 10 x 3.6 m, similar in dimensions to one of the mass concrete structure elements on the San Francisco-Oakland Bay Bridge, Caltrans changed to a high-strength concrete using 475 kg per m<sup>3</sup>, a high-range water reducer, a metekaolin as a high performance pozzolan, 15 mm maximum aggregate and fly ash.

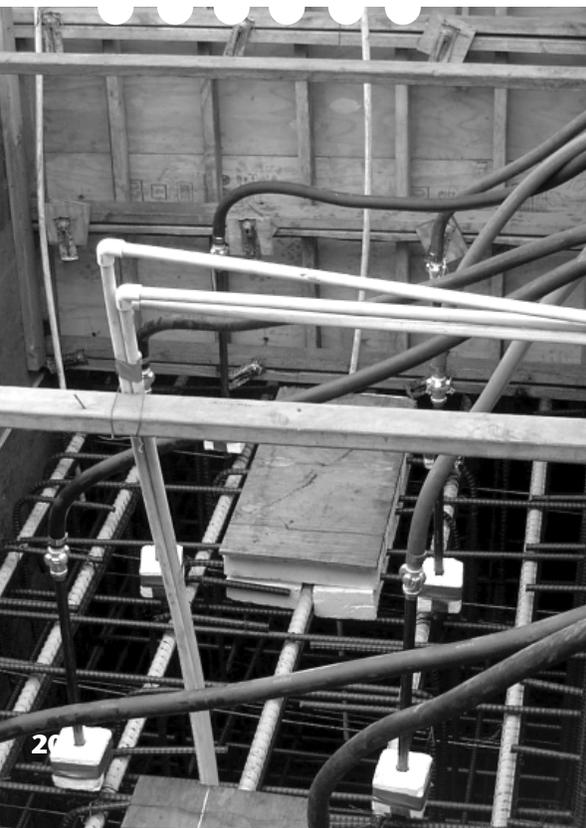
To control the temperature, Caltrans designed a cooling system consisting of 30 mm Schedule 40 steep pipe through which cold water from a large chiller was pumped. The pipes were configured into three square coils at the site, installed and secured similarly to the horizontal reinforcing steel. Vertical and horizontal distance between the pipes was one meter. Sixty liters per minute of chilled water—at a temperature of 4° C on day one and ending at around 21° C on day 7 after the chiller had been turned off—were pumped through each coil. The

Division of Research and Innovation facilitated the work while Matt Hertzal of the Office of Structures Construction administered the construction contract. Data was collected by METS.

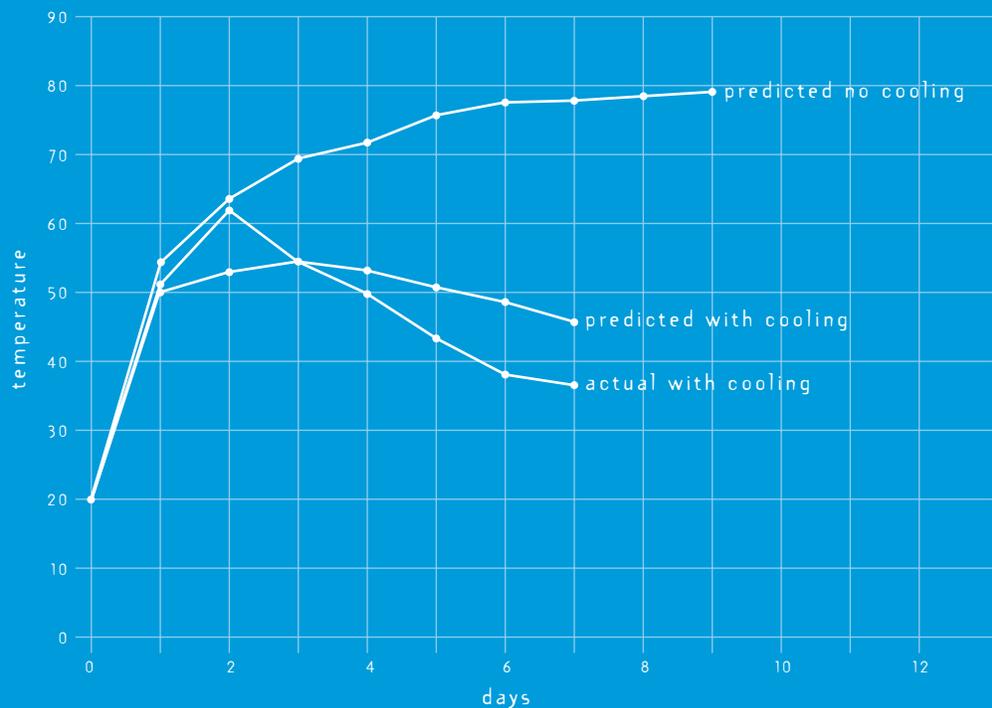
The concrete work on the Dublin footing yielded three conclusions, documented in a report written by Maggenti and issued in January 2001 by the District 4 Toll Bridge Program. “First,” Maggenti says in the report, “degradation of the concrete due to excess temperature did not occur, nor did thermal cracking. Second, temperatures were kept under 60° C and dropped within six days to 35° C. A comparison of uncooled lower-strength (having lower cementitious content, thus lower heat generation) concrete maintained a temperature over 50° C for almost two weeks.”

“Finally, the cooling system removed about 6° C each day from the structure. If it had not been installed, it could be reasoned that the maximum temperature on the second day after placement would have reached higher than 70° C, the critical temperature at which the strength of

*Cooling water, pumped through a concrete structure on the I-580/680 Interchange, removed about 6° C of temperature from the mass per day.*



Concrete Temperature Bent 18 580/680



the structure is affected.” The predicted uncooled temperature of the high strength concrete was over 80° C.

The study concluded with a recommendation that thermal control plans be required to cope with the generation of heat for construction of mass concrete structural elements. “For normal-strength concrete, a more or less passive approach can be used,” Maggenti says. “The dissipation of heat can be controlled by slowing the rate of strength gain by replacing cement with normal quality mineral admixture like fly ash; having low initial temperatures so the rock, sand and water can absorb heat; and lowering the cement content to reduce the amount of heat produced.”

“For high-strength concrete, a more active practice such as an internal pipe cooling system during curing appears to be needed.”

Today, Maggenti’s recommendations are being put into practice on the new Benicia-Martinez, Noyo and San Francisco-Oakland Bay Bridges.

“Any of the pilings larger in diameter than two meters can be considered mass concrete,” says Milan Nikolich, Substructure Leadworker on the Benicia Martinez Bridge, “which is most of them. These piles require 400 kilograms of cementitious material per cubic meter. The piers, footings and pier tables are all being fitted with cooling devices and with thermocouples to monitor the heat. The structures use ordinary 15 mm PVC pipe rather than steel for the cooling. Not all of the cooling systems are being turned on—only those in which interior temperatures reach the critical point at which it might affect the strength of the concrete. After the structures have been cooled as needed, the PVC will be filled with grout.”

