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GORDON

CASE STUDY 3

in Case Studies Rec'd from Dave 8/19/02

4.2.3. Sante Fe Chute (Case Study 3)

Portions of the following taken from:
Gordon, D.C., Davinroy, R.D., "River Restoration Measures in Four Secondary Channels of the Mississippi River, An Interagency Success Story," ASCE Wetlands Engineering and River Restoration Conference Proceedings, 1998.

In 1996, biologists and engineers from the U.S. Fish and Wildlife Service, the Illinois Department of Natural Resources, the Missouri Department of Conservation, and the St. Louis District Corps of Engineers, ventured on a joint environmental effort to improve riverine habitat conditions within Sante Fe Chute on the Middle Mississippi River. This effort was made possible by the authority of the St. Louis District Avoid and Minimize Environmental Program.

The agencies assembled a team of experts to formulize ideas and strategies for the purpose of developing aquatic diversity within the side channel at Mile 39. Design alternatives were tested by the team in the micro model at the AREC in St. Louis, Missouri. The use of the micro model enabled the team to address the complex sediment transport interaction problem between the side channel and the main navigation channel of the Mississippi River. Team members assembled at AREC on numerous occasions to jointly experiment with the micro model.

4.2.3.1 Problem Description

Sante Fe Chute was considered a high priority to the Corps partnering agencies for rehabilitation. The side channel parallels (Figure 1) the main river channel for approximately five miles and contains a dike and closure structure at the upper entrance. Compared to the main channel, bed elevations in the side channel are relatively high. At lower river stages, most of the bed becomes dry with isolated pockets of stagnant water that become disconnected from the main channel. Furthermore, depths throughout the reach are generally homogenous. Diversity, in the form of shallow and deep-water environments with areas of fast and slow flow, were desired to create important backwater habitat to support aquatic species. The team used a micro model to investigate structural designs to enhance the environmental diversity in the chute while ensuring navigable depths in the main channel.

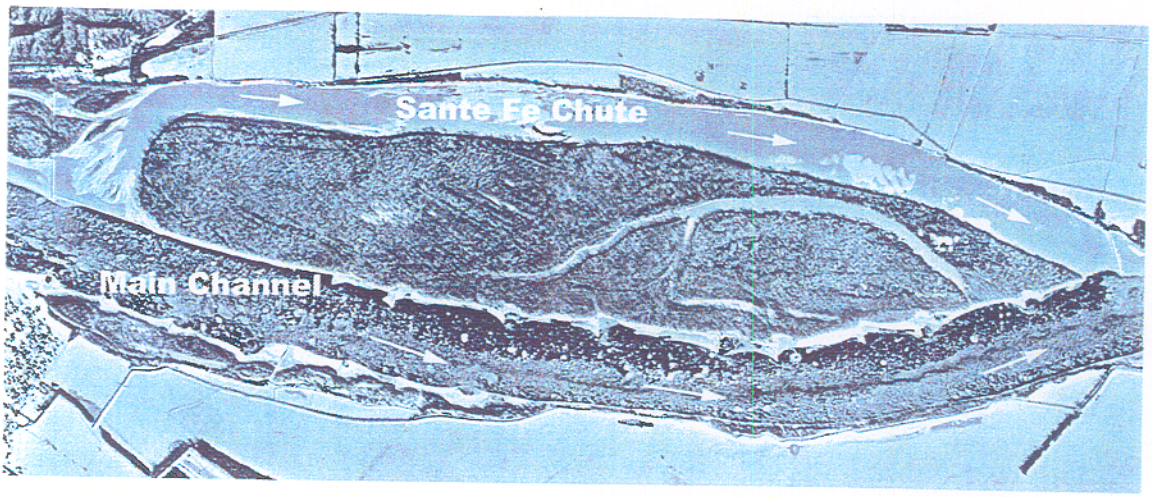

Figure 1: Sante Fe Chute, Middle Mississippi River

4.2.3.2 Sante Fe Chute Micro Model

The micro model was constructed according to 1994 aerial photography of the study reach. The scales of the model were 1 inch = 600 feet, or 1:7200 horizontal and 1 inch = 100 feet, or 1:1200 vertical for a 6:1 distortion ratio.

