



United States Department of the Interior

U.S. GEOLOGICAL SURVEY
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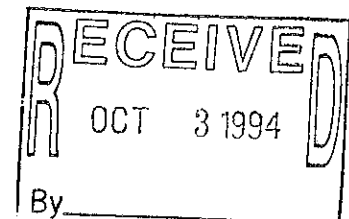
September 29, 1994

Mr. Robert Watson, P.E.
 Assistant-Chief Dam Safety-Floodplain Management Section
 Bureau of Water Regulation and Zoning
 Wisconsin Department of Natural Resources
 101 South Webster Street
 Box 7921
 Madison, Wisconsin 53707

Dear Mr. Watson:

This letter is in response to your July 1, 1994 letter reviewing the "Hydrologic Analysis of Ebner Coulee at LaCrosse, Wisconsin" that was submitted to Gary Lepak of Wisconsin Department of Natural Resources (WDNR) by the U.S. Geological Survey (USGS) on April 1, 1994. Pages 1 and 2 of your letter indicate that redoing the hydrologic analysis of Ebner Coulee is beyond the scope of the study originally recommended to the Federal Emergency Management Agency (FEMA) by WDNR. Complete details of the WDNR proposal to FEMA were not available to the Illinois District of the USGS. Therefore, the project proposal prepared by the Illinois District of the USGS to FEMA indicated that a review of the hydrologic procedures applied in the original Flood Insurance Study was needed for several reasons (discussed in detail below). Because FEMA did not contend this issue, the new hydrologic analysis was done.

The primary reason the new hydrologic analysis was done was that sufficient information to reproduce the design hydrographs applied in the original floodplain delineation was not provided in the Flood Insurance Study report (Federal Emergency Management Agency, 1984) and supporting reports (U.S. Army Corps of Engineers, 1976 and 1967). In particular, no information is given regarding (1) the loss rates applied to the design rain storms, and (2) the temporal distribution and duration of the design storm. The selection of the loss rates is extremely important to the determination of the volume of runoff and the peak discharge. The primary evidence supporting the design hydrographs applied in the original Flood Insurance Study were the results of the Bureau of Public Roads method, the Cook method, and scaling of flood frequency from Gilmore Creek at Winona, Minnesota. This support was questionable because the Bureau of Public Roads and Cook methods are highly empirical and inappropriate for a watershed as steep as Ebner Coulee, and the scaling procedures applied are inconsistent with current recommended procedures. Further, the results of the hydrologic analysis done by the consultants who designed the Ebner Coulee box culvert differed significantly from the original Flood Insurance Study. These analyses raised concerns in the City of La Crosse regarding the original hydrologic analysis.



Upon detailed review of the procedures applied in the original Flood Insurance Study additional inconsistencies were found in the application of the methods. These inconsistencies were of two general types: inconsistencies with respect to current practice and inconsistencies in the computational results and procedures. The scaling of flood-frequency information from Gilmore Creek at Winona, Minnesota involved inconsistencies with respect to current practice for floodplain delineation. The Gilmore Creek flood-frequency analysis was done graphically. This procedure was acceptable at the time the analysis was done (1967) because the U.S. Water Resources Council had not yet recommended that the Log Pearson Type III approach be used for all flood studies. However, at the time the Flood Insurance Study was done the Log Pearson Type III approach was the standard for all flood studies, and it seems recomputation of the flood frequency by this approach would have been appropriate. Further, the area scaling ratio applied in the original Flood Insurance Study has been superseded by the equations developed by Krug and others (1986).

The computations for the synthetic-hydrograph methods were inconsistent in the procedures applied and the computational results. For the Rational Method, in order to obtain a peak discharge of 1,010 cubic feet per second (ft^3/s) for an area of 470 acres with a runoff coefficient of 0.41 the design rainfall must be 5.24 inches per hour (in./hr). This value is considerably less than the 5.85 in./hr obtained from U.S. National Weather Service Technical Publication 40 (Hershfield, 1961) for a storm duration of 20 minutes at La Crosse, Wisconsin. For the Clark Unit Hydrograph Method, the hydrographs measured on Gilmore Creek were computed in a questionable manner so that the unit hydrographs determined from the five largest floods would have nearly identical peak-discharges. Further, the optimal value of the watershed storage coefficient determined for Gilmore Creek by the U.S. Army Corps of Engineers (1976) was much higher than that determined by the USGS by calibration of HEC-1 to the five largest floods. The storage coefficient applied to Ebner Coulee, as a result of the analysis done by the U.S. Army Corps of Engineers (1976), seems unrealistically high for such a steep, small watershed.

