



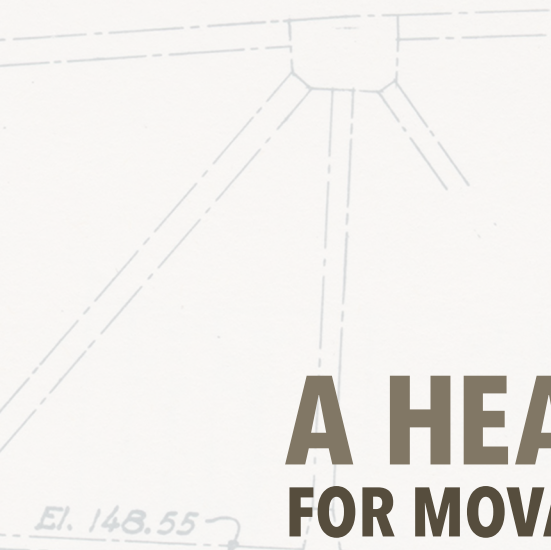
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A HEAVY LIFT FOR MOVABLE BRIDGES

CALTRANS PREPARES AGING SPANS FOR NEW ERA

CALTRANS CALLS THEM MOVABLE BRIDGES, BUT IN THE PAST SEVERAL YEARS, THEY'RE MOVING LESS EASILY AS AGE AND WEAR HAVE TAKEN THEIR TOLL ON THE HISTORIC SPANS IN THE SACRAMENTO-SAN JOAQUIN DELTA REGION.

Left: The Rio Vista Bridge towers above the landscape as twilight approaches in the Sacramento-San Joaquin Delta. Like other movable bridges in Caltrans' system, years of use have taken their toll on the Highway 12 Rio Vista span. An extensive rehabilitation effort is underway. Caltrans photo by John Huseby



Caltrans owns and operates 14 working drawbridges — nine in the Delta waterway region that takes in San Joaquin, Sacramento and Solano counties, three farther north on the Sacramento River, and a pair that cross Oakland Estuary in Alameda County. Another three movable bridges near the confluence of the San Joaquin River still carry vehicle traffic, but no longer open for boats.

Although a majority of the 14 operating movable bridges date back to a bygone era, their transportation function is anything but antiquated. In addition to vehicular traffic, the bridges accommodate a busy flow of shipping commerce, much of it in agricultural and construction products, from the Central Valley to the seaports of San Francisco and Oakland.

Caltrans' movable bridges also have long served as an important gateway for recreational boaters in the Sacramento and Delta regions. And there's the aesthetic and cultural value for Delta residents — the classic steel truss structures are an irreplaceable reminder of their region's rich waterway history.

However, the operating systems that have been lifting and closing heavy bridge sections for up to 100 years are straining to keep up with the demands of a modern-day transportation network. Unlike their fixed counterparts, movable bridges function as machines — a synchronized system of gears, gates, locks, motors, cables and other machinery to accommodate dual roles serving vehicular and boating traffic.

And like any machine, the bridges break down. In the case of the older spans, built in the 1920s and '30s, their internal workings are reaching the end of their useful life.

SIGNS OF DISTRESS

Within the past nine months, four of Caltrans' most heavily-used movable bridges had to be closed at times to accommodate emergency repair work. The Rio Vista Bridge, a popular link between the Central Valley and Bay Area on State Route 12, had to close briefly to traffic last August after a mechanical gear that raises and lowers the span sustained damage.

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Trouble struck again in December 2018 when Three-Mile Slough Bridge, south of Rio Vista, was briefly immobilized when its drawbridge jammed in the up position. A faulty lift mechanism was the culprit, and required emergency repairs.

A month later, the Isleton Bridge on State Route 160 was closed to repair a bridge locking mechanism. In addition, access to Sacramento's iconic Tower Bridge that links the city and West Sacramento has been restricted several times in the past year as key mechanical components have been replaced, as has an aging cable system that hoists and lowers the bridge section for passing boats.

Closures can mean long delays for motorists and commercial vehicles forced to take alternate routes. In the case of the Rio Vista work, travelers diverted at either end of the bridge had another 90 minutes added onto their trips because of the limited road options across the Delta.

