Groundwater quality development in response to infiltration of lake water into an aquifer

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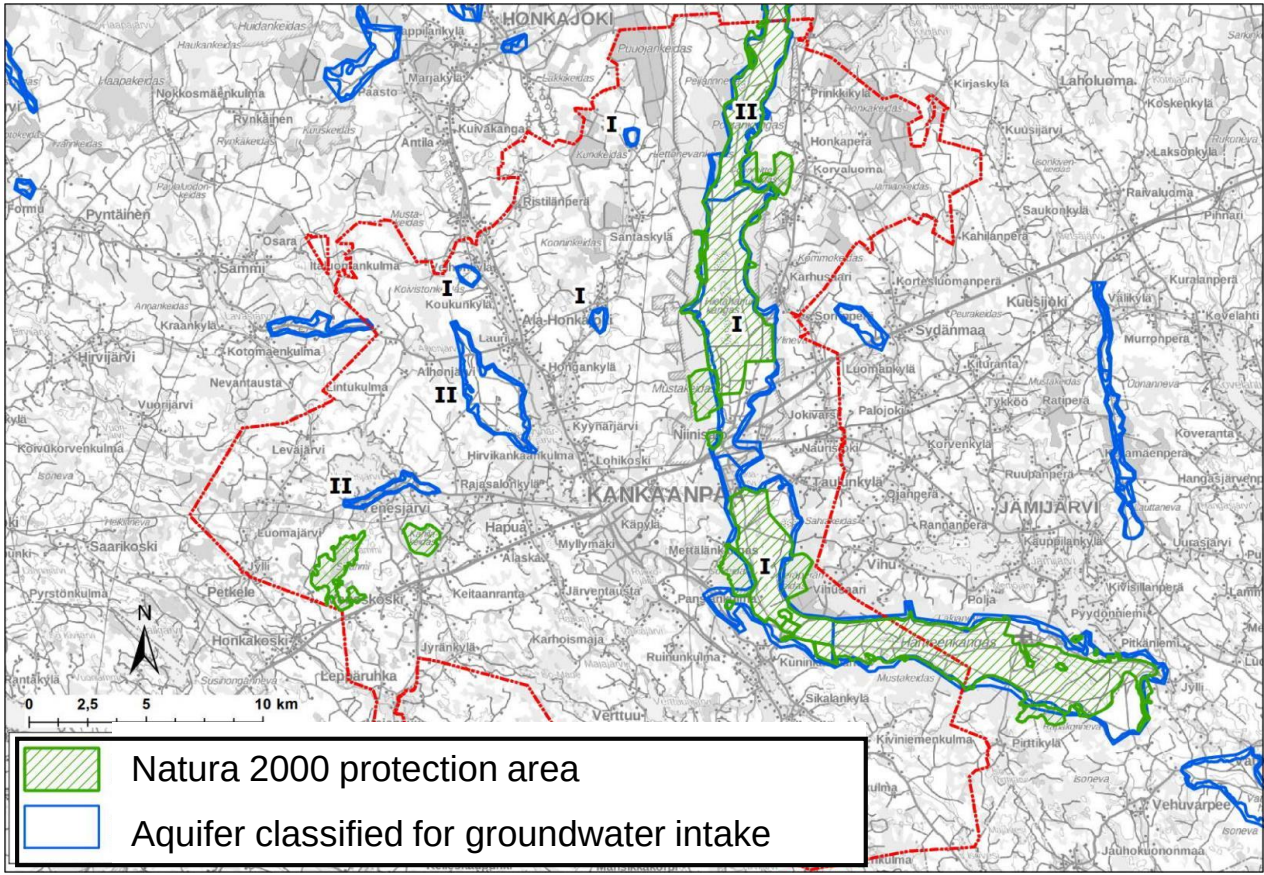
Laikko spring, Rautjärvi

Background

The increasing awareness of the importance of groundwater for ecosystems limits the possibilities for establishing new groundwater intakes

Especially vulnerable are spring ecosystems, streams and wetlands



Case Kankaanpää community: Aquifers and Natura 2000 areas are overlapping

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Managed aquifer recharge – a solution for sustainable groundwater use

- Reduce the pressure on natural groundwater use
- Help to maintain the water balance at wetlands and springs

In the Nordic context the key question in MAR is:

How will the capacity of the aquifer to filter natural organic matter evolve over the long term?

