

Case Study 20. Deep Creek Low-Water Bridge

Location

North Central Florida. Osceola National Forest. Road 237-1 at Deep Creek, 1/4 mile north of Forest Road 262-2 and about 11 miles NE of Lake City, Florida.

Crossing Description

This low-water bridge was constructed in 1991 (figure A128). It is built of preformed concrete T-sections set parallel to the direction of streamflow. The T-sections are supported by two concrete mud sills placed on the sand and clay streambed. The channel and surrounding area are quite flat and the flood plain is several hundred feet wide. The bridge approximates the channel dimensions, and it does not alter flow velocities and sediment transport enough to cause significant channel changes. When water overtops the bridge, there is virtually no plunging flow (the site is backwatered) and velocities remain moderate. Periods of submergence typically last for 1 to 2 weeks.



Figure A128. Looking downstream at the low-water bridge, November 2003.

Setting

Coastal Plains and Flatwoods Section (232-B). The landform is a flat alluvial plain with poor natural drainage and an abundance of wetlands. Elevation of the channel bottom at the crossing is 97 feet above mean sea level. Riparian cover is a dense, multilayered mixture of hardwoods, gum, and palmetto.

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Why Was This Structure Selected?

The principal reasons for choosing a low-water bridge here were water quality protection and cost. The district wanted a bridge to keep vehicles out of the water and to protect the streambed and banks. Deep Creek is a perennial, fish-bearing stream that has extended periods of very low flow. Because of the wide flood plain, a bridge with normal clearance would have been several times as long to span the frequently flooded area and would have cost over three times as much. Fish passage was another objective, and the low-water bridge provides it.

Crossing Site History

The previous structure at this location, a wooden bridge, was destroyed by fire in the late 1960's. All-terrain vehicles continued to ford the stream at the site. Water quality and channel damage concerns led to a cooperative effort between the forest and the Florida Department of Environmental Protection to construct a permanent crossing (Webb 1994).

Road Management Objectives

Road 237-1 is maintained for passenger vehicles, and is used for both timber management and recreation. Road density in the area is high and there is alternative access to the area beyond the crossing. The long duration traffic interruptions (overflow occurs 1 to 2 times each year for several weeks at a time) are acceptable because of the availability of alternative routes.

Stream Environment

Hydrology: Annual rainfall in the Flatwoods is about 55 to 60 inches, well-distributed throughout the year. The area is a mosaic of swamps and drylands with only a few feet of relief distinguishing them. It is difficult to define drainage-basin boundaries in this area of extremely low relief, but the contributing watershed at the site is probably on the order of 10 to 20 square miles. As in the rest of the Flatwoods, flow in Deep Creek fluctuates widely. During most of the year, the stream flows only a few feet wide in the center of the channel and may be subsurface in some locations. Generally, overbank flows are expected once or twice a year. Streamflow rises very rapidly as the shallow ground water storage fills during rainfall events, and overbank flow is typically sustained for two or more weeks.

Channel Description: Deep Creek is a Rosgen E5 channel type. Channel slope estimated from the topographic map is on the order of 0.1 percent and the frequently inundated flood plain is several hundred feet wide. A traditional bridge would have required approach fills, potentially damming part of the flood plain, but this low water bridge allows floodwaters

to utilize the entire width of the flood plain and to flow freely down the valley. The stream is about 10 feet wide where it flows through undisturbed forest, with nearly vertical 2-foot-high banks stabilized by an intertwined mass of roots. At the crossing site, the stream is about 40 feet wide, and the bridge matches this width. Soils in the area, including the streambed and banks, are mixed sand and clay. Because of long periods of very low surface flows, vegetation overgrows much of the streambed and tends to stabilize sediment deposits. During overbank flow in March 2003, water velocity in the thread of fastest flow was estimated at between 1 and 2 feet per second (figure A129).



Figures A129a and A129b. A129a. March 13, 2003. Bridge is under approximately 6 feet of water. Note depth marker on right. A129b. Looking opposite direction along bridge, November 2003.

