

DESIGN RAINFALL DISTRIBUTIONS BASED ON NOAA 14 VOLUMES 1 AND 2 DATA

William Merkel, Hydraulic Engineer, USDA-NRCS, Beltsville, MD,
William.Merkel@wdc.usda.gov, Helen Fox Moody, Hydraulic Engineer, USDA-
NRCS, Beltsville, MD, Helen.Moody@wdc.usda.gov, and Quan D. Quan, Hydraulic
Engineer, USDA-NRCS, Beltsville, MD, Quan.Quan@usda.gov

Abstract

For hydrologic design purposes, the Natural Resources Conservation Service (NRCS) has historically used rainfall distributions derived from rainfall frequency data. For example, the Type I, Type II, and Type III are in general use throughout the United States. NRCS hydrologic models including Engineering Field Handbook Chapter 2 (EFH-2), WinTR-55, and WinTR-20 make use of these rainfall distributions.

The original rainfall distributions were developed from rainfall frequency data contained in US Weather Bureau Technical Paper 40 (1961) and NWS Hydro-35 (1977). NRCS Technical Paper 149 (TP-149, 1973) describes the way in which the Type I and Type II were developed and shows plots of rainfall versus duration at several locations. The National Weather Service released NOAA Atlas 14 Volumes 1 and 2 in 2004. Volume 1 is for the southwest and Great Basin states and Volume 2 covers the Ohio River Basin and adjacent states.

Since more years of rainfall records, more rainfall gages, and more sophisticated techniques were used to develop NOAA Atlas 14 Volumes 1 and 2, it was expected that the current standard NRCS design rainfall distributions would not apply any more.

The standard design rainfall distributions are based on nesting the high intensity short durations within the longer lower intensity durations. For example, the 5-minute duration is assumed to be within the 10-minute duration which is in turn within the 15-minute duration. This process is continued until the 24-hour duration is reached. The non-dimensional aspect of the rainfall distribution is that durations from 5 minutes to 12 hours are represented as a ratio of that duration rainfall to the 24-hour rainfall.

Maps of these rainfall ratios were developed using Geographic Information System (GIS) technology. The goal was to identify regions of similar rainfall distribution. A map of a multi-state area with a regional rainfall distribution was developed along with a 24-hour rainfall table for use in hydrologic design models. The rainfall distribution proved to be too variable to represent large regions within a reasonably small error tolerance.

Another alternative investigated was to develop a site-specific rainfall distribution based on the rainfall/duration/frequency data for a location. This approach preserves the intensities within a rainfall distribution with minimum error. A computer program was written to use the NOAA rainfall/duration/frequency data at a specific site to develop a set of rainfall distribution tables for WinTR-20.