DRISI SOLUTIONS LAB 2022

Transforming ideas into solutions

Division of Research, Innovation and System Information

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Acknowledgments

Those bright, bug eyes belong to a remote controlled robot that spends its days probinginside the dark, watery interiors of Caltrans culverts to assess their condition. Culverts channel streams and stormwater under roadways and protect them from flooding and erosion. They can fail over time due to usage, age, or environmental conditions. Failed culverts can present hazards for motorists, cause traffic delays, and damage the surrounding environment. This robot provides a clear view inside the culverts, sparing its human operators the experience of crawling through narrow tunnels lined with dingy water and unknown inhabitants.

Contents

Dara Wheeler, Division Chief

A New Era in Transportation

What's new? That's a question that the Division of Research, Innovation and System Information (DRISI) answers every day. From research to innovation to data technology, DRISI is on the cutting edge, supporting nearly every business area in Caltrans— Design, Maintenance, Planning, just to name a few. And the work we do in these and other areas directly and indirectly affects major projects and helps achieve the goals set forth in the **Caltrans 2020-2024 Strategic Plan**.

Achieving these goals is a collaborative effort, and DRISI brings our technical expertise, data-based solutions, and knowledge gleaned from our academic and private-sector partnerships to make positive, transformative changes to the travel network and deliver results. I invite you to take a moment to read about some of DRISI's most recent significant undertakings in this report. There is truly something for everyone.

For instance, our article on the Advanced Highway Maintenance & Construction Technology (AHMCT) Research Center highlights how DRISI contributes in many ways to making California's transportation system safe by collecting incident data to help guide improvements and identifying new technologies. Read about how repurposing failing malls that are along existing transit lines is a sustainable option for cities and suburbs to reduce sprawl while addressing housing shortages. And for all of you data lovers out there, learn about DRISI's role in collecting and maintaining GIS data that can be used to generate map-based and 3D visual representations.

Finally, I want to share one of DRISI's most recent endeavors to increase the number of projects that are implemented following successful research. DRISI is dedicating additional resources to this effort to help viable projects move from research to implementation. This seed money can be used to create a prototype, provide training, pay for marketing, or hire a subject matter expert. In November 2021, DRISI held its first Research Implementation workshop to review newly completed research and select projects that could benefit from seed money. We know that through this new process DRISI can better support its customers and continue to lead Caltrans toward a more efficient and innovative future.

Innovation Expo 2022: From Ideas to Solutions

The DRISI-sponsored Innovation Expo is an opportunity for those inside and outside of Caltrans to share new ideas, processes, and technologies in transportation and learn about the advances being made by the various districts and divisions to address Caltrans' goals and strategies. The first Innovation Expo in November 2020, which was moved to a virtual event due to the COVID pandemic, drew over 1,300 participants from across California and 13 other states.

Mark your calendars:

Innovation Expo 2022 is scheduled for November 8 and 9. It will also be virtual and showcase innovations across all of Caltrans, demonstrating a wealth of ideas and implementations to achieve our commitments to people, programs, partnerships, and the planet.

Caltrans Goals

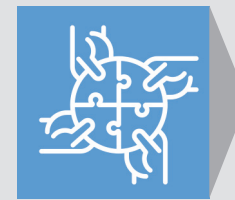**Safety First**

Cultivate Excellence

Enhance and Connect

Stewardship and Efficiency

Lead Climate Action

Equity and Livability

Learn more about the Caltrans goals in this **summary from the Caltrans 2020-24 Strategic Plan.**

Look for these icons on the articles to see how DRISI supports the Caltrans Strategic Plan.

Partners in Safety

Every day Caltrans work crews, operators, and maintenance teams perform tasks to maintain the roads and improve transportation operations. Patching potholes, removing litter, cleaning narrow culverts, clearing snow from steep mountain passes, zoning off work areas and diverting traffic, conducting land and hydro surveys—these are just a sampling of the ongoing maintenance tasks where safety is of the utmost importance.

For over three decades, DRISI has worked closely with the **Advanced Highway Maintenance & Construction Technology** (AHMCT) Research Center at the University of California, Davis, to discover, develop, evaluate, and deliver technological solutions that improve the safety and efficiency of the transportation system for both the traveling public and Caltrans' workers. With a focus on human-centric systems and software, the AHMCT Research Center has improved maintenance practices by introducing semi-automated equipment to reduce work-related injuries and keep workers out of harm's way.

Research often begins by evaluating emerging commercial systems and their applicability for Caltrans operations—can the product be used as is or how it can be tweaked and improved to meet Caltrans' needs,

using off-the-shelf components and systems whenever possible. An equally important piece is whether the manufacturer's claims are accurate. Using commercially available products saves time and money and builds on the manufacturer or developer's expertise and expenditures. And not everything makes it past critical evaluation. Some products are rejected because they don't bring value to Caltrans operations.

The AHMCT Research Center supports Caltrans' top priority of safety first by developing, testing, and deploying prototype machines, devices, systems, and software that improve safety.

> **Part of our work is deployment support and training for the new technology and equipment. Implementation is key: It doesn't count if no one uses it.**
>
> **— Bahram Ravani, Co director, AHMCT Research Center**

▲ Fast-flowing water can remove sand and gravel around a bridge's foundation, creating scour holes and compromising the structure's integrity, one of the main causes of bridge failure. Topographic and bathymetric surveys are vital for modeling water channel flow and early detection of bridge scour. This easily deployable, manned boat–based bathymetric survey system composed of mapping technology and echo sounder sensors measures discharge and collects flow velocity (magnitude and direction) information at the water surface over a large spatial extent. Caltrans divers now have 3D images of piers and the surrounding bathymetry to plan their dives and supplement their inspections at locations too deep for diving. The project also deployed drones to collect aerial images to generate topographic point clouds and digital terrain maps.

