

## EXECUTIVE SUMMARY

Built between 1967 and 1969, the picturesque Brookwood Drive Bridge has served as the gateway into the Brookwood neighborhood for 50 years. The covered timber Warren-truss structure, with its signature red paint, crosses over Jacoby Creek near the community of Bayside in Humboldt County.

In 2013, the Humboldt County Department of Public Works conducted a field inspection and bridge condition evaluation to determine what was needed to ensure the bridge would remain a safe way for pedestrians and vehicles to cross the creek for many years to come as it is the only access route into the community.



The primary concern identified in the evaluation was the presence of wood destroying pests which, if not treated, had the potential to cause significant irreversible damage to the lower truss chords and floor beams of the bridge, which are important structural members. Other issues like paint wear, pedestrian walkway and railing deterioration, and needed roof repairs were identified as well.

Rather than replacing the well-designed and constructed bridge which was built by Earl Biehn and Charles Roscoe, first head of the engineering department at Humboldt State, the County worked to preserve and restore the rare and locally significant bridge.

Rehabilitation measures were identified as a cost-effective strategy and the County used unique design and construction techniques to complete the project. The project successfully navigated uncharted regulatory requirements as it was the first time a wooden bridge was fumigated in California. It also used compressed natural gas to maintain utility service during construction operations. The pedestrian walkway was restored to its original appearance while updating its design for current code loading and standards.

The rehabilitation efforts for the bridge were completed in October 2018 by Quincy Engineering (Engineering Design Firm), Kernen Construction (Contractor), and SHN (Construction Management). The bridge should continue to serve the residents of Brookwood and Humboldt County for the foreseeable future.

## Preservation, Safety, Access and Quality Improvements to Local Street & Road System



In the late 1960s a new subdivision, Brookwood, was built near Bayside in Humboldt County. The picturesque gateway into the community is a covered, timber pony truss structure that carries only one lane of traffic in and out of the area. Designed and constructed by local residents including Earl Biehn and Charles Roscoe, the former chair of the Engineering Department at Humboldt State University, the bridge is a source of great pride for locals. While the bridge was well-designed and built for the standards of its day, many of the traffic safety features, such as bridge railing and pedestrian railing, did not meet current criteria.

The bridge's vulnerability to decay and deterioration due to its timber construction meant that it requires much more ongoing maintenance than a concrete or steel bridge. However, because of the local significance of the bridge, the County opted to preserve this beautiful and rare covered wooden bridge instead of replacing it.

The rehabilitation efforts included:

- Fumigation of the bridge to eliminate wood destroying beetle infestation;
- Topical treatment of exposed timber surfaces to prevent re-infestation of the bridge;
- Replacing the deteriorated pedestrian walkway and handrail;
- Replacing existing traffic railing to meet current safety standards;
- Replacing untreated portions of the bridge deck system;
- Replacing and repairing roofing as needed; and
- Repainting the exterior of the covered timber housing structure.

All of these components have extended the service life on the bridge and improved both vehicular and pedestrian traffic and safety in and out of the Brookwood community.

### Project Innovation

In California, there are only a handful of wooden covered bridges throughout the state. To preserve these often historically significant bridges requires regular maintenance as they are subject to issues like wood rot and deterioration as well as pest damage. In lieu of replacing the bridge over Jacoby Creek in Humboldt County, the County was able to work with bridge engineering firm, Quincy Engineering, to identify the best, most cost-effective alternatives that would:

- Preserve a locally engineered and hand-built, rare wooden covered bridge
- Provide a safe, reliable, and long-lasting structure to serve public vehicle and pedestrian traffic
- Modify design features to increase future durability and reduce maintenance

- Minimize environmental impacts to Jacoby Creek from construction operations
- Be cost effective in the long-run compared to full bridge replacement options

This project utilized a variety of innovative techniques. Because of the large amount of damage to the wood due to wood-boring beetles, the bridge needed to be fumigated.

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This is the first known fumigation of a wooden covered bridge in California.

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Adding to the complicated nature of this project was that the fumigation needed to occur over a fish bearing creek.



