Performance and Effects of SCS Floodwater Retarding Structures in the 1979 Easter Floods*

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I'm sure you all remember the spectacular and devastating flood that occurred here in Jackson in April of this year. Estimates of damage range from $500,000,000 to $1,000,000,000 in the Jackson area alone.

The rainfall that produced this flooding covered a large area and was very intense at many locations. This map (figure 1) shows the total rainfall in inches for a 30 hr storm period.

At Louisville, Mississippi, the rainfall was 21.5" or 2.4 times the 100 year-24 hr rainfall or 69 percent of 6 hr PMP. Tallahaga Watershed in shaded area was located near the center of this storm. Many people try but it is impossible to project a frequency for such a storm.

As would be expected, not all the damage occurred at Jackson as shown here at a bridge near Ackerman. I guess you could say some people were left hanging by the storm. Channel scour, erosion, and land loss are also major problems not to mention sand deposit damage shown in background and in this close up.

SCS does not design floodwater retarding structures to control such a large storm. It is impractical and too expensive to do so. The design rainfall that we do use is based on potential damage and hazard to downstream property and life should the structure fail for some reason.

Comparison of rainfall amounts, for the three hazard levels, figure 2, shows their relationship to the 21.5" of rain that fell in 30 hours at Louisville. Notice also the change from 24 hr to 6 hr storm duration for the emergency spillway and freeboard storms. I have presented this data so we can have a common understanding of the storm magnitude.

The proof of all design, of course, is in its performance. How did these SCS structures fare under this intense storm? I have several pictures taken during the peak structure flow and then shortly after showing what damage did result from this massive storm.

This is Tallahaga Structure No. 13 inlet channel to the emergency spillway during flood stage. This structure was subjected to the 20 inches of rainfall, had a flow duration of some 50-60 hours, and had 1.3 ft. depth of flow in the control section. It is an a+ hazard design.

Looking further into emergency spillway with flow pattern waves appearing. Top of dam is in background. Flow has been higher as noted by debris on the abutment slope.

Looking at outlet, notice rather tranquil flow until it hits the fence and areas beyond. This minor obstruction and cow path/road irregularities beyond the fence caused considerable turbulence and erosion. We feel this turbulence was a major contributor to erosion damage that occurred. A closer look shows turbulence and outlet ditch flow.

There was no damage to emergency spillway control section.

Or in parts of outlet section. This is the same fence we saw three pictures before where the outlet section turbulence started.

Erosion is shown a little clearer in this picture looking back upstream noting the abrupt absence of vegetation at the fence line. This picture was taken almost 2 months after the flood showing the effect of losing topsoil.

This is a little further back still looking upstream at the fence showing the scour.

A phenomenon observed at several structure sites was what I call a "hop and skip" flow condition initiated by surface irregularities. Three scour and three skips are shown in this picture. Repair cost for this damage is estimated to be $1,000—a minor cost considering the flood it controlled.

This is another Tallahaga Structure, no. 10, that controlled the 20-inch storm. This is the outlet section of the emergency spillway which had no vegetation on it. The pool level had been drawn down for a spring seeding of the structure when the flood hit. Flow depth has been higher but flow waves can still be seen for the 2.1 ft. flood flow depth in the control section. The structure is an a+ hazard design.

Looking towards the emergency spillway outlet, we see another fence and associated turbulence. Each fence post hole had been washed out by the flow forces. Notice the turbulence below the fence. A cow path was thought to have initiated a hop and skip flow in this area. A later picture shows this more clearly.

Emergency spillway bottom scour on the unvegetated surface was to be expected. Some weeds and native vegetation had limited effect in the control section.

Further down towards outlet, the flow velocity increased and scour deepened to remove topsoil.

Hop and skip area scour. Note enlarged post holes.

This shows the hop and skip scour more clearly. Note the chunks of soil in foreground that were washed out. Estimated repair cost is $1,500.

This is Tallahaga Structure No. 12, also subjected to the 20-inch rainfall with the emergency spillway outlet flowing 2.0 ft.