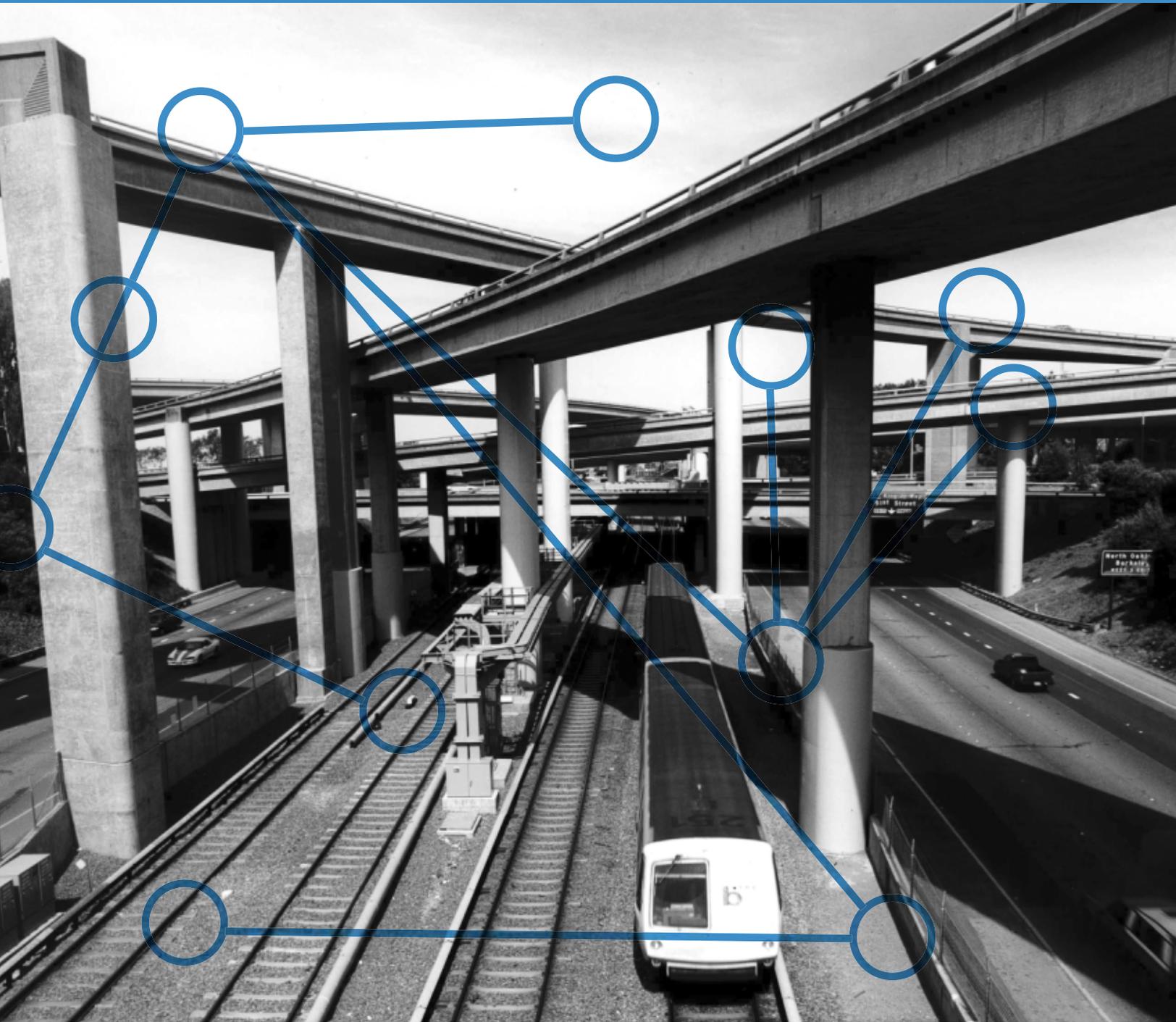
“Our research has been valuable,” says Maggenti. “California’s citizens who drive over these high-strength structures may not know that they’re safer because of the research—but they will be.”—*Gene Berthelsen*

**THESE PILES REQUIRE 400 KG  
OF CEMENTATIOUS MATERIAL  
PER CUBIC METER.**



INNOVATION IN >

HOUSEHOLD TRAVEL SURVEYS



# GPS FOR TRAVEL SURVEYS



Every 10 years since 1966, Caltrans has been developing trip information that it and local and regional agencies use for a number of planning purposes, including development of travel models. Trip information is also used by the Federal Highway Administration to compare state-by-state statistics on trip purpose and to develop estimates of future transportation needs.

And since 1966, the data has been collected by contacting California residents, providing them with a trip diary and asking them to prepare an accurate log of every single trip they took on a single day. In 2000–2001, Caltrans recruited about 24 000 households to participate in the survey.

A trip may consist of a walk to the drugstore, a bicycle trip to the park, a ride on light rail to work or use of a company car to call on a client.

From this diary, transportation agencies are able to calculate such things as the number of trips taken by a representative household, average vehicle occupancy, the time and distance of a typical trip, and a number of other factors crucial to planning a region's transportation system.

"The problem with the traditional telephone and travel diary survey methods is that they are very expensive and time-consuming," says Ayalew Adamu, Headquarters Statewide Travel Analysis Chief. "It is expensive to develop the respondent group and it is expensive to collect and process the data. And in addition to that, we have always been convinced that there was under-reporting. Respondents' memory decay, failure to understand or to follow survey instructions, unwillingness to report full details and simple carelessness all contribute to an incomplete collection of data in self-reporting surveys. Travel surveys in the past have assumed this to be in a range of between 15 and 25 percent."



Efficient and cost-effective collection and delivery of accurate location, mode of travel and trip purpose information are critical to providing decision-makers with the information they need for policy evaluation and transportation planning.

So when the time came for the 2000 Caltrans Household Travel Survey, Adamu and his boss, David Saia, Chief Office of Travel Forecasting and Analysis, went looking for a way both to improve the accuracy of the data and to reduce its cost.

What they found was the global positioning system, or GPS.

In the late 1990s, pilot studies had confirmed that GPS technology could improve the accuracy and completeness of travel data. In 1998, GPS equipment had been used in a household travel survey in Texas, but the U.S. government's intentional GPS signal degradation (known as selective availability) at the time made it difficult to assess its benefit.

Then, in May of 2000, the federal government announced that it was ending selective availability. Overnight, that improved GPS's positional accuracy from a 50–100 m range down to 5–10 m. This accuracy, as well as its continuously declining cost compared to the rising cost of traditional surveys, made the technology more feasible.

AYALEW ADAMU,  
HEADQUARTERS  
STATEWIDE TRAVEL  
ANALYSIS CHIEF

INNOVATOR



*continued*

In February 2001, Caltrans initiated the GPS component of the California Statewide Household Travel Survey—the first large-scale GPS-enhanced travel survey of its kind. The plan allowed for in-depth analysis of weekday travel, while controlling for household, person and travel characteristics in three regions. Five hundred households were recruited from within the 16 990 that were participating in the statewide household travel survey.

Each of the 500 households was provided three GeoStats GeoLogger GPS units; respondents needed only to plug the power connector into the vehicle's cigarette lighter and place a combination GPS receiver/antenna with magnetic mount on the roof. The households were given both paper diaries and in-vehicle GPS data loggers. Respondents recorded travel information in the paper diaries, whose data were collected by computer-assisted telephone interview retrieval methods and then compared with the processed GPS data to identify under-reported trips and other reporting discrepancies.

Data elements recorded by the GeoLogger included date, time, latitude, longitude, speed, heading, altitude, number of satellites and horizontal dilution of precision, to measure positional accuracy. It stored the data in standard National Electrical Manufacturers Association units and converted it into user-specified units and formats upon download. The devices logged all GPS points at one-second or five-second frequencies for which the speed was greater than 1.6 km/h; points were not logged when speed was equal to or less than 1.6 km/h.

After factoring in household travel survey dropouts, GPS study dropouts and power failures, study managers estimated that the 500 units would produce complete data for 300 to 400 households. Given the small sample size as compared to the statewide sample and allowing for deployment efficiencies, a sampling plan was developed for San Diego, Sacramento and Alameda counties. The five counties in the Southern California Association of Governments region were also surveyed.

Numbers of trips, trip lengths, times of day and trip purposes were then compared for the GPS and diary-reported data and trip rate correction factors were developed for this sample. Study staff evaluated the applicability of these rates to other households with the same demographic characteristics statewide. This approach provided significant insight into the determinants of trip under-reporting.

Initially, 2611 diary-reported trips were recorded—a rate of 7.3 per day. This compared to 2128 reported across the 523 vehicles instrumented for the study, or 8.9 trips per day—a shortfall of 22.7 percent of the reported 483 trip shortfall. When the missed GPS trip count was included, the shortfall increased to 584 trips, 9.3 per day, or 27.4 percent.

When comparing the initial results for the three counties, the discrepancy in reporting accuracy is significant between Sacramento (41.6 percent adjusted under-reporting) and the other two counties. It is important to detail the differences in reporting levels across the study based on region, household and trip characteristics. It will also be important to look at the proxy reporting percentages across each of these three counties since proxy reporting often results in a lack of accurately reported data.

Use of GPS in household travel surveys indicates that under-reporting of trips in standard diary-based surveys may be as high as 40 percent, a crucial loss of data for future planning.



The potential advantages of using GPS for transportation surveys are numerous. They include:

- Greater accuracy
- Cost and time savings
- Automatic collection of trip origin, destination and route data
- Routes recorded for all trips, allowing for the post-processing recovery of unreported trips
- Accurate trip start and end times, as well as trip lengths automatically determined
- Verification of self-reported data
- Passive traces of vehicle routes over multi-day periods
- Enhanced understanding of observed travel patterns and the decision process related to travel
- On-time information for policy evaluation and cost-benefit analysis

Both Saia and Adamu are highly optimistic about the future of GPS-assisted travel surveying. “In the future, we will probably provide GPS units for people to wear on their person so we can measure all trips instead of just vehicle trips,” says Adamu. “And we will probably swap the roles of the diaries and the GPS tracking, so that the diaries are providing additional information about the GPS-tracked trips, rather than GPS verifying them.”