The number of bridge raisings vary according to location. The Mokelumne River Bridge along Highway 12, a busy recreational opening to the Delta, saw the most boat traffic in 2017, with 1,399 openings and 1,829 vessels passing through — almost 90 percent of them were personal craft. The next highest number of openings in 2017 was recorded at Three-Mile Slough Bridge near Antioch — 1,038, with a greater mix of commercial vessels, 337, going under the raised bridge.

Other movable bridges still operating see much less boat traffic. The Steamboat Slough Bridge, which connects Delta islands two miles upriver from Rio Vista, opened only 80 times in 2017.



The Garwood Ferry Bridge opened in 1934 across the San Joaquin River in Stockton, connecting that city and the Central Valley to Contra Costa County and the East Bay via State Route 4. Built as a swing bridge that rotated on a central pier, the Garwood Bridge no longer opens for boat traffic.

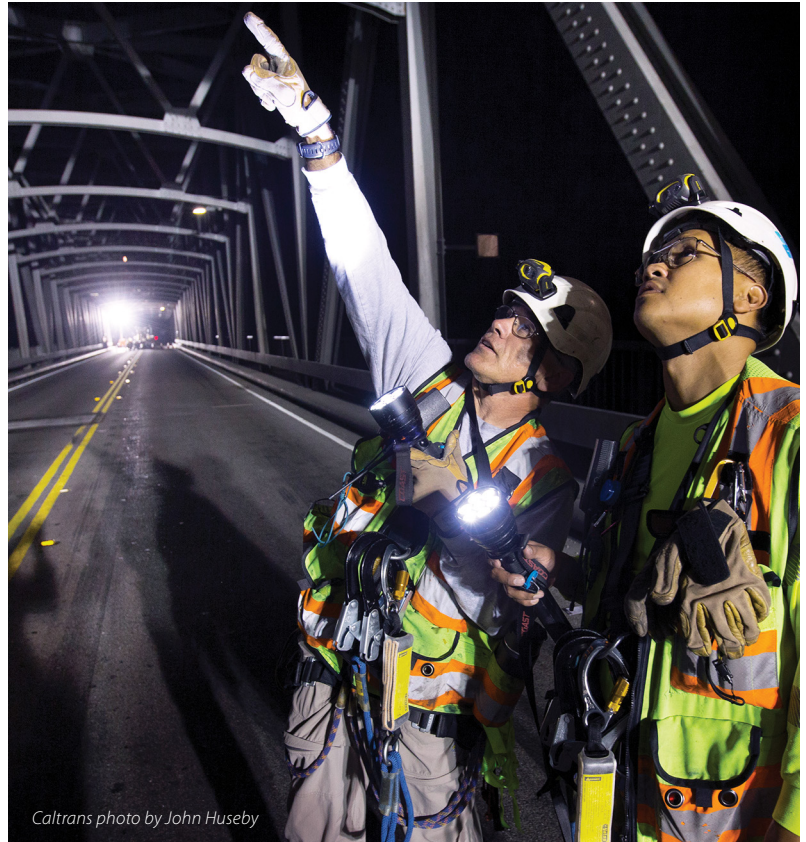


Caltrans photo by John Huseby

Caltrans' Alfredo Carranza measures joint tolerances on the Rio Vista Bridge during a recent round of repairs.



The Rio Vista Bridge, pictured in 1952, would undergo a major rebuild from 1957-60 into its present configuration. The original bridge opened in 1919 no longer exists.



Caltrans photo by John Huseby

Outfitted with climbing gear, Roman Granados, left, and Mark Efe, Caltrans employees who belong to a certified climbers group that perform bridge inspections, check out a section of the Rio Vista span.

The slew of recent repair work is just the first round of an extensive series of improvements that Caltrans plans for its movable bridges. The upgrades, and heightened response strategies, were outlined in a Delta Movable Bridge Management Plan drafted by a team of Caltrans division engineers and regional district representatives in response to the multiple equipment failures.

EMERGENCIES HASTEN NEW ACTION PLAN

The bridge plan lays down a series of immediate and intermediate actions, as well as revisions to inspection and maintenance practices. They are:

- Improve emergency response communications, roles and responsibilities.
- Identify and immediately repair critical movable bridge component deficiencies.
- Establish a redundancy system (keeping spare parts, an alternate backup system) in case of unexpected breakdowns. Because many of the parts are so specialized, it can be difficult to find vendors. In the case of the Rio Vista gearing, the unit had to be shipped across the country for repairs.