To mitigate potential negative environmental impacts due to fumigation and topical treatment, only low volume containers and hand equipment were used during the application to limit the size of a potential spill. A stream protection containment system (SPCS)/workers' platform was built to keep chemicals, paint and construction debris out of the water as well as give construction crews access to make repairs to the lower portion of the bridge.

Another unique technique was the use of Compressed Natural Gas (CNG). There was a natural gas line attached to the side of the bridge. In order to safely maintain utilities service to the Brookwood neighborhood, CNG was used to deactivate the gas line through the project site. Pacific Gas & Electric (PG&E) does not use this option frequently; however, by doing so, it helped keep the project schedule on track, kept service in place, and was a much safer option than completely replacing the line.

## Model for Future Projects

This method used in the restoration project had never been used in a public vehicular bridge in California. There were numerous, uncharted regulatory requirements, and this paved the way for future wooden bridge preservation projects. Extensive coordination was performed early and often with the State Department of Pesticide Regulations, Humboldt County Department of Agriculture, and the licensed fumigator who performed the work. Due to the unconventional nature of the work, initially there was uncertainty over regulatory and legal authority over the project. Through extensive coordination, a path for acceptance by all regulatory agencies involved was charted. Special Provisions were included in the construction contract documents to ensure the project's low bid Contractor would complete the project in a manner consistent with the agreed approach including



specialized submittals and construction field meetings prior to various operations with all parties involved and engaged. Future non-residential fumigation projects can use this precedent as a model for compliance.

## Sustainable Positive Outcome

Prior to the project, the majority of the structural components of the existing bridge were viable for continued use with substantial remaining useful lifespan. Rehabilitating and replacing only the damaged portions of the existing bridge avoided wholesale demolition and disposal of entire structure. This prevented sending large volumes of useful structural timber and concrete materials to a landfill disposal facility when they could be re-incorporated into the preserved structure.

In addition to gas fumigation to arrest the immediate threat of further boring beetle activity, use of the topical pest treatment substantially reduces the risk of future re-infestation for the foreseeable future. Portions of the approach roadway were also re-graded and re-paved to better handle stormwater drainage and prevent water infiltration onto structural timber elements. Along with incorporation of treated timber materials to replacement deteriorated elements, it is expected that the routine maintenance burden to the County for this bridge will be substantially reduced in the future, both in effort and recurrence intervals.

## Project Cost-Effectiveness

### *Design Phase*

The County had initially considered replacing the bridge; however, based on a life cycle cost analysis performed by Quincy Engineering, the most cost-effective option was to rehabilitate the bridge. The cost to rehab the bridge and maintain the structure to the end of its serviceable life was nearly 20% less than the estimated replacement and future maintenance costs. This recommendation was a positive outcome, especially for the community that wanted to keep the locally significant bridge open and preserve it for years to come.

### *Construction Phase*

Humboldt County initially had planned to go into construction in the Summer of 2017; however, after receiving only two bids from contractors that were significantly higher than anticipated, the County decided to re-advertise the project later in the year in hopes of drawing greater attention to this unique project and receiving a larger pool of bids to increase bid competition and cost efficiency. The process included increasing typical bid development times, additional advertisement processes, and a pre-bid meeting to discuss the more unique aspects of the project that clarify questions and concerns of bidders in order to help reduce costs associated with risk built into received bids. The contract was ultimately awarded to Kern Construction, a local contractor with family ties to the bridge. Two generations of the family had previously worked on the structure. Construction began in the summer of 2018 and was completed in October 2018.

## Positive Environmental Effects

One of the key concerns was the potential effect that fumigating pest abatement operations on the bridge would cause on the environment and Jacoby Creek including potential public safety issues related to the fumigation operations. Meetings with coordination regulatory



agencies and the residents of the community were used to determine how to best meet the project needs while minimizing environmental impacts.

Ultimately, it was determined that the best course of action was construction of a temporary single-lane detour bridge to serve vehicles and pedestrians during fumigation and topical treatments. Placement and construction of the temporary bridge were specified in the construction contract in such a way as to minimize activity and disturbance in the creek. To minimize impacts to the environment, the detour crossing had to span the entire width of the creek without any supporting structures below the Ordinary High Water Mark (OHWM). It also had to avoid impacting the banks of the creek below the OHWM on both sides of the creek.



