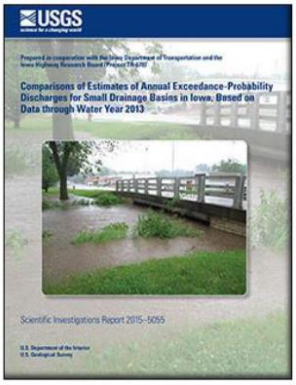

Project TR-678 Technical Brief: Comparisons of Estimates of Annual Exceedance-Probability Discharges for Small Drainage Basins in Iowa, Based on Data through Water Year 2013

http://pubs.usgs.gov/sir/2015/5055/

Traditionally, the Iowa DOT has used the Iowa Runoff Chart and single-variable regional regression equations (RREs) from a USGS report (published in 1987) as the primary methods to estimate annual exceedance-probability discharge (AEPD) for small (20 mi^2 or less) drainage basins in Iowa. With the publication of new multi- and single-variable RREs by the USGS (published in 2013), Iowa DOT needs to determine which methods of AEPD estimation provide the best accuracy and the least bias for small drainage basins in Iowa. In response to this need, the USGS, in cooperation with the Iowa DOT and the Iowa Highway Research Board, initiated a statewide study in 2014 to compare and evaluate AEPD estimates from five different AEPD-estimation methods.

Twenty five streamgages with drainage areas less than 2 mi^2 and 55 streamgages with drainage areas between 2 and 20 mi^2 were selected for the comparisons that used two evaluation metrics. Estimates of AEPDs calculated for the streamgages using the expected moments algorithm/multiple Grubbs-Beck test analysis method were compared to estimates of AEPDs calculated from the 2013 multivariable RREs; the 2013 single-variable RREs; the 1987 single-variable RREs; the TR-55 rainfall-runoff model; and the Iowa Runoff Chart.

For the 25 streamgages with drainage areas less than 2 mi^2, results of the comparisons indicate that estimates of AEPDs calculated from the 2013 multi- and single-variable RREs, the 1987 single-variable RREs, and the TR-55 method tend to overestimate AEPDs and that estimates calculated from the Iowa Runoff Chart method tend to primarily underestimate AEPDs. The comparisons seem to indicate the best overall accuracy and the least bias may be achieved by using the TR-55 method for flood regions 1 and 3 (published in 2013) and by using the 1987 single-variable RREs for flood region 2 (published in 2013).

For drainage basins with areas between 2 and 20 mi^2, results of the comparisons indicate that estimates of AEPDs from the 2013 multi- and single-variable RREs and the TR-55 method tend to overestimate AEPDs, and that estimates calculated from the 1987 single-variable RREs

tend to overestimate and underestimate AEPDs. The comparisons seem to indicate the best overall accuracy and the least bias may be achieved by using the 1987 single-variable RREs for the Southern Iowa Drift Plain landform region and for flood region 3 (published in 2013), by using the 2013 multivariable RREs for the Iowan Surface landform region, and by using the 2013 or 1987 single-variable RREs for flood region 2 (published in 2013). For all other landform or flood regions in Iowa, use of the 2013 single-variable RREs may provide the best overall accuracy and the least bias.

An examination was conducted to understand why the 1987 single-variable RREs seem to provide better accuracy and less bias than either of the 2013 multi- or single-variable RREs. The re-assignment of hydrologic regions for streamgages and the use of a mixed landform calculation for the 1987 single-variable RREs seem to have had no substantial effect regarding the relative accuracy and bias compared to the 2013 multi- or single-variable RREs for drainage basins with areas less than 20 mi^2.

A comparison of 1-percent annual exceedance-probability regression lines for hydrologic regions 1–4 from the 1987 single-variable RREs and for flood regions 1–3 from the 2013 single-variable RREs indicates that the 1987 single-variable regional-regression lines generally have steeper slopes and lower discharges when compared to 2013 single-variable regional-regression lines for corresponding areas of Iowa. The combination of the definition of hydrologic regions, the lower discharges, and the steeper slopes of regression lines associated with the 1987 single-variable RREs seem to provide better accuracy and less bias when compared to the 2013 multi or single-variable RREs; better accuracy and less bias was determined particularly for drainage areas less than 2 mi^2, and also for some drainage areas between 2 and 20 mi^2. The 2013 multi- and single-variable RREs are considered to provide better accuracy and less bias for larger drainage areas.

Results of this study indicate that additional research is needed to address the curvilinear relation between drainage area and AEPDs for areas of Iowa. The development of two sets of RREs for large and small drainage areas, and the development of a method to resolve the problem of transitioning estimates of AEPDs between the two sets of RREs, may need to be reconsidered in future research for flood-estimation studies in Iowa.