CE 3305 Fluid Mechanics; Quiz 2 Name: SOLUTIONS

CE 3305 Fluid Mechanics; Spring 2014
Quiz 3

1. Capillary rise can be used to approximate the height water will rise above a water table because interconnected pores in the soil act like capillary tubes. This behavior means that deep-rooted plants in the desert only need to grow at the top of the "capillary fringe" as depicted in Figure 1 to obtain water; they do not need to extend down into the water table.

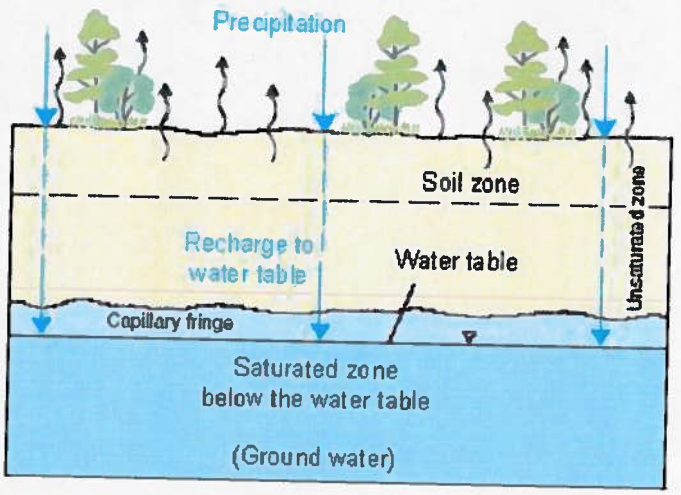

Figure 1: Sketch of near surface, sub-surface water compartments

a) Assuming that interconnected pores can be represented as a continuous capillary tube, how high is the capillary rise in a soil of silty loam with a pore diameter of 10 μm?

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$d = 10\mu m \times \frac{m}{10^6 \mu m} = 0.00001\,m$

$\Delta h = \frac{4\sigma}{\gamma d}$ Eq. 2.26.

σ (Fig 2.16) $= 0.0728\,N/m$

γ (20°C) (Table A.5) $= 9790\,N/m^3$

$\Delta h = 4(0.0728\,N/m)/[9790\,N/m^3 (0.00001\,m)] = 2.97\,m$

b) Is the capillary rise greater in a soil of fine sand (pore diameter $\approx 0.1mm$) or a soil of fine gravel (pore diameter $\approx 3.0mm$)?

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Fine sand has greater Δh.

REVISION A