▼ Meet DAD (the one on the right), also known as a driveway assistance device, used when two opposing directions of traffic need to share one lane in a low-volume area. Typically, lane sharing is managed by stationing human controllers at each end of the work zone to direct vehicles when it is their turn to go. However, placing human flaggers at locations that have only a few cars per day is not productive, but controls are still needed to prevent vehicles going against the traffic flow and colliding or disrupting operations. This rented DAD can be controlled remotely, increasing safety and reducing costs. AHMCT modified the changeable message sign to be actuated by an approaching vehicle to inform the driver of the actual wait time.
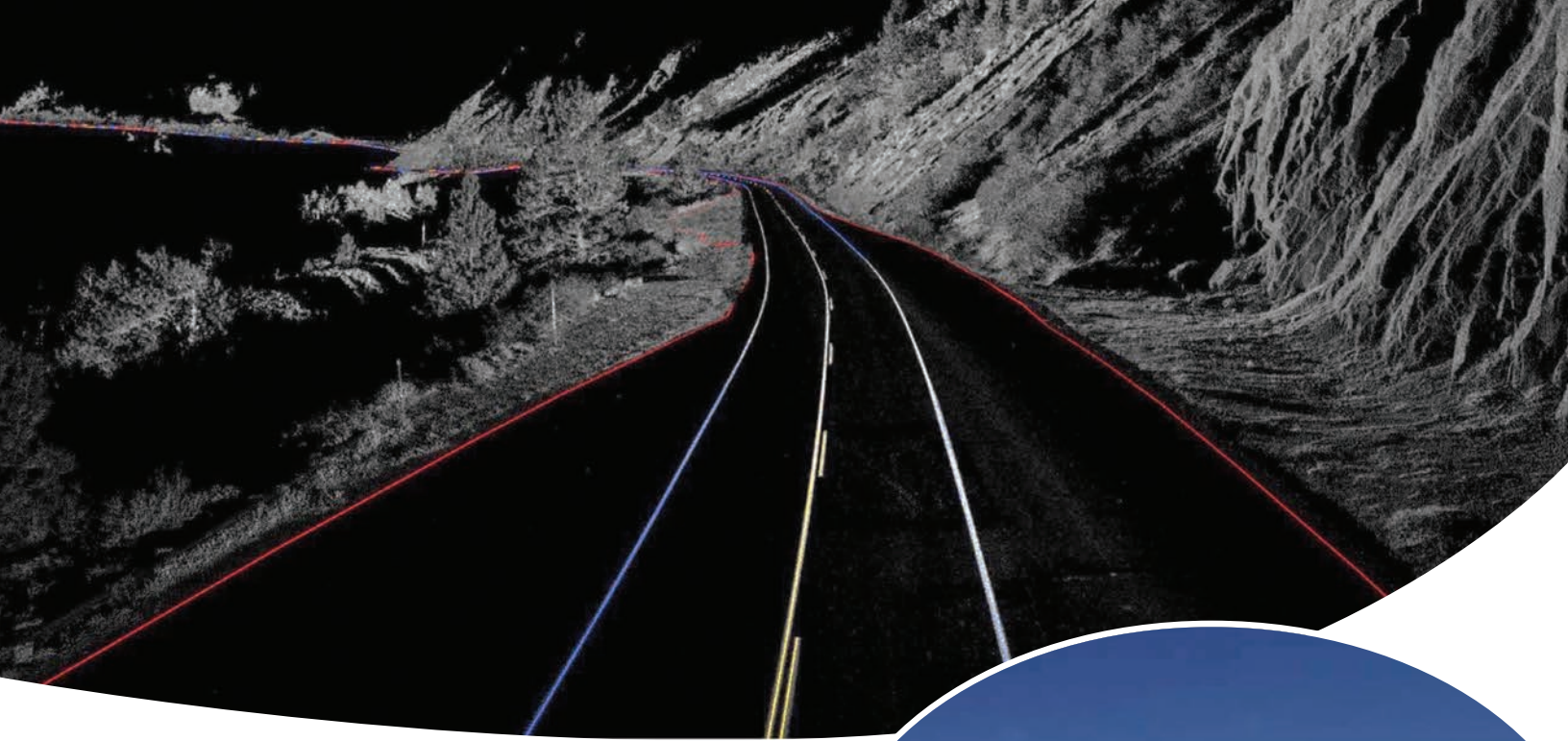
▲ Caltrans has eight mountain passes that are closed over the winter and reopened each spring by snowplow operators clearing the many feet of accumulated snow. With few visual indicators, it's difficult to locate and stay on the road. The Mountain Pass Road Opening (MPRO) system guides drivers safely through deep snow by tracking the contour of the roadway and indicating the position of roadside obstacles, such as guardrails and signage. The MPRO system starts with a 3D, high-precision map of all the roadway elements. The information is collected with a Mobile Terrestrial Laser Scanner (MTLS) mounted on a Caltrans van traveling at highway speed. AHMCT had partnered with DRISI and the Office of Land Surveys 10 years previously to adopt this scanning technology, which keeps surveyors safe because they're not exposed to traffic and captures all features of the roadway area accurately and rapidly.

▶ The MPRO software converts the reference information into an image viewed by the operator on the in-vehicle computer. The system is portable, easy to install, and sharable across multiple vehicles. The benefits are many: With minimal capital investment and decreased environmental impact, the passes are open sooner, operators are working in a safer environment, and vehicles aren't sitting in the repair shop from hitting guardrails, rocks, or other features hidden by the snow.

▲ Culverts channel water under roads and highways. During storms and water flow, debris builds up in the culverts. If the debris is not removed, flooding can cause damage to the surrounding area. Cleaning culverts is a labor-intensive process and, depending on the size, can be difficult to access.

Our focus is on improving safety, mobility, and efficiency with the goals of lean operations, reliability, and minimizing environmental impacts.

