WELL FIELD OPTIMISATION FOR WATER SUPPLY FROM AN ARTESIAN AQUIFER

Client: Water and juice production company, Russia

Objective: Determine the minimum amount of production wells and the minimum distance between them to sustain the required water supply while not exceeding the permitted drawdown

Method: Test different wellfield configurations in an analytical model (AMWELLS)

A sustainable water supply of 2000 m^3/day is required for a water and juice production company. Sufficient groundwater resources are available in the Vendian artesian aquifer at a depth of 150 m below ground level in the close vicinity of the water factory (industrial area near the St-Petersburg airport). The aquifer is relatively homogeneous, with a thickness of 50 m at the study site, a hydraulic conductivity of 2 m/day and a storage coefficient of 0.001. The aquifer static water level is 20 m above the aquifer's top.

The objective of this study was to determine the optimal well field layout that:

- Could sustain water supply of 2000 m^3/day for 25 years;
- Minimized both the number of wells and the distance between them;
- Resulted in a drawdown that would not exceed 20 m at any location after 25 years.

Exceeding this value would change the aquifer regime from confined to unconfined, and this was not permitted by the State environmental regulations. Pumping the required amount from a single well would result in a 41.5 m drawdown after 25 years, exceeding the permitted value.

Optimisation of the well field was conducted using the AMWELLs module, that applies the superposition principle to common analytical solutions for aquifer drawdown.

Optimisation was conducted for two types of well field layouts: a line of wells and a circle of wells. The number of wells was changing between 2 and 5 for different model runs, and distances between production wells were varied as well. The optimisation process aimed at determining the minimum number of wells and at the minimum distance between them for the condition that drawdown in any well would not exceed 20 m after 25 years of well field operation.

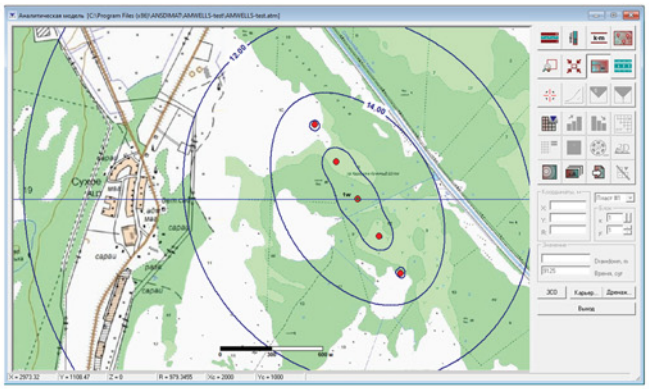

Fig. 1. Well field layout with a line of wells and simulated drawdown contours after 25 years of the well field operation

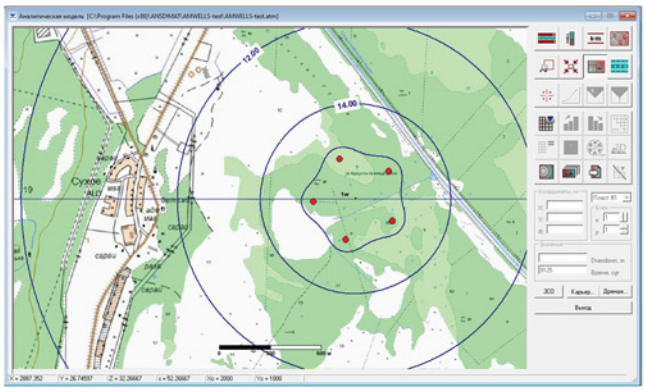

Fig. 2. Well field layout with a circle of wells and simulated drawdown contours after 25 years of the well field operation

The optimal well field layouts are presented on Fig.1 (line of wells) and Fig.2 (circle of wells). Fig.3 shows that the permitted drawdown won't be exceeded either for the 2-km line of 5 production wells or the 700 m diameter circle of 5 wells.

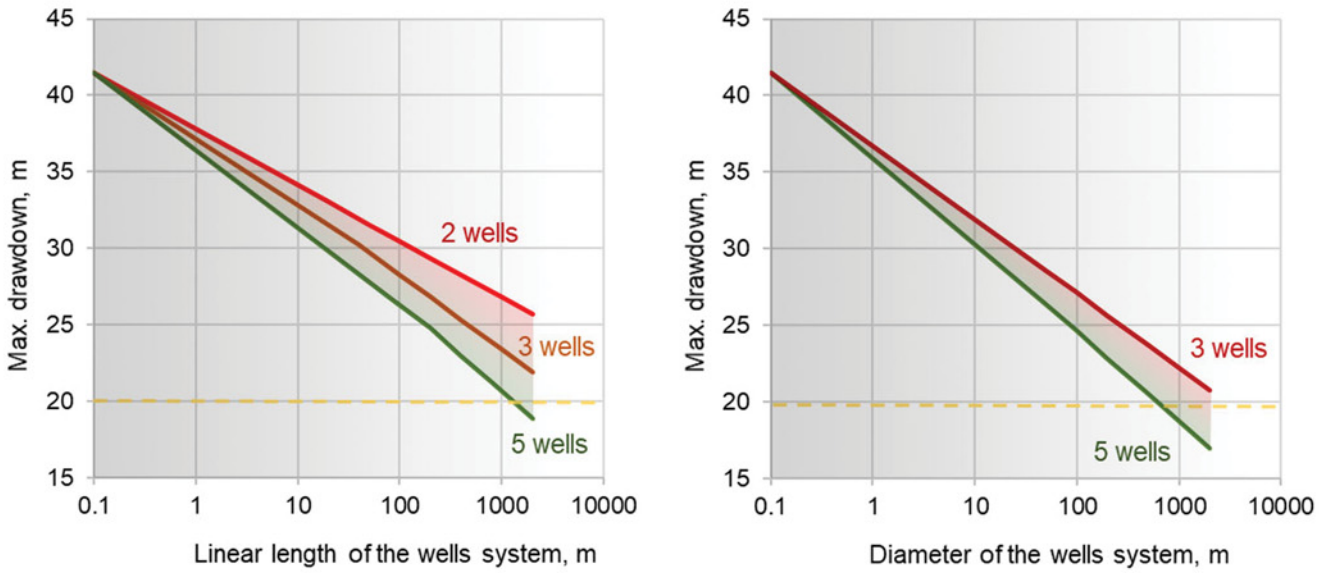

Fig. 3. Maximum drawdown as a function of a number of wells and well field dimensions.
Left – line of wells; Right – circle of wells