Structure Details

Aquatic Organisms: There are no riverine threatened or endangered species in the Flatwoods. Warmouth (a perch), pikerel, catfish, and grinnel (a mudfish) along with several aquatic snakes and spotted frogs, leopard frogs, and bullfrogs are present in area streams. Frog numbers are limited by predatory fish. The fish survive extended low or subsurface flow periods in holes that are deep enough to remain wet throughout the year. Fish passage is desired and this structure provides it. Fish (perch) have been observed (and caught) passing over the bridge during high flows. It is not clear whether the riprap blanket under the structure may constitute a barrier for aquatic species crawling along or through the streambed.

Water Quality: Streamflow in the Flatwoods is brown in color due to its organic content. pH can be below 5. Hydrocarbons and other vehicle-derived toxic chemicals are a concern contributing to the use of bridges rather than rockbed fords on perennial streams like Deep Creek. The structure and its hardened approaches protect water quality by keeping vehicles out of the water and by protecting the stream's bed and banks from rutting.

Structure: Two 18- by 18- by 40-inch prestressed concrete beams were set across the channel with the top of the beam at channel bed elevation (figure A130a). Eight-foot wide by 2-foot high by 18-foot long double-T sections, precast to HS 20-44 bridge specifications, were placed parallel to streamflow on the concrete beams. Normally in this kind of construction, the foundations are placed on the streambanks supporting the T-sections which span the channel. Here, the supports cross the channel and the T-sections are parallel to the direction of flow. Three-foot deep by 4½-foot high abutments on each end hold the structure in place. A concrete deck 5½-inches thick, and curbs create a safe running surface on the T-sections.

Bank stabilization and approaches: The approach road is crowned and slopes at about 2.6 percent into the crossing (figure A130b). A 1-foot thick layer of class II riprap over geotextile fabric extends 130 feet on each side, armoring the excavated slopes, road shoulders, and downstream banks from erosion. A riprap blanket 1½-foot thick was also placed between the bearing beams, as well as 4 feet upstream and 6 feet downstream from the foundations (figure A130c).

Cost: \$58,000 in 1991.

