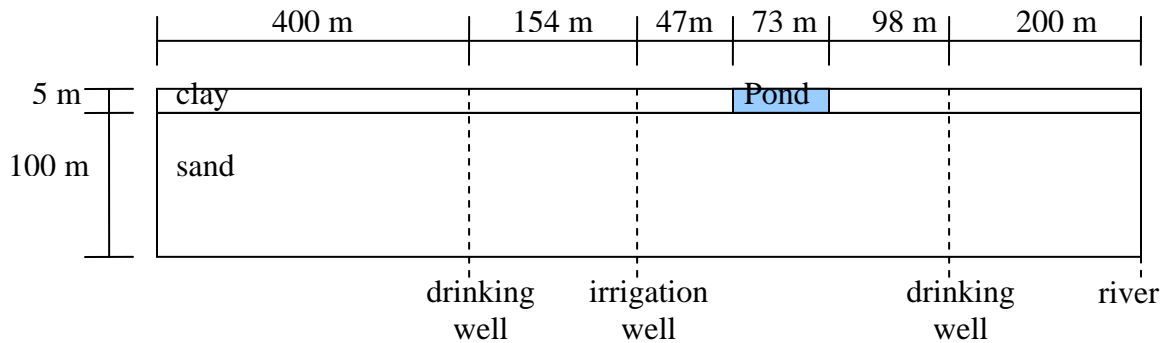


Numerical Modeling Assignment 2

The goal of this homework is to understand the vertical flow and transport within the Bangladeshi aquifer by constructing a two-dimensional model in FEFLOW.

The figure below illustrates the 2-D section that we are interested in modeling:



The cross section has the same properties as the 3-D section modeled in the first numerical modeling homework (e.g., same pond depth, well depths, well extraction rates, evaporation and precipitation rates, hydraulic conductivities, and standing level of field water). A major help in setting up this cross section is to select “vertical problem projection” in the Problem Class window. Also select the “Flow and Mass Transport” option in this window since we want to explore mass transport in the assignment. Finally, be sure that your wells draw water from a vertical length of screen and not from just one individual point. Make sure that you can save your mesh before proceeding with your model. If you can’t save it, reduce the number of elements.

Please describe your initial conditions and flow boundary conditions for this 2D domain. Run your flow model for one 100-day long dry season. Be sure that your flow results make sense. Screen capture some head values and briefly describe the flow patterns in the domain. On day 100, what is the vertical flux of water from the clay layer into the aquifer? How much of this flux comes from the pond?

Now we want to see exactly where water from the field, pond and river moves within the aquifer. To do this, sequentially add a “tracer” to each of these components and see where this tracer migrates during thirty 100-day dry seasons (irrigation began about 30 years ago in Bangladesh). Assume that flow and transport do not occur during the monsoon seasons that interrupt the dry seasons. However, be careful with how you deal with the water level in the pond for this simulation. If you run the model continuously for 3,000 days, the pond might dry out. In reality, the pond gets recharged each monsoon season. Make some good simplifying assumptions to deal with this problem. Let us know

what you end up doing. Please describe what you see and include some screen shots. Where do the drinking water wells obtain most of their water?

Let us say that Charlie's field research in Bangladesh has shown that the arsenic concentrations in drinking water wells are related to how much young surface water the wells extract. However, it is not clear which surface water body is responsible for the contamination (i.e., fields, ponds, or rivers). Using the knowledge gained from the above simulations, where would you move the irrigation well in order to reduce the amount of young 1) field water, 2) pond water, and 3) river water enter the drinking water wells? Why? Try moving the irrigation well to these locations and for each situation show us the resulting concentrations entering the drinking water wells after 30 years worth of dry seasons. (There is a nice feature in FEFLOW that allows you to refine the mesh. Using this feature will make moving the well easy.)

Extra Credit

Determine the residence time of water within the aquifer. White Papers Vol. 1, p. 139 explains an easy and efficient way to do this. Run the flow field to steady state conditions before you add the tracer to the surface.