Vulnerability Assessment of Groundwater Aquifer due to the Construction of the City Tunnel in Malmö, Sweden

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The main focus of this project is to make a vulnerability assessment of the groundwater aquifer during the construction of a new railway tunnel, the Citytunneln in Malmö, in south Sweden. The most important groundwater supply for the city of Malmö is a well area called Grevie, situated in the confined aquifer of Alnarpsströmmen east of the city of Malmö. The wells have been in operation for 108 years producing approximately 200 l/s drinking water mainly for the city of Malmö.

The aquifer is in contact with the Baltic Sea in the south and the Sound between Copenhagen and Malmö, Öresund jn the west. Although salinity of the salt water here is not high, about 9‰, salt water intrusion still can significantly impact fresh water quality and hence lead to soil salinisation. Some old buildings in the centre of Malmö city are built on wooden piles, which can be destroyed if groundwater levels sink. These can be attacked by fungus in aerobic conditions and decompose rapidly.

During construction work of the tunnel, about 1000m^3/hour of water from combined leaking groundwater and seepage of seawater from the harbour has been pumped. Also, groundwater abstraction for drainage of subsurface construction 300-3000 m from the shore has been performed. A vast part of the groundwater has been retrofitted in the aquifers, but some water has been replaced with municipal tap water in order to sustain the water heads of the aquifers.

In the paper, the extent of change of groundwater/seawater interface due to pumping and retrofitting during the construction face is presented and the net effect on water resources assessed. A number of observations will be presented, such as the effect on the piezometric level of fresh groundwater in the area, to what extent the lowering of groundwater level during construction work enhances salt water intrusion, how the freshwater/salt water balance is changed, to what extent changes in chemical composition of groundwater takes place due to ion exchange with the limestone bedrock, how the salt water/fresh water interfaces is affected by the tap water retrofitting, how redox is changed and if these effects are transient or permanent.

Evaluation and analysis of the obtained results according geological and hydraulic conditions can be used to predict probable response of the groundwater system to the underground construction work. Comparisons with the salt water/fresh water changes due to the recent construction of the underground Metro of Copenhagen will also be presented.

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