PROJECT

West Sammamish River Bridge

City of Kenmore, Washington

by Kevin S. Kim and Hana D'Acci, Jacobs, and John Vicente, City of Kenmore

In August 2022, the city of Kenmore, Wash., celebrated the opening of a new bridge to replace the structurally vulnerable southbound bridge carrying 68th Avenue NE over the Sammamish River. Located at the north end of Lake Washington, West Sammamish River Bridge is a major arterial, carrying about 20,000 vehicles per day. The original bridge was built in 1938 with cast-in-place concrete box girders.

During a routine inspection in 2013, crews discovered cracks in the bridge's concrete box girder, as well as scour concerns around the timber cofferdams surrounding the in-water bridge piers. The City of Kenmore hired a consultant engineer to investigate these issues and, later, to lead replacement efforts for the aging bridge. The parallel East Sammamish River bridge, which was built in the 1960s and carries northbound traffic, remains in place because it did not exhibit the same deterioration as the much older southbound structure.

Aerial view of the construction site showing the precast, prestressed concrete tub girder erection. Photo: City of Kenmore.

The new West Sammamish River Bridge is a 600-ft-long, five-span structure with precast, prestressed concrete tub girders and an 8-in.-thick minimum cast-in-place concrete deck. The typical bridge section carries two 10-ft-wide lanes of southbound traffic and a 16-ft-wide multiuse path for bicyclists and pedestrians. The superstructure is supported by 5 × 4 ft, rectangular cast-in-place columns on 8-ft-diameter drilled shafts. The bridge is enhanced by an approximately 11-ft-wide, 32-ft-long, semi-oval overlook supported by a concrete cantilevered crossbeam at pier 3. Other improvements include a concrete bench on the overlook with a series of historical oars serving as both public art and separation from the multiuse path, architectural railings, LED lighting, and new landscaping along the corridor.

Key Project Challenges

Replacing the bridge at its original location posed many challenges, including a limited construction staging area, a brief window for in-water construction, and a need to maintain two lanes of traffic in each direction throughout construction. During preliminary design, the team developed a

profile

WEST SAMMAMISH RIVER BRIDGE / KENMORE, WASHINGTON

BRIDGE DESIGN ENGINEER: Jacobs, Bellevue, Wash.

PRIME CONTRACTOR: Ceccanti Inc., Tacoma, Wash.

CONCRETE SUPPLIER: CalPortland, Kenmore, Wash.

PRECASTER: Concrete Technology Corporation, Tacoma, Wash. —a PCI-certified producer

OTHER MATERIAL SUPPLIERS: Seismic isolation bearings and elastomeric bearings: D. S. Brown, North Baltimore, Ohio; geofoam blocks: FMI-EPS LLC, Post Falls, Idaho; ClearCast forms: TrueTech Bridge, Raleigh, N.C.

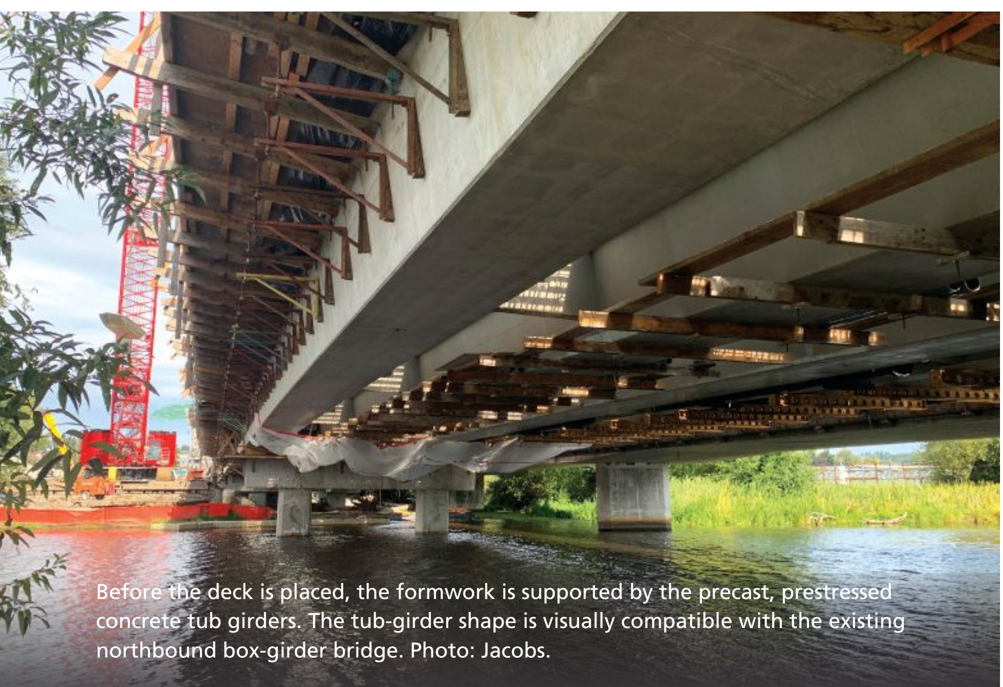
detailed plan to address those challenges as part of the biological assessment. The schedule included staged demolition and construction sequences that allowed two lanes of traffic to be maintained in each direction throughout construction. Additionally, the team proposed building a temporary trestle during the limited window for in-water work on the downstream side of the existing bridge. Some of the notable project challenges included the following.

