

Flood Frequency Research Needs

The Hydrologic Frequency Analysis Work Group (HFAWG) was formed in December 1999 to recommend procedures to increase the usefulness of the current guidelines for Hydrologic Frequency Analysis computations (e.g., Bulletin 17B) and to evaluate other procedures for frequency analysis of hydrologic phenomena. The HFAWG currently has 17 members from Federal agencies, academia, interest groups and private citizens who attend meetings in person or by teleconference. An additional 10 members are kept informed of HFAWG activities through emails and other correspondence. The membership of the work group and other information is provided on the following web site <http://acwi.gov/hydrology/Frequency/>).

Bulletin 17B, *Guidelines For Determining Flood Flow Frequency*, provides a list of additional research needs (Interagency Advisory Committee on Water Data, 1982). The list in Bulletin 17B and HFAWG knowledge of the subject suggests the following research needs:

- Frequency analysis for ungaged watersheds using hydrologic models based on design rainfall storms and continuous simulation and computation of measures of uncertainty,
- Frequency analysis for regulated watersheds and computation of measures of uncertainty,
- Procedures for determining that the annual peak flows are a representative time sample of random homogeneous events,
- Procedures for adjusting for the effects of watershed change such as urbanization and deforestation,
- Identification and treatment of mixed populations,
- Comparative analysis approaches that can be used to validate Bulletin 17B results such as the use of flood estimates from rainfall records,
- Procedures for identification and treatment of outliers, zero flows, and historic/paleoflood information,
- Procedures for computation of regional or generalized skew,
- Selection of alternative frequency distributions and fitting methods such as L-Moments, Maximum Likelihood and Expected Moments,
- Procedures for computation of confidence limits that reflect the uncertainty in the skew coefficient.

After discussing the above list of research needs, the HFAWG decided on a plan for investigating possible improvements in Bulletin 17B. The HFAWG limited their initial efforts to a subset of the above research needs that could be accomplished in a reasonable time frame and with limited resources. The concept is to maintain the spirit of Bulletin 17B through fitting the Pearson Type III distribution to the logarithms of the annual peak flows using a method of moments approach. Any deviation from this base method would require significant testing and evaluation. Other research areas requiring significant research that will be undertaken later include developing guidance for ungaged watersheds, procedures for evaluating nonhomogeneity in the annual peak flows, treatment of mixed populations, and comparative analyses to validate Bulletin 17B results

The following plan was discussed with the Subcommittee on Hydrology on January 12, 2006 and determined to be a reasonable initial effort for improving Bulletin 17B guidelines. As funding and resources become available, more comprehensive research will be undertaken. The following plan is presented to the Advisory Committee on Water Information (ACWI) to inform the members of investigations that the HFAWG will undertake in 2006. Results of these investigations will be reported at subsequent ACWI meetings.

Hydrologic Frequency Analysis Work Group Plans to Investigate Possible Improvements to Bulletin 17B

Issue

The Hydrologic Frequency Analysis Work Group (HFAWG) met on November 14 and 15, 2005 in Alexandria, Virginia to discuss possible revisions to Bulletin 17B, published in 1982 (Interagency Advisory Committee on Water Data, 1982). The HFAWG requests the approval of the Subcommittee on Hydrology (SOH) and, subsequently the Advisory Committee on Water Information (ACWI), to evaluate possible improvements to Bulletin 17B.

Background

Some thirty years have passed since parts of Bulletin 17 were assembled in response to the administration's and congress's (House Document No. 465) concern for the development of uniform procedures for flood frequency analysis. As stated in the FOREWARD of Bulletin 17B, "An accurate estimate of the flood damage potential is a key element to an effective, nationwide flood damage abatement program." Motivation for national flood frequency guidelines was to reduce flood damages. As stated in the FOREWARD, "This present revision is adopted with the knowledge and understanding that review of these procedures will continue. When warranted by experience and by examination and testing of new techniques, other revisions will be published." It is with this spirit that the following investigations are proposed.

Approach

Bulletin 17B guidelines were developed by Federal agencies, requested for use by Federal agencies, so Federal agencies should provide the leadership and funding in investigating revisions to the current guidelines. The motivation and approach are as follows:

- Why - revised guidelines may provide more robust procedures with improved accuracy and consistency (to be demonstrated with limited testing).
- How – evaluation and testing by HFAWG members with the major effort provided by Federal members of the HFAWG.
- Cost - contributed time of Federal and non Federal HFAWG members, no additional funding is being requested.
- When – evaluation and testing and draft revisions to Bulletin 17B to be completed by December 31, 2006; coordination, review and approval process to be completed in 2007.
- Product – a revised Bulletin 17C (assuming revisions are warranted).
- Review and approval process – coordination with SOH, ACWI, Office of Management and Budget (OMB) and a public comment period.

Proposed scope of work

Based on recently completed research, the HFAWG proposes to investigate the following possible improvements in Bulletin 17B:

1. Evaluate and compare the performance of the Expected Moments Algorithm (EMA) (Cohn and others, 1997) to the weighted-moments approach of Bulletin 17B (Appendix 6) for analyzing data sets with historic information and paleoflood data.

- Apply EMA and Bulletin 17B to gaging station data that include low and high outliers and historic data and those that do not. Develop criteria for determining if EMA provides more accurate and consistent flood estimates.
 - Review and evaluate the published literature for comparisons of EMA to conventional Bulletin 17B procedures.
 - Recommend improved plotting position formula when historic data are available.
2. Evaluate and compare the performance of EMA to the conditional probability adjustment of Bulletin 17B for analyzing data sets with low outliers and zero flows.
- Apply EMA and Bulletin 17B to gaging station data that include low and high outliers and historic data and those that do not (same data set as noted above). Develop criteria for determining if EMA provides more accurate and consistent flood estimates.
3. Describe improved procedures for estimating generalized/regional skew.
- Evaluate revisions needed in Bulletin 17B to describe improved procedures for estimating generalized/regional skew based on recently completed research.
4. Describe improved procedures for defining confidence limits.
- Evaluate revisions needed in Bulletin 17B to describe new procedures for defining confidence limits that include the uncertainty in the skew coefficient.
 - Describe confidence limit procedures for EMA (if adopted).

Summary

Possible improvements to Bulletin 17B will be based on recently published literature and limited testing using gaging station data. The HFAWG considers the above investigations to be those that can be accomplished in a short period of time with limited resources. Revisions (that are justified by the limited testing and evaluation) to Bulletin 17B will be made by HFAWG members with Federal members providing the major support. Any consensus revisions of Bulletin 17B will be completed by December 31, 2006 and submitted to the SOH, and the ACWI for approval with appropriate coordination with OMB. The review and approval process will be completed in 2007. The possible changes are considered significant improvements that would warrant the publication of a new Bulletin 17C.

References

References that describe recent research that will serve as the basis for possible improvements to Bulletin 17B are available at: <ftp://ftp.usbr.gov/jenland/HFAWG/>

Cohn, T. A., W. L. Lane, and W. G. Baier, 1997, *An algorithm for computing moments-based flood quantile estimates when historical flood information is available*: Water Resources Research, 33(9):2089-2096.

Interagency Advisory Committee on Water Data, 1982, *Guidelines For Determining Flood Flow Frequency*: Bulletin 17B of the Hydrology Subcommittee, Office of Water Data Coordination, U.S. Geological Survey, Reston, Virginia, 183 p.