“This will have enormous benefits in the amount of time it takes to process the data, as well as the cost,” says Saia. “It will allow us to do the survey every five years instead of every 10 years—and that will give this rapidly changing state much better information on which to plan.”—*Gene Berthelsen*

# KIDS TRAINS

"AMTRAK'S SAN JOAQUINS HAD A PROBLEM," SAYS DENNIS WINGER, A CALTRANS RAIL TRANSPORTATION ASSOCIATE RESPONSIBLE FOR THE DIVISION OF RAIL'S PASSENGER INFORMATION AND COMMUNITY OUTREACH PROGRAMS. "BY 2000, RIDERSHIP WAS DOING VERY WELL DURING THE SUMMER MONTHS AND HOLIDAYS, BUT GENERALLY, BETWEEN SEPTEMBER AND MAY, THE NUMBER OF CUSTOMERS USING THE TRAIN HAD HIT A PLATEAU."

INNOVATION IN > RAIL MARKETING



As Caltrans consulted with the San Joaquin Valley Rail Committee, made up of representatives of communities served by Amtrak, it became evident that the period of the annual slump coincided remarkably with the duration of the school year. "It wasn't any great stretch to come up with the idea of a school program," Winger says.

And that program has been wildly successful—successful enough to give the San Joaquins and its 16 daily round trips the second-largest percentage in group growth last year of any line on Amtrak's system. Importantly, this ridership increase was accompanied by the system's largest increase in group revenue, meaning that the program had attracted the new riders without incurring additional costs. So impressive was this performance that rail programs in other states, looking for similar results, have copied the Caltrans program almost to the letter.

Acting in concert with the Valley Rail Committee and Amtrak, Winger devised a program to offer groups of school children round trip rides on the San Joaquins at the discounted price of five dollars anywhere on the route.

"It was important not to 'dilute' fare revenue," Winger says. "That is, you want to fill empty seats, not give lower-priced rides to people who were going to ride the train anyway."

The school program, dubbed "Kids n' Trains," does just that. Ridership on the San Joaquins is lowest during mid-week during the school year. Winger identified the superintendents of 40 school districts served by the trains. Next, he developed a simple fax that outlined the discounted fares and transmitted it to them in February 2001. The hope was that the superintendents would get the word out to their field trip organizers.

"We got an avalanche of responses," Winger says. "By the end of the school year, just four months later, we had carried 42 groups, a total of 4200 kids, parents and teachers. And the good thing about that was that we had no diminution in the number of regular-fare riders."

As summer rolled in with its increased ridership for the San Joaquins, plans were developed for improving and expanding the program the following year. Trips would be bookable throughout the school year and, to raise additional revenue, the route was broken into zones with

round trip fares set at \$5, \$10 or \$15 depending on distance traveled.

Winger also created an attractive booklet that explained the program to teachers and other potential users, along with a destination guide. "Kids are traveling for educational purposes," he says. "So if they're interested in politics and government, there's a description of destinations that match that interest. Obviously Sacramento and the Capital is an important one for that."

Other interests included agriculture, the arts, cultural studies, entertainment, technology and so on.

This time, materials were mailed to all public and private schools to put them directly in the hands of teachers planning the trips.



INNOVATOR

DENNIS WINGER,  
CALTRANS RAIL  
TRANSPORTATION  
ASSOCIATE

*continued*



*Response to the Kids n' Trains program has increased the share of Amtrak California operating expenses paid from passenger revenues.*

“By this time word of the success of the program was getting passed around,” Winger says. “We added the Pacific Surfliner Route after officials at Burbank Airport offered a tour of the airport for school kids. The first trips were just between the northern end of the route and the airport, but that proved so successful that we eventually added all destinations clear to San Diego, with a two-zone structure.”

Between September 2000 and May 2001, Amtrak carried 18 000 students and their adult chaperones on 277 trips statewide. In the 2001–02 school year, this grew to 33 000 riders on 347 trips. Current year bookings exhibit sustained growth.

“We like to think we’re creating future trips with this program,” Winger says. “I get letters from kids all the time saying that they enjoyed the trip so much that they plan to take another one with dad and mom. So much of really effective marketing is based on trial and word-of-mouth. I like to think we have developed 55 000 permanent Amtrak customers and ambassadors.

The Caltrans rail marketing program is independent from but works cooperatively with Amtrak’s national rail marketing program. Annually, Caltrans budgets about \$5 million for advertising and promotional activities that

include advertising, passenger information, promotions, rail station openings, radio promotions and contests, etc. The advertising budget is spent on a full range of media, including radio, television, outdoor and print.

The Division of Rail’s operating budget also includes paying half of the salary of Amtrak marketing specialist Tom Sponsler, who Caltrans considers indispensable in developing its promotional programs.

“We consider Caltrans and Amtrak together to be a marketing team,” says Chuck Wittig, manager of the Caltrans-Amtrak marketing advertising and public relations contract. “After all, the service is called ‘Amtrak California.’ We meet with Amtrak’s West Coast marketing staff regularly. If Amtrak is doing a nationwide advertising campaign, we may buy additional space in California media to piggyback on their advertising. And we develop our own promotions and statewide advertising campaigns. It’s a very strong relationship—has been for a number of years, and it’s getting stronger.”

“We believe that’s why state-supported Amtrak services are among the most successful in the USA, even though California’s culture traditionally has not been a rail culture.”—Gene Berthelsen

*“We believe that the Kids n’ Trains program is creating thousands of new, permanent Amtrak customers each year,” says Dennis Winger.*



INNOVATION IN >

BUS PROPULSION



# ZERO EMISSION BUS DEMONSTRATION PROJECT

That unlovely diesel bus, the one that belches particulates and rides like an International Harvester combine, may become a thing of the past if a demonstration at Alameda-Contra Costa Transit District—funded in part by an \$8 million Governor's Traffic Congestion Relief Program grant—yields positive results.

*continued*



**INNOVATOR**  
ROSS CHITTENDEN,  
SUPERVISING TRANSPORTATION  
ENGINEER,  
GOVERNOR'S TRAFFIC  
CONGESTION RELIEF PROGRAM

The transit district, using these funds along with \$6 million from various other sources, has concluded contracts with ISE Research of San Diego, UTC Fuel Cells of Connecticut and the Van Hool Bus Company of Belgium to purchase up to three fuel cell-powered buses and to install a hydrogen fueling station for the buses.

"The funds from the governor's program made all the difference in the world," says Jaimie Levin, AC Transit's Director of Marketing and Communications. "Transit districts all over the United States are currently strapped for funds, and AC Transit itself is feeling the pinch of the current economic downturn. But even in this

environment, with these funds, we are able to undertake a program that may well be the start of a revolution in city transportation."

In June 2000, Governor Davis unveiled the Traffic Congestion Relief Program, giving Caltrans the task of delivering a series of highway, rail and transit projects to ease traffic congestion in some of the state's most heavily traveled corridors.

AC Transit's Fuel Cell Program also uses funds from the California Air Resources Board, the Bay Area Air Quality

Management District, the Federal Transit Fund Administration, the California Energy Commission, the U.S. Department of Energy Clean Cities Program and AC Transit itself.

