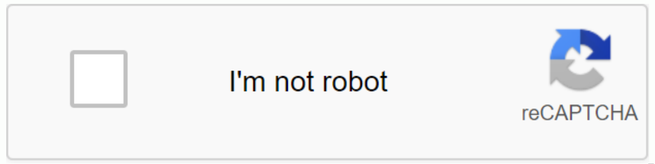

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Nrcs rational method runoff coefficients

Although HydroCAD is mainly used with the SCS/NRCS runoff methodology, it can also generate runoff hydrographs based on the Rational method. However, because the Rational method was primarily developed to predict maximum flows, its use for volume-sensitive routing calculations is not recommended. The Rational method predicts maximum runoff according to the formula: Q-CiA, where C is a runoff coefficient, i is the rain intensity, and A is the sublayer area. This formula applies to U.S. evaluation or metrics, as long as they are used as consistent units. (In traditional U.S. use, intensity and area occur in inches per hour and acres, respectively. Unit conversion leaves a factor of approximately 1.01, which is typically ignored in manual calculations, but must be included to match HydroCAD results.) In order to generate a complete runoff hydrograph, runoff is assumed to start at the start of the storm and increase linearly to the maximum value. The maximum runoff is maintained until the duration of the event has elapsed, and then decreases linearly to zero. The rate at which the hydrograph goes up and down is based on the Tc and an up/down factor. For the standard rational method, the up and down factors are one. That is, the increase and fall occur during the exact interval Tc. Variations of the Rational method (often called the Modified Rational method), can use different up and down factors, which can be set directly in the configuration. Calculation screen. When using the Rational method, you must specify the correct intensity and duration. If an IDF file is defined, the intensity is automatically calculated for each duration. An IDF file also allows the use of the duration analysis report, simplifying the process of determining critical duration on each node. Since a hydrograph produced by the Rational method does not reflect the total runoff or intensity variations of a real storm, it is not recommended for the design and analysis of arrest ponds. It is strongly recommended that SCS-UH or SBUH methods be used when performing pond routing calculations. Frequently Asked Questions Why is HydroCAD Peak less than when using Q-CiA? The duration of the rain should be greater than or equal to the Tc multiplied by the increase factor (usually 1), otherwise the runoff will not have time to rise to the maximum value. You may also need to use a smaller time step (dt) to have enough resolution to capture the momentary peak. Why is there a flat lid on the hydrograph? The flat top is when the duration is longer than the Tc multiplies by the increase factor. Runoff will remain constant until the end of the rain duration has elapsed. (See illustration above.) When I change the duration, why are all sublayers recalculated? Since rain is supposed to be uniform throughout the site, the same duration and should apply to all sublayers. There is no point in combining hydrography for different events, as they cannot occur at the same time. This illustrates the inherent complexity of using Rational for everyone except for the simplest of watersheds. What happens when I combine multiple sublayers? A trapezoidal hydrograph is generated for each sublayer, and the hydrographs are added together. All sublayers will use the same intensity and duration, as described above. However, tc is a physical feature of each sublayer, so Tc values are not modified. If the duration is less than a given Tc, that sublayer will not have time to reach its theoretical maximum, and will produce a triangular hydrograph with a reduced peak. If the duration exceeds the Tc, the peak is reduced due to the lower rainfall intensity associated with the longer duration, resulting in a flat hydrograph. The peak time will also vary, depending on the Tc for each sublayer. Note: The sum of the maximum flows produced by different durations would be incorrect. This approach violates the assumption of uniform rainfall throughout the site. When combining flows from multiple areas, all sublayers must be subject to the same rain conditions. How can I determine the intensity of the rain? Although you can enter intensity manually in the settings . . . . . Calculation screen, it is more convenient for HydroCAD to look for the value of a suitable IDF curve. What duration should I use? Although some locations may dictate the use of a specific duration of rain, proper use of the rational method requires that critical duration be used for each point in the watershed. How can I determine critical duration? For a single sublayer, the critical duration is equal to the Tc, but for complex watersheds the critical duration is more difficult to determine and often requires a trial-and-error approach. HydroCAD-7 (and later) simplifies this process with automatic critical-duration analysis. This report analyzes a large number of duration/intensity combinations (based on the specified IDF curve) to determine the duration that causes the highest maximum flow at a given point in the watershed. (For a pond or range, critical duration is the value that results in the highest elevation of the water surface.) To view the critical duration report, open a report window on the desired node and select the Duration tab. (If the Duration tab is missing, you may not have provided an IDF file in your configuration. Calculation screen.) To generate the report, click the Refresh button. For a single sublayer, the critical duration will be equal to the Tc. as it moves downstream, critical duration will increase, especially for a pond, which takes longer to fill up to its maximum elevation and discharge. For more information, click the Help button Screen. Why are Rational and SCS runoff values different? The Rational and SCS methods use different equations and can generally be expected to produce different results. Even if the results are similar under certain conditions, the nonlinear nature of the scS runoff equation means that the results will deviate as the rain depth or C/CN values are changed. For further reading The following article by Paul Schiariti, E.P. provides more information on the Rational Method, including comparisons with the SCS method, and a discussion on critical duration (see page 7). Our thanks to the New Jersey Conservation District Employees Association for publishing this document. Basic hydrology - TR-55 versus the modified rational method Although HydroCAD is mainly used with the SCS/NRCS runoff methodology, it can also generate runoff hydrographs based on the Rational method. 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It is strongly recommended that SCS-UH or SBUH methods be used when performing pond routing calculations. Frequently Asked Questions Why is the peak less than when using Q-CiA? The duration of the rain should be greater than or equal to the Tc multiplied by the increase factor (usually 1), otherwise the runoff will not have time to rise to the maximum value. You may also need to use a smaller time step (dt) to have enough resolution to capture the momentary peak. Why is there a flat lid on the hydrograph? The flat top occurs when the duration is longer than the Tc multiplies by the magnification factor. Runoff will remain constant until the end of the rain duration has elapsed. (See illustration above.) When I change the duration, why are all sublayers recalculated? Because rain is supposed to be uniform throughout the site, the same duration and intensity should be applied to all sublayers. 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