Ty Lasky, Co director, AHMCT Research Center

With remote-controlled tunnel muckers, the operator stands outside the culvert—no working in confined spaces. The machines can fit in rectangular culverts as small as 4 feet by 4 feet or round culverts 5 feet in diameter, and are capable of removing large rocks and debris.

For more ways the AHMCT Research Center collaborates with DRISI, visit **http://ahmct.ucdavis.edu.**

Connecting the (Data) Dots

With help and contributions from DRISI, the state of California has created a vast data storehouse detailing its services, facilities and geographic information available at the click of a mouse to the public.

The **California State Geoportal** uses the latest Geographic Information Systems (GIS) technology to gather millions of points of data generated by state government and organize it into map-based or 3D visual representations. Visitors to the site can get big picture views of location-based information grouped by category, or drill down to find more granular detail about state services or operations.

The 42 datasets about the State Highway System each contain layered map levels of information. Site visitors can choose overlays embedded with the particular data points of information they are seeking about the highway system, its location and its functions.

For example, a family that plans to travel along U.S. 395 through the state can call up the dataset showing the number of rest stops along the route (five), listed on a graphic table, and a map displaying the services of each (vending, dog walk, RV facilities, etc.). Or, since the route travels the dramatic east side of the Sierra Nevada, they can find out how many vista points there are (10), and exact locations.

The Caltrans-supplied transportation component of the state geoportal doesn't just serve vacationers. Emergency responders can get quick access to datasets giving specifics about Caltrans and local bridges, public airports, heliports or Caltrans' postmile system to

Today, almost every division involved in highway system maintenance, project planning and delivery, traffic operations, and asset inventory and management relies on GIS technology.

pinpoint locations of incidents on the highway system. Trucking firms whose business depends on knowing state highway restrictions and conditions can pull up information on allowable weight loads for specific routes, locations of freight intermodal points for transfers, or the status of inspection facilities.

Commuters visiting the state site can view where traffic bottlenecks are, average daily traffic counts, locations of park-and-ride locations, or, tiring of the daily drive, look up train and bus facilities.

DRISI continually refreshes and verifies its existing information on the state geoportal, and is working on new categories of collected transportation data to introduce. DRISI also collects and posts GIS-based data on its **website** that is readily available to the public, featuring 57 map datasets separated into highway, railroad, airport and boundary categories.

Caltrans Embraced GIS Use Early

The state geoportal is the leading edge of the data revolution that Caltrans and other state agencies have been rolling out for public viewing and reference.

As steward of the State Highway System, Caltrans, through DRISI's Office of Data Services and Technology, was one of the early users of geospatial technology. GIS is one form of geospatial technology, the computer rendering of location-based data into digital map layers that can be viewed, organized, analyzed and integrated through geographic software programs.

The use of GIS at Caltrans began in the early 1990s, when the Department first began collaborating with GIS pioneer and industry leader Esri (Environmental Systems Research Institute), based in Redlands. With leaps forward in technology — more powerful computers, internet capability, and sophisticated geographic software programs — GIS became an indispensable tool that allowed Caltrans planners and engineers to plot project details in a digital realm.

Not only could data be visualized through GIS mapping, but layered in a "sandwich" fashion, enabling project managers to evaluate information and spot patterns, relationships and potential problems that may have previously gone undetected.

Caltrans planners use GIS to sandwich layers of information about a particular project to analyze its impacts.
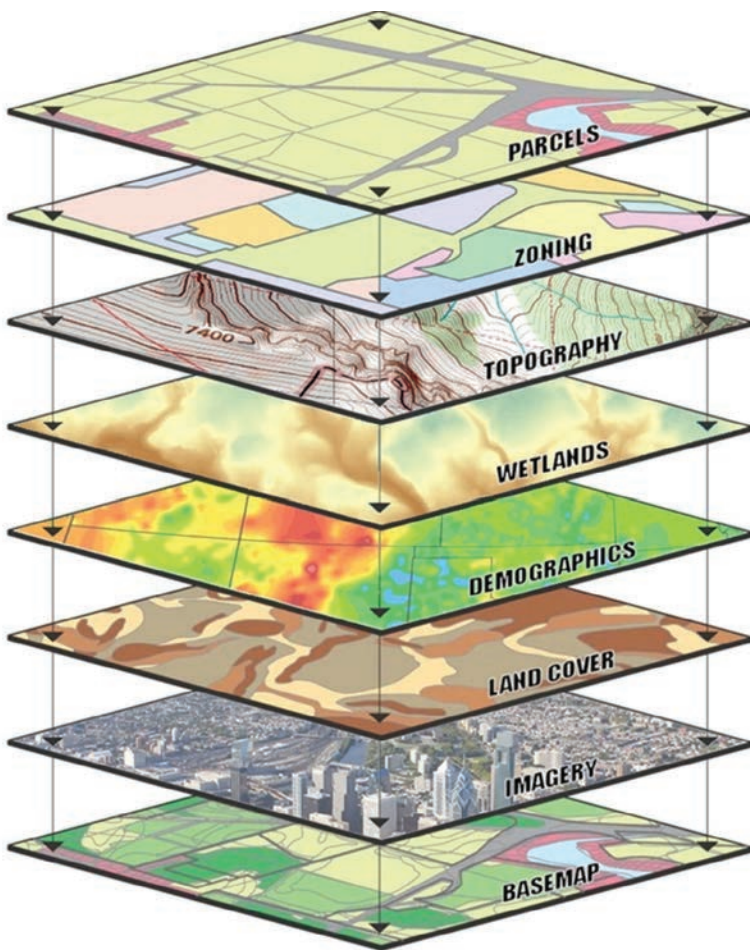
Opening Up Data Access

GIS usage has been an integral part of Caltrans operations for years, but much of the data generated was kept internally and not easily shared.

But the ability to present complex sets of geographic data via two-dimensional and 3-D web-based interfaces has opened up new ways to communicate with the public about state government, and Caltrans, operations.

