GS407/507 River Environments – Fluvial Hydrology Problem Set

Using the equation lists on p. 35-47 of your field guide, and the unit conversion charts on p. 123-130, solve the following problems. Show all of your math work and calculations!

1. The rational runoff method predicts peak runoff rates (discharge = vol / time) from data on rainfall intensity (i.e. rainall into drainage basin) and watershed characteristics (e.g. underlying bedrock type and infiltration capacity). The governing equation is:

$$Q_{pk} = 0.278CIA$$

Where Q_{pk} = peak discharge of drainage basin in m^3/sec, I = rainfall intensity in mm/hr, C = infiltration factor of watershed (asphalt/concrete = 0.80, thin soil over bedrock = 0.40), and A = drainage basin area in km^2.

A. Determine the peak discharge (in cubic meters per second) for a drainage basin experiencing a rainfall event with the following characteristics: drainage area = 10,000 acres, rainfall intensity = 1.25 cm/hr, and substrate = loamy soil over sandstone. Show all of your work.

B. If a drainage basin has an area of 175 km^2 and experiences a 30 mm/hr rainfall event with a 500 m^3/sec peak discharge, calculate the infiltration factor for the watershed. Show all of your work. Based on your answer, is this watershed likely rural/forest or highly urbanized? Explain your reasoning.

C. If 30% of a forested, 1000 km^2 watershed is urbanized, calculate the anticipated peak runoff associated with a 0.5 in/hr rainfall event.

2. If a river channel has a discharge of 5 ft^3/sec and a cross-sectional area of 5 m^2, calculate the average velocity of the river in m/sec. Show all of your math work.

3. Empirical data show that hypothetical watersheds in the western Cascades have peak flood discharges every 2-3 years as described by the following equation:

$$Q_{2.33} = 34.5A^{0.93}$$

Where Q = peak discharge in ft^3/sec and A = drainage area of a given basin in acres. Calculate the expected peak discharge for a drainage basin with an area of 125 km^2. Show all of your work.