UTAH DEPARTMENT of ENVIRONMENTAL QUALITY
WATER QUALITY

DWQ Guidance for Calculation of 90th Percentile Storm Event

Utah Division of Water Quality

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LID in Spanish Fork: vegetated swale with underground Infiltration gallery

Permit Requirements

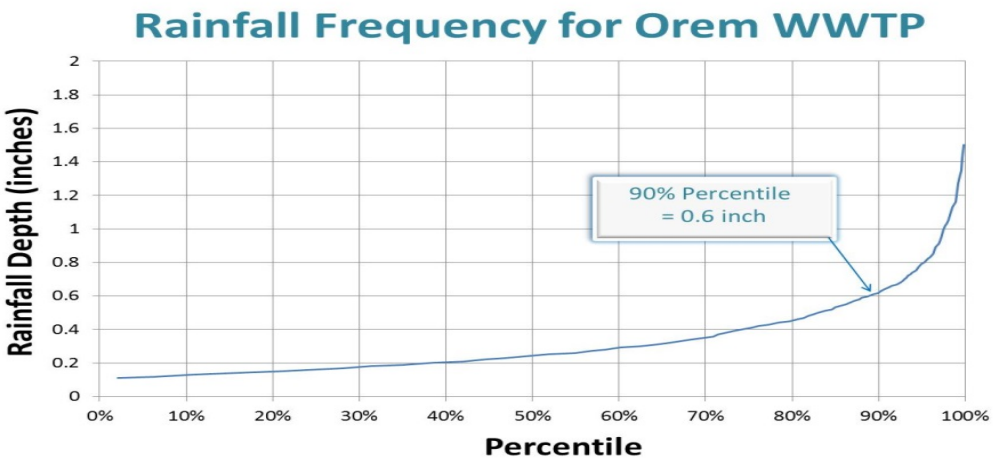
The General Permit for Discharges from Small Municipal Separate Storm Sewer Systems (MS4s), UPDES Permit No.UTR090000 (Permit), was reissued effective March 1, 2016. Permit Part 4.2.5.3.4, Long-Term Storm Water Management in New Development and Redevelopment (Post-Construction Storm Water Management) requires new development or redevelopment projects that disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale to manage rainfall on-site, and prevent the off-site discharge of the precipitation from all rainfall events less than or equal to the 90th percentile rainfall event. This requirement is to be implemented within 180 days from the effective date of this Permit (i.e., September 1, 2016). This permit requirement is to be accomplished through the use of Low Impact Development (LID) and Green Infrastructure (GI) practices that are designed, constructed, and maintained to infiltrate, evapotranspire and/or harvest and reuse rainwater.

90th Percentile Rainfall Depth

The 90th percentile rainfall depth represents the depth of rainfall which is not exceeded in 90 percent of all runoff producing rainfall events within the time period analyzed. In other words, 90 percent of the rainfall storm events that produce runoff will be less than or equal to this depth. The majority of Utah MS4s have a 90th percentile rainfall depth of between 0.6 – 0.7 inches. The rainfall depth corresponds directly to rainfall volume (not the same as runoff volume) when applied over an area. For example a 90th percentile rainfall depth of 0.65 inches applied over a 10-acre site equates to approximately 0.5 acre-feet or 875 cubic yards.

Precipitation Data for Utah

NOAA NCDC weather stations report snowfall events in millimeters (mm) and precipitation events (including melted snow) in tenths of mm. For days with recorded snowfall, the snow-water equivalency is included in the precipitation column. First convert the data to inches. Then sort the precipitation data from low to high and eliminate events less than 0.1 inch, because they do not generally result in any measurable runoff due to absorption, interception and evaporation. Then eliminate days with recorded snowfall as snowfall does not immediately produce runoff. Once the data has been truncated, utilize the PERCENTILE function (k= 0.9) to calculate the 90th percentile value of the data. To develop a frequency curve which depicts the percentile of rainfall events greater than or equal to a given rainfall depth, either 1.) assign a rank to each of the precipitation values and calculate the exceedance probability percentile for each value, or 2.) calculate several percentiles utilizing the PERCENTILE function (k = 0.1, 0.2....0.8, 0.85, 0.9, 0.95, etc). Graph precipitation depth (inches) vs. Exceedance Probability Percentile (See Orem Example below).



Steps for Calculation of 90th Percentile Rainfall Depth

1. Obtain long-term daily rainfall data.
2. Sort data low to high.
3. Edit out snowfall and small events (<0.1 inch).
4. Use the Excel PERCENTILE function to calculate the 90th percentile rainfall depth.

Summary

Retaining rainfall events equal to or less than the 90th percentile rainfall event reduces the runoff from smaller frequently occurring storms, which account for the majority of the annual precipitation volume. Determination of the 90th percentile rainfall depth allows for calculation of a water quality volume for which designers can choose LID/GI techniques to infiltrate, evapotranspire and/or harvest and reuse the runoff generated. The 90th percentile depth is commonly recognized to maximize the cost of controls and water quality benefits, as graphically portrayed by the upward inflection of the curve. This criteria also incentivizes limitation of impervious areas and promotion of LID/GI.

References

Urban Stormwater Retrofit Practices Manual No. 3. Center for Watershed Protection. August 2007.

Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act. USEPA. December, 2009.