The state geoportal, with Caltrans' contributions, is one example of this transparency. But Caltrans and CalSTA websites offer other road-related information conveyed through GIS mapping. Some examples:

QuickMap — Perhaps the best known, and used, GIS-enabled service on Caltrans' website is QuickMap, which displays real-time traffic information to help travelers make smart decisions before they take to the road. QuickMap uses a Google Maps application infused with information supplied by Caltrans, Waze and other sources. QuickMap averages 104,000 visitors a month and the mobile application has been downloaded more than 397,000 times to Android and iOS devices.

StoryMap — Caltrans districts are beginning to utilize this new GIS-based form of storytelling that merges layered maps, photos and text into themed presentations. Using Esri's ArcGIS software program, Caltrans GIS specialists in **District 11** (San Diego area) and Bishop-based District 9 created web pages that tell vivid stories about transportation attributes in their region. D11 assembled a **pictorial StoryMap** display to describe how local artists transformed nondescript highway underpasses, walls and ramp sides into vibrant expressions of art around the San Diego area. The east side of the Sierra Nevada serves as the stunning backdrop for a D9 StoryMap **biking guide** to the district's best routes, from the Mojave Desert to Yosemite National Park.

Freeway Art
How and Why Caltrans Incorporates Art in Transportation Spaces

Map Key

1 Encinitas Up Close
2 Dawn to Dusk
3 Blowing Leaves
4 Mr. Toad's Ride
5 Seagulls
6 Gateway Mural
7 Nexus Eucalyptus
8 Wheels-Rodoviarie
9 Kids Being Kids
10 Trellis
11 Pylons
12 Buena Vista Avenue Mural
13 Martin Luther King Mural
14 Mine-A-Lisa
15 Art Outside the Box
16 Chicano Park Murals
17 Sealife
18 Sunburst
19 Bridge Details
20 Map of Imperial Valley
21 Dogwood Overcrossing & Landscape

A pioneering software program, StoryMap, takes GIS in a new direction. Here, Caltrans' San Diego-based District 11 created a visual presentation featuring freeway art in the region.

To encourage biking, District 9 created a StoryMap guide. District 4's GIS-enabled map shows the Bay Area's network of bicycle routes and facilities.

District outreach — District 4, representing the nine-county San Francisco Bay Area, and D11 in Southern California spotlight transportation options or services on their public-facing web pages. The San Diego district site shows the locations and features of park-and-ride and bicycle facilities, a driving distance estimator, culverts and the Freeway Art StoryMap, among other services. In Northern California, Oakland-based D4 produced a GIS-enabled map of bike routes and facilities that is part of its area bicycle plan, as well as a self-help online version of their public map counter that provides various right of way-related maps grouped by decade.

Safety matters — GIS also played a role in Caltrans' disaster response following the deadly 2018 Camp Fire in Paradise. Surveyors from Marysville-based District 3, whose territory includes the Paradise-Chico area, used GIS mapping to count the number of trees killed within highway right of way, and estimate the amount of hydroseeding needed to rejuvenate burned areas.

Caltrans' GIS staff also have produced maps that were singled out for national recognition. GIS-enabled maps created in D11 and D3 have been chosen for inclusion in the prestigious Esri annual map book that features the year's most innovative or creative work in digital geographic mapping, and serve as a resource for other map designers around the world.

The Office of Data Services and Technology:

- **Publishes and maintains the Caltrans Linear Referencing System**
- **Maintains the Caltrans GIS Data Library**
- **Coordinates and publishes the Caltrans Web Map Gallery**
- **Manages the implementation and deployment of statewide GIS activities for Caltrans**
- **Creates and implements enterprise GIS systems and services**
- **Leads the coordination of GIS activities at Caltrans**
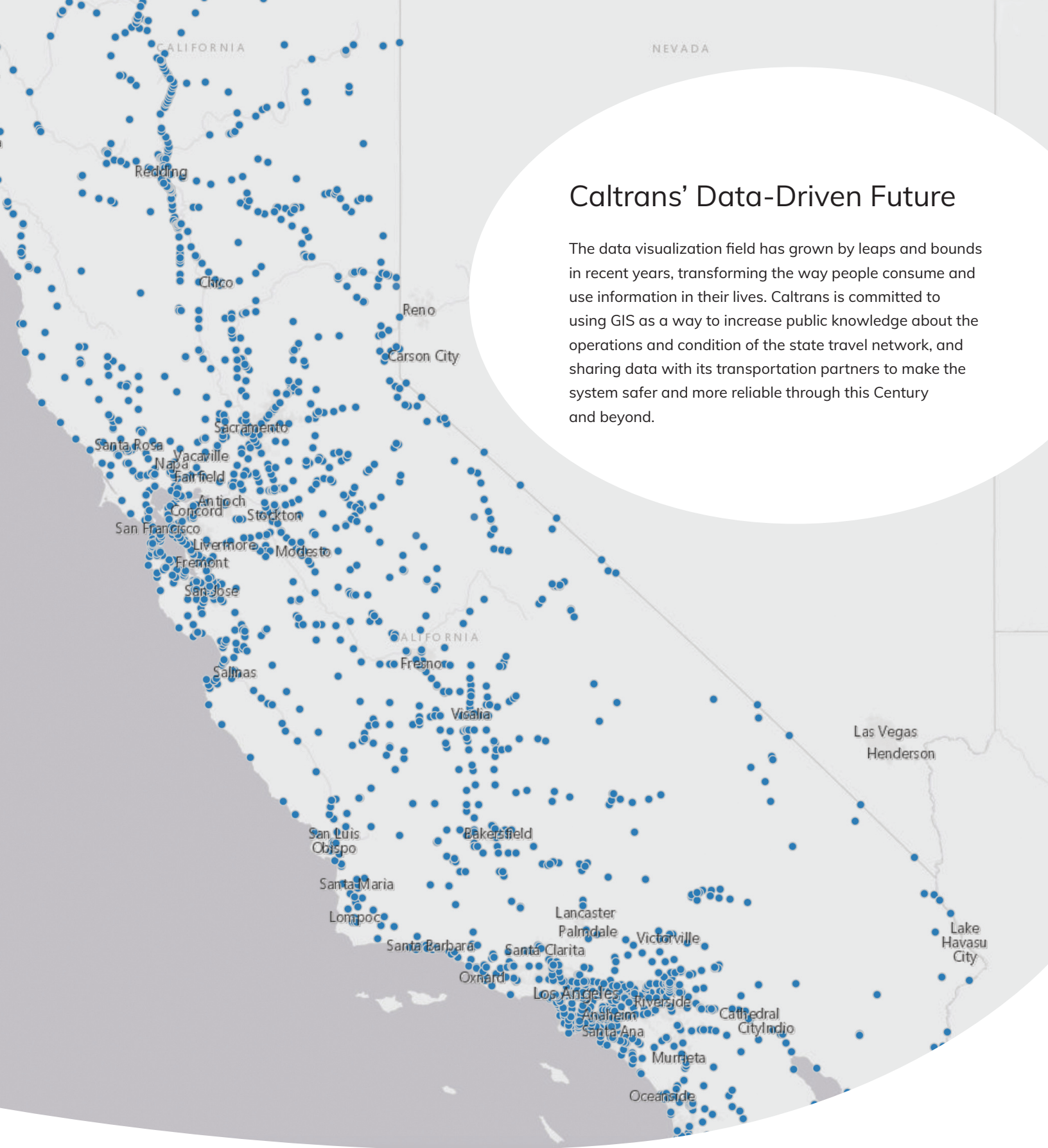
Caltrans' Data-Driven Future