On page 2 of your letter it is implied that the USGS analysis seems predisposed to reducing the peak discharges and the width of the regulatory floodplain. This is incorrect. The quote from page 1 of the Hydrology Report must be read in full context, specifically:

"Whereas the 10-percent exceedance probability flood is considerably less than the 1-percent exceedance probability flood used to define the regulatory floodplain, operation of the box culvert could potentially lead to a significant reduction of the regulatory floodplain."

This is a fairly obvious statement that improvements in drainage could reduce the regulatory floodplain. This was the motivation for doing the reevaluation of the floodplain along Ebner Coulee. The later statements in the Hydrology Report speculating that the design discharges applied in the original Flood Insurance Study might be unrealistically high were made on the basis of the results of the scaling of frequency data from hydrologically similar

watersheds and the results of TR55 simulation. These results indicated that the best estimate of the 1-percent exceedance-probability flood is around 1,050 ft³/s as opposed to the 1,430 ft³/s applied in the original Flood Insurance Study. In fact for some of the synthetic methods applied, 1,430 ft³/s was greater than the 0.002-percent exceedance-probability flood. 0.2% ?

The point is well taken on page 2 of your letter regarding the volume of runoff being at least as important if not more important than the peak discharge. However, three factors should be considered. First, computation of the volume of direct runoff is highly dependent on the loss rates applied, which are not reported in the original Flood Insurance Study. Second, because the synthetic hydrograph methods applied are based on the Unit Hydrograph the volume of direct runoff is directly proportional to the magnitude of the peak discharge if the shapes of the design hydrographs are similar. Thus, if the peak discharge decreased 40 percent, the volume of direct runoff would also decrease 40 percent. The attached figure compares the one-percent exceedance-probability flood computed with TR55 and that determined in the original Flood Insurance Study (the TR55 result was shifted 7 hours so that the peak times of the two hydrographs are similar). It can be seen that the peak regions of the hydrographs are similar but the rising and recession limbs of the hydrographs are significantly different. Despite these differences in shape, the ratio of the depth of direct runoff 3.40 in./2.48 in. = 1.37 is similar to the ratio of the peak discharges 1,430 ft³/s/1,030 ft³/s = 1.39. Third, the volume of spill is also related to the amount of time that the runoff rate exceeds the capacity of leveed Ebner Coulee channel. Computation of spill for a flatter, more attenuated hydrograph, such as estimated in TR55, would result in more water remaining in the main channel of Ebner Coulee and less water spilling into the flood-prone neighborhoods upstream of the entrance to the box culvert.

Finally, the USGS is the nation's earth-science agency. The mission of the USGS is to collect and analyze data and present the results of these analyses to cooperating agencies and the general public in an unbiased, scientific way that allows users to make informed decisions on water-resources issues. Therefore, the USGS normally does not make recommendations regarding how the results of data collection and analyses done by the USGS should be applied. Further, the FEMA Guidelines and Specifications for Study Contractors indicate that if questions arise regarding the appropriate analyses (hydrologic or hydraulic) to apply these questions should be submitted to the Regional Project Officer for resolution. It is our understanding that WDNR acts as Regional Project Officer for FEMA. Thus, the "Hydrologic Analysis of Ebner Coulee at La Crosse, Wisconsin" was submitted to Gary Lepak for review and comment.

Your letter advises that application of the hydrologic analyses from the original Flood Insurance Study is preferred. Therefore, the USGS will continue the study applying the hydrographs computed in the original Flood Insurance Study as input to Ebner Coulee as simulated with a combination of HEC-1 and HEC-2. The HEC-2 models provided to the USGS on computer diskette along with your letter will be modified to account for the operation of the box culvert.

Mr. Robert Watson

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Finally, it would be greatly appreciated if WDNR could send electronic copies of the HEC-1 output containing the design hydrographs applied as input to Ebner Coulee in the original Flood Insurance Study if available. These hydrographs may be included in the microfiche documents that detail the original Flood Insurance Study. However, electronic copies of this information would greatly facilitate the completion of the project.

