

Case Study 13. North Fork Consumnes River Tributaries Box Culvert Vented Fords

Location

Central California. Eldorado National Forest, Placerville Ranger District. About 18 miles ESE of Placerville. North Fork Consumnes River basin. Meiss Cabin Road, Forest Road 52 upstream of Capps Crossing.

Crossing Description

These structures are concrete boxes with removable grate tops, designed to permit removal of bedload and woody debris that could jam the opening. The example here has slab approaches, upstream and downstream cutoff walls, and a sloping concrete floor intended to concentrate low flows along one wall for fish passage (figure A80). The box is set at natural stream grade and slope. At that slope, flow across the smooth concrete floor is too fast to allow fish to swim up. Riprap protects the cutoff walls. There are several of these structures along Forest Road 52 near the Capps crossing (case study 21).



Figure A80. One of several grating-top box culvert fords on tributaries of the North Fork Consumnes River.

Setting

Sierra Nevada section (M261-E). Rocks are mixed granitic, volcanic, and meta-sedimentary. Ponderosa pine-mixed conifer forest. Summers are dry. Rain-on-snow is a common cause of floods.

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Why Was This Structure Selected?

The Meiss Cabin road runs along the edge of the North Fork Consumnes River valley bottom, where several steep tributaries exit steep, confined valleys and abruptly deposit their bedload. The grate-top box structures are designed to survive plugging without failing. A secondary goal at some sites was to permit fish passage up-and downstream.

Crossing Site History

Previous structures at these sites were culverts, which had plugged and been replaced by progressively larger culverts over a period of years. All of the tributary crossings failed in the January 1997 storm event (figure A81). At one crossing, a Hilfiker welded wire headwall was so battered by boulders that it had to be removed. Refer to case study 21 for a review of watershed history and condition that explains why these tributaries are transporting so much rock and sediment.



Figure A81. Typical flood damage at edge of North Fork Consumnes River valley after 1997 rain-on-snow flood.

Road Management Objectives

Forest Route 52 is a gravel-surfaced, main collector road (maintenance level 3) used for recreation, timber haul, administrative access, and access to private land. Occasional closures due to severe weather are acceptable, but dependable summer access is required.

Stream Environment

Hydrology: These tributaries drain watersheds that are only a few square miles in area. Some streams are perennial; others intermittent. Large floods often occur during midwinter rain-on-snow events, but spring snowmelt normally causes the annual peak flow.

Channel Description: In gold rush days, roads ran right up the channels to get to mining or timber harvest areas. Coarse sediment is in ample supply in the streambeds (figure A82). These tributaries may naturally be B3 channels, but they are so disturbed in the vicinity of the crossings that they are difficult to classify. Channel slopes are at least 3 percent. Valleys are narrow and the streams are moderately entrenched.



Figure A82. Aggraded boulder-bed intermittent tributary of the North Fork Consumnes River, July 2002.

Aquatic Organisms: Little is known about fish use of these tributaries, but the assumption is that fish use the perennial streams, and may even access the intermittent ones during high flows. Downstream fish passage is required during falling flows to avoid isolating fish in upstream pools. The boxes were designed with a tilted floor and small trench to concentrate water to pass fish and other aquatic species during low flows. These may indeed provide downstream passage. However, because the concrete floor is much smoother than the streambed, and the structure is at stream slope, water velocities are likely too fast for upstream movement during low

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flow. Three-inch fish downstream of one culvert in July 2002 were unable to swim past the backwatered section (figure A83). There may be flows where some fish can move upstream. The structures are no more than 12 feet long, so larger fish may be able to negotiate them at higher flows.



Fish were attempting to move upstream in July 2002, but flow in the trench was too shallow and too fast.

Water Quality: These structures are unlikely to adversely affect water quality. By comparison with the previous structures at these sites—culverts and fills that failed during floods—they will protect water quality by not adding road derived sediment to the already high sediment loads in this watershed.

Structure Details

Structure: The structure is a small box culvert with an open top and cattleguard driving surface that can be removed for cleaning (figure A84). Concrete approaches dip into the ford, which has a total length of 75 feet (figure A85). The concrete box is 8 feet wide and 4 feet deep. The box floor slopes slightly perpendicular to the direction of flow to force low flow to concentrate in the trench at one side of the box. An upstream cutoff wall 9 inches deep runs the full length of the ford and is heavily riprapped.

Bank stabilization and approaches: Class VII riprap is used to armor the streambanks up and downstream of the concrete approaches where the structure would overtop.



Figure A84. Close up of grate-top vented ford.

Cost: No information available.

Safety: There are no ford signs, but object markers with posts are at each corner of the concrete slab. Sight distance is good, so the structures can be seen from a long distance away.