- **Protecting the environment during the project.** Environmental stewardship was an important priority for the city as the team undertook this project. Planning, permitting, and constructing the new bridge presented numerous challenges to the environmental team. Because the cracks noted in the concrete girders and settlement of the existing bridge indicated a need for prompt action, the team set out to expedite the environmental permitting process. Challenges associated with the project included accommodating endangered aquatic species and adjacent recreational facilities. The team coordinated with 20 state and federal agencies to obtain 18 permits and approvals—nearly every permit possible in Washington. There were also strict in-water work requirements, including no more than 45 days of work each year in July and August. The environmental team collaborated with the contractor to support an aggressive three-year construction schedule, ensuring environmental compliance while keeping the project moving forward.

- **Minimizing public inconvenience during construction and protecting lives and property.** Kenmore is an active and vibrant community.

In two cases, removal of the existing concrete foundation required that sections be cut in half. Photo: City of Kenmore.

In addition to serving as a vital transportation route for people traveling to and through the area, the bridge is surrounded by popular recreation attractions such as a boat launching park, recreational boating on the Sammamish River, Rhododendron Park, Burke-Gilman Trail, and Inglewood Golf Course. Traffic was a frequent concern among community members. The original plan was to maintain two lanes of southbound traffic at all times by constructing the bridge in stages. However, when construction began in 2020, the traffic volume dropped significantly because of the COVID-19 pandemic. As a result, the city allowed the West Sammamish River bridge to be constructed under full closure while one lane of traffic was maintained in each direction on the East Sammamish River Bridge. With the full closure of the West Sammamish Bridge, the contractor was able to expedite construction within two in-water seasons instead of three. The design team provided



Before the deck is placed, the formwork is supported by the precast, prestressed concrete tub girders. The tub-girder shape is visually compatible with the existing northbound box-girder bridge. Photo: Jacobs.

CITY OF KENMORE, OWNER

BRIDGE DESCRIPTION: 600-ft-long, 45-ft-wide, five-span bridge over the Sammamish River located at the north end of Lake Washington in the Seattle, Wash., area. The bridge carries about 20,000 vehicles per day and provides access to a major regional trail system, Burke-Gilman Trail, for bicyclists and pedestrians with a 16-ft-wide multiuse path.

STRUCTURAL COMPONENTS: Twenty WSDOT UF60G5 precast, prestressed concrete tub girders, 110 to 140 ft long, supported on seismic isolation bearings, 8-in.-thick cast-in-place concrete deck, cast-in-place concrete pier caps, 5 × 4 ft rectangular concrete columns, and 8-ft-diameter drilled shafts

