Geophysical Research Abstracts, Vol. 8, 00621, 2006
SRef-ID: 1607-7962/gra/EGU06-A-00621

Modeling the impact of groundwater withdrawal: a case study from northern Denmark

M. Skjøtt Linnberg (1), F. Holmgren Møller (1), N.A. Wahl (2) and M. Westergaard (1)

(1) B study board, Aalborg University, (2) Dept. of Civil Engineering, Aalborg University (wahl@civil.aau.dk)

The exploitation of the Danish groundwater resources is increasing and therefore there is a continuously search for suitable well sites. Volsted Plantation, situated approx. 20 km south of Aalborg in northern Jutland, is one such site, where a new battery of wells might be established in the near future. In the southern outskirts of Volsted Plantation, a fish farm is situated, producing disease free fish fry. A few artesian springs are the sole sources of water to the fish farm, with a discharge of approx. 1,55 mill. cubic meters/y.

This project investigates the impact of an annual groundwater withdrawal of approx. 1 mill. cubic meters on the total discharge of the artesian wells. The deterministic groundwater modelling system MODFLOW was used to determine the effect of the groundwater withdrawal and resulting solute fluxes. Two scenarios were selected, differing only in the fictive placement of the battery of wells, one (site 1) situated about 800 m to the N of the fish farm and another one (site 2) about 1,300 m to the N of the farm. A geologic model with five strata, with the lowest lying one comprising cretaceous limestone and the other four strata primarily comprising glacial and postglacial sediments (sand with clay lenses) was made use of.

The groundwater recharge of the modelling area was based on the base flow of the nearby stream, which was estimated to approx. 0.43 cubic meters/y. By using spatial land-use data, the groundwater recharge was differentiated spatially to amount between 0.27 and 0.59 cubic meters/y. The other parameters used in the model were the hydraulic conductivity of the geological strata and the leakage coefficient for the streams. The determination of the hydraulic conductivities was based on literature

values and pumping tests, carried out on experimental wells in the modelling area. The leakage coefficients for the streams were determined from extensive field tests, including profiles resulting from ground penetrating radar, drillings and slug-tests. Modelling parameters were calibrated and the groundwater recharge was set to a fixed rate.

The result was a decrease in the water-flow through the fish farm. With the well site 1 placed 800 m N of the fish farm, water flow decreased by approx. 30 %. With the well site 2 placed 1,300 m to the N of the farm, water flow decreased by approx. 15 %.

This means that the production of disease free fish fry is threatened by the planned groundwater withdrawal, implying future production has to be altered to match the new conditions. It is apparent that according to this investigation, the well site should properly be placed the furthest away from the fish farm, as to minimize the withdrawal impact. This should however be weighted against other relevant aspects such as protective capabilities of the plantation and properly checked with the EU framework directive under all circumstances.