The data visualization field has grown by leaps and bounds in recent years, transforming the way people consume and use information in their lives. Caltrans is committed to using GIS as a way to increase public knowledge about the operations and condition of the state travel network, and sharing data with its transportation partners to make the system safer and more reliable through this Century and beyond.

You can view the annual average daily truck traffic of the marked locations and other Caltrans GIS data maintained by DRISI at https://gisdata-caltrans.opendata.arcgis.com.

Thank you to the **Mile Marker** where portions of this article first appeared in Fall 2020.

Why House Hunters Should Head to the Mall

The 55-acre Chula Vista Center is on a trolley line and surrounded by 10 bus stops. It can accommodate 1,622 to 4,455 dwellings. Google Map image.

It's noon at the mall, and the parking lot has a smattering of cars. The anchor department store is shuttered, and the remaining shops are barely getting by. California, like the rest of the nation, has been grappling with what to do with the growing number of shopping centers left empty by consumers shifting their purchases online, with the COVID-19 pandemic only accelerating this trend.

With many shopping malls having sizable footprints, ranging from 40–100+ acres, and often served by existing transit lines, a possible answer is to build housing on these sites. California's housing deficit is estimated between 2.5 and 3.5 million units. Rezoning and redeveloping underutilized malls could help close the housing gap while leading to less traffic congestion, air pollution, and greenhouse gas emissions.

To assess the potential of converting distressed malls to transit-oriented housing or mixed-used centers, DRISI partnered with the University of Southern California's METRANS Transportation Consortium. Using equity, environmental, and transit accessibility criteria, the study identified 10 underutilized malls with redevelopment potential in California's four largest metropolitan regions of San Diego, Los Angeles, San Francisco, and Sacramento.

When assessing the feasibility of transforming a mall, transit access was a critical piece. The malls studied typically had three to four bus lines providing service to the site, and several had a transit center located on site or within walking distance.

> **Repurposing failing malls that are along existing transit lines is a viable infill option for cities and suburbs to reduce sprawl while addressing housing shortages.**

For each redevelopment scenario, the researchers calculated the potential number of housing units based on two measures of density applicable to mixed-use neighborhoods. After reserving 50 percent of a mall's acreage for rights of way and open space, the estimates compared erecting four-story buildings versus six stories. For example, an 80-acre mall could accommodate a blend of four-story buildings with ground-level retail, townhomes, and surface parking to yield 2,360 dwelling units on 40 acres. The same 40 acres with six-story mixed-used buildings over retail and with underground parking could yield 6,480 dwelling units.

At 73 acres, the Arden Fair Mall in Sacramento, which has a transit center with five bus lines and is 1.4 miles from a light rail stop, could be redeveloped with 2,153 to 5,913 dwelling units, depending on density.

Some of the owners of the reviewed shopping malls have expressed interest—or are already pursuing—redeveloping the sites into mixed use centers with significant housing additions, presenting opportunities for public-private partnerships. For example, the city of

Citrus Heights is actively looking into redeveloping the 96-acre Sunrise Mall, which is located within a half mile of 10 bus stops, to a mix of housing and commercial use. The current plans include 1,125 housing units. Based on the density guidelines used by the researchers, the site could yield 2,832 to 7,776 units. And the current owners of the Northgate Mall in San Rafael have submitted redevelopment plans for a mixed-used village with 1,358 apartments on it 42 acres. Located next to US 101, the mall is served by five bus routes. With higher density, the proposed number could be more than doubled 3,321.

Repurposing failing malls can also address the deficit in affordable housing units. The study found that if one-third of the dwellings were affordable, the profiled malls could provide 20 to 54 percent of their cities' affordable housing targets for the coming eight-year housing planning cycle.

Bringing new life to dying malls in the form of transit-oriented housing could meet so many of California's challenges: build more sustainable housing while taking advantage of existing transit, stop sprawl, create a more walkable community, and attack climate change.

