American University of Beirut
Faculty of Engineering & Architecture
Department of Civil & Environmental Engineering

CIVE 441 Engineering Hydrology **Spring 2011**
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QUIZ I

NAME: **ID:**

This is a closed book, closed notes 90-min exam. The use of non-programmable calculators is allowed. Write clearly☺

PROBLEM 1: Is not exploiting groundwater an option?
A 50-km^2 watershed is the home of 80,000 inhabitants, who require an average of 200L ($0.2m^3$) of water per person per day. The average precipitation depth is 800mm a year, spread over 60days; evapo-transpiration is about 40% and the average infiltration rate is 0.2mm/hr.

The recently elected mayor has decided to close all wells.

1.1 Is this a wise decision?

1.2 According to the recently published GEF/UNDP/MoE Lebanon's Second National Communication to the UNFCCC, "the effect of climate change on water resources is expected to be significant as a result of decrease in precipitation and projected changes in its spatial and temporal distribution, in addition to an increase in evapo-transpiration...A reduction of 6 to 8% of the total volume of water resources is expected...". Based on this, would you change your recommendation for problem 1.1 above?

Bonus: what does the UNFCCC stand for?

PROBLEM 2: Is the average infiltration rate reasonable?

A civil and environmental engineering student who lives in the area described in problem 1 is interested in further studying the infiltration rate used in problem 1.

He decides to estimate Φ (the average/constant infiltration rate) from the following rainfall hyetograph assuming an interception storage of 1 in and using the following soil parameters: hydraulic conductivity k=0.25 in/hr, soil suction head ψ_s=7in, and increase of moisture content in the soil $\Delta\theta$=0.35:

Time (hr)	0	2	4	6	8
$\sum P$ **(in)**		3	7	9	9

2.1 Calculate and plot the infiltration rate using Green Ampt equation

2.2 Calculate and plot the estimated Φ rate (in/hr)

2.3 Compare the Φ rate to the average infiltration rate used in problem 1[1]. Is such an approach reasonable – i.e. can the average/constant infiltration rate calculated in this problem be compared to the average/ constant infiltration rate used in problem 1? Why?

[1] 1 in = 2.54 cm

PROBLEM 3: What about the irrigation wells?

Farmers who live in the area described in problem 1 decide to organize a strike because the mayor's new policy has not taken into consideration irrigation water.

They have 2 wells located at the coordinates (x;y) (m;m)= (0;0); (0; 1000) and the sea-front is along the y-axis at x=1000m. The aquifer's transmissivity is 3 m^2/min and storativity 0.15. They claim the total pumping rate is not exceeding 1.75 m^3/min.

The Mayor is accusing them of over-exploiting groundwater as the municipality monitoring well located at (0; 500) shows a drawdown of 2mm after 24hrs of pumping.

3.1 What do you think? Assume equal pumping rates at the two wells

3.2 What is the steady state drawdown at the monitoring well?

3.3 Is the position of the mayor justifiable?

Thursday April 7th – common class to both sections:
Do not forget to bring your laptops (with HEC-HMS already installed!) and a hard copy of the HEC-HMS example posted on Moodle