

Problem 7

Hydraulic engineers in the United States often use, as a unit of volume of water, the *acre-foot*, defined as the volume of water that will cover 1 acre of land to a depth of 1 ft. A severe thunderstorm dumped 2.0 in. of rain in 30 min on a town of area 26 km². What volume of water, in acre-feet, fell on the town?

Solution

Volume is the product of area and depth. The area is 26 km², and the depth is 2 in. Convert them to acres and feet, respectively, using the conversion factor at the bottom of page A-5 ($10^4 \text{ m}^2 = 2.471 \text{ acre}$).

$$26 \text{ km}^2 \times \left(\frac{1000 \text{ m}}{1 \text{ km}} \right)^2 \times \frac{2.471 \text{ acre}}{10^4 \text{ m}^2} = 6400 \text{ acre}$$

$$2.0 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} \approx 0.17 \text{ ft}$$

Therefore, the volume in acre-feet is

$$\begin{aligned} \text{Volume} &= \text{Area} \times \text{Depth} \\ &\approx (6400 \text{ acre})(0.17 \text{ ft}) \\ &\approx 1.1 \times 10^3 \text{ acre-feet.} \end{aligned}$$