CASE STUDY FOR ENVIRONMENTALLY SENSITIVE CHANNEL DESIGN

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PROJECT LOCATION AND DESCRIPTION

The Steele Bayou Basin is bordered on the west by the mainline Mississippi River Levee and on the east by the Deer Creek Basin. Black Bayou and Main Canal join about 30 miles below Greenville to form Steele Bayou. The Black Bayou basin extends from its source in Bolivar County, about 12 miles north of Greenville, Mississippi, to mile 68.0 on Steele Bayou. The total drainage area of Black Bayou is 160 square miles. This includes the 28 square mile area above Greenville that is split between Main Canal and Black Bayou. The project area for Item 1A extends from the mouth of Black Bayou at mile 0.00 to mile 6.30 as shown in Figure 1.

BACKGROUND

The lower 3.5 miles of Black Bayou was enlarged by the Black Bayou Drainage District in the mid-1940s to provide increased flood protection for the area. As a result of this construction, eight oxbows were formed within this reach. Of these, six are contained in whole or part within Leroy Percy State Park. Many of these oxbows have remained partially open to Black Bayou and provide some measure of relief through conveyance of overbank flood flows.

The lower 3.5 miles of Black Bayou can generally be described as a flat, narrow channel with steep banks (created by prior construction) that, in places, extend as much as 17 feet above natural ground.

The reach of Black Bayou between miles 3.5 and 6.3 differs from the lower reach in that it is generally comprised of a wide channel with alluvial bars below top bank. The alluvial bars promote vegetative growth which reduces flow conveyance through the reach.

CURRENT STEELE BAYOU PROJECT STATUS

The construction of the Steele Bayou Project is complete to near the mouth of Black Bayou. This completed work resulted in a significant reduction of flood stages at the mouth of Black Bayou. The lower reaches of Black Bayou have benefitted from the Steele Bayou channel enlargement, which has reduced the base flowline for several miles upstream in Black Bayou (Figure 2). This benefit on the lower reach of Black Bayou was used in developing the plans for Item 1A and for all plans evaluated. The construction of a weir at mile 56.0 on Steele Bayou has increased the minimum water surface elevation to 90.5 feet. This, however, will not adversely impact the passage of flows through the system.

HYDRAULIC CONSIDERATIONS

Significant flooding problems exist within the Upper Steele Bayou Basin. These include structural flood damages within the city of Greenville and surrounding area, as well as agricultural flooding throughout the basin. Isolated structural flooding also occurs throughout the basin.

Item 1A represents the first item of work in the continuation of the overall plan to reduce these flooding problems. The plan was originally designed to be compatible with an array of improvement alternatives that were analyzed as part of the reformulation studies. In all cases, stages within the Item 1A reach would be lower than pre-project conditions. However, the stage reductions are less than the previously authorized plan which included channelization from the mouth to the upstream end of Black Bayou.

Item 1A has been developed as a compromise plan, weighing the need for flood control against the resulting damage to the environment. The proposed plan represents the maximum improvement acceptable from an environmental standpoint and the minimum improvement acceptable from a flood control standpoint.

PLAN

The Steele Bayou Basin Reformulation Study included analysis of eight alternatives for Black Bayou above mile 6.3. Each of the alternatives provides for improved flood protection while maintaining and/or enhancing environmentally sensitive areas. As mentioned above, the proposed plan for Item 1A was compatible with all alternatives considered. It offered flood reduction for all

upstream channel alternatives considered. Without the level of protection achieved by Item 1A, stages within the lower reach of Black Bayou would be increased due to increased peak flows resulting from the upstream work.

The plan for Item 1A consisted of selective clearing and snagging from mile 0.00 to mile 6.3, construction of low-water weirs at miles 0.02 and 3.42, bridge protection at mile 0.2, and removal of fill material at the head of oxbows.

Channel Improvement

Selective clearing and snagging provided flood improvements with only minimal impacts to the area. This included the removal of brush, log jams, snags, and other material from the river where significant blockages occur. This work was confined within the top banks of the channel and typically limited to one bank. Selective clearing and snagging was limited to the area between elevations 93.0 and 100.0 feet, NGVD, from the mouth to just downstream of the Highway 12 bridge (Figure 3). Upstream of Highway 12, the selective clearing extended from elevation 96.0 to 100.0 feet, NGVD (Figure 4). The maximum cleared width was limited to 250 feet.