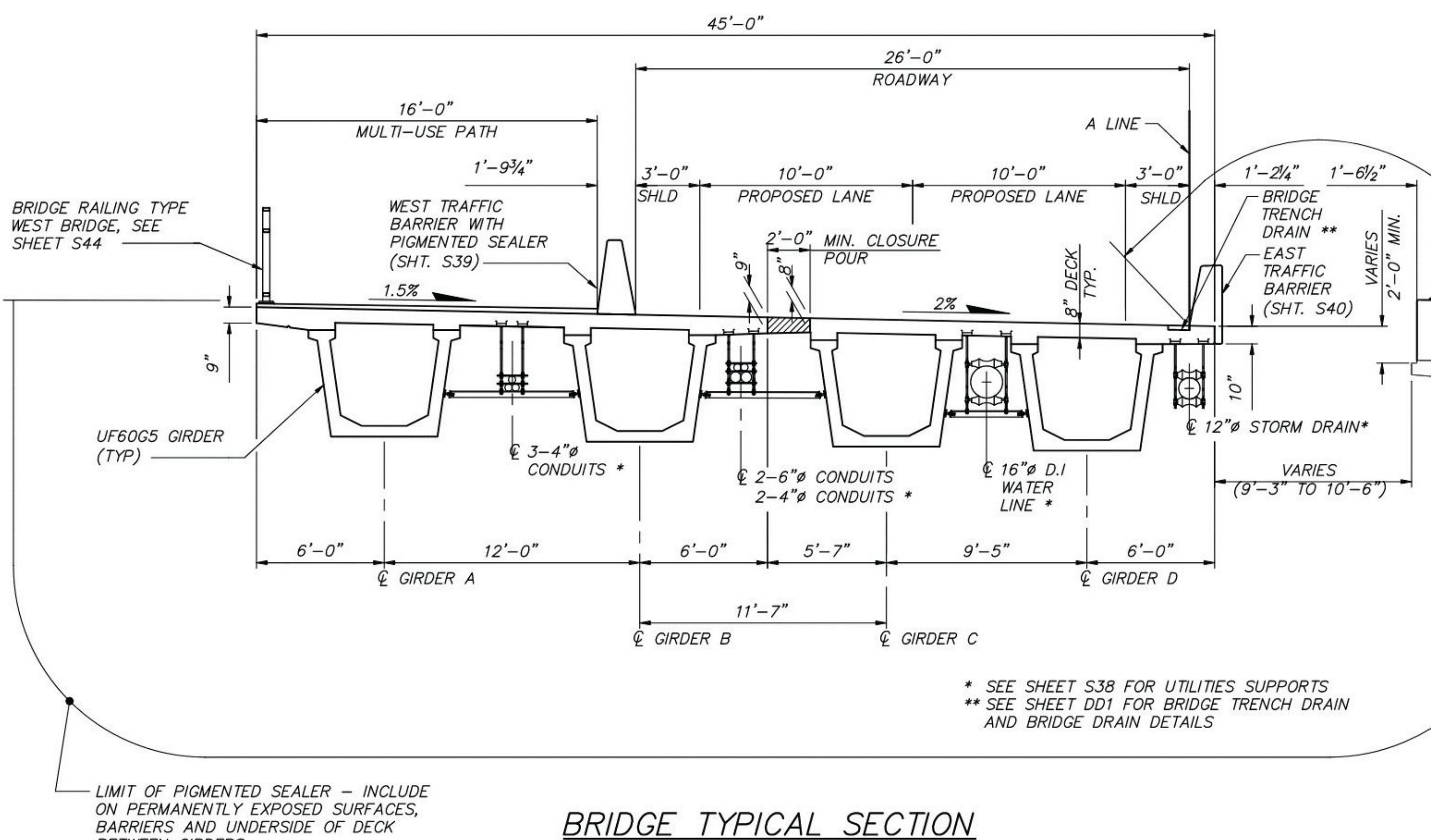
BRIDGE CONSTRUCTION COST: Approximately \$20 million (\$650/ft^2)

AWARD: 2023 American Council of Engineering Companies Washington Design Excellence Award for Complexity consistent, detailed information about closures and other impacts in advance, using newsletters, postcards, and email updates, in addition to website and social media posts. Pedestrians and bicyclists also rely on the bridge, and a popular boat launch in the river was temporarily affected. The design consultant worked with the city and community to understand the needs of all users and then proactively worked with local contractors to incorporate strategies into the plan set for advancing necessary work while minimizing disruptions.

Installing one of the precast, prestressed concrete tub girders. The typical girder is 110 ft long and weighs 165 kip. Photo: Jacobs.

- **Removing existing bridge foundations.** As-built plans of the original 1938 bridge were a close match for what was discovered in the field, but removing the structures proved to be extremely difficult. A local specialty contractor pumped the sediment from below the concrete foundations and exposed the supporting timber piles. Once the piles were exposed, divers threaded lifting cables underneath the foundation sections. While the cables were suspended from a crane, the divers used underwater chainsaws to cut the existing pilings. When the pilings were all cut, the crane lifted the existing concrete foundation out of the river, which was dangerous and time-consuming work. The four foundations weighed between 140,000 and 200,000 lb each. Two of the foundations were so heavy that they exceeded the capacity of the cranes and could not be lifted without first being cut in half vertically. The contractor worked extended hours during the in-water work window to complete the foundation removal.

The bridge typical section. The structure carries two 10-ft-wide lanes of southbound traffic and a 16-ft-wide multiuse path for bicyclists and pedestrians. Figure: Jacobs.



At the roadway approaches, geofoam blocks are placed over traditional gravel materials to mitigate settlement of the highly compressible peat layers. Photo: City of Kenmore.

Seismic isolation bearings—rubber bearings with lead cores —reduce the seismic demand on the concrete columns and foundation. Great blue herons are featured on the pier columns because the Sammamish River is a major habitat for the species. Photo: Jacobs.

Accelerated Bridge Construction

Because in-water work had to be completed during a narrow window while traffic was maintained on the busy corridor, the team applied the following accelerated bridge construction techniques to expedite construction.