The MainPlace Mall in Santa Ana is 49 acres with approximately 20 acres dedicated to parking served by three bus lines and a nearby Metrolink train line. The current owners have submitted plans to convert it to a mixed-use project, including 1,900 apartments. The site could yield 1,445–3,939 dwelling units with ground-level retail. Google Map image

> **Many shopping centers range from 40–100+ acres, typically with half of the acreage reserved for parking. With sustainable planning, converting a failing mall could boost housing supply and provide efficient transit.**

The struggling 82-acre Southland Mall in Hayward, of which 70 percent is covered by parking, is surrounded by suburban development on all sides. Located 2.5 miles from the Hayward BART station and served by four bus lines, the mall could accommodate 2,419 to 5,542 dwelling units. Google Map image.

For details about the malls studied, view the final report: **Failing Malls: Optimizing Opportunities for Housing**.

Highway Trivia: Name That Number
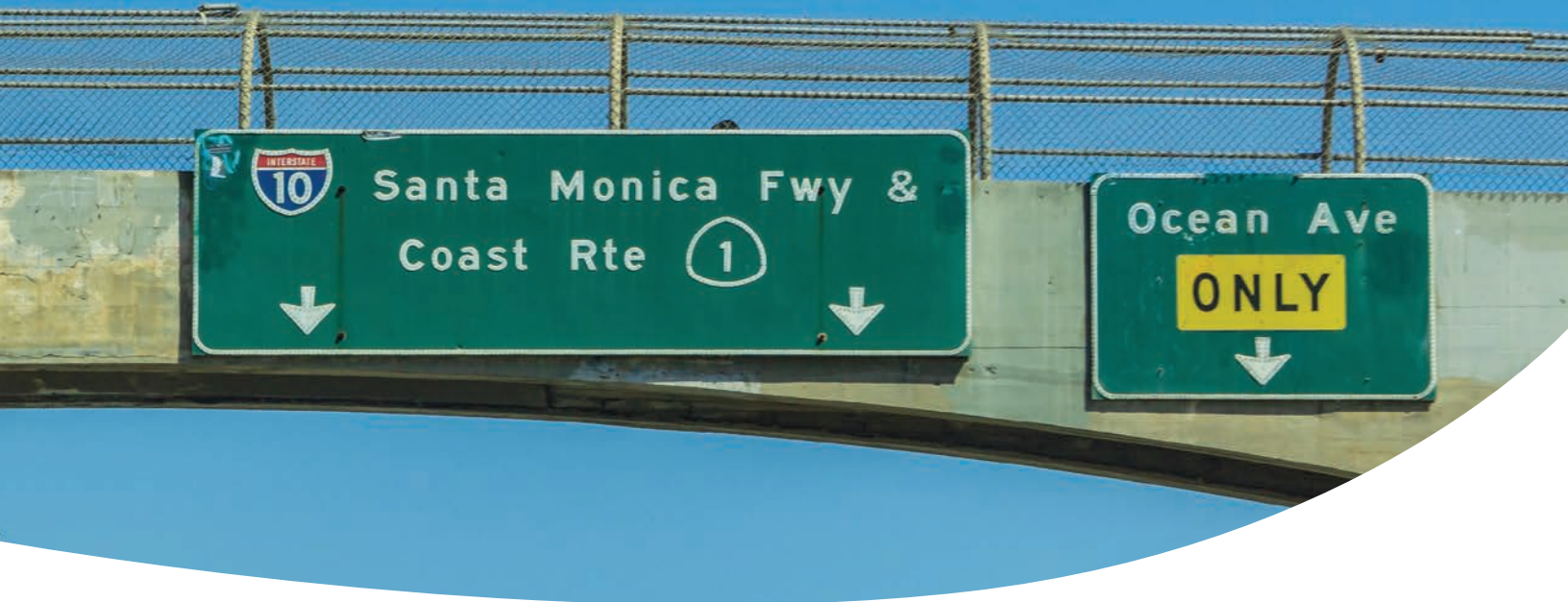
You say the Nimitz; I say 880. You can take the I-10 to the beach, unless you call it the Santa Monica Freeway. And how did the Ventura Freeway end up being both Highway 101 and 134? California's distinctive highway naming system with its regional distinctions has been the fodder of many a late-night skit.

In addition to having a number, a route can have a name and, in some cases, multiple names. When the State's modern freeway system was being constructed, Southern California routes often took the name of a local destination. We have the Santa Ana, San Bernardino, and the Harbor Freeway to San Pedro. Many of these freeway monikers were made official by the Highway Commission in the 1950s, and some remain unofficially named through local usage.

Over the past few decades, ad hoc guidelines and criteria have led to the majority of freeway, highway, and structure names being designated through legislative action in memory of an individual, group, or historical event. And that list has grown to over 700 names.

Avenue of the Giants, stretch of Route 254

To mitigate controversy and promote fairness, in 2020, the Senate and Assembly Transportation Committee recommended a policy for naming or designating State highways and highway structures.

DRISI's Office of Highway System Information and Performance is responsible for compiling and cross-referencing this daunting catalog of routes, bridges, and other facilities. *Named Freeways, Highways, Structures and Other Appurtenances in California* categorizes them all by name, number, and historical usage. It also delves into the background of each named structure and stretch of highway.

Discover which routes go all the way back to the Gold Rush. Learn why I-70 in Sutter County is called the Farm-to-Fork Corridor or about the stretch of Route 140 into Yosemite Valley appropriately named All Year Highway. It's all there from A to Z, Route 1 to 980.