Prior to construction, a team surveyed the area and determined the appropriate vegetation to remain following construction. This team was composed of a hydraulic engineer, a biologist, a forester, a construction specialist, the adjacent landowner, etc. This team marked each tree that was to remain within the construction limits. The criteria that the team operated under was as follows:

1. Leave all cypress and tupelo gum trees.
2. Remove willow trees less than 15 inches in diameter at breast height (DBH).
3. Give preference to leaving 'nut' trees and other desirables.
4. Remove vines and woody undergrowth.

As stated above, this selective clearing area was limited to the area from elevation 93.0 or 96.0 feet, NGVD, to elevation 100.0 feet or a maximum width of 250 feet.

The minimum distance between remaining trees was approximately 10 feet. The selection team had some leeway in this distance to minimize the destruction of valuable or desirable trees. This procedure was coordinated with Mississippi Department of Wildlife, Fisheries and Parks (MDWFP) personnel.

The construction was accomplished in such a manner that minimal damage was inflicted on the remaining vegetation. The precise method of construction was determined as a joint effort between the Corps and appropriate landowners. Debris was disposed of by one of the following methods:

1. Piled and burned.
2. Piled and left for habitat above top bank level.
3. Chipped.
4. Removed from the site.

Low-Water Weirs

Low-water weirs were constructed to provide a minimum water surface elevation that would hinder vegetative growth. By reducing regrowth of this vegetative cover, a reduction of future channel maintenance would be realized.

The first weir was located near the mouth of Black Bayou (mile 0.02) and has a crest elevation of 93.0 feet. The second weir was located at mile 3.42, just below Mississippi Highway 12, and has a crest of 96.0 feet, NGVD. These weirs were constructed with riprap placed on a slope of 1 vertical to 6 horizontal downstream of the weir (Figure 5). This eliminates the hydraulic roller effect and thus enhances the safety of the structure. This was considered necessary because the structure will be located in an area utilized for recreation and water activities.

Grade/Water Control Structures

In the Steele Bayou Basin, nonpoint sources are likely to contribute nearly all of the suspended solids entering the streams. This runoff from agricultural fields introduces a large volume of sediment into the riverine system. To reduce the volume of sediment that enters the system, nine grade/water control structures were built (Figure 6). These structures create temporary detention basins and control the runoff from agricultural fields. Lowering the suspended sediment load reduces sediment deposition, maintains stability, and decreases the need for future channel maintenance. Another benefit of the grade/water control structures is the ability to establish wintering waterfowl habitat areas by ponding water during the winter months.

Oxbows

Additional flowline reductions were accomplished by the reuse of two abandoned oxbows within the state park. The heads of these oxbows were originally closed during the 1940's channel construction with subsequent filling

of the lower end. Improved conveyance through Item 1A was accomplished by removal of fill material at both ends of the oxbows. This excavation was limited to the upstream 100 to 150 feet of each oxbow. No clearing was allowed within the oxbows except for this excavation area. Excavated material was disposed within the existing embankment in a manner that was agreed upon with the state park representatives. The purpose of the excavation was to increase the flow capacity of the oxbows during flood periods.

CHANNEL MAINTENANCE

The Board of Mississippi Levee Commissioners for the Mississippi Levee District would normally have the responsibility for maintaining the channel work. However, at the request of the MDWFP, consideration will be given to allowing maintenance of that portion of the work within Leroy Percy State Park to be performed by the State of Mississippi. Details of this agreement remain to be resolved. Maintenance would be performed in a selective manner consistent with the design criteria for the initial construction.

ACCEPTABILITY OF DESIGN

Construction of Item 1A is physically complete. To date, all parties involved in the design of the project (i.e., Corps of Engineers, project sponsor, the MDWFP, landowners, etc.) appear to be satisfied with the design. It is the feeling of all parties that the design truly represents a good compromise between the need for flood control and the protection of the environment.

CONCLUSION

Channel improvement through or near environmentally sensitive areas will differ greatly. Every area encountered will be unique in its own way. The whole concept of channelization in sensitive areas can be accomplished provided sufficient detailed studies are performed and coordination with all involved parties is maintained. As with the above case and the use of selective clearing and snagging, the project was evaluated down to the last tree.

