Example Problem 4A-5_2, Overland Sheet Flow

Determine ($T_{c\ sheet}$) for a flow length of 65 feet.

Given:

Average slope: S = 0.02 ft/ft

Manning coefficient: n = 0.24 (well established dense grasses, see Table 6)

Recurrence interval: T = 10 years

Keokuk, Iowa: Section Code = 09 (See Table 2)

Solution:

1. Select $T_{c\ sheet}$ from Table 2 (a portion is shown below). Start with 10 minutes, which corresponds to an I = 5.88 in/hr.

		10-year
section	Duration	Intensity (in/hr)
09	15-min	5.04
09	10-min	5.88
09	5-min	6.72

2. Use Equation 4A-5_4 with I = 5.88 in/hr to compute $T_{c\ sheet}$:

$$T_{c\ sheet} = \frac{K_u}{I^{0.4}}\left(\frac{nL}{\sqrt{S}}\right)^{0.6} = \frac{0.933}{5.88^{0.4}}\left(\frac{0.24\times 65}{\sqrt{0.02}}\right)^{0.6} = 7.72 \text{ min.}$$

3. The calculated value of $T_{c\ sheet}$ is not within 1 minute of the assumed value of 10 minutes.

4. Try value of $T_{c\ sheet}$ close to the calculated value. Try $T_{c\ sheet}$ = 8 minutes. This falls between 10 minutes and 5 minutes in Table 2, so this will require interpolating for (I).

$$\frac{8-10}{5-10} = \frac{I-5.88}{6.72-5.88}, \text{ so } I = 5.88 + \frac{8-10}{5-10}(6.72-5.88) = 6.22 \text{ in/hr.}$$

Calculate $T_{c\ sheet}$ and compare to the assumed value of 8 minutes:

$$T_{c\ sheet} = \frac{K_u}{I^{0.4}}\left(\frac{nL}{\sqrt{S}}\right)^{0.6} = \frac{0.933}{6.22^{0.4}}\left(\frac{0.24\times 65}{\sqrt{0.02}}\right)^{0.6} = 7.55 \text{ min.}$$

The calculated value and assumed value of $T_{c\ sheet}$ are within one minute of each other, so $T_{c\ sheet}$ = 8 min.