



Sacramento River Channel Restoration

A major flood in January 1970 significantly changed the shape and flow of the Sacramento River downstream of the Glenn-Colusa Irrigation District (GCID) intake channel. Approximately 4 miles north of Hamilton City, a meander was cut off, which reduced the river reach by approximately 2.5 miles (RM 202.5 to RM 205). The riverbed gradient within this reach continued to degrade with seasonal flood events. The degraded river gradient decreased water surface elevations by 3 feet at the GCID diversion, leaving much of the fish screen out of the water. The lower water elevations contributed to unacceptable fishery losses at the existing drum screen facility.

In 1989, the NOAA Fisheries (formerly the National Marine Fisheries Service) designated the winter-run Chinook salmon as an endangered species. In 1990, federal legislation listed the fish as threatened. Growing resource agency (NOAA Fisheries, California Department of Fish and Game, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers [USACE], U.S. Bureau of Reclamation [USBR], and California Department of Water Resources)



Upstream view of Sacramento River gradient facility and rock slope protection

Stabilization of the Sacramento River channel is essential to the success of GCID's fish screen project.



In-river excavation



In-river construction using drag line



In-river construction using longitudinal berm



Project Objectives

- Ensure fish-friendly flow conditions by emulating natural riffles on the riverbed
- Achieve efficient screen operation by restoring and maintaining the original water surface elevations at the fish screen
- Facilitate safe and effective fish passage across the screen by providing appropriate water velocities
- Provide appropriate water surface elevations to safely conduct fish through the bypass system under gravity flow
- Enable recreational boat navigation in the vicinity of the GCID intake by providing sufficient water depth in the main river channel

concern over the loss of juvenile salmon at the GCID intake led to a federal court injunction against GCID pumping any water out of the river. A stipulated agreement was reached in 1991 that allowed GCID to divert a limited amount of water during the winter-run Chinook's peak migration period, if improvements were made to the intake and exit channels and screening facilities.

During the early 1990s, GCID and the resource agencies began a joint effort to develop a long-term solution. The existing drum screen facility was retrofit with a vertical flat-plate fish screen facility to enable GCID to divert at lower river levels and still allow for safe fish passage. This screen was only an interim solution because it did not meet the resource agencies' new and more stringent performance criteria.

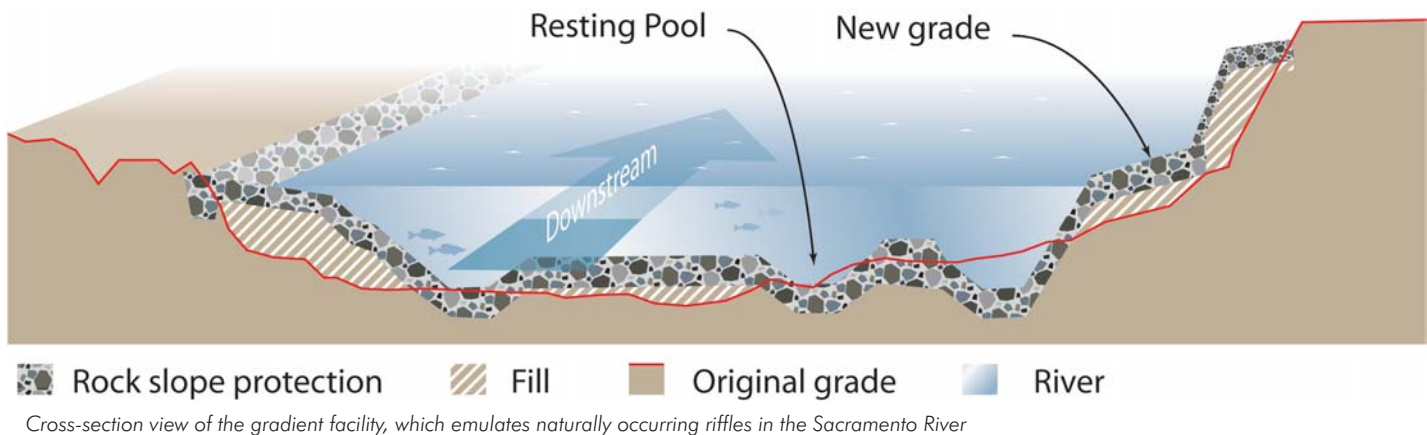
To protect fish and facilitate their safe passage past the GCID intake and pump station, GCID and USBR completed construction of a flat-plate fish screen facility. This approximately 1,100-foot-long structure consists of the 480-foot interim screen, installed in 1993 and upgraded in 2000, and a 620-foot screen extension, completed in 2000.

The Gradient Facility Project

A long-term solution known as the Gradient Facility was developed to control the meandering of the Sacramento River so that the flow would not be reduced at the intake again.

The USACE was the lead agency for the design and construction of the gradient facility (or riffle) in the Sacramento River. The gradient

Beneath the Surface



facility is critical to the long-term proper operation of the new fish screen structure under inevitable changing river conditions. It ensures effective fish screen operation by stabilizing the riverbed to provide the required water surface elevation at the fish screen.

It also facilitates safe and effective fish passage by providing adequate flow velocity past the screen, as well as flow conditions that enable the screen facility fish bypass system to safely conduct fish downstream of the screens under gravity flow. The design of the gradient facility emulates naturally occurring riffles in the Sacramento River and provides sufficient water depth for recreational boating through this reach of the river.

Gradient Facility Components

To achieve the desired natural riffle configuration, the in-river portion of the gradient facility includes sheet piles placed at specified elevations and intervals in the riverbed. The top of the structure is as much as 4 feet above the original riverbed. The rock slope protection is supplemented by 3 sheet-pile cutoff walls that extend beyond either riverbank to protect the gradient facility during storms. The buried sheet piles are surrounded and covered by rock slope protection, which extends 1,000 feet along the river channel and along approximately 2,500 feet of the levee banks, both upstream and downstream of the structure. The rock slope protection maintains the proper



Major Project Elements

- Gradient facility consisting of sheet piles and rock slope protection to emulate natural riffles and stabilize the riverbed
- Bank and channel rock slope protection to maintain the river channel alignment and protect the gradient facility and fish screen from damage during high flows
- Revegetation of the construction site and offsite habitat restoration to mitigate and compensate for effects of construction activities



Replanted vegetation along the banks of the gradient facility



Aerial photo of gradient facility construction on east side of river



Sheetpile wall with rock slope protection in place



Installation of one of the sheet pile cutoff walls



Project Challenges

- Completion of the project in one construction season to comply with regulatory restrictions on the annual timing and duration of in-river construction to minimize impacts to fish
- Concurrent construction of both the fish screen and gradient facility
- Uninterrupted delivery of irrigation water supplies during construction

river channel alignment and protects the gradient facility and fish screen from damage during high flows. A backwater effect resulting in slightly higher water surface elevations upstream is generated by a slight downstream constriction of the protected banks.

Revegetation

Rock slope protection was covered with fill materials to create a surface to replant riparian vegetation including grass seed and trees, such as willows, elder, ash, alder, valley oak, sycamore, and cottonwood.