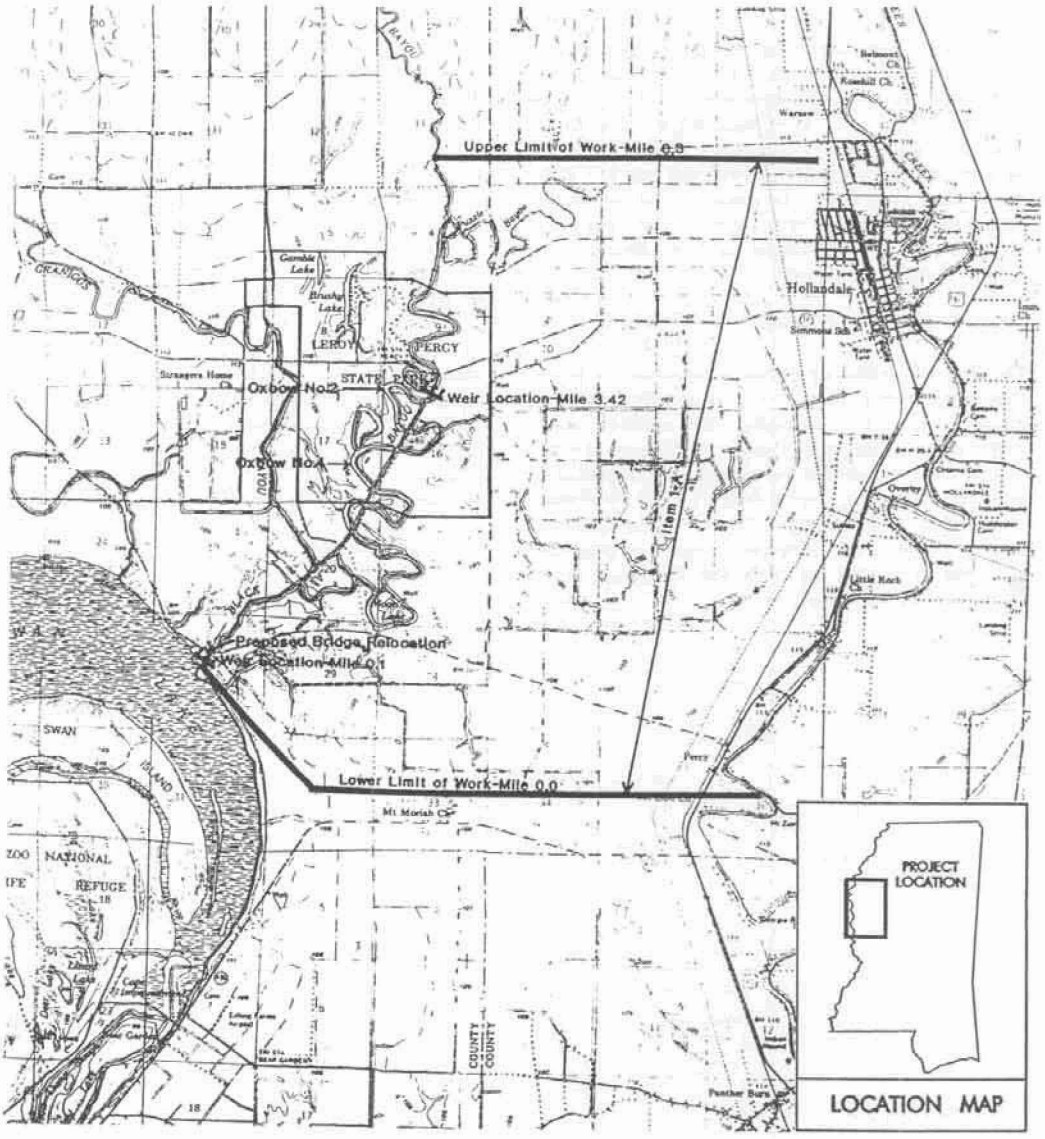

Figure 1. Location Map

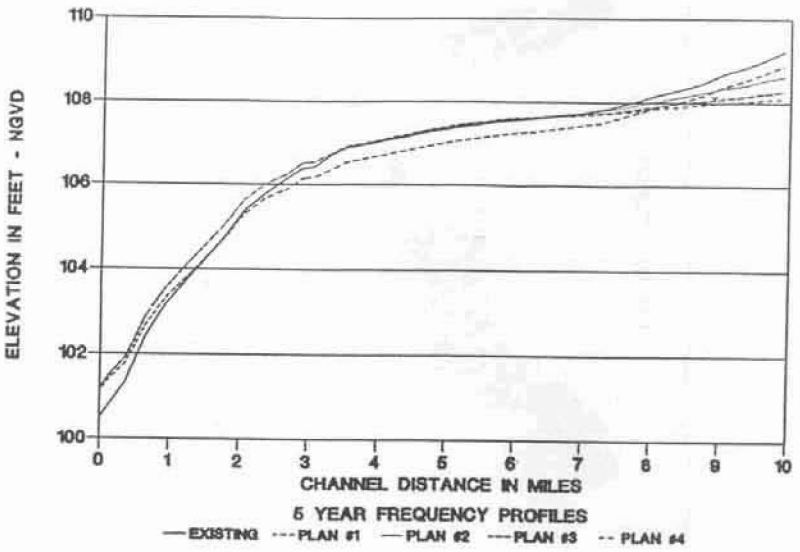

Figure 2. Profiles for a 5-Yr. Frequency Flood

