Hydrogeological field investigations to assess the potential for large-scale utilization of groundwater for cooling at Gardermoen, Norway

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Oslo Airport City AS is planning a sustainable business park at Gardermoen, Norway, with energy solutions delivered by Statkraft Varme AS. The business park is situated on Norway's largest aquifer, the ice-marginal Hauerseter delta deposit (~9700 years BP) (Longva & Thoresen 1989). Statkraft Varme AS has engaged Norconsult AS to assess the local groundwater's applicability as a heat sink. The business park will be built stepwise, with an estimated peak cooling demand of ~5 MW in year 2036 (i.e., planned completion year of the business park).

The Gardermoen aquifer has been the subject of numerous hydrogeological studies, especially in the periods immediately before, during and after the opening of Oslo Airport Gardermoen (OSL) in 1998. Groundwater from the aquifer is already being utilized at numerous locations for heating and cooling of buildings (e.g., the aquifer thermal energy storage (ATES) scheme at OSL). Previous studies have shown that groundwater with high iron and manganese concentrations (i.e., high clogging risk) can be expected at greater depths in the aquifer.

Therefore, the focus of Norconsult's assignment was to find suitable well locations within the designated study area, with regards to…

(1) well capacity (i.e., to cover the estimated high cooling demand)
(2) groundwater quality (i.e., low iron and manganese concentrations), and

Hydrogeological field investigations were carried out in May-June 2023, comprising test drillings with sediment sampling for grain-size distributions, water quality field measurements and sampling, and pumping tests of test wells. Based on results from these investigations, the location, design and dimensioning of two full-scale wells and a test infiltration basin were carried out. The full-scale wells and infiltration basin were established in September-October 2023, and subsequently test-pumped.

The investigations have revealed…

(1) groundwater with low iron and manganese concentrations in shallow parts of the aquifer within the study area, and
(2) considerable variations in (expected) well capacities due to variations in the aquifer's sediment composition horizontally and vertically.

This has led to recommendations of establishing production wells with well screens located in the shallower part of the aquifer. This means groundwater drawdown (s), which should not be below the top of the pumping well screen, will be a limiting factor for the groundwater extraction capacity (Q). Thus, production wells should be established in the coarse-grained parts of the aquifer, where the specific well capacity (Q/s) will be higher.

Further work will comprise testing of infiltration capacity by means of basin vs. injection well(s), possible hydraulic advantages of placing intake below the top of the well screen. This will lead to recommendations for future design and development of Statkraft Varme AS' groundwater cooling scheme at Oslo Airport City, Gardermoen.

The authors would also like to underscore that the project's duration and its step-by-step approach to developing the area, lends itself to incremental improvements in methodology and energy solutions.

References

Longva, O. & Thoresen, M. K., 1989: The age of the Hauerseter delta. *Norsk Geologisk Tidsskrift 69*, 131-134