INTERPRETATION OF PUMPING TESTS USING NUMERICAL MODELS FOR CONDITIONS OF HIGH VARIABILITY OF HYDRAULIC PROPERTIES IN PROFILE (ALLUVIAL AQUIFER)

Client: Paks II. Ltd (Hungary)

Objective: Determination of vertical distribution of hydraulic properties in the alluvial aquifer

Method: The aquifer test was interpreted using ANSDIMAT numerical module for radial flow simulations

On the construction site of a Nuclear Power Station, hydrogeological conditions are controlled by the hydraulic properties of alluvial deposits. The hydraulic properties are relatively homogeneous in plan, but display high variability in profile.

Understanding the distribution of zones of higher and lower permeability was necessary for predicting inflows into the excavation during the construction of the Power Station.

To determine hydraulic properties of the alluvial aquifer, more than 10 pumping tests were conducted from partially penetrating pumping wells that were screened to target various intervals of the alluvial aquifer.

Although commonly used analytical solutions can model multi-layered systems with aquitards and aquifers, they cannot correctly account for profile zones with smooth changes in hydraulic properties. Therefore, these tests were interpreted with the numerical (radial) module of ANSDIMAT. The module incorporates pre- and post-processing tools for the RADFLOW computer code[1].

Fig.1 illustrates the vertical discretisation of hydraulic conductivity for one of the test sites. Fig.1 also shows the vertical position of screens for pumping wells and the location of observation wells.

The **RADFLOW** models for each site were calibrated to drawdown response in monitoring wells. Fig.2 and 3 present examples of match between observed and simulated drawdowns for the calibrated model. The final set of calibrated parameters for each model layer is presented on the Table below.

Fig.4 shows the depression cones caused by pumping from the lower and the upper intervals respectively.

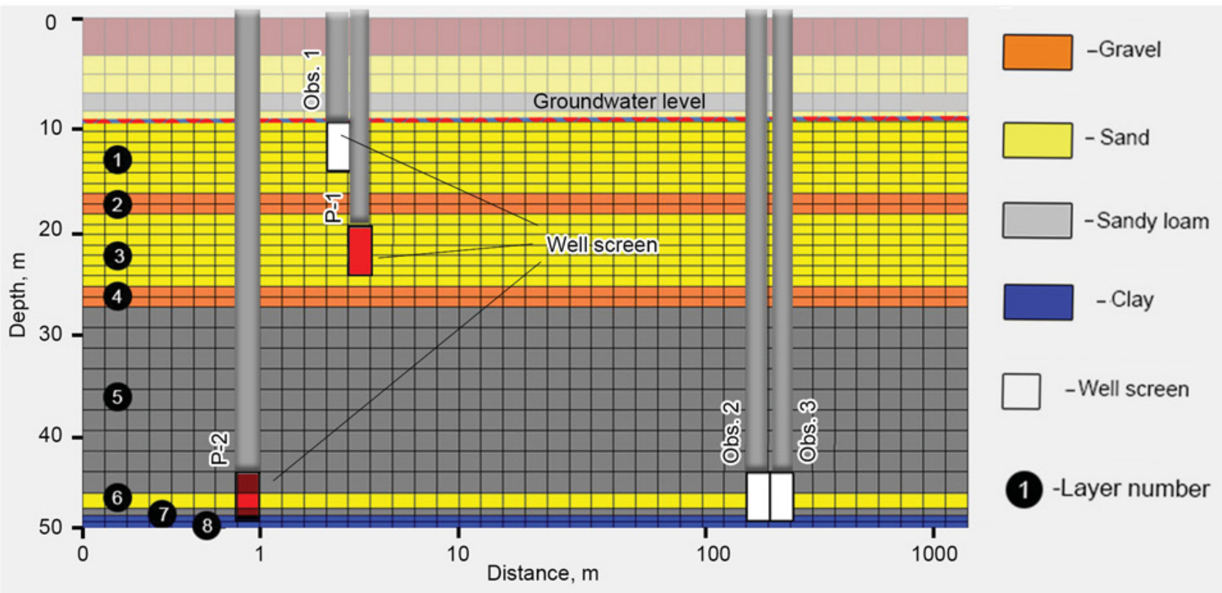

Fig. 1. RADFLOW model set up: property zones, location of pumping and observation wells, P-1 & P-2 site

[1] – G.S. Johnson, D.M. Cosgrove, Idaho Water Resources Research Institute, http://www.if.uidaho.edu/~johnson/ifiwrri/radflow/radflow.html

The numerical radial flow simulation is more reliable for interpretation of layered aquifer systems than more simplified analytical solutions. Furthermore in this study, parameter non-uniqueness, a common issue in aquifer tests interpretation, was significantly reduced by including tests from intervals at different depths in the model.

