

Victoria Bend Navigation Assessment: Analysis, Modeling, Construction, and Monitoring

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Extended Abstract

Victoria Bend is located on the Lower Mississippi River (LMR) at river mile (RM) 591-599 between Helena, AR and Arkansas City, AR. Both the White River and Arkansas Rivers meet the LMR near the bend and the reach includes the Old White River Cutoff which formed in the early 1900's when the upstream meander of the LMR migrated down valley into the White River. These complexities make this portion of the river one of the more unique reaches on the LMR. Victoria Bend has also historically been a complex and difficult reach to manage from a sediment and navigation perspective, often referred to as the worst reach on the LMR by mariners. Numerous river training structures have been constructed throughout its history and continuously modified in an attempt to improve the channel and reduce dredging needs (Figure 1)

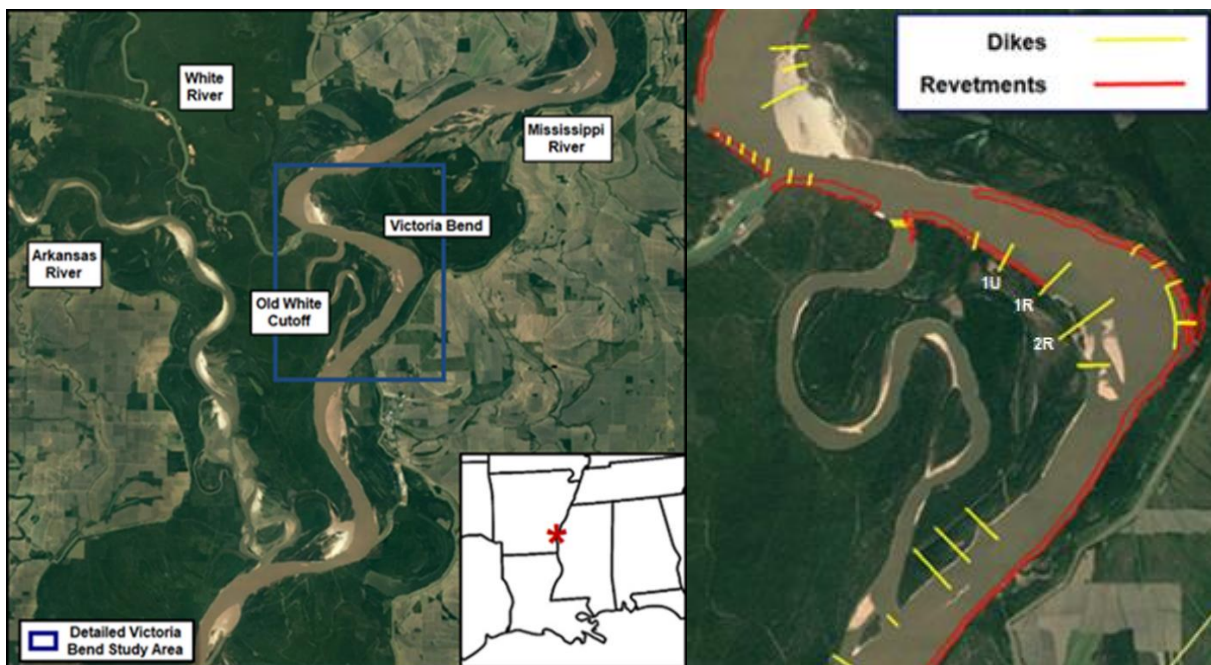


Figure 1. Location Map (left), River Training Structures (right)

Even with the all of the river training structures, maintenance dredging has remained necessary to provide an adequate navigation channel. This culminated in 2019 when sedimentation during a major flood event required navigation to be shut down for 13 days, as dredging was needed to reopen the channel, with significant costs to the navigation industry and the USACE. The 2019 flood was a long duration high flow event with water levels above flood stage for almost five months. On the receding limb, groundings were reported well above typical levels for low water navigation concerns and prompted a river bottom survey revealing nearly 30 ft of deposition in parts of the navigation channel (Figure 2).