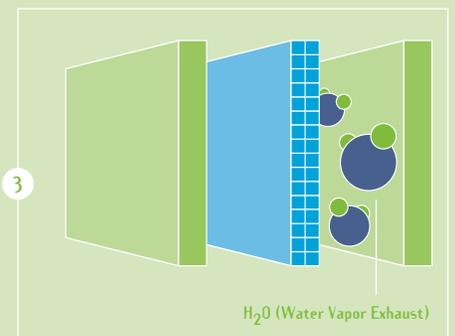
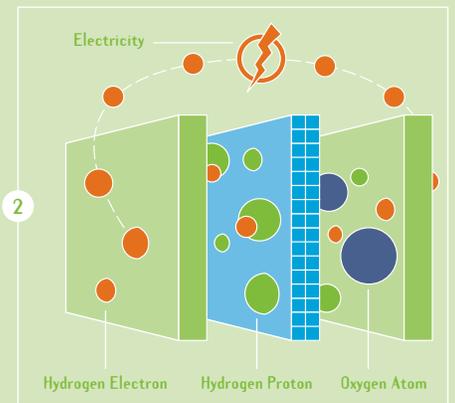
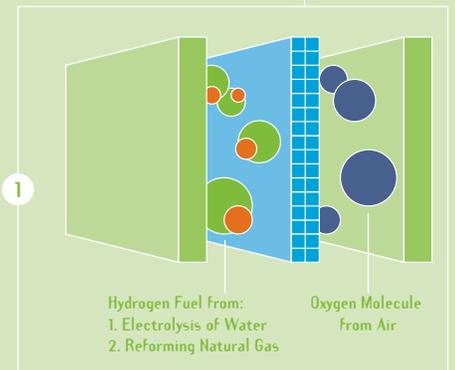
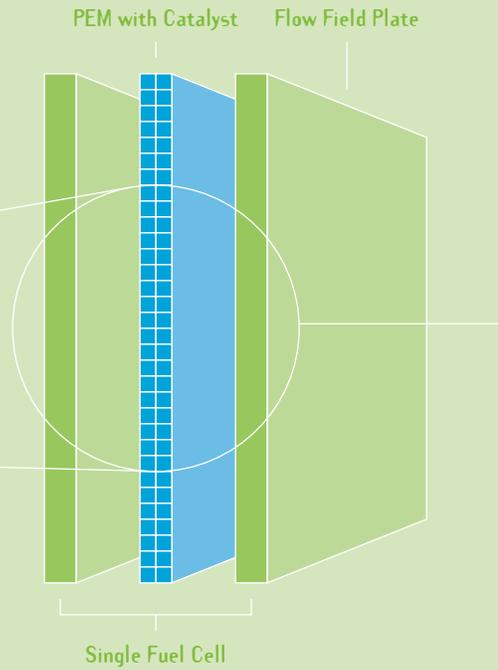
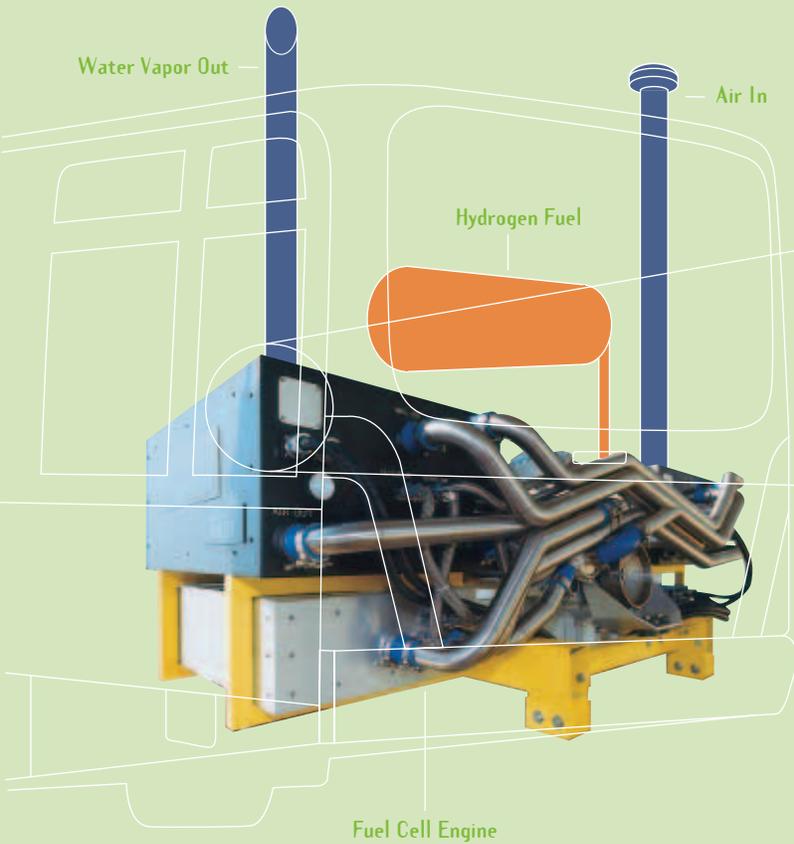
These funds, a total of \$14 million, will procure three 12 m-long, advanced-design, low-profile buses from Van Hool, ISE and UTC at \$3 million each. They will be evaluated over a two-year period with an option to extend the evaluation for two additional years.

The buses allow passengers to enter and alight quickly and safely through wider and better-placed doors. There are large, expansive windows on all four sides of the bus, open standing-room areas with "lean-to" pads and improved ADA access for wheelchair passengers. The buses will be marked with AC Transit's new corporate symbol, the first change in the symbol since the district was formed 43 years ago.

ISE Research and United Technologies of Connecticut, which manufactures the fuel cells, will fit the engines to the buses in this country. "The design of heavy-duty fuel cell engines has been refined to the point that buses weighing in excess of 13 600 kg are able to carry capacity loads of 50 to 60 people up grades in excess of 15 percent," says Levin. They can travel at freeway speeds of up to 100 km/h and maintain on-time scheduling demands with quick and efficient acceleration."

*continued on page 32*





### Fuel Cell Bus Propulsion System

A PEM (proton exchange membrane) fuel cell is made of two conductive plates sandwiched together with a special plastic membrane coated with a catalyst.

- 1 Hydrogen (produced by electrolyzing water or reforming natural gas) and oxygen (extracted from the air) are fed through channels in the plates, hydrogen on one side and oxygen on the other.
- 2 Only part of the hydrogen atom, the proton, can pass through the membrane. The other part, the electron, has to take the long way around through an external circuit, creating useful electricity.
- 3 The oxygen atoms attract protons through the membrane, as well as electrons that have traveled through an external circuit, generating the byproducts of water and heat.

A fuel cell will operate continuously as long as hydrogen and oxygen are supplied. Single cells grouped together make a fuel stack to produce the required amount of power, measured in kilowatts.

The benefits are enormous, Levin says. “There are no emissions and no engine noise; the buses operate as smoothly as those with a diesel engine. And there are larger benefits for the country in reducing dependence on fossil fuels and a reduction in carbon-based greenhouse gases.

“There are several things we need to find out, though,” Levin says. “Can they operate for 17 hours a day—day after day—on the East Bay’s steep hills, freeways and trunk lines? Right now we service and refuel hundreds of buses every day. Will it be possible to refuel a hydrogen-powered fuel cell bus in five to seven minutes, as we do with a diesel? What if we are able to prove that the propulsion technology is successful but we can’t develop the infrastructure to fuel it?”

The answer to that question will lie in the installation of a fuel cell refueling facility that is capable of producing at least 150 kg of hydrogen daily. The hydrogen will be produced from a variety of sources, which may include electrolysis of water or reformation of natural gas. After generation, the hydrogen will be compressed and sent to storage in tanks on-site. From storage, a dispenser will fill the on-board fuel tanks at 5000 psi.

The fueling station may also serve automobiles operated by the California Fuel Cell Partnership as well as visiting demonstration buses and AC Transit’s own fleet of light-duty vehicles that support the bus program.

AC Transit joined the California Fuel Cell Partnership in 2000 with an eye toward developing the new propulsion technology. That partnership, made up of a number of vehicle, propulsion and energy companies as well as government agencies, is exploring the practicality of fuel cells in transportation. “We became aware of the “ZEBus” (a fuel cell vehicle now on loan to Sunline Transportation, based in Thousand Palms, California) that had been on loan to various transit agencies, and began to look for funds,” Levin says.

The funds for the demonstration were approved in 2001. AC Transit will construct the fueling facility and fit the buses with fuel cell engines over the coming year, with a startup of service in 2004.

To date, the California Transportation Commission has approved more than \$3.6 billion of the \$5.3 billion contained in the TCRP.—*Gene Berthelsen*



# TO DATE, THE CALIFORNIA TRANSPORTATION COMMISSION HAS APPROVED MORE THAN \$3.6 BILLION OF THE \$5.3 BILLION CONTAINED IN THE TCRP.

## COMPLETED PROJECTS

Coaster Commuter Rail: Acquire new locomotive in San Diego County

West Hollywood: Repair on Santa Monica Boulevard in Los Angeles County

Westbound State Route 94 to Northbound Interstate 125 connector in San Diego County

Feasibility Study for grade separations along the Union Pacific Railroad tracks in Elk Grove in Sacramento County

Sacramento County: Sacramento Emergency Clean Air/Transportation Program, clean diesels

Sacramento County: Sacramento Regional Transit, low-emission buses

Sacramento County: Route 50/Sunrise Boulevard interchange

San Bernardino County: Metrolink service, construct track and signal improvements to extend passing siding near Pomona

San Diego County: North San Diego County Transit District, acquire compressed natural gas buses and transit vans

San Diego County: Route 5/805 interchange, reconstruct and widen

San Diego County: State Route 56, construct new freeway between I-5 and I-15

San Diego County: Construct new freeway on Otay Mesa

San Francisco Bay Area: Regional Express Bus Program, procure suburban and over-the-road express buses

San Francisco County: Balboa Park BART Station, Phase I expansion

San Francisco County: SF Muni Ocean Avenue Light Rail

San Francisco County: SF Muni Third Street rail extension

San Francisco/San Mateo/Santa Clara counties: Caltrain Peninsula Corridor, acquire rolling stock

San Francisco/San Mateo/Santa Clara counties: Caltrain Peninsula Corridor, construct third main track and related track and signal improvements

San Francisco and Marin counties: Golden Gate Bridge, seismic retrofit

San Joaquin Valley counties: Emergency Clean Air District, clean diesel program

Santa Barbara County: Santa Barbara Metropolitan Transit District, acquire and install automated vehicle location tracking system

Santa Clara County: Route 101, widen freeway, improve Rte 101/85 Interchange

Santa Clara County: add second main track between Tamien and Lick stations south of downtown San Jose

Santa Cruz County: Santa Cruz Metropolitan Transit District, low-emission buses

Santa Barbara County: State Street Smart Corridor Advanced Traffic Corridor System

Santa Clara County: Route 85/Route 87 Interchange

Santa Cruz County: Santa Cruz Metropolitan Transit District, low-emission express buses

## PROJECTS UNDER CONSTRUCTION OR IN PROCUREMENT

Alameda County: Capital Rail Corridor, Harder Road Overcrossing

Alameda and Santa Clara counties: Track and signal improvements for Capitol Corridor intercity rail line.

