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Memorandum

TO: Sharon Kliwinski, National Park Service, Washington, DC
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FROM: Thomas H. Yorke
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SUBJECT: Technical Review of the Hydrology and Hydraulics of the Congaree River, Richland and Lexington Counties, SC

This memorandum responds to the request for technical assistance received by the Associate Director for Water of the U. S. Geological Survey (USGS) from the Associate Director for Natural Resources Stewardship and Science of the National Park Service (NPS). In a memorandum dated July 13, 2000, the NPS requested that the USGS review the hydrologic analysis and hydraulic modeling that was used to determine the draft Flood Insurance Rate Map and Flood Insurance Study for the Congaree River upstream from the Congaree Swamp National Monument. During subsequent communications with NPS staff, we were informed that the Federal Emergency Management Agency (FEMA) was revising the hydrologic analysis and rerunning the hydraulic models. We agreed to delay our review until the analyses were updated by FEMA.

I contacted Mr. Mike Buckley of FEMA to inform him that we had a request from the NPS to review the hydrology and hydraulics of the Congaree River. He informed me that they had completed the reanalysis of the hydrology and suggested that we review the hydrology before they simulated flood elevations with new flood discharges. We provided the document, "Comments on Flood Frequency Analysis for the Congaree River at Columbia, South Carolina," to FEMA on July 30, 2000. The document, which is attached, commented on four different options for estimating the 1-percent chance flood discharge for the Congaree River at Columbia. We determined that each method had some deficiencies because of either the analytical approach or the length of record of floods that was used. We suggested that FEMA consider weighting the results of two methods. One method used a more defensible approach with data only from 1926 to 1998; the other method used the whole systematic flood record for the Congaree River at Columbia, but the method for estimating the effects of Lake Murray was based on only two data points. FEMA accepted our recommendation and developed a weighted flood frequency curve that yielded a 1-percent chance flood discharge of 292,000 cubic feet per second. We concur that the discharge of 292,000 cfs is a valid estimate of the 1-percent chance flood discharge.

FEMA subsequently completed the hydraulic analysis of the Congaree River and distributed the document, "Appeal Resolution for Congaree River in Richland and Lexington Counties, South Carolina," on September 26, 2000. We received copies of the document and accompanying CD with ancillary information on October 2, 2000. Our staff reviewed the document and evaluated the hydraulic models that were used to determine the base flood elevations for Richland and Lexington Counties. The attached document, "USGS Review comments regarding the hydraulic models used for the Appeal Resolution for Congaree River in Richland and Lexington Counties, SC," concentrates on the 2-dimensional model (RMA2) that was used to assess effective flow areas in the floodplain. Unfortunately, we did not have time to thoroughly evaluate the 1-dimensional model (HEC2) that was used for locating the floodway and determining the base flood elevations.

Our review identified a number of deficiencies in the RMA2 model and errors in some of the data points used in the model. The grid resolution used to model the study area is outdated and is a remnant of computational constraints from earlier modeling studies. A more refined grid probably would result in smaller numerical errors, but the overall result of the modeling might be the same. We need to point out that FEMA used the 2-dimensional model only to assess flow patterns and conveyance landward of the levee on the Richland County side of the Congaree River.

Our analysis did identify a significant error in the downstream water surface elevation used for the calibration of the RMA2 model. When we reran the RMA2 model with the correct boundary condition for the 1976 flood, the absolute differences between the measured and computed water-surface elevations were greater for 5 of the 7 locations with observed data. The model could be recalibrated and fine tuned for a better fit with the observed data, but it is unlikely that the flow patterns in the floodplain will be affected appreciably.

As indicated above, we did not have the opportunity to rerun the HEC2 model to determine how sensitive the model is to the errors we found in the RMA2 model. We suspect that the base flood elevations will change, but the overall result of the FEMA restudy will not change. There will be significant flow in the floodplain on the Richland County side of the Congaree River, the base flood elevation in Lexington County will be higher, and the base flood elevation landward of the levee in Richland County will be lower.

I will be in the office the remainder of this week. Please call me if you have any questions about this memorandum or the attachments.

(See attached file: CongareeHydrology.doc)
(See attached file: CongareeHydraulics.doc)

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