Course:

- ***GW Flow and Contaminant Transport Modeling (MSc in EnvE &HgE)***

Homework #5/2019: Determination of the capacity and well head protection area of a well farm of a small village

<u>Hydrogeological problem</u>

Establishment of a well farm of three production wells on a shallow aquifer situated in a small valley is under planning. The geological investigations were performed using 30 drillings. The boreholes discovered a sandy gravelly layer of an approx. 13 m total thickness. The boundary of the alluvial system was determined by geologists. The shallow aquifer is not only recharged by precipitation but also by a silty layer surrounding the shallow aquifer, moreover a small creek in hydrodynamic contact with the aquifer is also crossing the site. The location of the planned wells is given. The task is to determine the capacity of the wells (with at least 1 m saturated aquifer thickness at the wells) and - using this determined capacity - to delineate some protection zones round the wells based on the 20 days, 6 months, 1 and 5 years transit time.

The data of the site investigations already performed are documented in several files with names as follows:
The boundary of the aquifer - ***Kiekel_boundary.****
The data of drillings (coordinates and AQ thicknesses) - ***Furas_borehole.****
The hydraulic conductivity values determined by pump tests - ***Furas_borehole.****
Surface elevation map: ***Terep – Surface.****
Location of the creek: ***Patak – Creek.****

Additional information: The average recharge from precipitation is 75 mm/year. The average groundwater potentials are 1 m below surface. The creek has an average width of 5 m. The riverbed conductivity is 0.5 m/d, the riverbed thickness is 0.25 m. The stage (water level) in the creek is 1.2 m below surface (the river discharges the aquifer in primary state). The average depth of the creek is 1.7 m measured from the water level in the creek. There is a continuous recharge at the aquifer boundary from a silty formation in all sides. The average hydraulic gradient of 2 m/km in this silty formation is perpendicular to the boundary of the shallow alluvial aquifer.

Modeling tasks:
Task 1. Building of a steady state model of the system (all not mentioned data can be chosen in the realistic range).
Task 2. Implementation of wells on locations A, B & C. Determination of maximal production rates where the system can still work in steady state (well farm capacity determination)
Task 3. Determination of pathlines starting from the wells to determine the influence zones of 20 d, 6 m, 1 and 5 yr.
Task 4: Delineation of well-head protection areas by the contour of influence zones.

Materials to be presented:

<u>In printed form a short report of the problem with</u>
- the description of the model
- the details of the chosen data set
- graphic presentation of the mentioned potential fields (primary state and after installation of wells) or drawdown distribution (when all new wells are active)
- graphic presentation of pathlines at different transit times
- the evaluation of results

<u>Digitally (only at the end of semester)</u>
- report in document form
- dataset of primary state and operational conditions
- plots in graphical form