Contra Costa County: State Route 4, widen and add HOV lanes between Railroad Avenue and Loveridge Road in Pittsburgh

El Dorado County: Folsom Light Rail

Fresno County: San Joaquin intercity rail service, construct second main track from Calwa to Bowles

Fresno, Kings and Tulare counties: Cross Valley Rail, upgrade freight rail track from Visalia to Huron

Imperial County: Route 98, widen in the city of Calexico

Los Angeles County: Olympic Blvd/Mateo Street intersection, remodel, install new signals

Los Angeles County: Victory Boulevard corridor, automated traffic signal coordination

Los Angeles County: MTA, Los Angeles to Pasadena Blue Line

Los Angeles County: Construct new siding for Metrolink service in Sun Valley

Marin County: Route 101, HOV lane in San Rafael

Orange County: Melrose Avenue and Placentia Road, construct grade separations in the city of Placentia

Orange County: Route 22, construct sound walls

Riverside County: Route 91/60/215 interchange, widen freeway and structures for HOV lanes through downtown Riverside on Route 91



S O U N D E N G I N E E R I N G

INNOVATION IN > PAVEMENTS





#### INNOVATOR

BRUCE RYMER,  
SENIOR TRANSPORTATION ENGINEER,  
ENVIRONMENTAL DIVISION

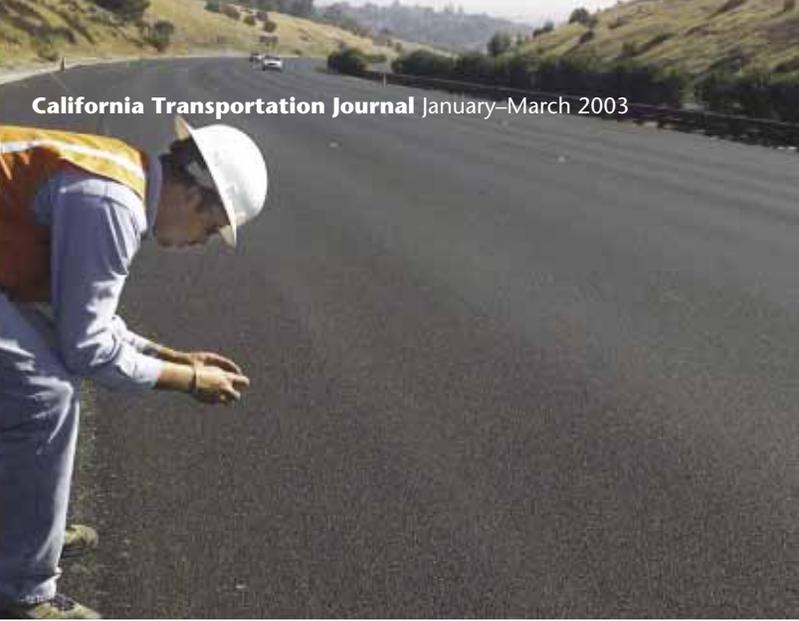
In the quiet, sun-drenched high desert of Los Angeles County, the double sonic boom of a space shuttle on final approach to nearby Edwards Air Force Base interrupts the solitude, while other experimental flying vehicles from the renowned Palmdale Skunk Works traverse the blue sky, stealthy and quiet, unheard and unnoticed.

On the ground, among the Joshua trees and a carpet of brilliant orange California poppies, Caltrans engineers blend into the landscape with their orange vests. They go unnoticed, conducting their own experimental work and using the latest technology and engineering creativity to examine noise generated by earthborne automotive vehicles.

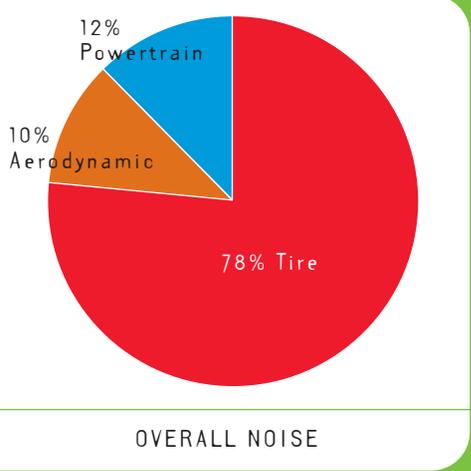
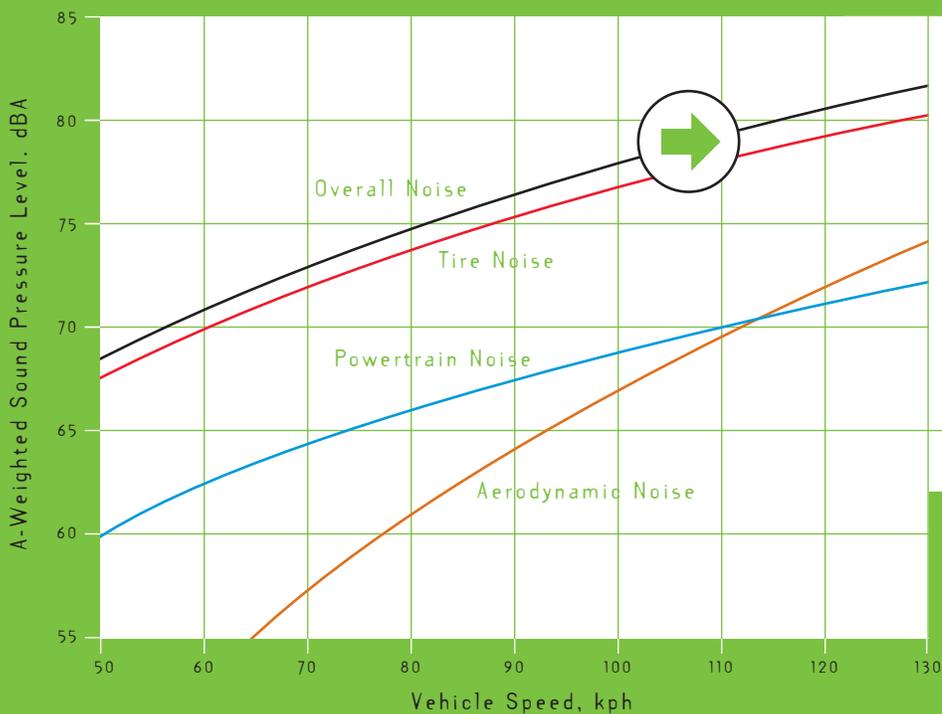
Work at this remote location is part of a long-term study that is attempting to determine just how much noise is generated by interaction of tires on pavement—and whether traffic noise can be turned down by altering the pavement surface. These workers are modifying a technical noise measurement approach used by private automotive manufacturers in tire development research. Other agencies such as USDOT Volpe, the Arizona Department of Transportation and the Institute of Transportation Studies at Berkeley are involved and have a keen interest in the results.

Caltrans is striving to understand better the complex realm of traffic noise—the unavoidable byproduct of an automotive culture and a major “ear-sore” for those living near a well-traveled highway corridor. What makes highway acoustics so complex is its variability: different types of vehicles generate different noise levels at different speeds under different environmental conditions.

*continued*



Typical Highway Noise Source Breakdown for Light Vehicles



The average highway vehicle has four principal noise generators: mechanical noise, exhausts, and aerodynamic and tire/pavement noise. Of these, the only one that any department of transportation has direct control over is the pavement—half of one of the four principal noise sources.

Is pavement a significant contributor to overall traffic noise levels? Research indicates that it is. On the average light vehicle at freeway cruise speed, tire/pavement noise accounts for 75 to 90 percent of the overall noise energy. What this means is that if the noise level at the pavement can be turned down, the overall traffic noise levels will also drop. (See chart at left.)

Turning down the noise level at the source actually may be more effective than using a sound wall to block the noise. Sound walls can be a big-ticket item on a project. To be effective, a sound wall should be placed close to the source of the noise or close to the person hearing the noise, but this is not always practical. Sound walls are meant to provide an acoustical shadow and are most effective at a range of 60–75 m behind the wall.

Regular sound walls aren't always the best mitigation for traffic noise impacts when context-sensitivity comes into play. Many homeowners don't wish to be fenced in by high walls and others don't want their views blocked. Glass walls cost two and a half times more than regular masonry walls and are a maintenance problem. Another shortcoming of sound walls occurs when the geometrics and topography force the effective sound wall location to fall outside Caltrans' right of way.