*References in this report, except to Fig. 1 and 2, are to slides not reproduced in this publication.

deep at the control section. This structure is also an a+ hazard design. As usual, a fence crosses the outlet and has created some turbulence.

This is the same emergency spillway after the storm with some scour in the vegetated bottom. The next picture stands near the fence and looks up stream at this same scour.

The scour is more evident from this picture. Scour has essentially removed within the 6" of topsoil that we spread for vegetative growth.

Again, a fence across the emergency spillway appears to encourage scour. It could be that a cow path along that fence set up the initial turbulence.

Some gullying did occur beyond the fence. Estimated repair cost is $1,000.

You have probably noted that none of these dams has been overtopped. What happens when one does? We had a partially completed dam that did overtop. Rock had been stockpiled at a low point in the fill and protected a portion of the flow area.

Water has been slightly higher than shown here as evidenced by the debris line.

Another picture of the rock showing water filtering thru it. Note unwashed ridge in upper center of picture.

This shows the same ridge on the backside of the 14' high dam after flood flow. Note the rock on left side of picture which was washed onto the downstream valley floor.

This rock was washed over the dam and actually protected the plunge basin created by the overfall. Note compacted soil layers.

Figure 1.

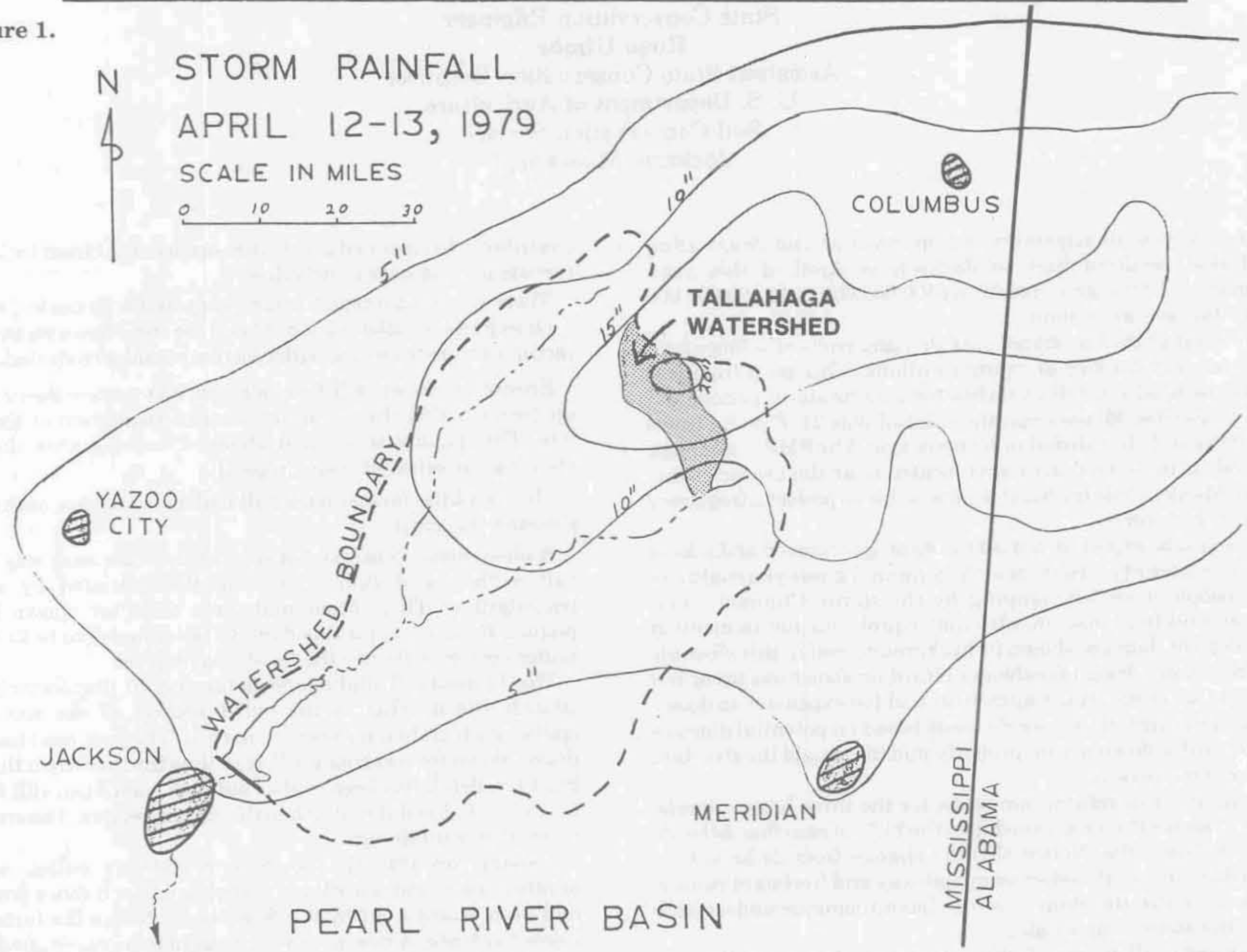

Figure 2.

RAINFALL COMPARISON

Louisville, Mississippi
April 12-13, 1979 30 hr. Rainfall 21.5"

Soil Conservation Service Design Criteria

(a) Hazard:
Damage to rural land, roads, and farm buildings.
25 yr. 24 hr. Principal Spillway Rainfall 7.2"
6 hr. Emergency Spillway Rainfall (20% PMP) 6.3"
6 hr. Freeboard Rainfall (30% PMP) 9.2"

(b) Hazard:
Damage to homes, minor railroads, and main highways, or utilities.
50 yr. 24 hr. Principal Spillway Rainfall 8.0"
6 hr. Emergency Spillway Rainfall (30% PMP) 9.2"
6 hr. Freeboard Rainfall (52% PMP) 16.0"

(c) Hazard:
Loss of life or serious damage to homes, commercial buildings, important utilities, highways, or railroads.
100 yr. 24 hr. Principal Spillway Rainfall 8.8"
6 hr. Emergency Spillway Rainfall (41% PMP) 12.7"
6 hr. Freeboard Rainfall (100% PMP) 31.0"