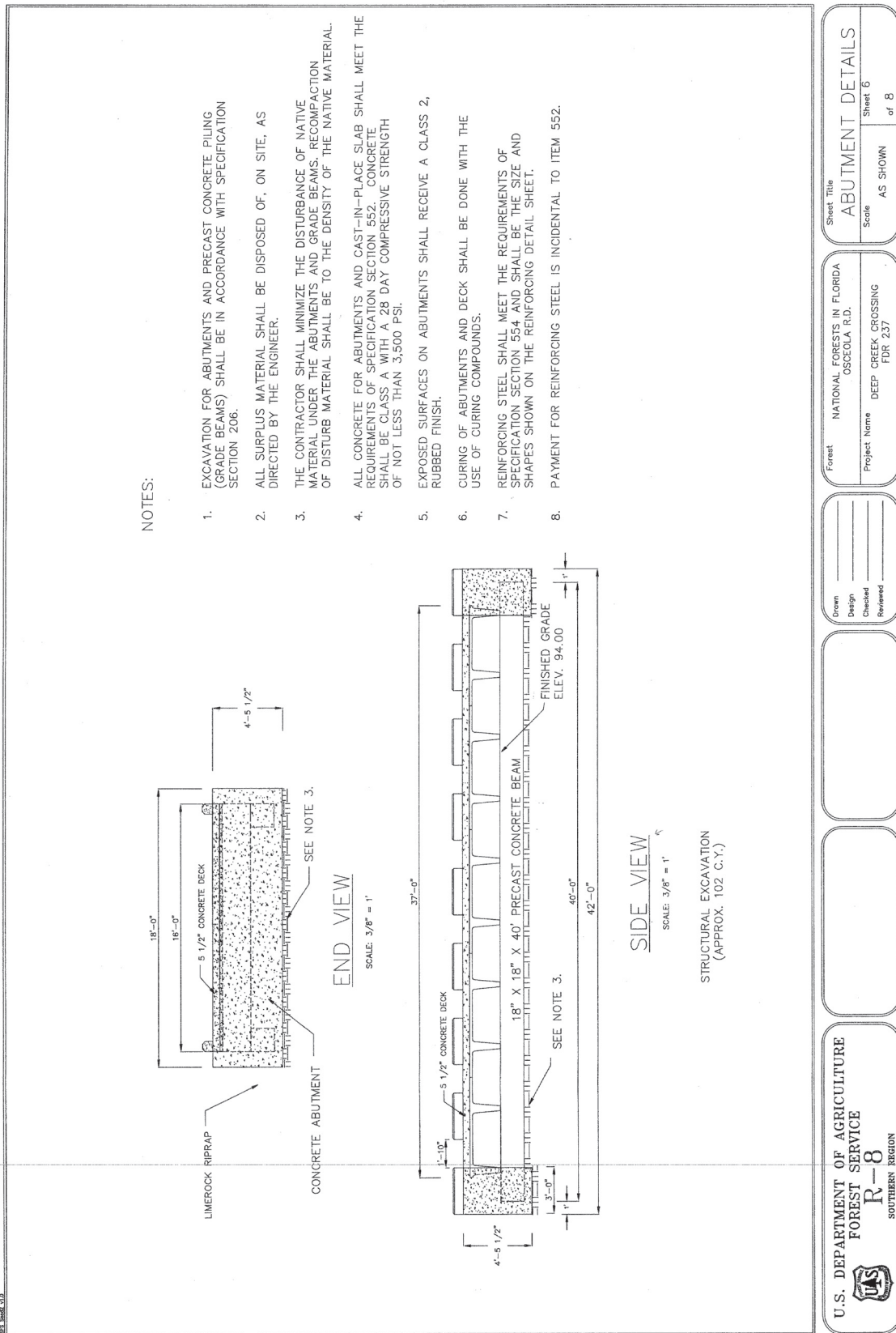


Figure A130a—1990 contract drawing, side view. A full size drawing may be found on the CD included in the back of this publication.

