CIE 5440. Large AEM Assignment

Due date: 9:45, Tuesday 29 May, 2018

Introduction

The purpose of this exercise is to use TTim for analyzing pumping test data from an aquifer test conducted near a river with possibly significant bed resistance and non-linear geometry. The test well and observation wells are screened over only a portion of the aquifer thickness.

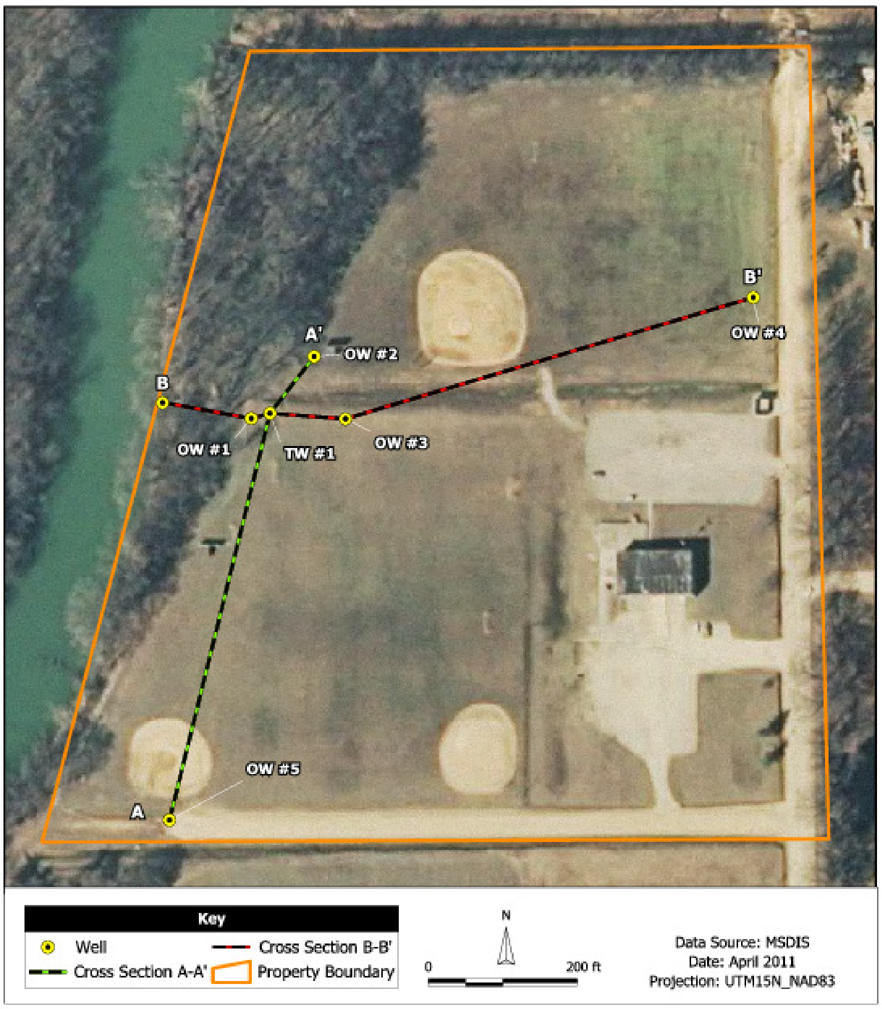

Figure 1: Layout of puming well (TW), observation wells, and geological sections

The aquifer test was performed next to the Black River, 2 km NorthEast of Poplar Bluff, Missouri (USA), to assess the potential yield of a riverbank filtration system for water supply. A test well and five observation wells were installed at the site, as shown in Fig. 1 (scale is in feet). The geologic sections shown on Fig. 1 are presented in cross sections in Figs. 2 and 3. The boring logs indicate that the aquifer consists of sand

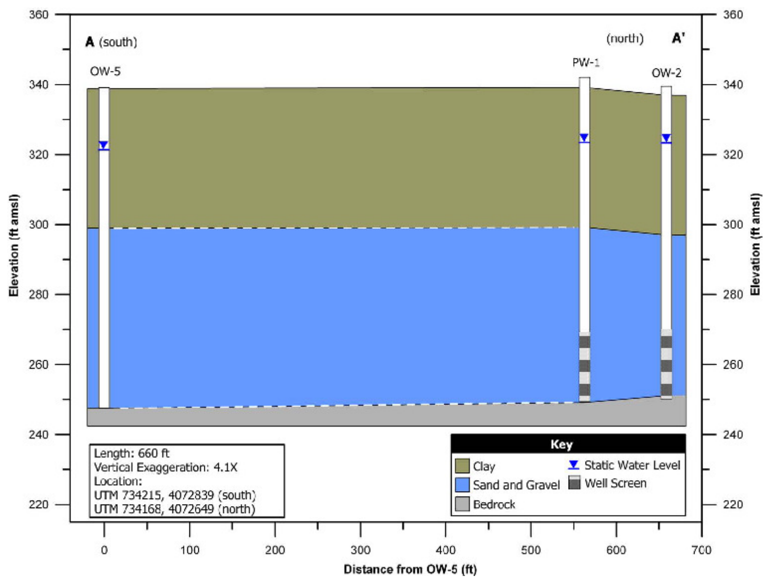

Figure 2: Cross section along A–A'