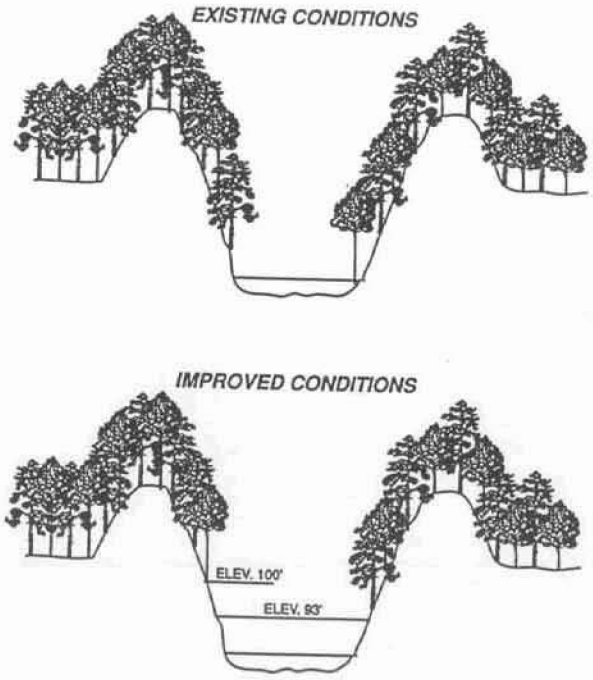

Figure 3. Concept Drawing - Selective Clearing & Snagging

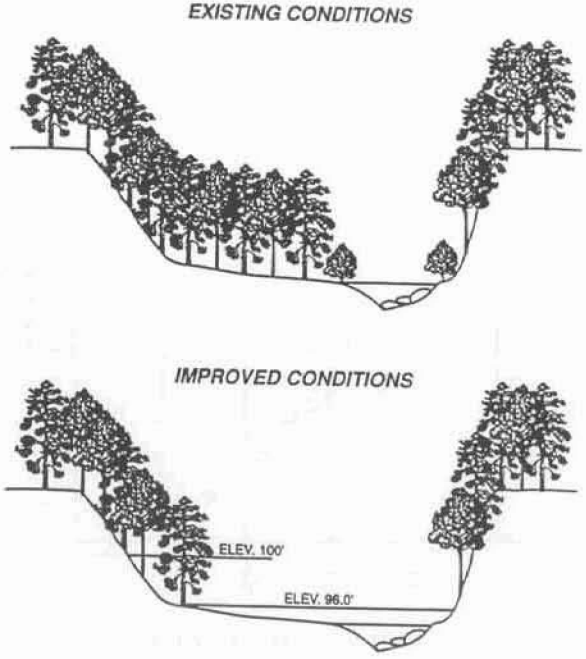

Figure 4. Concept Drawing - Selective Clearing & Snagging