To find out who or what your neighboring routes commemorate and become a whiz at highway trivia, check out **Named Freeways, Highways, Structures and Other Appurtenances**.
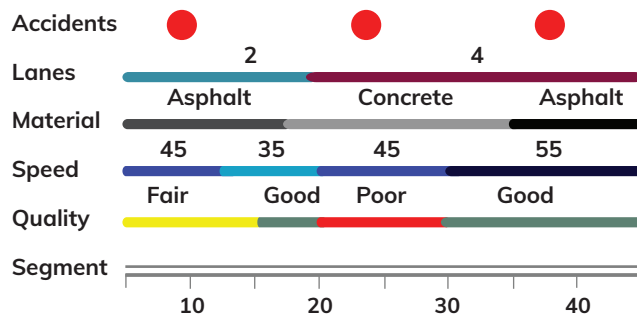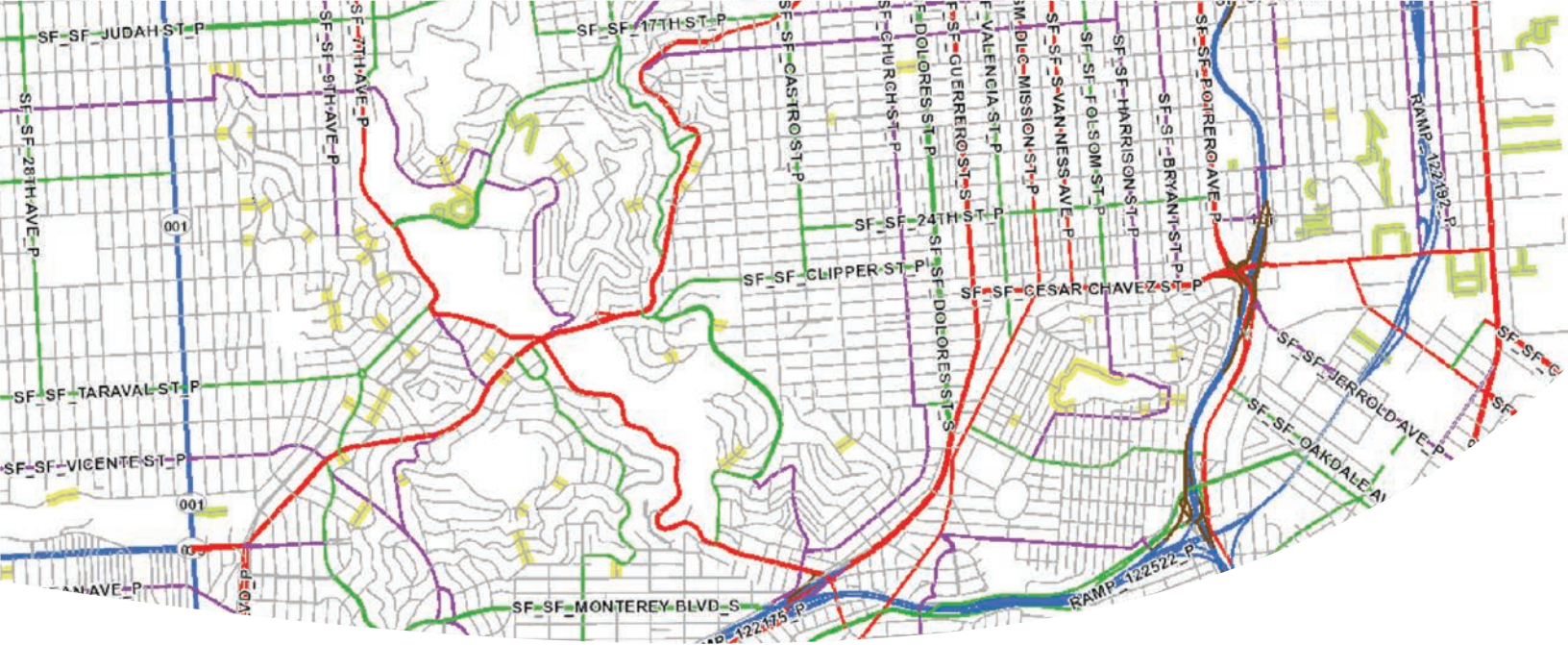
Where's Waldo? Ask ARNOLD.

Otherwise known as the All Road Network of Linear Referenced Data, ARNOLD is a federal program that requires all departments of transportation to standardize and improve the mapping of every road to facilitate the accuracy of GIS data to support a wide range of transportation activities, such as emergency services, modeling traffic demand, and managing pavement condition. And yes, it can help you find Waldo.

With linear referencing, things along a linear feature—like a highway—are located according to how far down that feature they are. It could be a known point, like an offramp or intersection, or a length along the feature, such as a guardrail, a speed limit, or type of road surface. You can use a linear referencing system (LRS) to represent a transportation network and layer on multiple characteristics and events associated with route segments on the line, such as signage, road conditions, crashes, or construction projects, without affecting the underlying linear geometry.

Rather than storing multiple instances of one segment according to each applied attribute, an LRS keeps one version of the geometry and references the data to it. The attributes can be associated with any segment along the linear feature independently of where the feature begins or ends. Attributes can be updated, added, or removed without affecting the segment.

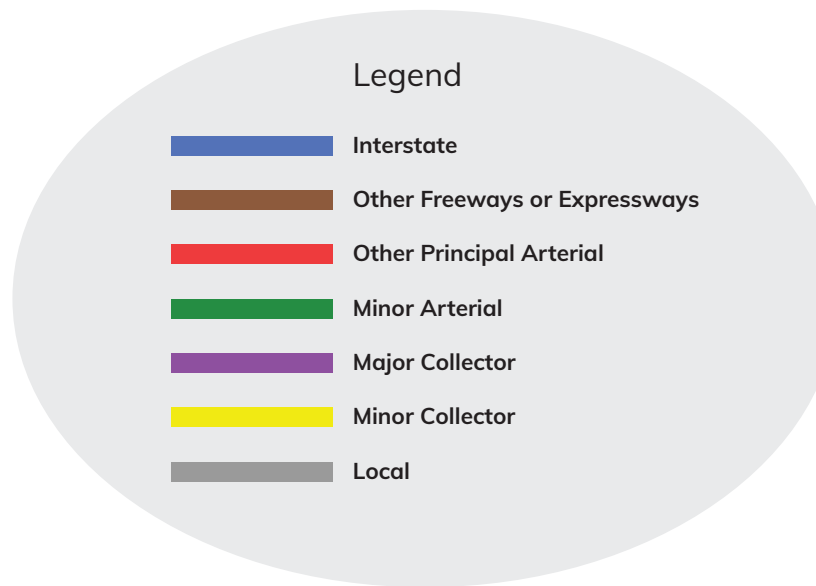|				
Accidents	●		●	●
Lanes		2		4
Material	Asphalt		Concrete	Asphalt
Speed	45	35	45	55
Quality	Fair	Good	Poor	Good
Segment	10	20	30	40

Example of an area that has been updated with the latest geometry and high-precision editing.