Because of the sensitive stream corridor and presence of listed fish species and critical habitat, the construction period was highly limited, allowing only a short work window in which the rehabilitation could occur. As mentioned previously, a stream protection containment system (SPCS)/workers' platform had to be built by workers without large equipment in the creekbed to keep chemicals, paint and construction debris out of the water as well as give construction crews easy access to make repairs to the lower portion of the bridge.

## Effective Collaboration and Partnerships

In 2011 Caltrans performed an inspection of the bridge, showing it was functionally obsolete and had a sufficiency rating of 37.7. The Federal Highway Administration was willing to fund 100% of the replacement cost of the bridge. However, after Brookwood residents expressed concern about potentially replacing the bridge at a public meeting in 2013, the County hired Quincy Engineering to perform additional inspection and analysis on the existing bridge to verify the feasibility and cost-effectiveness of a rehabilitation option as well full replacement. Upon completion of the bridge assessment, Quincy Engineering and County presented the findings and ways to save the bridge to the community at another public outreach meeting. Residents provided feedback during the discussion and on comment cards and via a SurveyMonkey survey. The community had the opportunity to weigh in on which rehabilitation and access strategy they preferred. Below are the questions and options neighbors could answer:

- Which rehabilitation/access strategy do you prefer during bridge rehabilitation?
  - Close bridge for fumigation and provide a detour bridge for vehicles/pedestrians

- Close bridge for fumigation and provide a separate detour bridge for pedestrians only
- Keep bridge open for topical treatment with closures in the order of hours
- No preference
- If the bridge is to be closed with a detour provided, which do you prefer?
  - Detour for vehicles and pedestrians
  - Detour for pedestrians only
  - No preference
- If the bridge is to remain open with closures during the day, which do you prefer?
  - Both morning and afternoon closures with shortest construction duration
  - Only morning closures with longer construction duration
  - Only afternoon closures with longer construction duration
  - No preference

It was clear that the community wanted construction to be completed as quickly and efficiently as possible and was willing to accept a level of inconvenience to achieve this goal. Taking the local residents' concerns into consideration and working collaboratively with them helped ensure the success of the rehabilitation project. Involving the community and local residents in development of the preferred temporary traffic detour facilitated acquisition of Temporary Construction Easements required for the detour road and structure.

## Project Benefits to Other Cities & Counties

Because this was the first time a wooden covered bridge was fumigated in the State of California, there were numerous and often unknown hurdles to clear:

- Determination of regulatory agency jurisdiction and applicable laws for fumigation on this type of structure;
- Coordination with the utility company for determining risks and acceptable mitigation for performing a fumigation around and adjacent to an active gas pipeline and electrical distribution line; and
- Crafting custom warning signage and adopting special security measures to monitor the longer than usual gas fumigation process which was needed to achieve the highest certainty of pest elimination.





Now that the requirements are known, communities that wish to restore/revitalize the other remaining covered bridges can look to this project as an example of how to successfully and cost-effectively do so.

## Technological Innovation

In order to minimize disruption of gas service to residents, the County and Quincy Engineering worked with PG&E to use compressed natural gas (CNG) to deactivate the gas line through the project. By doing so, it avoided having to completely construct a new separate gas line to bypass gas service around construction activities. Elimination of the bypass gas line greatly streamlined project schedule and costs associated with utility coordination. It also reduced project cost, footprint, and schedule duration during the construction phase. While this technique is not typically used by PG&E, it was determined to be a simpler and cost-effective method to achieve project goals while protecting public safety.

## Advancing the Goals & Priorities of Improving Local Street & Roads

For over 50 years, the Brookwood Drive over Jacoby Creek Bridge has served as the gateway (as well as only entry/exit) to the beautiful Brookwood community in Humboldt County. Locals designed and built the bridge and have great pride in it. Rather than replace the bridge with a new one, the County found an innovative, first-of-its kind way to preserve one of California's few remaining wooden covered bridges. The repairs made to the bridge have made it safer for both vehicles and pedestrians to cross, prevented future pest infestations, and have restored it to its original red painted luster. Saving and preserving this bridge was a win-win for the County and the Brookwood community.