But quiet pavements are not yet accepted as noise mitigation for traffic noise in the U.S. because of several unknowns—the longevity of the pavement and any corresponding noise attenuation properties and the life cycle costs of quiet pavements versus sound walls. The Caltrans research into highway acoustics is meant to provide information about these unknowns.

Until now, two approaches—both using the scalar quantity of sound pressure—have been used for measuring the noise impact of different pavements. One involves setting up a microphone array and collecting noise data from the roadside. Another measures noise levels from inside an enclosed trailer. Each has its advantages and disadvantages.

The new Caltrans approach is unique. It places sensitive microphones on a moving vehicle, ahead of and behind where the tire impacts the pavement, to measure sound

intensity—a vector quantity with both magnitude and direction. It zeroes in on just the tire/pavement noise and ignores the other three vehicular noise sources and any other extraneous noises. An analogy would be hearing a quarterback's calls over the din of rowdy fans in a football stadium. By separating the tire/pavement noise from the other noise sources, different pavements can be more accurately compared to one another.

On a project in the San Francisco Bay Area, Caltrans is doing just that—examining the impacts of various pavements on traffic noise levels. Amid the rolling hills of San Mateo County on Interstate Highway 280 just south of San Francisco, aging concrete pavement is being resurfaced with three different pavement treatments: regular grind and micro-grind of the existing concrete pavement, and an overlay of rubberized open-graded asphalt concrete.

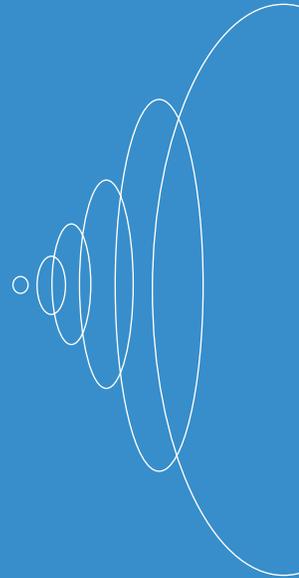
Each surface will be evaluated for its noise attenuating effectiveness relative to the preconstruction noise levels. Under the old method of measuring noise levels from the roadside, this location would be especially challenging because of the rolling topography, roadway cross-sections and frontage road traffic noise. By contrast, Caltrans' new method can identify variations between the three pavement surfaces quickly and accurately.

While the physics behind the Caltrans sound intensity-based methodology is complex, the physical implementation of this approach is the simplest of all the measuring methods. Data collection and reduction is relatively quick and doesn't require encroachment permits or large bulky equipment, and measurements are taken from a vehicle operating at freeway speed.

By comparison, roadside pressure measurements are influenced by a mix of wind and traffic, and the trailer measurement can generate other noise sources. There is a downside to the sound intensity hardware—a pothole can do a lot of damage to the microphones and tire jig.

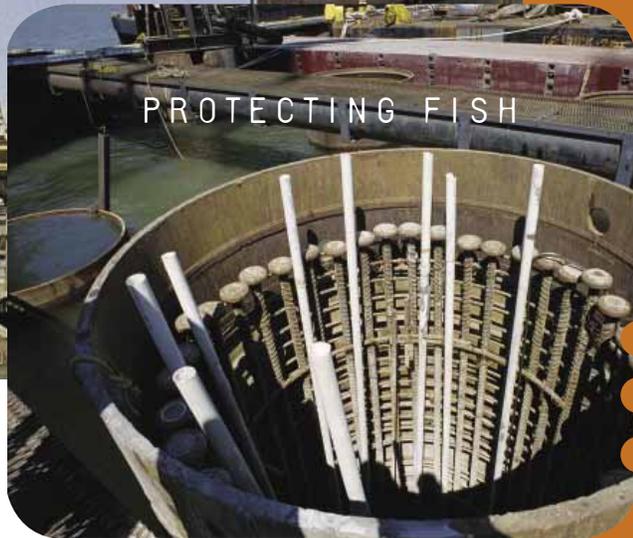
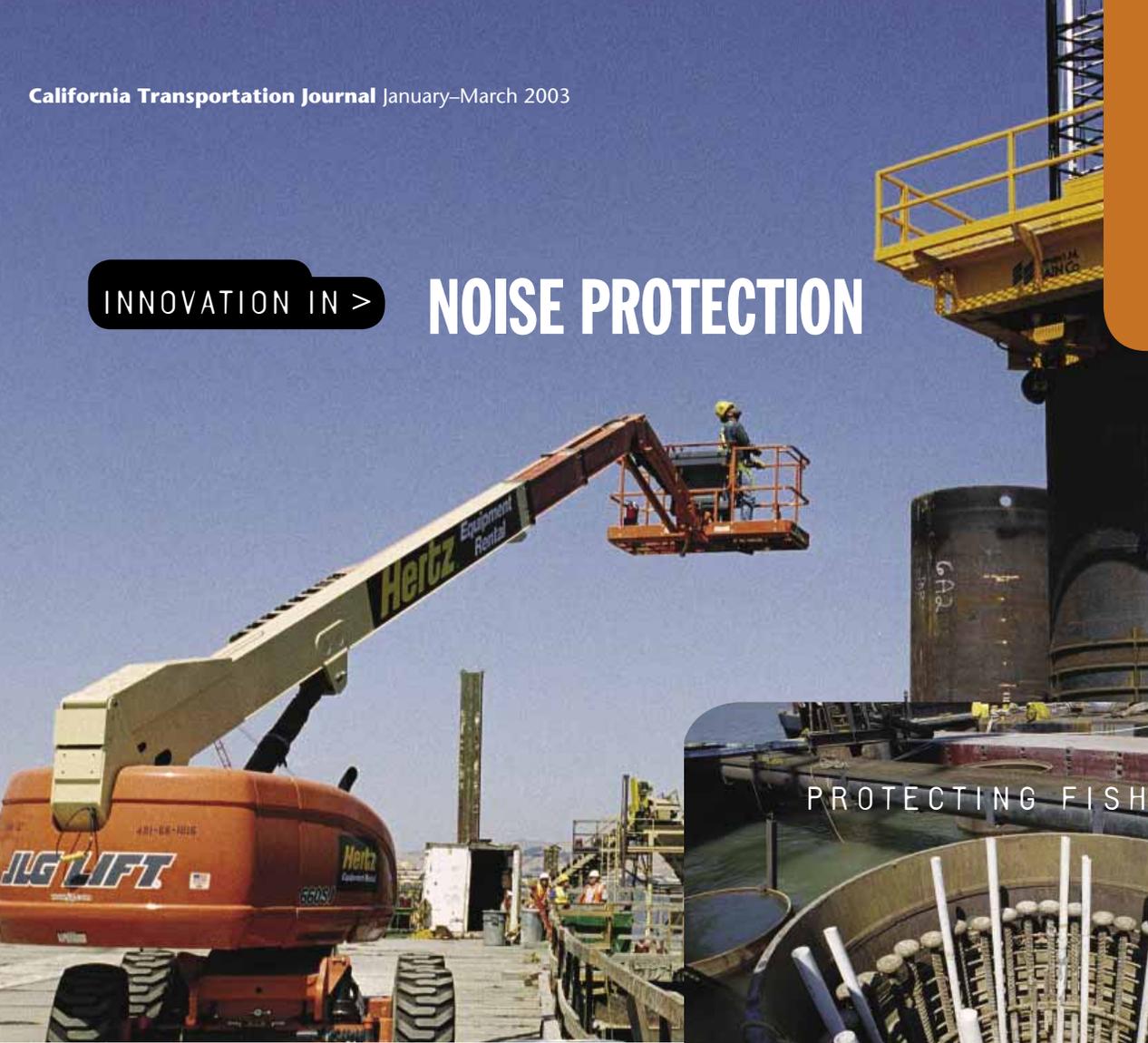
With this new measuring technique, Caltrans will be capable of accurately comparing the acoustical properties between various types of pavement surfaces. A pavement noise index to rate the noise levels will become another bit of information used in the environmental decision-making process of highway construction projects.

The state of the art for measuring tire/pavement noise has been elevated to a higher level—and Caltrans is at the forefront.



INNOVATION IN >

# NOISE PROTECTION



Driving the colossal piles to support the Benicia-Martinez Bridge requires a force of 200 tonnes for each strike, enough to make the huge steel pile bounce like a spring when fully seated. When the pile is struck, it rings like a bell.

In the air this ringing can be heard for hundreds of meters. But sound travels about 3500 times more efficiently in water than in air and can produce trauma to the inner ear, eyes, blood, nervous system, kidneys and liver of nearby fish.

Caltrans Division of Environmental Analysis and Construction staff devised a combination of a steel shell around the pile and filling the void with a bubble field. The solution virtually eliminated damage to the fish but was too expensive for implementation in the deep waters of the Carquinez Strait.