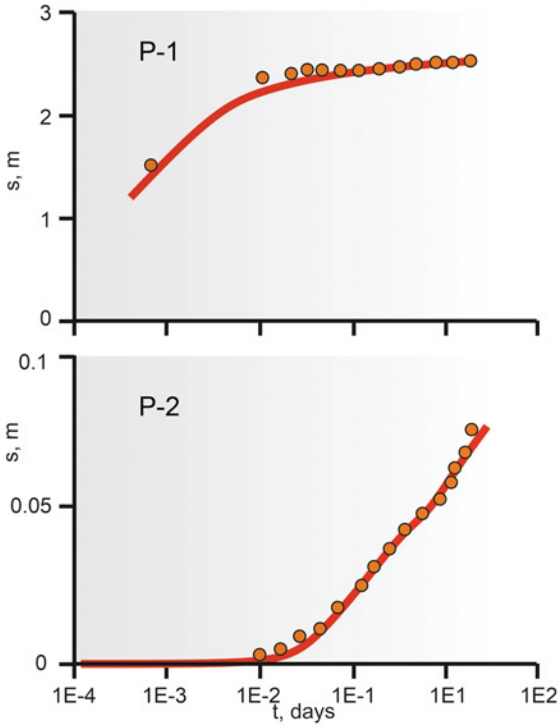

Fig. 2. Comparison of observed and modeled drawdown values in test well P-1 and observation well P-2

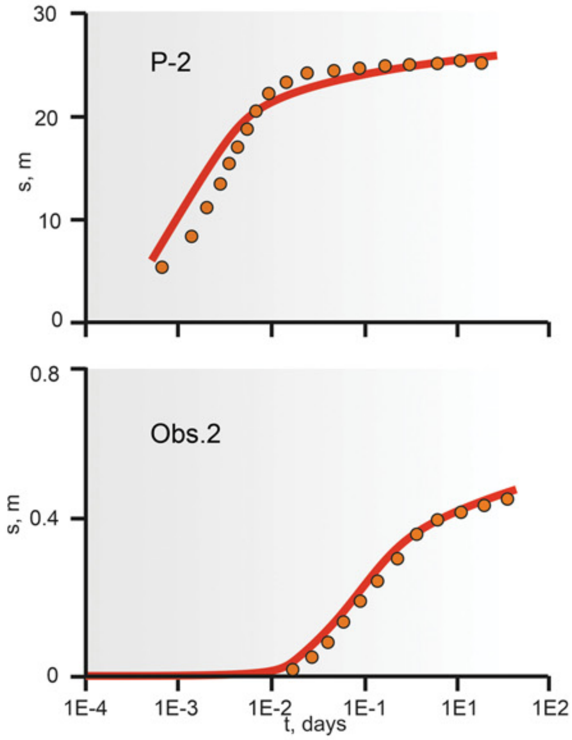

Fig. 3. Comparison of observed and modeled drawdown values in test well P-2 and observation well Obs.2

Table – Final calibrated parameters at the test site

#*	Lithol.	Depth to the layer bottom, m	k_x, m/d	k_z, m/d	S_s, 1/m	S_y, -
1	Sand	17.0	40	30	0.25	0.25
2	Gravel	19.7	60	60	0.25	–
3	Sand	26.4	39.5	5	0.02	–
4	Gravel	28.0	60	60	0.02	–
5	Silt	46.0	0.1	0.01–0.0015	0.000005	–
6	Sand	47.5	1.7	1.7	0.000005	–
7	Silt	48.2	0.1	0.0001	0.000005	–
8	Clay	49.4	0.0001	0.0001	0.000005	–

* layer number in the Fig.1

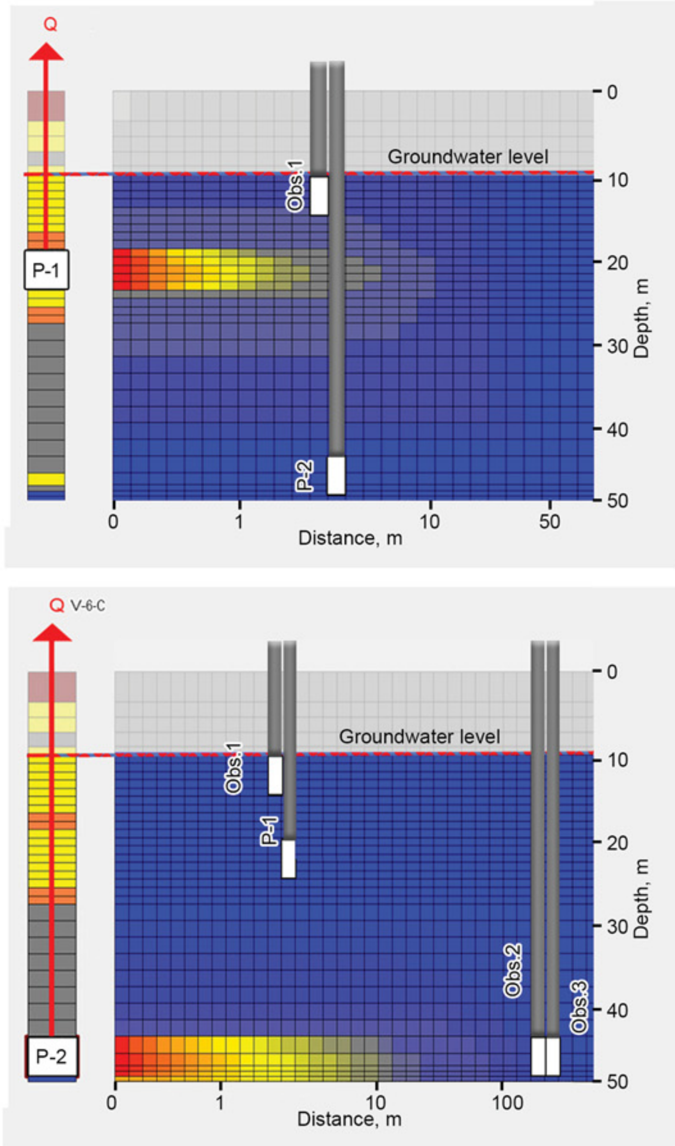

Fig. 4. Drawdown distribution through tested section at the end of the pumping test in the well P-1 (from above) and P-2 (from below)