and gravel confined on top by a 12-m-thick clay layer and below by bedrock consisting of low-permeability material. The aquifer has a fairly uniform thickness of 15 m across the well field. The test well and the observation wells are screened over the bottom 6 m of the aquifer, except for well 1, which is screened over 9 m. The test well has a diameter of 0.3 m. The river lies on top of the aquifer and cuts partly through the confining clay layer. A 72-hour constant rate aquifer test was conducted with an average pumping rate of 3145 cubic meters per day. The coordinates of the locations of the five observation wells are converted to meters and given in Table 1.
The following 7 files are provided:

1. ow1m.txt –time (minutes) and drawdown (m) measured at OW1
2. ow2m.txt– time (minutes) and drawdown (m) measured at OW2
3. ow3m.txt– time (minutes) and drawdown (m) measured at OW3
4. ow4m.txt– time (minutes) and drawdown (m) measured at OW4
5. ow5m.txt– time (minutes) and drawdown (m) measured at OW5
6. rivereast.txt – x, y cooridinates (m) of the east river bank

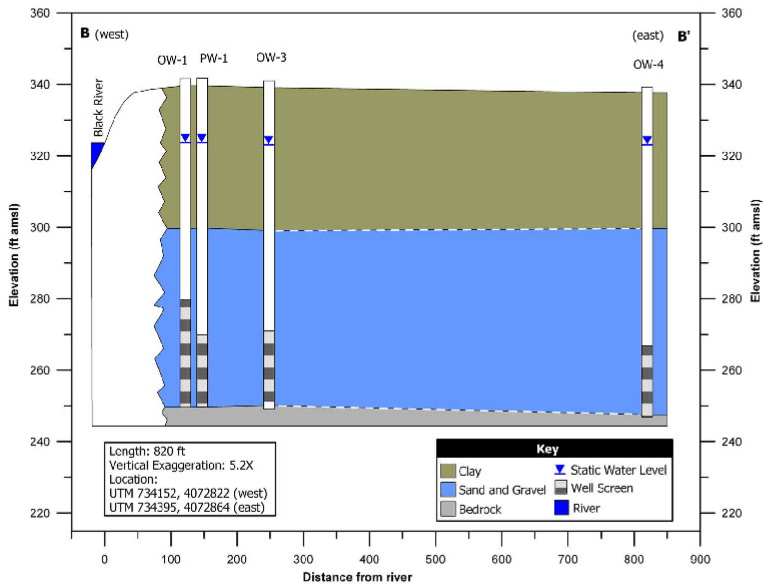

Figure 3: Cross section along B–B'

Table 1: Location of pumping well (TW) and observation wells (OW) converted to meters from original data

Well	x (easting)	y (northing)
TW	734197.1	4072815.9
OW1	734189.4	4072813.8
OW2	734215.0	4072839.4
OW3	734227.8	4072813.8
OW4	734394.9	4072863.5
OW5	734155.9	4072649.8

Questions

Develop a Jupyter Notebook where you answer the following questions. Document your work by providing enough information to understand what you are doing. Approximate the aquifer with one model layer.

Question 1. Determine the hydraulic conductivity and specific storage coefficient of the aquifer by using the measurements at one observation well at a time without taking into account the river. This results in 5 separate estimates of k and S_s. Create 5 graphs showing the data of each well and the best-fit line of the modeled head. A semi-log plot may be the best.

Question 2 Determine the hydraulic conductivity and specific storage coefficient of the aquifer by using the measurements at all observation wells simultaneously without taking into account the river. Create one graph showing the data of each well and the best-fit line of the modeled head. A semi-log plot may be the best. Report the root mean square error.

Question 3 Determine the hydraulic conductivity and specific storage coefficient of the aquifer by using the measurements at all observation wells simultaneously and by including the river, assuming the river is in full contact with the aquifer (no bed resistance). Create one graph showing the data of each well and the best-fit line of the modeled head. A semi-log plot may be the best. Report the root mean square error. Is the value of the root mean square error smaller than for Question 2?

Question 4 Determine the hydraulic conductivity and specific storage coefficient of the aquifer and the bottom resistance of the river by using the measurements at all observation wells simultaneously and by including the river, assuming the river has a leaky bed. Create one graph showing the data of each well and the best-fit line of the modeled head. A semi-log plot may be the best. Report the root mean square error. Is the value of the root mean square error smaller than for Question 3?

Collect your answers for Questions 2, 3, and 4 in one large table.