- Prioritize an upgrade/modernization schedule for critical electromechanical systems to improve operational reliability and maintenance.
- Revise inspection and maintenance practices to detect and repair issues before failures occur.

The management plan also calls for formation of a dedicated movable bridge "strike team" responsible for day oversight, minor repair, and ensuring the smooth mechanical/electrical operations of the State's drawbridges. An 11-person team is being formed and range of responsibilities developed.

In the meantime, emergency repairs will begin at the bridges deemed at greatest risk of operating failure. The movable bridges in the Delta at Three-Mile Slough (opened in 1949), Isleton (1923), Paintersville (1923) and Steamboat Slough (1924) are scheduled for \$20 million in major electrical/mechanical upgrades and seismic retrofit at Paintersville through a director's order, issued to complete time-sensitive, critical repairs.

Two director's orders also have been approved to repair, replace and upgrade electromechanical components on the Rio Vista Bridge totaling about \$10 million.

The span that now stands, built in 1944, is getting a major overhaul. (The original Rio Vista bridge opened in 1919, but no part of it remains.) As part of the Rio Vista Bridge Preservation Project, a massive cleaning and repainting job is now underway, a \$20 million effort scheduled to continue through spring 2020. Upgrades of the bridge's core working components are planned next, while deck and rail improvements and other roadway fixes, including ADA upgrades, will be the focus of another project scheduled for 2022.

Caltrans also is taking no chances with the Tower Bridge, opened in 1935. In addition to the earlier work, an emergency contract is awaiting approval to replace the main mechanical drive system, electrical control system, add back-up controls, and replace worn bearings and balance chains. Caltrans expects to spend another \$5 million overall on the Tower rehabilitation effort.

ADDING, STANDARDIZING KEY PARTS

To make its movable bridge system less susceptible to breakdowns and repair delays, Caltrans also plans on compiling an inventory of key spare parts and standardizing equipment to reduce the dependence on custom parts that are difficult and expensive to obtain.

It's anticipated that the electromechanical system upgrades on all of Caltrans' operating movable bridges will be completed in the next five years.

Caltrans also owns and operates two ferries in the Delta, at Cache Slough connecting Ryer Island and Rio Vista, and Steamboat Slough linking Ryer with Grand Island. The ferries are part of Caltrans' movable bridge system, and the new bridge management plan outlines a strategy to improve their reliability and maintenance. The vessels are considered extensions of the State Highway System and transport visitors,

SACRAMENTO – SAN JOAQUIN DELTA MOVABLE BRIDGES

BRIDGE	TYPE	DAILY VEHICLE TRIPS	YEAR BUILT
ISLETON	BASCULE	5,500	1923
LITTLE POTATO SLOUGH	SWING	18,100	1991
MINER SLOUGH	SWING	1,300	1933
MOKELUMNE RIVER	SWING	18,900	1942
OLD RIVER	SWING	14,900	1915
PAINTERSVILLE	BASCULE	2,000	1923
RIO VISTA	VERTICAL LIFT	24,000	1944
STEAMBOAT SLOUGH	BASCULE	2,000	1924
THREE-MILE SLOUGH	VERTICAL LIFT	23,700	1949

OAKLAND ESTUARY MOVABLE BRIDGES

BRIDGE	TYPE	DAILY TRIPS	YEAR BUILT
SAN LEANDRO BAY	BASCULE	40,000	1953
SAN LEANDRO BAY BICYCLE	BASCULE	-	1995

SACRAMENTO RIVER MOVABLE BRIDGES

BRIDGE	TYPE	DAILY TRIPS	YEAR BUILT
KNIGHTS LANDING	BASCULE	8,300	1933
MERIDIAN	SWING	8,000	1977
TOWER	VERTICAL LIFT	16,500	1934-35

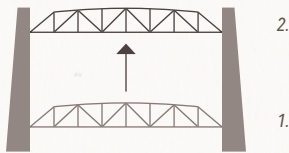
MOVABLE BRIDGE TYPES



BASCULE

Bascule bridges, are the earliest form of movable bridge. They have one or two sections, called leaves, that open on a hinge, or trunnion, that pulls the leaf up to allow vessels to pass. The bascule design features concrete counterweights.

Bascules can be partially raised to allow smaller boats through, speeding the opening and closing process. Caltrans' Isleton Bridge is an example of a bascule bridge.