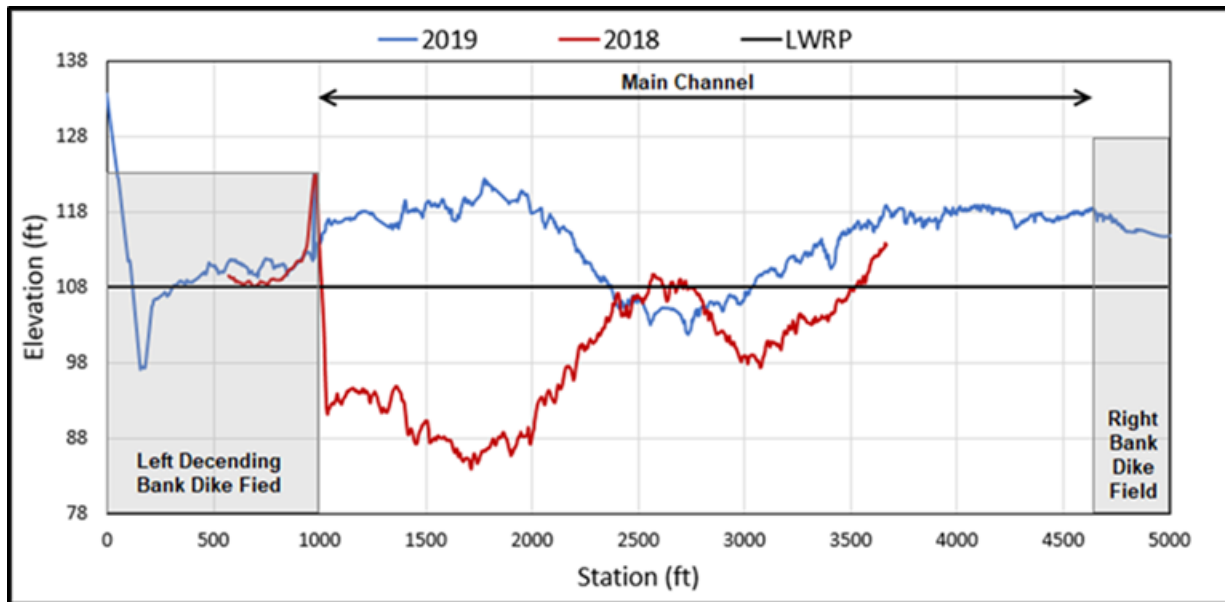


Figure 2. Comparison of pre (2018) and post (2019) flood cross sections. Black line at elevation 108 represents o elevation referenced to the low water reference plane (LWRP) or simplified as low flow water levels.

In response to the closure, the USACE Vicksburg District partnered with the Coastal and Hydraulics Laboratory of the Engineer Research and Development Center to conduct a study evaluating options to improve navigation with the goal of reducing dredging requirements and preventing the extreme shoaling from reoccurring in the future. The study included analyzing historical channel morphology and environmental concerns along with developing and utilizing a two-dimensional Adaptive Hydraulics (AdH) model to assist with evaluating alternatives recommended by both mariners and river engineers. Ultimately, the analysis and modeling along with environmental concerns and river engineering experience quickly progressed, filtering through numerous alternatives, and led to an initial Phase 1 design to be constructed during the next low water cycle. Phase 1 consisted of repairing and modifying existing structures. A sill at the upstream end of the Old White Cutoff which limits flow through the side channel and dikes on the left bank were repaired to original design grade. Additionally, modifications were made to three dikes on the right bank. Dikes 1U and 1R were extended 300 ft while dike 2U was extended 200 ft and raised 5 ft. The dike work was completed in summer of 2020. Figure 3 includes an example of some of the modeling performed to assist in evaluating potential alternatives. Modeling was focused on evaluating changes to flow patterns through the bend and increasing flow through the main channel to prevent sediment deposition in the navigation channel. Phase 1 resulted in a 20% increase in flow through the main channel within the model for 1,000,000 cfs representing channel forming discharge.

