Exceedance Probability Analysis for the Ellicott City, Maryland Rainfall Event of 30 July 2016

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Updated: 1 August 2016

The Hydrometeorological Design Studies Center (HDSC) analyzed annual exceedance probabilities (AEPs) of the worst case rainfall for the Ellicott City, Maryland event that occurred on 30 July 2016. AEP is probability of exceeding a given amount of rainfall for a given duration at least once in any given year at a given location. It is an indicator of the rarity of rainfall amounts and is used as the basis of hydrologic design.

For the AEP analysis, we look at a range of durations and select one or two critical durations that show the lowest exceedance probabilities for the largest area, i.e., the "worst case." Since the beginning and ending of the worst case period is not necessarily the same for all locations, the AEP maps do not represent isohyets at any particular point in time, but rather within the whole event.

The rarity of this event is illustrated in the figures below. Figure 1 shows how the maximum observed rainfall amounts compared to corresponding rainfall frequency estimates for AEPs up to 1/1000 (0.1%) for durations from 5 minutes to 6 hours for a rain gauge in Maryland - ELYM2 Ellicott City (39.27333°N, 76.80444°W). The rain gauge is part of the Hydrometeorological Automated Data System (HADS). The AEPs are estimates from NOAA Atlas 14 Volume 2. As can be seen from Figure 1, observed rainfall amounts have probabilities of less or equal to 1/1000 for durations up to 3 hours.

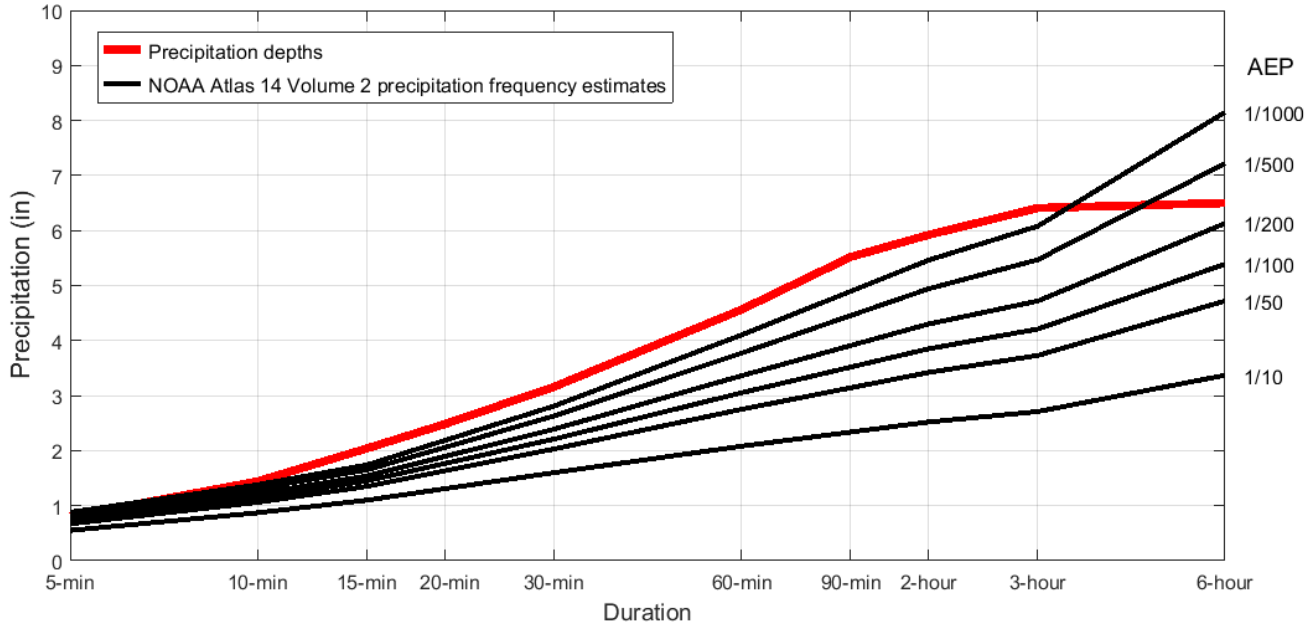

Figure 1. Maximum observed rainfall amounts in relationship to corresponding rainfall frequency estimates for the ELYM2 gauge.

The map in Figure 2 shows the areas that experienced 3-hour rainfall magnitudes with AEPs ranging from 1/10 (10%) to smaller than 1/1000 (0.1%). Rainfall frequency estimates are from NOAA Atlas 14 Volume 2. Rainfall amounts were derived from the National Centers for Environmental Prediction, Environmental Modeling Center's Stage IV analysis. Stage IV data is a mosaicked product of regional hourly multi-sensor (radar + gauges) precipitation estimates produced by the National Weather Service's River Forecast Centers. Hourly rainfall grids were aggregated to overlapping 3-hour durations, and the maximum amount of rainfall was extracted for each grid cell inside the area of interest.