VERTICAL LIFT

Vertical lift bridges are the rarest, with only five remaining examples in California. Lift bridges have two towers by which a central span can be raised to allow for waterway passage.

Perhaps the most famous existing lift bridge in California is the Tower Bridge, linking Sacramento and Yolo counties. Built between 1934 and 1935 in the Streamline Moderne style, the Tower Bridge features exceptional parallel tower legs, adding to the vertical effect. Another example is the Rio Vista Bridge, with the approach spans built in 1944 and the lift span built in 1960.

SWING

Swing bridges rotate on a center pier to permit passage on the waterway. Swing bridges were first constructed in California in the 19th century, but fell out of favor by the early 20th century because of several disadvantages in their design: They operated slowly, had to be fully opened to allow vessels through, and, most importantly, they required a central pier in the center of a navigation channel.

In Caltrans inventory, the Meridian Bridge on State Route 20, and the Garwood Bridge on the San Joaquin River are examples of a swing bridge. However, neither does much swinging these days – the Meridian, the farthest northern drawbridge on the Sacramento River, experiences little ship traffic and is only opened for inspections, while Garwood on SR 4 in Stockton is not opened.

By the middle of the 20th century, the era of the movable bridge had passed as engineers opted to construct high, fixed span crossings.

Source: Caltrans Historic Bridges Inventory Update, 2004



BRIDGE DEPARTMENT
 ... DESIGN SECTION ... 11
 Project Designer: *R. T. Fuller*
 Chief Designer: *William N. Hedgpeth*

DESIGN	By <i>R. T. Fuller</i>	Checked <i>W. Hedgpeth</i>
DETAILS	By <i>C. Hills</i> 10-56	Checked <i>W. Hedgpeth</i>
QUANTITIES	By <i>C. Hills</i>	Checked <i>J. P. Sullivan</i>

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residents and equipment free of charge — the Real McCoy II on Cache Slough serving as State Route 84, while the J-Mack plies Steamboat Slough for 400 feet as State Route 220.

GOLD RUSH BEGINNINGS

Movable bridges in California date back to the Gold Rush, when the first one was built in Oakland in 1853, according to Bernard C. Winn in *California's Drawbridges — The Link to California's Maritime Past*. There were at least 250 drawbridges constructed up and down the State since that time, but as of 1995, only 70 remained, according to Winn.

And of those still standing, a relative few open for boat passages these days. Two of Caltrans' movable bridges on the Sacramento River north of the capital, the Meridian Bridge (built in 1977) at State Route 20 on the Colusa-Sutter county line, and the Knights Landing span (1933) on State Route 113 at the Yolo-Sutter county line are opened only for inspections and see few vessels. No work is planned on those spans.

Caltrans also owns two drawbridges in the Oakland area. The Bay Farm Island Bridge, which serves as State Route 61 connecting to the city of Alameda, was built by Caltrans in 1952 but is maintained by the Alameda County Public Works Agency. The same arrangement exists for a pedestrian-only

movable bridge built alongside the main Bay Farm bridge in 1995, the only one of its kind in the country. It opens and closes in tandem with the vehicle bridge.

The U.S. Coast Guard regulates the openings and closings of Caltrans' movable bridges, and sets schedules for individual spans. Bridge tenders, who are Caltrans employees, manage operations from control centers on site.

As with other parts of the State highway network, bridges have been the beneficiary of increased funding from the Road Repair and Accountability Act of 2017 (Senate Bill 1). Major maintenance projects such as bridge work are funded from the State Highway Operations and Protection Program (SHOPP), which pays for emergency repairs, safety projects, highway asset preservation and certain operational improvements. The 2018 SHOPP received \$18 billion last year from the California Transportation Commission, a \$7 billion increase from the 2016 allocation primarily due to SB 1 revenues. **MM**

Sources: Prakash Sah, Chief, Caltrans Office of Electrical, Mechanical, Water and Wastewater Engineering; Michael B. Johnson, State Asset Management Engineer; Bernard C. Winn, *California's Drawbridges — The Link to California's Maritime Past*



The Tower Bridge in Sacramento had just opened when this photo was taken in 1936. The Delta King paddlewheel ship, seen in background, was still traveling between Sacramento and the Bay Area. The iconic link between Yolo and Sacramento counties, across the Sacramento River, has undergone about \$5 million in renovations in the last year, and about the same amount will be spent on upcoming repairs.