Another picture of overfall. Again note the embankment compaction layers. These are quite tough and erosion resistant compared to natural valley soil.

Some 12-15" of scour did occur on top of the fill and some at the top of slope where rock did not restrict flow. Cost of damage repair was about $5,000.

These slides show how the large floodwater retarding structures performed during this intense storm. Before I conclude the presentation, it would be appropriate to comment briefly on performance of the numerous small farm ponds. Ninety-nine percent performed as designed without damage but several failures did occur. This pond has been repaired but two 12" R/C pipes were put through fill to serve as emergency spillway—the same condition as before the break. He can expect another failure at some future date. Another structure almost identical in size and design exists behind the camera. It too failed and was repaired.

A wire screen over the principal spillway on this pond was blocked by debris, and the emergency spillway set near the top of the dam was blocked by debris on another screen causing overtopping and failure. Notice slide failure on right bank.

Cattle tracking around this tree and a high emergency spillway contributed to this failure.

The general conclusion drawn by SCS field people is that failures occurred where proper design and maintenance were not provided. That was the case at these three failures and several other sites we looked at.

Performance of the SCS floodwater retarding structures and farm ponds during the intense April storm can be termed nothing short of excellent. This is not a biased statement. Reports from Mayor Glasgow of Ackerman: "The Soil Conservation Service watershed project helped us avoid absolute disaster during the recent flood. Without this project, we'd have been in the same position as Jackson. If we hadn't had the project, we would have had one-half of the town and half the businesses, including the Courthouse, inundated. But, because this project protected us, water didn't get into a single commercial building, and only three houses had a slight amount of water."

The benefits gained from flood reduction of these structures is to the credit of these local individuals who foresaw the project advantages and worked diligently to get the project measures installed.