Still, the technology is practical for other locations and promises to become a tool in the Caltrans environmental protection arsenal.



INNOVATOR

ANDREW BASKERVILLE,  
CALTRANS STRUCTURES REPRESENTATIVE,  
BENICIA PROJECT

INNOVATION IN >

# PUBLIC OUTREACH

## TOWER BRIDGE

Sacramento's most recognizable landmark after the state Capitol—the historic Tower Bridge—was last painted in 1977. After a quarter of a century of enduring searing summer heat, blustery winds and rust-inducing winter rains, this magnificent structure was ready for a fresh, new coat of paint.

What color should the bridge be painted? And who would have the final say about it?

Caltrans District 3 decided to take the novel approach of asking Sacramento-area residents decide that issue by voting on one of three options.

This marked the first time that Caltrans had allowed local residents to decide such an issue. Both the public and the media applauded, and Governor Davis called the vote an example of his effort to give the public a voice in making decisions affecting them. Other jurisdictions in and outside of California are now embarking on similar campaigns.



INNOVATOR

DAVID ANDERSON,  
DISTRICT 3  
PUBLIC INFORMATION OFFICER



## people

### Isolation Inspires Creativity

"I think, growing up in Bishop and being isolated from shopping opportunities and supplies, I've had to learn to be creative," says Christy Galvin, an Assistant Caltrans Administrator in District 9. And it was that creativity that Galvin used to create a training center that is fast becoming a model for other offices in and outside of District 9.

Limited space, limited time, a limited budget and a request from District Director Tom Hallenbeck for a multifunctional training/conference center gave Galvin a perfect opportunity to use her creativity.

There was no question that the district, whose remote location sharply limits opportunities for training, needed a training center. Employees often must travel outside the area, which takes them away from their work for several days.

After Hallenbeck gave Galvin three months to get the center up and functioning, she visited other training centers, sent out user surveys, studied software and searched for "freebies," all with the purpose of cramming the center into a very small space.

In her search she found desks that were designed to have a flat computer monitor viewed through a window in the tops of the desks. With this discovery she was off and running.

With the computers and monitors under the meeting tables, instructors and trainees were free to interact without having to crane their necks around the monitors to talk to each other—and there was plenty of working space for



workbooks, notes and other materials. The center now offered plenty of room for conferences and meetings, with space for displaying maps and video viewing. The training center features hidden wiring, accommodations for left- and right-handed employees, meets ADA standards and is ergonomically designed.

"Christy did such a good job in designing the center, it is used by outside agencies, headquarters and other districts to provide training, show videos and give PowerPoint presentations," says Tom Hallenbeck. "And we're able to train 32 of our own employees in computer software each week."

"The biggest challenge for me was learning about the technology," Galvin says.

Galvin moved to Bishop when she was six. She has always been creative and optimistic about finding ways to get things done. She has worked for the past 12 years in various departments at Caltrans in Bishop.

Thanks to Christy for a job well done!—Susan Lent, Information Officer, District 9

CREATIVITY



# people

## District 6 Adopts a School

The students' rubber band cars are ready to roll in teacher Abril Garcia's physics class at Roosevelt High School in Fresno, and Caltrans engineers are right in the mix.

"The Caltrans engineers—we call them 'advisors'—have been great," Garcia says of those taking part in District 6's Adopt-A-School program. "They guide the students in the right direction and, from what I have seen, have formed good student-mentor relationships. I can't imagine the year thus far without them and am excited about the remainder of the year."

"We hope our volunteers at Roosevelt can be personal examples to the students," says Caltrans classroom volunteer Tom Garibay, a transportation engineer in Design in District 6. "Our presence has already made some students aware of what engineers do. We hope this will inspire them to become engineers at Caltrans."

The District 6 Adopt-A-School program is under the direction of coordinator Lisa Soleno. More than 35 Caltrans employees have signed on. At Roosevelt, Caltrans volunteers have worked with three physics teachers. The teachers share two classrooms, with seven class sessions in each room.

The engineers' involvement has made a difference. Says teacher Garcia: "A lot of these students don't realize they can graduate from high school and get a job of such importance—and pay. Seeing advisors who are so down-to-earth and such good people has helped my students realize that they too could be employed as engineers or in a similar field. Most of them are used to taking earth science and biology. I've noticed that a lot of them are finding success and interest in physics because of the real-world connection the Caltrans people bring to the classroom."

Besides the in-class mentoring, Caltrans volunteers guide the students on projects. The rubber band car project proved to be challenging from start to finish.

"The teachers have assigned student teams to the rubber band car project to teach them the principles of physics," Garibay says. "They have given the students rules to follow in designing and building the cars. Once the cars are built, student teams will compete against one another to determine which is the fastest or has the highest maximum average speed. As part of the competition, the students will learn to apply physics and engineering concepts to design, construction and analysis. They have already learned how to measure and graph distance versus time to calculate velocity."

As race day approaches and students finish their designs, the Caltrans volunteers show as much pride in the creations as the students do.—*Jane Sellers, District 6 Research Writer*



*Caltrans employee  
Gilberto Baca assisting  
a student.*



*Caltrans employee  
Angel Fernandez helping  
students.*



## people

### Sky's Not the Limit

If you thought the only way you would ever jump out of an airplane would be in an extreme emergency, you would definitely be in the majority. But Caltrans District 11 has a fair share of daredevils who love jumping out of a perfectly good airplane... just for the fun of it!

One of those is Value Analysis Coordinator Carmen Mullenix. Carmen became interested in skydiving while on a trip to Las Vegas in 1984 when she took a ride in a wind tunnel that simulated free falling. She became hooked and, shortly thereafter, took her first skydive. Now a competitive skydiver with more than 2100 dives, she has placed in several skydiving competitions.

Keeping it the family, Carmen met her husband Don while skydiving. Don, who works at the Chula Vista Maintenance Yard, is also a competitive skydiver, with 800 dives under his belt. The Mullenixes have been joined in both skydiving and matrimony for more than eight years. They even incorporated skydiving as part of their marriage ceremony.

Earlier this year, Carmen was approached by Kate Cooper, organizer of Jump for the Cause, Inc. to participate in a world record try. And on a recent Saturday afternoon, she joined with 131 women to build the largest ever free-fall formation consisting entirely of women ever, beating the previous record of 118 set in 1999 and holding the formation for 10.7 seconds: "No small feat in a mostly male dominated sport."

"The best news yet," Carmen says, "is that we raised \$385 000 for the City of Hope and brought worldwide media attention to the issue of breast cancer research.

Jump for the Cause oversees fundraising efforts for worthy charities; this year's benefactor is the City of Hope for Breast Cancer Research. Carmen not only will jump,



but has also committed to raising \$2500. She already has exceeded that goal by raising \$2600. With additional pledges coming in every day, she hopes to double that figure.

"I think what is most impressive is that more than 50 percent of the money raised has been contributed by colleagues here at Caltrans," says Carmen. "I am so amazed by the generosity of my Caltrans family. Everyone has been so supportive."

Laurie Espinoza of the Office of Engineering is one such contributor. When she heard about the fundraising skydiving event she wrote to Carmen, "As a survivor of both skydiving and breast cancer, I would like to make a donation." Espinoza was eager to dive again but found out she was expecting a baby. Now that she is a mom, skydiving is just a fond memory. "Skydiving was the biggest thrill of my life," she says. "The adrenaline rush lasts for days!"

Having an opportunity to talk to people about both skydiving and cancer is what inspired Carmen to get involved with the charity.

"I lost my grandmother to lung cancer when I was very young, and I've been a skydiver for more than 18 years. Both have had a profound affect on my life," Carmen says. "This is a great opportunity to use my sport for a great cause. Not only are Don and I raising money for breast cancer research, but it moves me towards my personal goal of participating in a world record attempt."

—Sharon K. Black, Caltrans Public Affairs, District 11



# people

## A Special Gift of Life

Susan Elkins, the Caltrans District 3 Budgets Officer, spent five long years watching Gary, her husband of 22 years, suffer from Alport's Syndrome, a rare hereditary disease that results in kidney failure. She attended the funerals of his brother Dan and sister Kathy, who succumbed to complications of the deadly disease. She could only provide a wife's support as Gary struggled to maintain a normal life as the father of their children, 19-year-old Gavin and 14-year-old Gabrielle.

Despite the failure of his kidneys and the painful insertion of a catheter into his abdomen for dialysis performed at home, Gary continued to make the daily commute to the Bay Area where he worked as an environmental superintendent with a company specializing in the disposal of hazardous waste. In 2001, Susan spent many days in hospitals as Gary endured five long hospital stays.

Gary's only relief would come from a kidney donor and he had already spent over four years on a waiting list. Nobody from Gary's family could be a donor so Gary kept waiting. Finally, Susan stepped forward and asked Gary and his doctors, "What about me?"