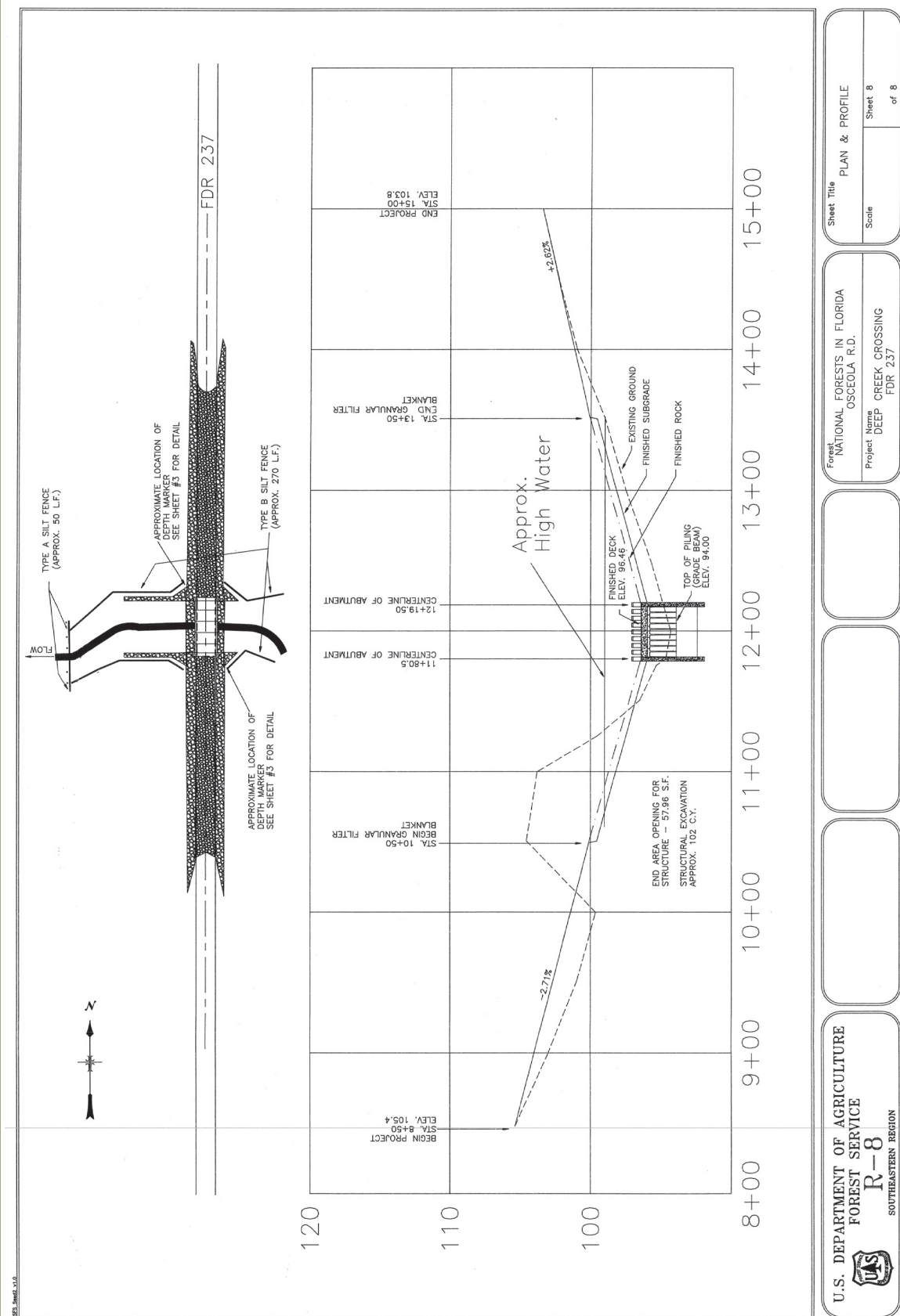


Figure A130b—1990 contract drawing, plan and profile. A full size drawing may be found on the CD included in the back of this publication.



Figure A 130c—1990 contract drawing, riprap and channel improvement. A full size drawing may be found on the CD included in the back of this publication.

Flood and Maintenance History

Safety: On each edge of the bridge large, bright-yellow numbers painted on 7-foot-high wood posts indicate water depth over the structure (figure A129). Flooding and fords are both common in the very low relief Flatwoods area, and residents are used to submerged roads, so no other warning signs are considered necessary here. Discontinuous curbs also provide security.

The low-water bridge was constructed in 1991 and has been overtopped regularly. No maintenance has been required, although the two outer openings are partially plugged. Because high flows can freely access the flood plain, the bridge survived large floods in 1994 and 1997 without any need for maintenance. Both of these floods caused significant damage to other structures in the area.



Figure A131. Sand and silt deposit downstream of the bridge (2003).

Summary and Recommendations

The current low-water bridge was constructed to match existing site channel dimensions. Site width was significantly wider than the natural channel due to the impacts of the previous bridge and subsequent all-terrain vehicle crossing. Sediment deposition is occurring both upstream and downstream as the stream adjusts to regain its normal width (figures A128 and A131). Given the availability of alternative access, it may be acceptable to allow this process to progress until sediment transport

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capacities are equalized with those in the adjacent channel. Channel narrowing can be expected to cause a few more days of traffic interruption per year.

Tommy Spencer, resources staff, and David Johnson, road manager, (Osceola National Forest) and Kathy O'Bryan, transportation systems engineer, and Will Ebaugh, hydrologist, (National Forests in Florida) contributed information and photos for this case study.