Summary and Recommendations

All the vented fords functioned well during the large flood in January 2006, an estimated 85-year flow. They were overtopped, but not blocked or damaged, and flow was not diverted away from the stream channels. For durability and ease of maintenance, these structures appear to be very appropriate in these difficult depositional settings.

Where fish passage is required, a similar grate-top box with an open bottom and natural streambed would better fit the need.

Ken Pence, engineering technician (retired); Cheryl Mulder, zone hydrologist; and Dave Jones, design engineer, from the Eldorado National Forest provided the background information and photos for this case study.

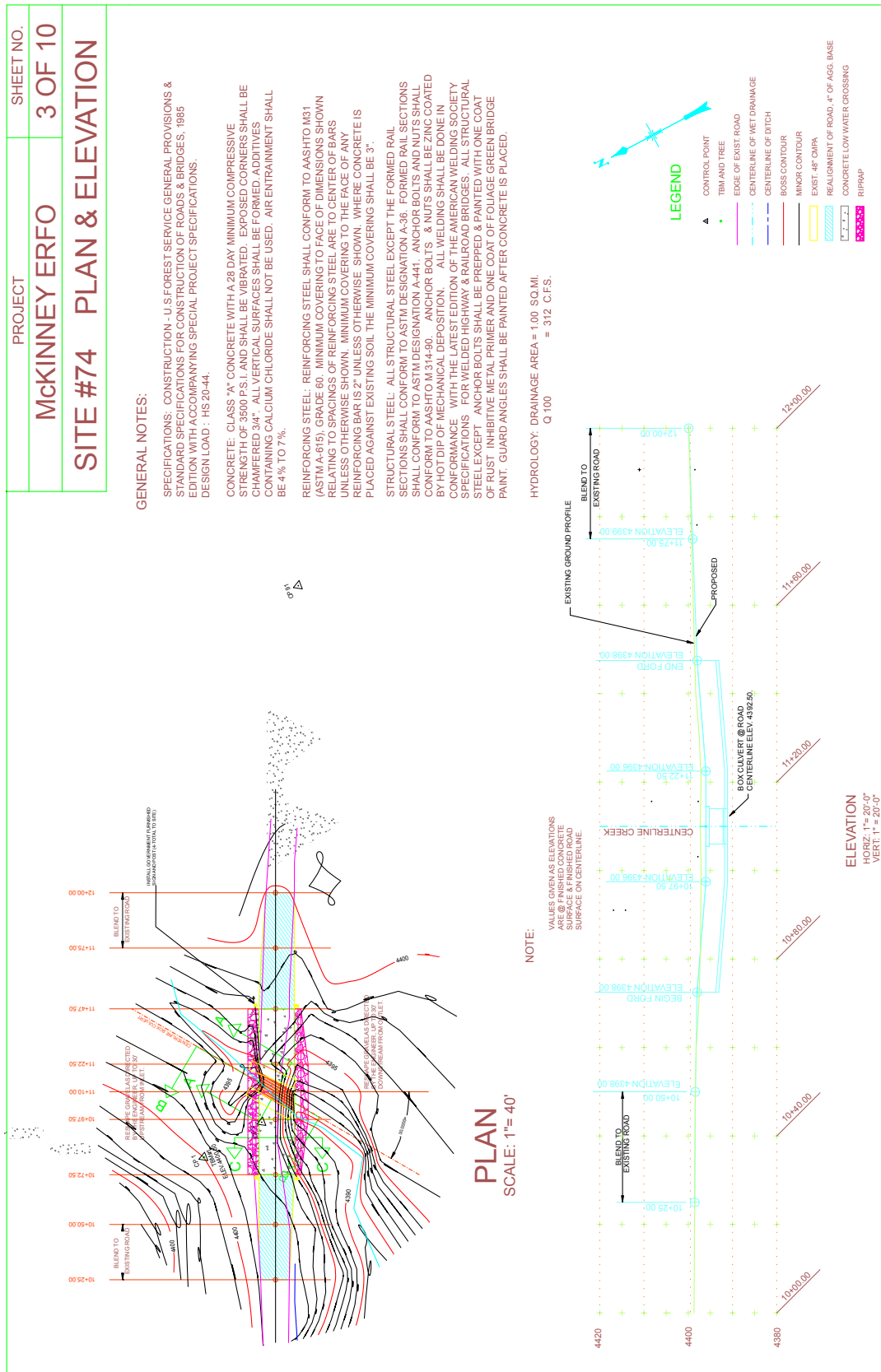


Figure A85—Site plan for McKinney Creek crossing, similar to Meiss Cabin Road box culverts but without the tilted floor. A full size drawing may be found on the CD included in the back of this publication.