The resolution of the Stage IV estimates (~4km) is unable to capture the rarest localized precipitation values, such as seen from the ELYM2 gauge in Figure 1. The Stage IV pixel that includes the ELYM2 gauge has a 3-hour rainfall amount of approximately 5.3 inches in contrast to gauge measurement of 6.41 inches. To account for the local underestimation of the Stage IV product, Stage IV rainfall values in the area were scaled by the 6.41/5.3 ratio. The resulting AEP map is shown in Figure 2.

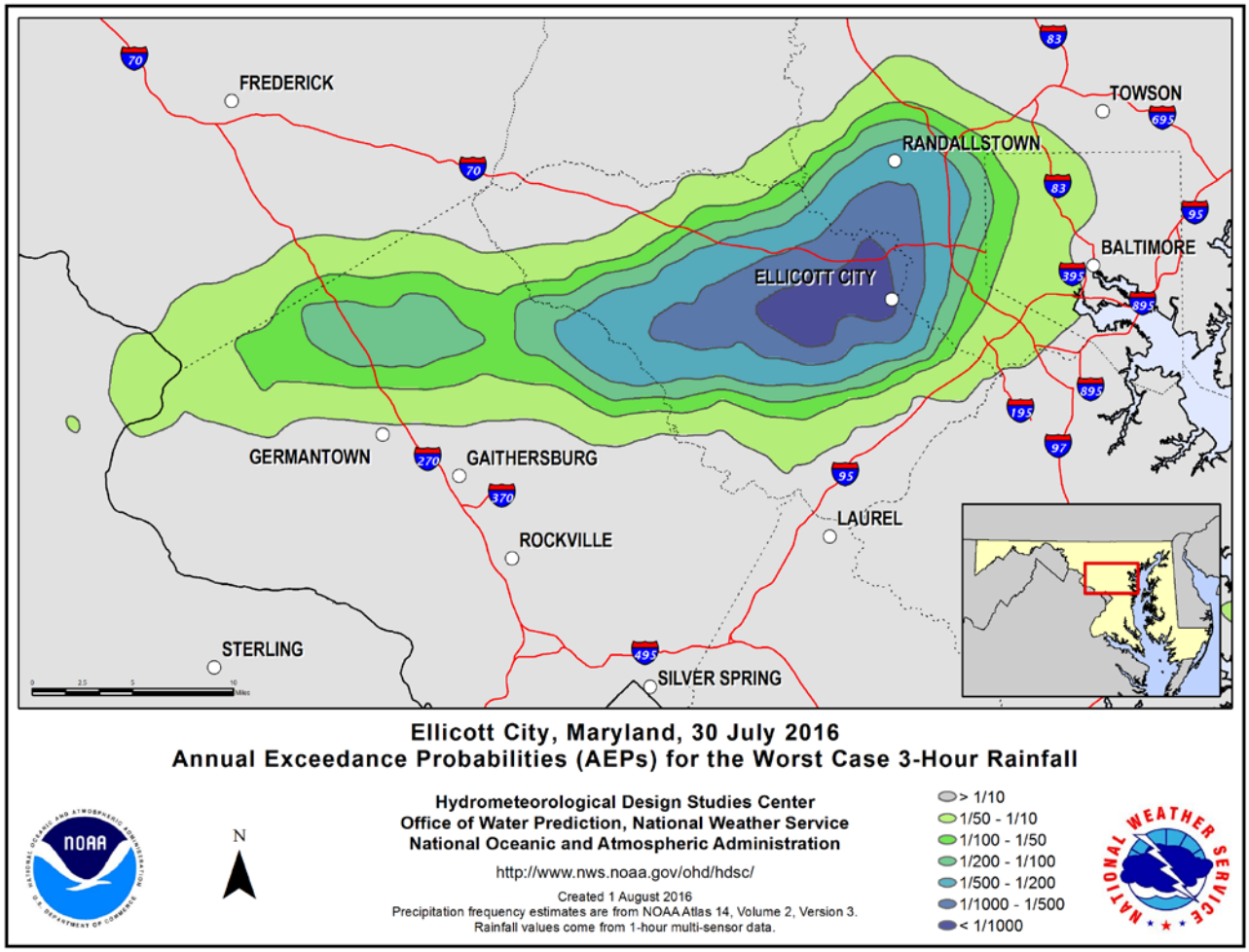

Figure 2. Annual exceedance probability for the worst case 3-hour rainfall.