Aim of this assignment

The aim of this assignment is to test your understanding of concepts introduced in Lectures 1-4.

What you need to do

1. All answers must be accompanied by correct question number.
2. Submit all answers in a single word file. Insert equations using Word's equation editor or Mathtype. You may also draw diagrams in word, if needed. Clarify all symbols in the text along with brief explanation of how you will solve the problem.
3. Your name and roll number should be mentioned on the first page of the file.
4. Name the word file as YourRollNumber_CE626_AS1.docx

Deadline

The assignment is due on 14th August 2018 at 5.30 pm.

Question 1

An unconfined stratified aquifer with three layers of different hydraulic conductivities is shown in Figure 1. A discharge of 3.5 m^3/d is known to pass through the aquifer. The piezometric head values as obtained from observation wells at different locations, at the beginning and end of each layer, are given below:

Boundary location	Distance from left end (km)	Piezometric head (m)
Layer 1 begins	0	70
Layer 1 ends, layer 2 begins	2.5	63
Layer 2 ends, layer 3 begins	6.5	60
Layer 3 ends	8	50

Find the hydraulic conductivity of the aquifer at each layer.

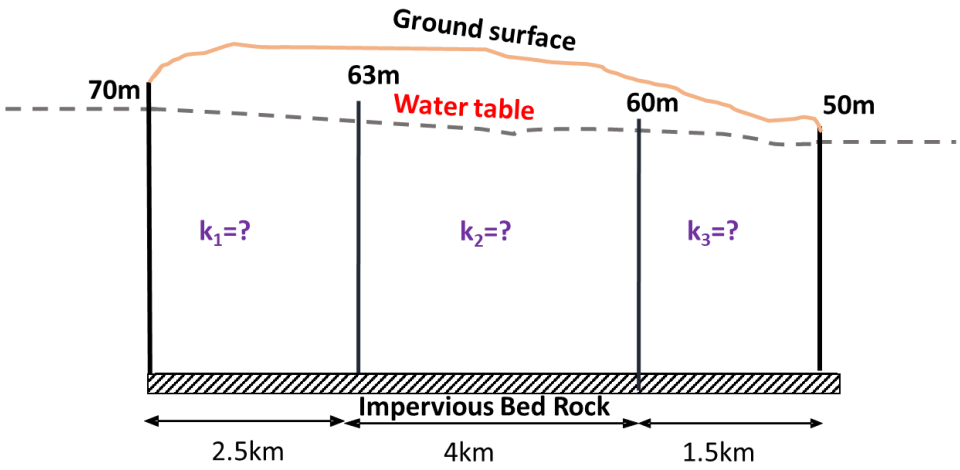

Figure 1. Schematic for the layered unconfined aquifer in Question 1.

(10 marks)

Question 2

An 80 m thick confined aquifer is continuously pumped for a long duration. Due to this, the piezometric head declines from 43 m to 37 m. The aquifer is composed of sandy gravel with a compressibility of 5.2×10^{-9} m^2/N and porosity of 20%. For these conditions, answer the following:

a) Compute the total volume of water withdrawn from the confined aquifer. (Hint: calculate storage coefficient)

b) If the aquifer is recharged artificially by 50 injection wells at a rate of 0.5 m/month, determine the time taken (in hours) to restore the head to the initial conditions in the aquifer.

c) Redo (a) and (b) above, if the aquifer is unconfined with specific yield of 20%.

d) Using the above analysis, what can you say about recharge rates in confined and unconfined aquifers?

Note: Compressibility of water in the aquifer is 4.8×10^{-10} m^2/N

Calculate surface area of the confined aquifer as: (last digit of roll no.*1000) km^2.

(10 + 5 + 10 + 5 marks)

Question 3

The river Mahanadi flows around a major part of the city of Cuttack, Odisha (Figure 1). The city is underlain with unconsolidated alluvial deposits with a hydraulic conductivity of 10^{-2} cm/sec. The depth to a confining clay layer is 100 m. The average annual rainfall over Cuttack is 1500 mm, of which 70% falls during the monsoon season. Assume that recharge to the unconfined aquifer underlying the city occurs only during monsoon and 30% of the incoming rainfall ultimately reaches the aquifer for recharge. Making suitable assumptions, answer the following:

a) If the average annual depth of river on either side of the city is 4 m and 5 m, assess whether a groundwater divide exists. If yes, how far is it from the left edge of the aquifer? Also estimate the height of groundwater table at the groundwater divide, if it exists.
b) Estimate the magnitude and direction of groundwater flow (in volume per unit time) for the region shown in Figure 1.
c) A contaminant spill occurs close to the location of the groundwater divide. In case there is no groundwater divide, assume that the contaminant spill occurs right in the middle of the island. Estimate the time taken for the contaminant to travel from the unconfined aquifer location right below spill zone to either rivers.
d) Assume that the city plans to supplement its daily water supply with groundwater pumped through the unconfined aquifer. The number of people living in the region shown in Figure 1 is 4,00,000 and the per capita demand for freshwater is 150 litres/ day. If the city supplements 50% of its daily supply with groundwater, how will the magnitude and direction of groundwater flow in the region change as compared to the situation in (a) above? How will the location of the groundwater divide change?

