

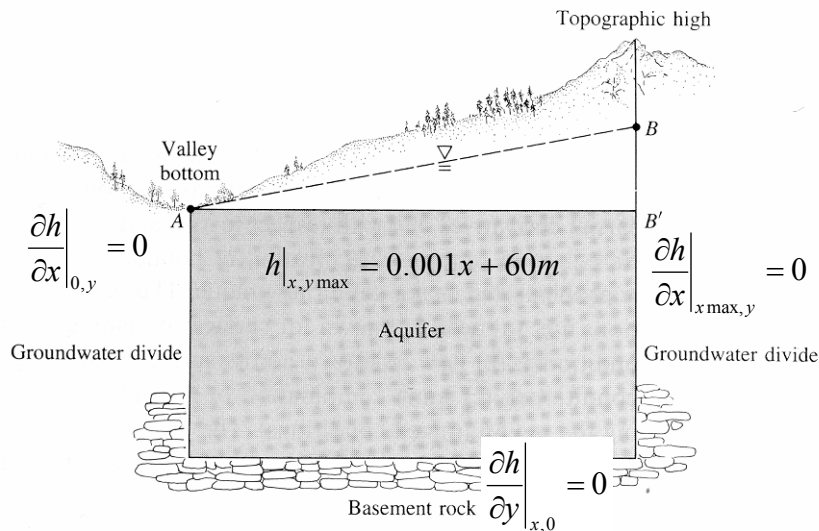
GLY-4822

Assignment 7

1. Solve problems 3, 4, and 5 from Assignment 6 using a 1-D spreadsheet finite difference model. Plot the results from both approaches on the same graph; use open symbols for the numerical solution and a solid line for the analytical solution.

2. The 2-D Laplace equation (Poisson equation without recharge) is $\frac{\partial^2 h}{\partial x^2} + \frac{\partial^2 h}{\partial y^2} = 0$. It can be

solved on a spreadsheet by iteration with a remarkably simple numerical stencil [for example, in cell c3, $h = (b3 + c2 + d3 + c4)/4$]. Use this model to solve for the heads in a domain 100 meters in the x direction and 50 m in the y direction. The head gradient along the top boundary (a constant head boundary) is 0.001 (head increasing with x) and the head at $x = 0$ is 60 m. The boundary conditions are those represented on the following figure (Wang and Anderson, 1982):



Plot and contour the heads, and draw the flowlines.

3. Change the upper BC in Problem 2 to include a sine function: $h = h_o + x \frac{dh}{dx} + 0.1 \sin(2\pi x/x_{max})$. Plot and contour the heads, and draw the flowlines.

4. The Thiem equation for steady state flow towards a well in a particular confined aquifer is

$$h = 10m + \frac{Q}{2\pi T} \ln \frac{r}{2000m} \quad (1)$$

The head is a function of the radial distance from the well r , which for a well centered at (0,0), is

$$r = \sqrt{x^2 + y^2} . \quad (2)$$

Take $Q = 2000 \text{ m}^3\text{d}^{-1}$ and $T = 300 \text{ m}^2\text{d}^{-1}$. Plot the head field using Excel.

5. Get the Groundwater Vistas software at <http://www.esinternational.com/software/Download.asp>. You will need to register. You can skip the 'last' installation step.

Use MODFLOW to solve the pumping well problem. Compare with the results obtained in Problem 4.

If you use the default x and y spacing of 100 m but set a 41 x 41 grid, your domain will be about 4000 x 4000 m with its center roughly at 2000, 2000 (at cell 21,21). That's a good place for the well.

To get $T = 300 \text{ m}^2\text{d}^{-1}$, the product $K b$ of course needs to be $300 \text{ m}^2\text{d}^{-1}$. So, if the aquifer thickness b is set to 10 m, K must be 30 m d^{-1} . For this homogeneous, isotropic aquifer $K_x = K_y = K_z$.

Set constant head boundaries of 10 m on all edges of the domain. Note that this is only an approximation to the Thiem equation, which has constant head at 2000 m RADIUS from the pumping well. If you are ambitious, you can set constant heads at the proper locations inside the model domain too.

Now, under MODEL, MODFLOW, PACKAGE OPTIONS, BLOCK CENTERED FLOW, make Layer 1 a confined aquifer. This corresponds to the assumption in the Thiem equation. If you don't make this change, your aquifer will dry up.

Under MODEL, MODFLOW, create the data set. Then under MODEL, MODFLOW, run the model and process the results.

Use PLOT, CONTOUR, PARAMETERS, PLAN to pick a reasonable contour interval and label font size.