Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
3rd Year 2nd Semester Examination – Dec./Jan. 2018/2019

Uva Wellassa University

MRT 387-1 Simulation of Groundwater Systems

This is a practical examination
Number of questions: Two (02)
Answer **all** questions
Question 1: Manual plotting, Question 2: Computer simulation
Time allocation: Two (02) hours
Mark allocation: 100

1. Figure 1.1 (Page 3) shows a schematic diagram of a well field located in an aquifer system. The hydraulic head distribution around the pumping well has been calculated using a groundwater flow model when the pumping well is in continuous operation. The hydraulic head values calculated for a part of the aquifer are shown in Figure 1.2 (Page 3) in plan view.

   (a) Contour the hydraulic heads and indicate the flow lines on Figure 1.2 using the given values. Use 6.80m, 7.40m, 8.00m, 8.60m and 9.20m as index contours.
   (20 marks)

   (b) Briefly describe the groundwater flow pattern. Draw a cross section of the potentiometric surface along XY. (Use the space on Page 4 for your answer)
   (10 marks)

2. Two pumping wells are located in an aquifer system consisting of two stratigraphic units with an areal extent of 1 km x 1 km. It is bounded by no-flow boundaries on the north and south. The western and eastern boundaries of the aquifer system are rivers that are in full hydraulic contact with both units. These boundaries can be considered as fixed-head boundaries. The pumping wells supply water to a community and they penetrate both stratigraphic units (Figure 2.1).

   Create a groundwater model for the above scenario using the MODFLOW program suite. Save your data in your working folder named "MRT15_your_index_number" on Z: Drive.

   Use following input data to create the model.

   Upper layer : Unconfined
   Lower layer : Confined
   Grid dimensions : 50 columns and 50 rows with 20m square cells
   Fixed-head boundaries along eastern and western borders in both layers
   Top of upper layer : 10m

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Top of bottom layer : 6m
Bottom elevations calculated
Time step : 9.46728E+07 s.
Initial hydraulic heads (both layers): 9.0m at western border, 8.0m in all other cells
Horizontal hydraulic conductivity (m/s): Upper 0.0001, Lower 0.0005
Vertical hydraulic conductivity (m/s) : Upper 0.00001, Lower 0.00005
Effective porosity : Both layers 0.25
Recharge : 7E-09 m/s (upper layer only)
Pumping Well 01; Location (Grid cell) and Pumping rate (m3/s): (35,40,1) -1E-10, (35,40,2) -0.008
Pumping Well 02; Location (Grid cell) and Pumping rate (m3/s): (20,15,1) -1E-10, (20,15,2) -0.01

Assuming a homogeneous and an isotropic aquifer system, run a steady-state flow simulation.

(a) Produce the hydraulic head distribution pattern of the lower stratigraphic unit (lower layer) using a contour plot when the pumping well is in continuous operation.

(50 marks)

(b) Plot the flow lines of the lower layer and overlay the contours. Save the graphics in picture format.

(20 marks)