(15+10+10+15)

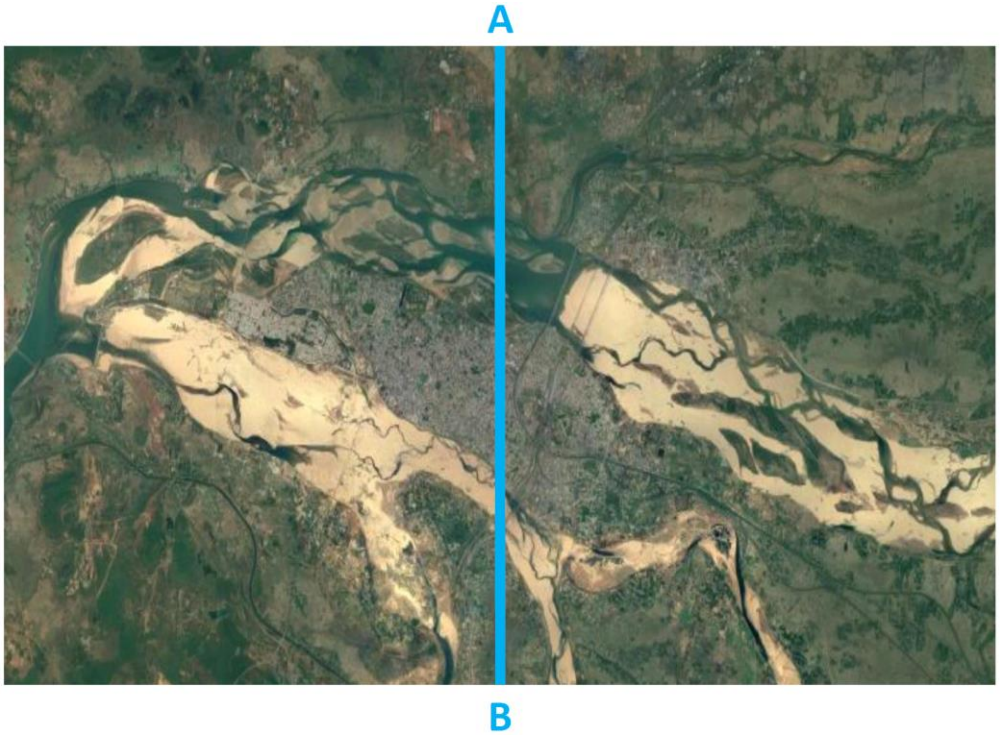

Figure 2. Location of Cuttack city between two branches of the Mahanadi river. Assume the length of the city flanked by the river as 2 Km.

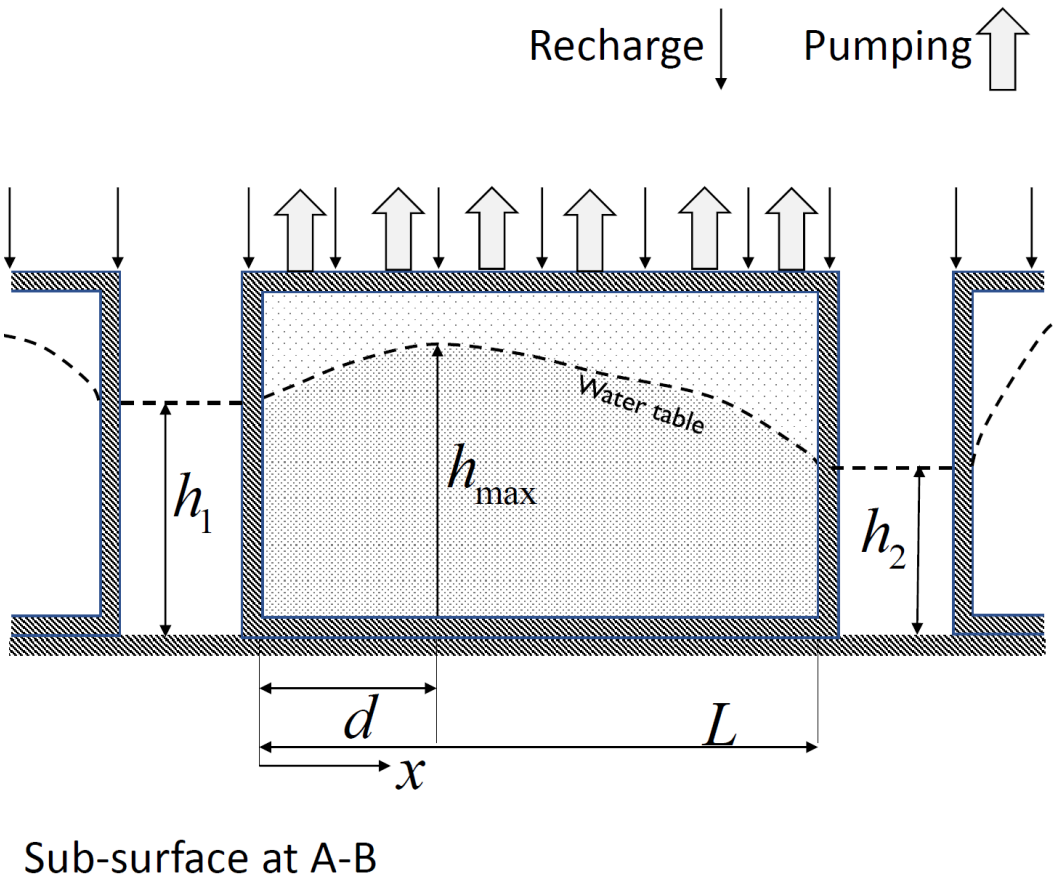

Figure 3. The sub-surface at section A-B. L=750 m.