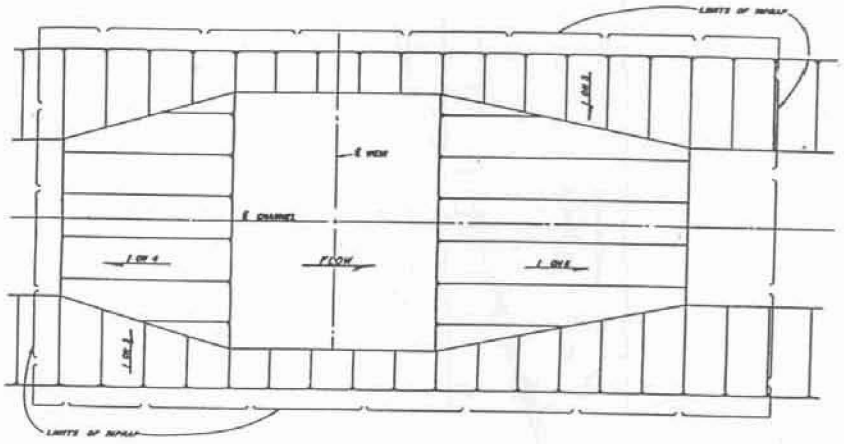

Figure 5. Low-Water Rock Slope Weir

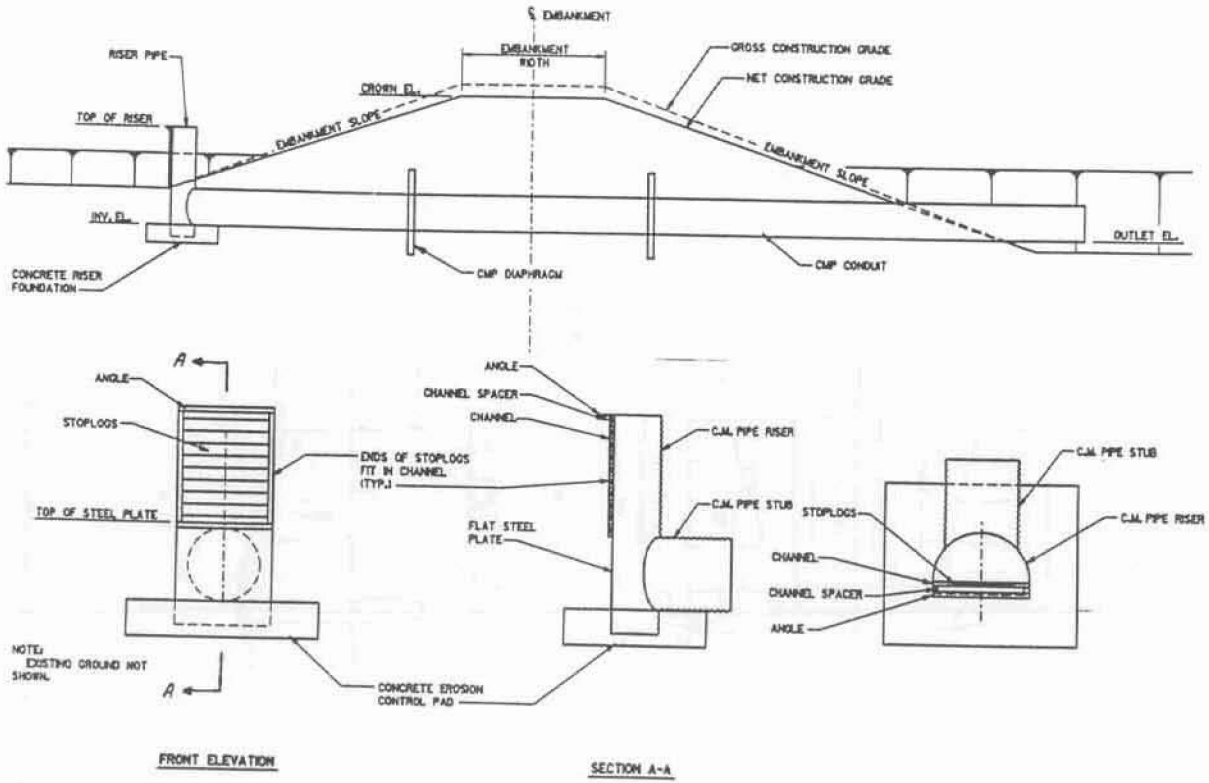

Figure 6. Grade/Water Control Structure