Homework #1 – River Basins and Sediment Yield due February 16

Problem #1 (25%) Derivation
Derive the relationship between Manning n and the Darcy Weisbach f from f = k/Re. Consider laminar flow on a densely vegetated surface with constant k = 500,000. Can you find the value of Manning n on a hillslope when i = 1 in/h and L = 120 m. Would Manning n be the same when i = 2 in/h?

Problem #2 (25%) Upland runoff in SI
During the Colorado flood of 1976 in case Study 3.1 pp. 42-46, determine the maximum rainfall during a period of 3 hours. Determine the following on a 300 ft long rectangular impervious surface at a slope of 10%.

- Compare the time to equilibrium with the rainfall duration.
- Determine the maximum flow depth, velocity, unit discharge, Reynolds number, Froude number and shear stress. Is the flow laminar or turbulent? Is the flow subcritical or supercritical?

Problem #3 (25%) Infiltration and vegetation in English units
The soil of a detention pond in Fort Collins is made of 20% sand, 50% silt and 30% clay and covered with grass (about 6 in high). Determine the soil type, porosity, suction head and saturated hydraulic conductivity. Plot the infiltration rate and cumulative infiltration as a function of time starting from dry conditions. What would be the accumulation of water in the pond at the end of the rainstorm described in Problem #2.

Problem #4 (25%) Sediment yield in SI units
Consider the area described in Problem #2 and the soil type and vegetation from Problem 3. Estimate all the parameters of the USLE and estimate the mean annual erosion losses in tons per acre per year. Also estimate the sediment delivery ratio and the sediment yield from this area. (Hint: Find the iso-erodent map of the US on the web)