Thank you very much for your comments. I hope this letter clears up any misunderstandings between WDNR and the USGS regarding the reasons for and results of the "Hydrologic Analysis of Ebner Coulee at La Crosse, Wisconsin." If WDNR has any questions regarding this letter or the progress of the remapping project, please call me at (217) 398-5374.

Sincerely,

Charles S. Melching

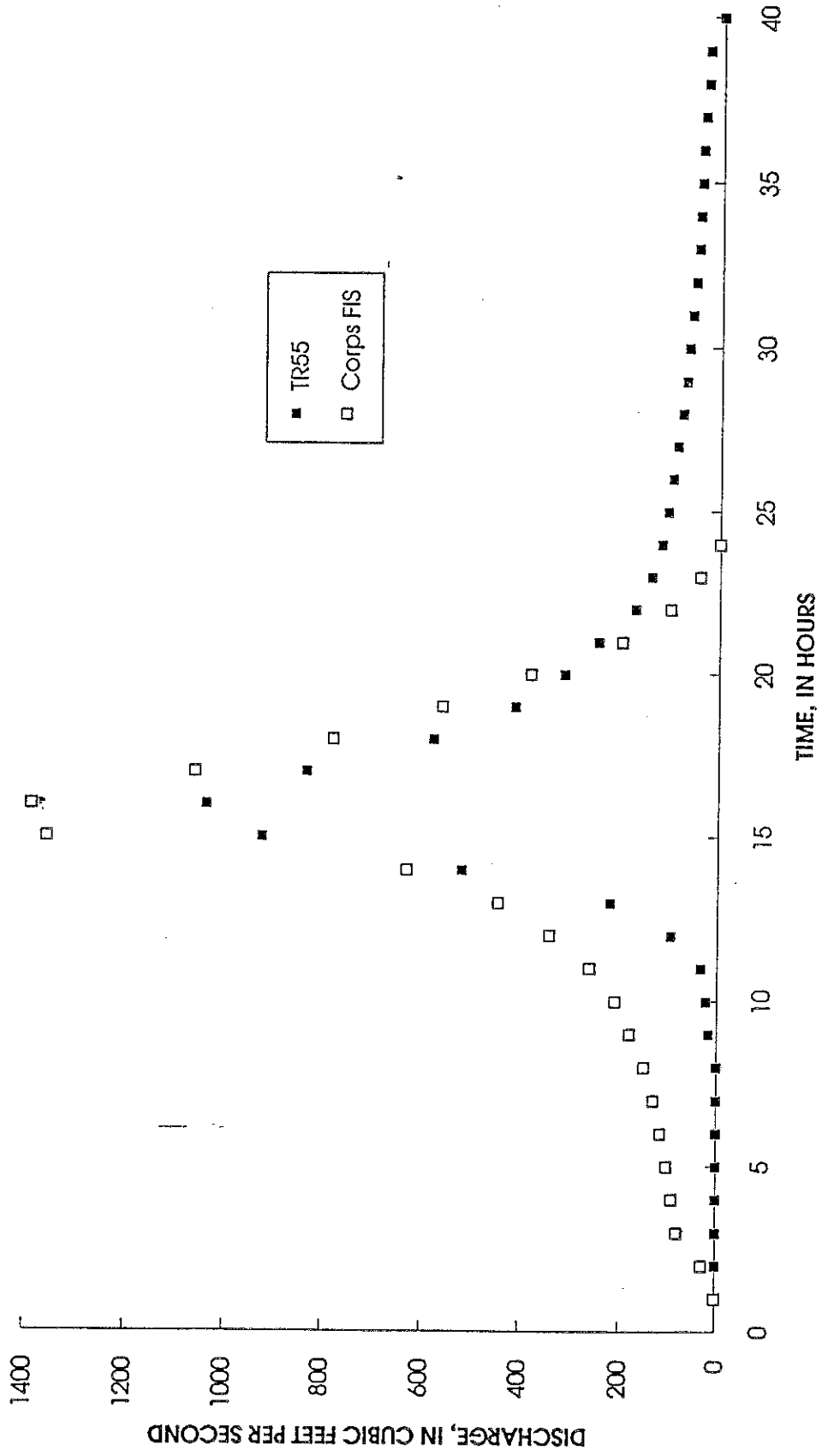
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Comparison of one-percent exceedance-probability flood computed with TR55 and the Clark unit hydrograph method in the original Flood Insurance Study (FIS)



References Cited

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