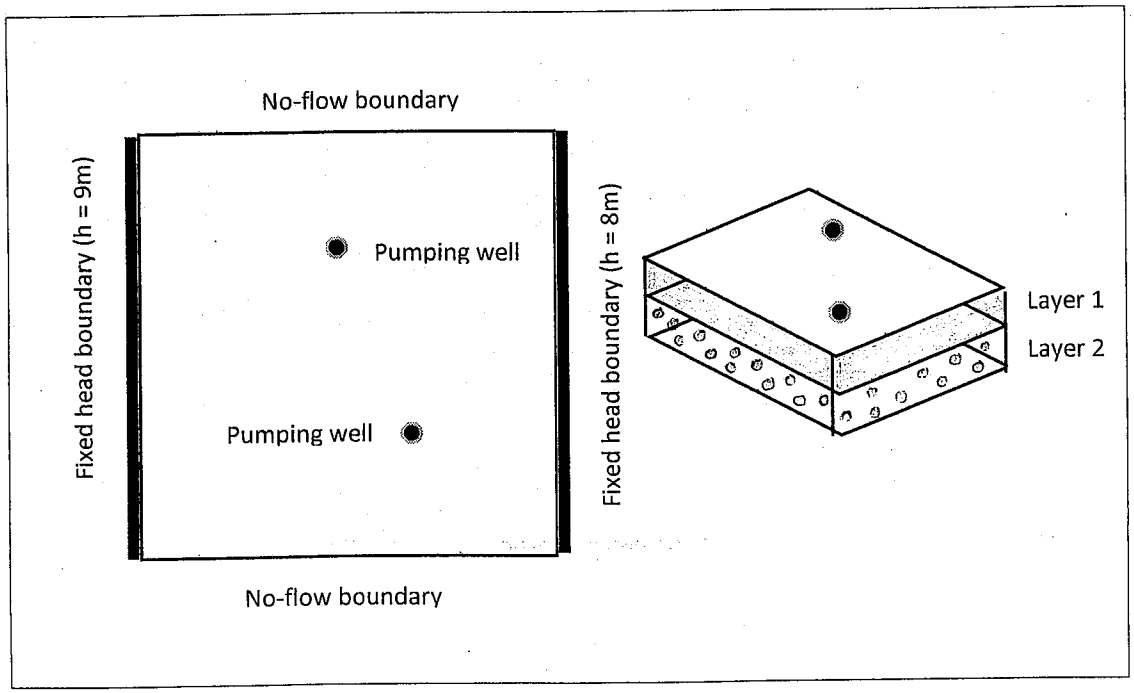

Figure 2.1. Schematic configuration of the aquifer system with pumping wells

Index No. UWU/MRT/15/_____

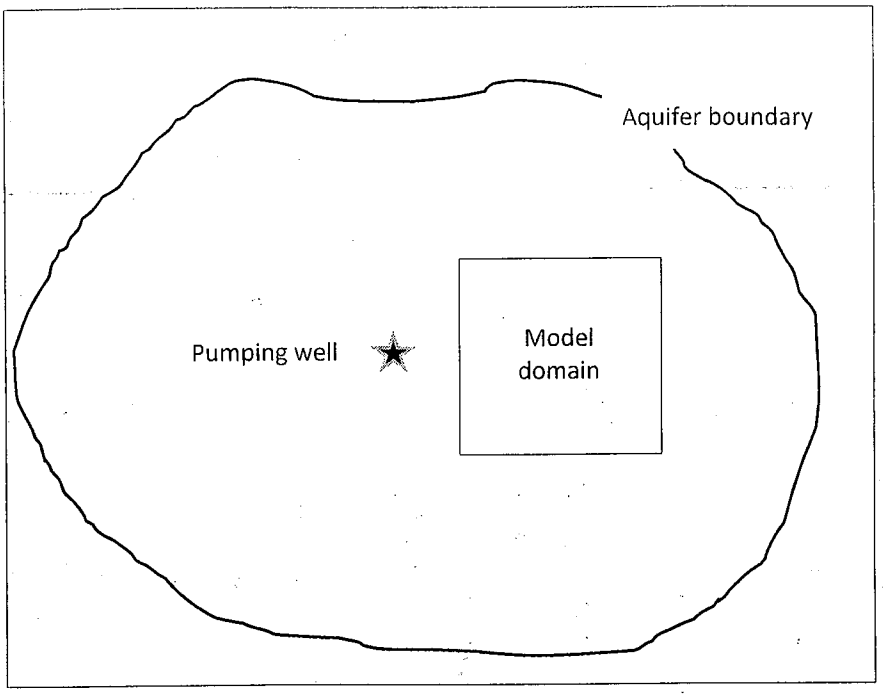

Figure 1.1. Well field in a homogeneous and isotropic aquifer system

7.40	7.60	7.80	8.10	8.40	**8.60**	8.90	**9.20**
7.00	7.38	7.60	7.80	8.25	8.40	8.60	8.90
6.80	7.10	7.39	7.58	**8.00**	8.38	8.57	8.81
6.40	7.00	7.30	7.58	7.62	8.18	8.52	8.70
6.39	7.00	7.10	7.50	7.62	8.15	8.57	8.70
6.41	6.90	7.30	7.50	7.61	8.10	8.48	8.82
6.80	7.10	**7.40**	7.58	**8.00**	8.40	**8.60**	8.90
7.00	**7.40**	7.60	7.80	8.10	8.45	8.90	**9.20**

X

Y

Figure 1.2. Calculated hydraulic head values in a part of the aquifer

Provide your answer to Question 1 (b) here.