Environmental Modeling
Homework #6
Due on Thursday, November 8, 2012

Problem 1.

(1) Write a Matlab script to solve the following nonlinear equation using the Newton-Raphson method:

$$1000 + 2x - 20x^2 + \log(x) = 0$$

Set the threshold of the difference to be 10^{-3}.

(2) Make a plot of $g(x) = 1000 + 2x - 20x^2 + \log(x)$ between [x=1: 20] and mark your solution on the plot.

Problem 2.

A precipitation event with a constant rainfall rate w of 5.0 cm/hr and a duration of t_w=5 hr, occurs over a deep soil column with the following soil hydraulic characteristics and an initial soil moisture content of 0.4.

Soil saturated hydraulic conductivity K_s is 4.17×10^{-4} cm/s, porosity ϕ is 0.5, the air entry tension ψ_{ae} is -50.0 cm, and the pore-size distribution index b is 5.4.

(1) Is there potential for ponding?
(2) Calculate the wetting-front suction $|\psi_f|$
(3) Calculate the time of ponding t_p.
(4) Calculate the cumulative infiltration F(t) from t=0 to t=t_p.
(5) Calculate the cumulative infiltration F(t) from t=t_p to t=t_w using Matlab and the Newton-Raphson method with a time step of 0.1 hr.
(6) Make a plot of F(t) from t=0 to t=t_w.
(7) Determine the infiltration rate f(t) from t=0 to t=t_w with a time step of 0.1hr.
(8) Make a plot of f(t) from t=0 to t=t_w.