After the model was calibrated, team meetings were held in which various alternatives were conceptualized with the primary goal of creating ~~bathymetric variance~~ diversity in bed elevations. Various modifications to existing river training works as well as other structural additions were tested in the model, including closure structure removal/modification, dredging, chevrons, and traditional dikes. Those designs that displayed promise in the model where then studied in greater detail using the established micro modeling methodology. A total of seven structural design alternatives were model tested to study their impacts on ~~sediment transport and bed patterns in~~ bed development both the side channel and main channel. The resultant bed configurations formed by each alternative were compared to the model base condition, whereby the most feasible and cost effective design ~~solution~~ alternative was selected.

It had long been believed by the agencies that the closure structure located at the upper entrance to the chute should be removed to restore flows to the backwater and remove or flush out much of the sediment that had accumulated. Model tests showed that this alternative would not have the desired effect. Additional bed load was able to enter the side channel, which ultimately decreased depths and filled in the only deep area of scour in the

side channel. Navigable depths were also lost in the main channel adjacent to where the closure structure had been located.

The design eventually chosen by the team for implementation in the Mississippi River encompassed an alternating dike scheme that created sinuosity in both the flow and sediment patterns of the side channel (Figure 2). The alternative produced the most positive effects to the flow and streambed of the side channel in the most cost effective manner.

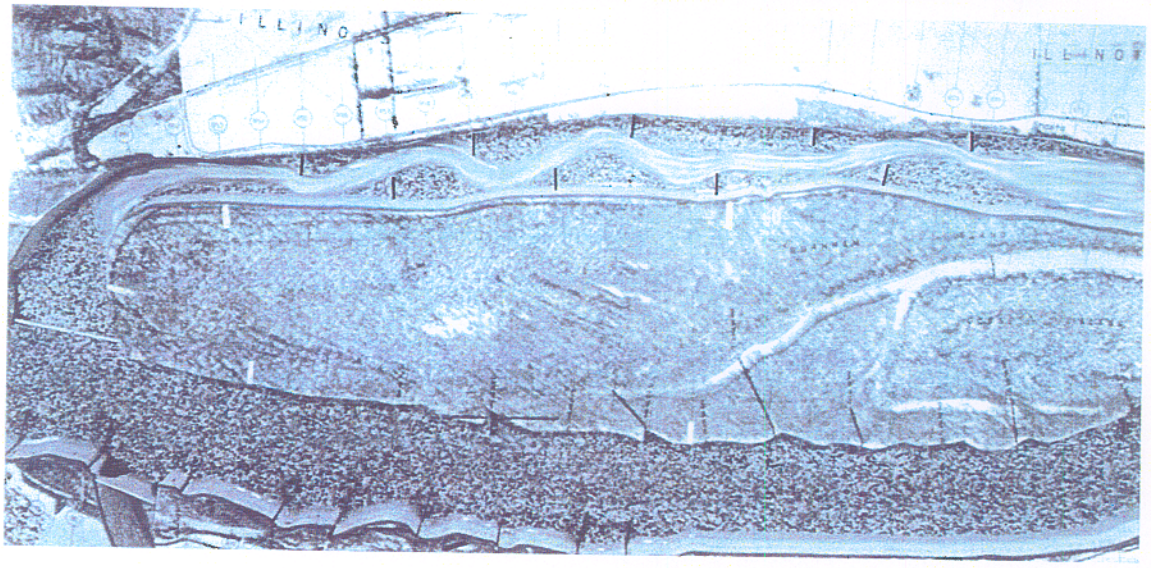

Figure 2: Micro Model Flow Visualization of the Constructed Design Shows a Sinuous Flow Pattern Created by Alternating Dikes in the Side Channel

Engineers then developed detailed construction plans and specifications with construction of the plan initiated shortly after completion of the model study in April of 1997 (Figure 3). However, due to funding constraints, the dikes were built significantly lower (10 feet) than recommended by the micro model study. Recent field monitoring of the design in the river has demonstrated that the riverbed has partially developed the predicted bed forms even with the structures at a lower elevation. It is believed that the desired bathymetric results will be fully produced once the structures are completed at their original design elevation in 2003.] conjecture

Figure 3: Two of the 7 Dikes Constructed in Sante Fe Chute.

Through the use this micro model, it was possible for a team of biologists and engineers to develop a cost effective, reliable design solution to the first side channel restoration project on the ~~Middle~~ Mississippi River. The hours spent together on the micro model provided an invaluable dialect and understanding among the interagency team members and set precedence for additional environmental engineering efforts on the river.

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Visualization & demonstration

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