- **Precast concrete girders compatible with the existing structure.** The northbound East Sammamish River Bridge is a five-span cast-in-place concrete box-girder bridge. To ensure that the new southbound West Sammamish River Bridge structure would be visually compatible with the existing bridge, the team decided to use precast concrete "tub-shaped" girders (WSDOT UF60G5) and the same span arrangement as the remaining northbound bridge. As such, two girder lengths were used on the project; span 2 had a girder length of 140 ft with a weight of 210 kip, and the other four spans had 110-ft-long girders weighing 165 kip. This aspect of the design not only expedited construction but also minimized impacts on environmentally sensitive areas.
- **Stay-in-place forms for bridge deck construction.** To expedite construction and minimize traffic disruptions, the design team used a transparent, acrylic stay-in-place form to construct the cast-in-place bridge deck. This type of form is not widely used in Washington state due to its higher material cost but was a good choice in this instance because it saved construction time and reduced the effort needed to set up and strip temporary formwork. This approach also provided safety benefits for construction workers. The transparent material allows for

The completed bridge's multiuse path and gathering overlook. Photo: Jacobs.

AESTHETICS **COMMENTARY**

by Frederick Gottemoeller

Simpler is often better. The West Sammamish River Bridge is a great example of this principle. There, keeping things simple was a necessity, not a choice. The project faced major traffic maintenance and environmental constraints, and simplicity made it easier to deal with them. The parallel East Sammamish River Bridge provided a helpful model of a concrete box-girder bridge from which to start, and the availability of standard precast concrete box girders (WSDOT UF60G5) made building the bridge simpler still. All this simplicity paid off when the COVID-19 pandemic erupted.

The memorable aspect of this bridge is what the designer did with these simple elements. The key details are at the overlook at the midriver pier. Look at the ends of the pier cap: they are slanted at the same angle as the box girder webs. There was no need to insert a different angle. In addition, the concrete bracket supporting the overlook is a massive concrete shape that appears to be an extension of the similarly massive pier cap.

Finally, the nine vertical "oars" of the monument on the multiuse path provide a vertical element that further delineates the position and importance of the overlook. The lightweight and simply patterned pedestrian railing offers a transparent horizontal feature that doesn't compete with the visual prominence of the overlook or interfere with travelers' views from the bridge.

Overall, the new bridge offers an attractive background and setting for the popular recreational attractions surrounding it.

future inspection of the bottom of the bridge deck as required by the Washington State Department of Transportation.

- **Geofoam blocks to mitigate settlement.** The bridge corridor is underlain by highly compressible peat layers, which are prone to settlement. To mitigate long-term settlement due to new roadway approaches at each end of the bridge, the design team recommended using geofoam blocks for the roadway subgrade instead of gravel. The geofoam blocks are extremely lightweight but structurally adequate to support the roadway without inducing any long-term settlement along the corridor. Use of geofoam blocks over the traditional gravel materials substantially shortened the construction duration.

Seismic Resiliency

The previous bridge lasted more than 80 years, and the city wants the new bridge to serve the public for decades to come, with a minimum 75-year service life. To achieve that goal, the latest technology was used to account for climate change, seismic conditions, and the day-to-day needs of the structure over the long term. Given the earthquake risks at the bridge location, seismic resiliency was an important component of the work. To accommodate seismic design requirements for a 1000-year design seismic event and to reduce the seismic demand on the concrete columns and drilled shafts, the design team used seismic isolation bearings to support the bridge superstructure. Although seismic isolation bearings are typically used on complex structures or seismically vulnerable older bridges, the design team specified them for this structure because they are suited for the presence of liquefiable soil layers, which would cause lateral spreading, and for short column heights that could not withstand the seismic displacement demands. A rubber bearing with a lead core was selected for its cost effectiveness and ease of installation.

Conclusion

The team anticipated certain challenges but could not have anticipated the onset of a global pandemic. Despite the initial pandemic shutdown, followed by a lengthy concrete delivery drivers' strike in the area, the design team was able to revise the construction sequences, and make other changes that enabled the project to meet the original construction completion date of fall 2022..

The City of Kenmore wanted more than just a bridge. They wanted transportation solutions for all modes, and a better overall experience for users of this heavily traveled corridor. The result was a successful project that replaced a vital piece of the city's infrastructure, giving the community an improved experience as they travel through the area. The community and the team were excited to celebrate the bridge's on-time completion at a ribbon-cutting celebration in August 2022.

Kevin S. Kim is vice president, northwest region bridge and structures lead, and project manager and Hana D'Acci is bridge design lead with Jacobs in Bellevue, Wash. John Vicente is city engineer for the City of Kenmore, Wash.

Nine vertical "oars" at the overlook on the West Sammamish River Bridge multiuse path delineate its position and importance Photo: Jacobs.