Linear referencing isn't new. It's a popular method to store spatial data in an intuitive way that facilitates analysis, insight, and data management. LRS data is also the foundational piece in digital transformation and GIS mapping. However, there are many methods to go about measuring, and those various approaches have led to inconsistencies and inaccurate data across the country. And not all public roads have been mapped. Hence the birth of ARNOLD in 2012. ARNOLD not only prescribes LRS guidelines but also broadens the criteria for all DOTs to create LRS datasets for all roads in the state, not just federally aided routes. DOTs are not the only entities that map roads within a state. Other local levels of government, such as counties and cities, are involved in road data collection and management, which has led to gaps and inconsistencies.

To meet the ARNOLD requirement, DRISI began a multiphase process to standardize the geometry across the state and all 58 counties to establish the base LRS dataset—not a small task—and then migrated the data to the ESRI GIS platform, which was completed in 2020. The project is now in the final stages of high-precision updates and coordinating data sharing among counties.

Legend

▬ (blue)	Interstate
▬ (brown)	Other Freeways or Expressways
▬ (red)	Other Principal Arterial
▬ (green)	Minor Arterial
▬ (purple)	Major Collector
▬ (yellow)	Minor Collector
▬ (gray)	Local

Thanks to ARNOLD, Caltrans can now access geospatial data regarding road conditions, terrain specifics, surrounding properties, infrastructure elements, accident-prone locations, evacuation routes, down to the exact geographic coordinates. With quicker access to detailed and accurate information, Caltrans has the ability to more efficiently assess and manage the transportation network and focus resources where improvements are needed . . . and find Waldo.

For more information, check out these DRISI StoryMaps: **Caltrans Postmile System** and the **Postmile Geocoder**

Denying Wildfires the Right of Way

With Caltrans climate studies predicting hotter temperatures and changing rain patterns, resulting in drier forests and foothills and raising the likelihood of catastrophic fires, maintaining fire-safe corridors to protects lives, homes, and habitats has become more urgent. Between 2015 and 2020, 81 separate wildfires damaged the Caltrans road network, leading to closures and expenditures of over $590 million. To reduce wildfire ignitions and ensure emergency evacuation routes, Caltrans and other state and federal agencies have been collaborating on thinning vegetation and creating defensible space within and alongside the Caltrans-owned right of way (ROW), which covers over 350,000 acres.

The Caltrans-sponsored 2019 Wildfire Vulnerability Assessment applied 21 factors, including population, topography, and emergency capacity, to the entire State Highway System, broken down into one-mile segments, to determine each section's wildfire risk to prioritize vegetation treatment. The report identified 2,600 centerline miles of roadway, approximately 17% of Caltrans 14,993 centerline miles, with significant fire risk and critical need of fuel reduction.

Burnable material means bigger fires. Caltrans has identified priority locations for vegetation treatment to help prevent wildfires from growing and spreading and keeping the roadways open for emergency responders and evacuees.

But with the 2020 fire season breaking numerous records, the 2021 **California's Wildfire and Forest Resilience Action Plan** calls for federal and state agencies to increase the pace and scale of forest management and wildfire resilience efforts by 2025 and beyond. In response to the Caltrans action items outlined in the plan, DRISI partnered with the University of California, Davis National Center for Sustainable Transportation to identify opportunities and obstacles to maintain fire-safe roadways.

The researchers updated the initial risk maps with additional and newly available data representing fire perimeters, climate risk, and fuels within the ROW and expanded the list of road segments that have the highest level of risk as well as creating a tracking system of treated areas with subsequent lowered risk.

The research also reviewed the current vegetation management practices within Caltrans' right of way and the steps that might be needed to increase vegetation treatments. For non-cultivated vegetation along the State Highway System, the methods applied vary based on the jurisdiction's requirements and the ecoprovince—different types of vegetation and landscapes, from redwoods to chaparral to desert,

require different approaches. Depending on these factors, Caltrans employs mechanical, chemical, manual, thermal, biological, or cultural methods.

Interviews with Caltrans staff members regarding vegetation management in the ROW brought up some of the current challenges for reducing combustible material. Safety is a concern as roadside workers are confronted with vehicles passing at high speeds. In areas that do allow herbicide application, drought complicates these treatments because they require rain for absorption, so alternative methods need to be considered. But primarily, vegetation control represents a small part of the budget, and resources are scarce.

Caltrans ROW transverses a broad range of adjacent landowners—private, local, and federal—and it is important for all relevant stakeholders to develop and implement forest thinning and vegetation management projects. The revised risk map and assessment of vegetation control practices provides a framework for engaging other agencies and fire officials in collaborative fuel reduction projects to protect roadway travelers and communities along highways and to reduce roadside ignitions along primary and secondary emergency evacuation routes.

The 2021 California's Wildfire and Forest Resilience Action Plan highlights the importance of defensible space and calls for Caltrans to develop a framework for safe road corridors with key agencies and stakeholders "to protect roadway travelers, communities along highways and to reduce roadside ignitions along primary and secondary emergency evacuation routes. Caltrans will identify highway corridors most in need of defensible space and develop a strategy in the spring of 2021 while seeking to align funding and crew resources."

View the final report: *2020 Critical Update to Caltrans Wildfire Vulnerability Analysis.*

For more information:

California Department of Transportation
www.dot.ca.gov

Division of Research, Innovation and
System Information
www.dot.ca.gov/research