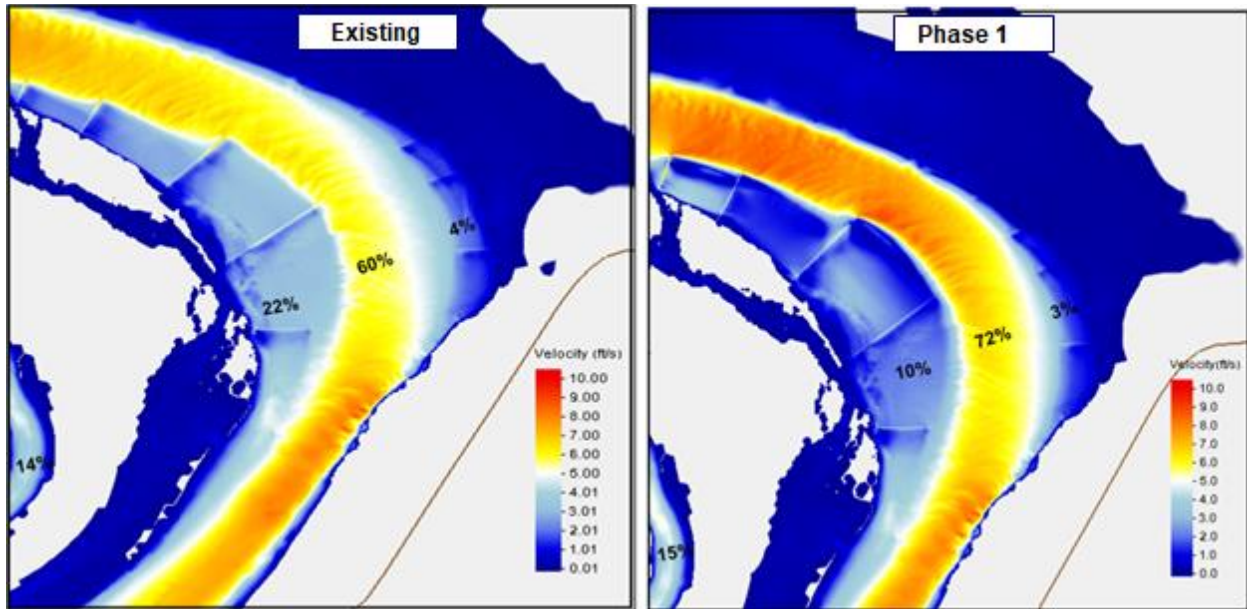


Figure 3. 1,000,000 cfs Modeled Velocity Comparison (Existing and Phase 1). Percentages represent flow through each section of the river: side channel, right bank dike field, main channel, and left bank dike field

After the Phase 1 construction, continuous channel monitoring was planned to determine if additional modifications to the reach (Phase 2) would be needed. Phase 2 alternatives, such as bendway weirs to widen the channel or additional channel constriction to deepen the channel were evaluated with future consideration dependent on the channel response to Phase 1. Monitoring to date indicates that navigation channel dimensions have continued to improve since Phase 1 construction. Significant deepening after construction can be seen between the 7/1/2020 survey and the 10/28/2020 survey (Figure 4). Initially there was some concern with the increase in velocities causing difficulty navigating during low water during 2021 but navigation conditions have continued to improve with channel widths in excess of 1000 feet at the -9 LWRP for the most recent surveys. Phase 1 continues to show promise and resiliency as limited issues arose for Victoria Bend during the extreme drought on the LMR during the fall of 2022.

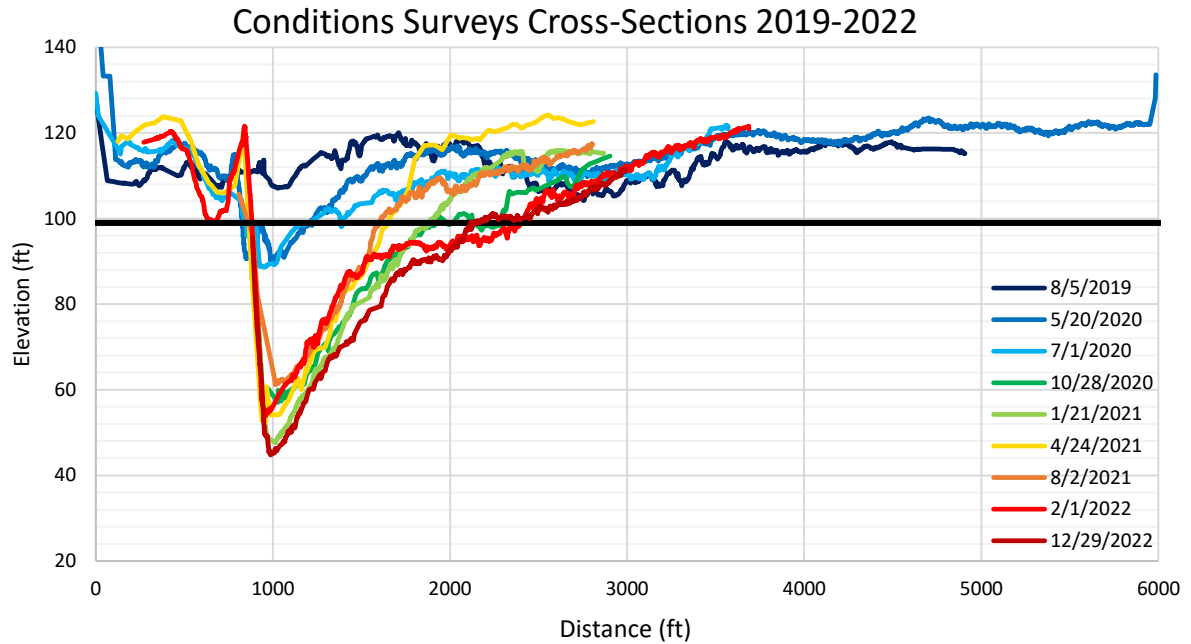


Figure 4. 2019-2022 Channel Monitoring. Black line at elevation 99 represents -9 LWRP or required elevation for navigation during low water conditions.

The accompanying presentation will present in more detail the history and difficulty of managing this reach, the analysis and modeling to support Phase 1 design, and the possibilities of Phase 2 alternatives moving forward.