For Gary, who worried about passing the disease to his own children, the answer to that question had always been an emphatic "no." "What if our children need your kidney in the future?" he would ask.

In May of 2001, Gary was forced to leave his job when doctors discovered a number of infections associated with his disease. He underwent surgery to place a catheter in his shoulder so he could begin hemodialysis three times a week for the removal of waste from his blood supply. With her husband out of work and in failing spirits, Susan made the decision to see if she could be her husband's organ donor. She didn't have to ask her children. "They were ready for their father to be healthy again," she said.

By November, Susan had completed the required medical tests and was thrilled to discover that she was a suitable donor. In April of this year, the couple went into the oper-

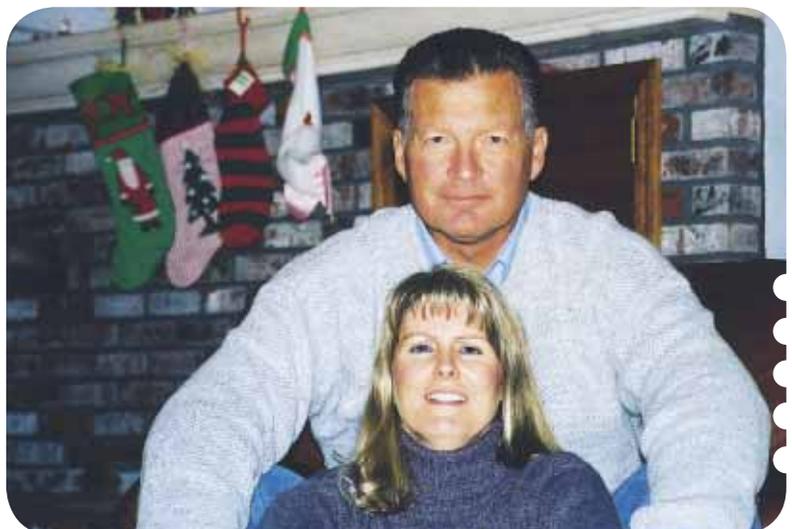
ating room; in a few short hours, the former high school sweethearts emerged, together more than ever.

These days, Gary is back to work and living a normal life despite the ever-present danger of organ rejection. "Gary is now the person I used to know," says Susan, who adds "things are as good now as they've ever been."

Susan and Gary are also becoming active in organ donor awareness. Their story will be featured in a living-donor brochure being prepared by the California Pacific Medical Center. Next spring, Susan will tell her story at a symposium of medical professionals. In the Marysville headquarters of District 3, where she has spent her 22-year career, she wears the green awareness ribbon of an organ donor. She is also an active blood donor, with more than 45 L in donations over the past 20-plus years, and is registered as a bone marrow donor with the blood bank.

Susan's kidney donation makes for an interesting conversation piece for family and friends. It's also the ultimate trump card for marital spats. "I win all the arguments now," she jokes, claiming her kidney went with "no strings attached."—Mark Dinger, Public Affairs Officer, District 3

*Gary and Susan Elkins, together more than ever.*





# people

## Humanity, Building Habitats

“There’s always a return for charitable work,” says Tony Harris, Caltrans Chief Deputy Director.

Harris, who spent several days in October working on a home project for Habitat for Humanity in Sacramento, says, “It was interesting to watch the leadership styles of those who headed up the various teams on the houses we built.”

A leader himself in his day job, Harris observed the styles of the team leaders as he worked as a “grunt,” pounding nails, painting and doing landscape work at the direction of others on the four homes that, when finished, will house needy families. “Some of the team leaders were very controlling,” he says. “Some just let it happen, and others were somewhere in between.”

“The homes started with a slab on Saturday morning,” Harris says. “We worked from seven in the morning until seven at night—about 50 of us—and had the house framed and the roof trusses up the first day. By the end of the Columbus Day weekend, the interior framing was done, the dry wall was in and the house was painted.”

The following weekend, Harris spent a half day operating a trencher as part of the landscape crew. “I found some muscles I never knew I had,” he says.

“The house was designed by an architect—probably a good one; but I now know what the Construction Division goes through when they get a set of plans,” Harris says. “Things just keep coming up that were not anticipated.”

“It was a great experience,” Harris says.

“One of my least favorite activities in life is to paint, but I even enjoyed that.”

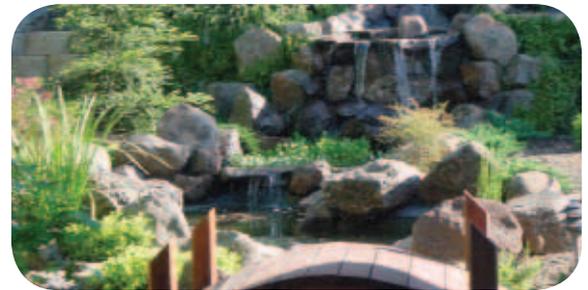
Harris says that he was glad to see two other Caltrans people on the project: Jeff Defevere, a Supervising Transportation Engineer in Headquarters, and Stanley Jacobs, also in Headquarters.

## Caltrans Guy Creates a Showplace

When Bella Vista High senior Mark Vasquez was riding his motorcycle over the undeveloped hills of the Sacramento suburb of Fair Oaks back in 1978, he had no idea that 20 years later he would buy a home in the same area and create a stunning Japanese garden.

Vasquez, an equipment operator for District 3’s Sacramento Bridge Maintenance, poured \$12 000 into his “garden of dreams.” It truly is an incredible sight—more than 100 evergreen plants, an 11-tier waterfall, a relaxing spa, an arched redwood footbridge and a pond teeming with Japanese gold fish.

Curving lines, water features, economical use of space, concrete figures such as lanterns, rocks and green plants evoke feelings of tranquility and peace. A Japanese garden has a wonderful flow to it, and each and every plant has its own individuality.



It only took working every weekend for 3 years to create this backyard oasis.

The arduous task would have taken even longer had it not been for the assistance provided by Vasquez’ longtime friend, Randy Freeman, an experienced landscaper. He didn’t charge a cent for his time, knowledge and muscle power. The two hauled away almost 7000 kg of material to create the waterfall and pond. They installed drainage and irrigation systems, added outdoor lighting and did all of the wiring and plumbing work.

Some of the job skills with concrete work and setting the forms that Vasquez uses daily on his job were quite helpful in putting all the pieces together. “I also give a lot of credit to my wife, Oulai,” Vasquez says. “She was very patient and even did some of the physical work.”

Vasquez’ fascination with this unique style of gardening began in a most unusual way. “Back in the late ’80s, I was watching the film, ‘The Karate Kid,’ and Mr. Miyagi’s backyard really caught my attention. That’s what sparked my interest,” Vasquez says.

*Chief Deputy Director Tony Harris used his recent weekends with Habitat for Humanity to study the leadership styles of others.*



# INVOLVE

## Editor's Notebook

### Mark Balsi is a big, husky guy

who looks a lot like the serious hockey player he has been for a large part of his life. That is, until you look down and notice that his right foot seems to fit into his shoe in an odd sort of way. The reason for that is that it's not a natural foot at all, but a prosthesis—sort of a wonderful one that you can program for walking, biking or other activities—but a prosthesis nevertheless.

Mark Balsi wears a prosthesis today because a driver, impaired by a combination of drugs and alcohol, sluiced all the way across four lanes of Interstate 280 in San Jose and nailed him and Loretta Garley as they worked to trim trees and clear brush on the highway roadside on January 19, 2001. The vehicle sliced off Balsi's leg just below the knee. Loretta Garley died several months later of other causes, never having returned to work.

Balsi does not remember the accident. He awoke while undergoing a CAT scan, which determined that his shoulder and ring finger had been broken and the back of his head split open. He underwent 18 months of painful rehabilitation, which included 10 operations, each taking a little more of his leg until his knee was removed.

Balsi returned to Caltrans in November; today, he works in the District 4's Transportation Management Center in Oakland. Glad to be back at work, he is thankful for visits from co-workers and other moral support from people he barely knew. "Melanie Silva, a part-time paramedic from the CCC crew we were working with, saved my life at the accident scene," he says.



"It has changed me as a person," he says. "I've had to learn to do things all over again, things as simple as walking a dog on a leash. Dealing with Christmas crowds at a mall is difficult because you never know if someone is going to jostle you and knock you off your feet. When I go to a hockey game with my nephew, I have to get there early and stay until most of the other people have left."

Still, Balsi has a positive attitude. He accompanies his nephew to hockey games and hopes eventually to get back on skates.

"Drivers have to be made to realize that there are people out there behind those orange cones," Balsi says. That's the lesson of Mark Balsi, Loretta Garley, Callie "Joel" Buser whose story is told on page 13 of this magazine, the 158 workers who have lost their lives and countless others who have been injured while giving California the gift of transportation.

"Slow for the Cone Zone," sure, but slow, too, for the people in the cone zone.