Raw water with a high content of natural organic matter (NOM)
Kouvolan vesi, Kouvola, Finland

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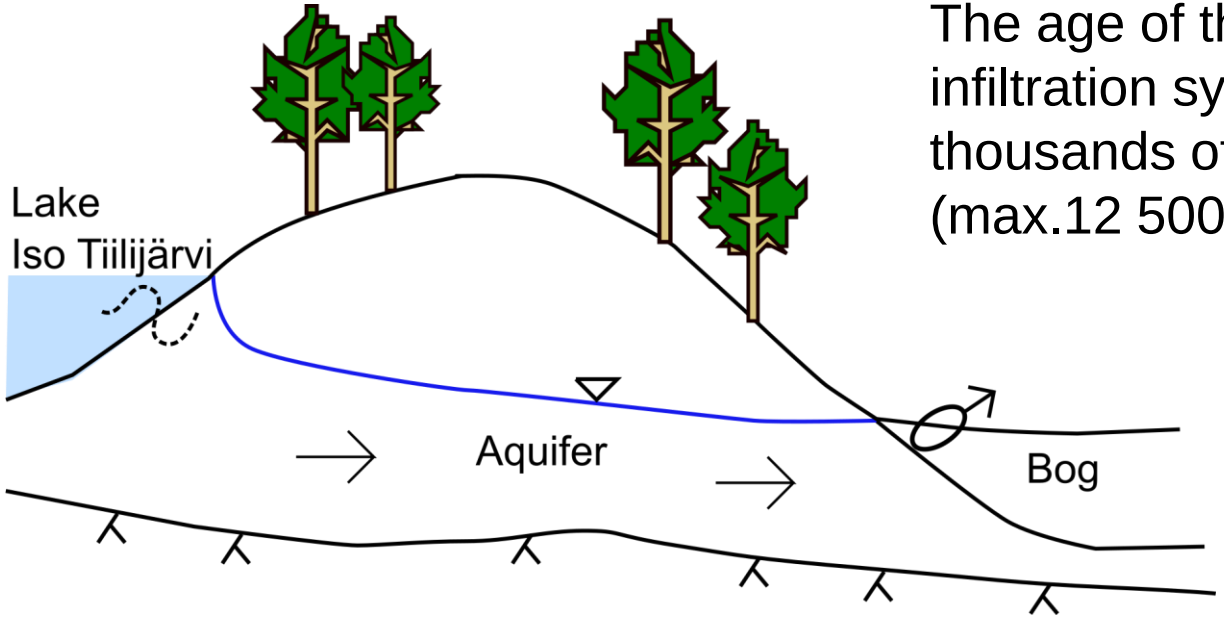
Our field site: a natural bank infiltration site as a surrogate to MAR

At a natural infiltration site, a much longer time scale can be achieved than by studying existing MAR sites.



The age of the bank infiltration system: thousands of years (max.12 500 yrs)

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Methods

Site characterization

$^{18}O/^{16}O$ and $^{2}H/^{1}H$ stable isotopes, drillings, soil samples, flow measurements, MODFLOW modelling.

Water chemistry

Total organic carbon, dissolved organic carbon, total inorganic carbon, oxygen, iron and manganese concentrations, conductivity and pH were measured from lake and groundwater samples. Organic matter was investigated by FT ICR MS.

Carbon budget calculation

Numerical modelling

Finite difference reactive transport model of transport and reactions of temperature, organic matter, oxygen, iron, manganese (advection, dispersion, retardation, degradation) written in Python programming language.

Results

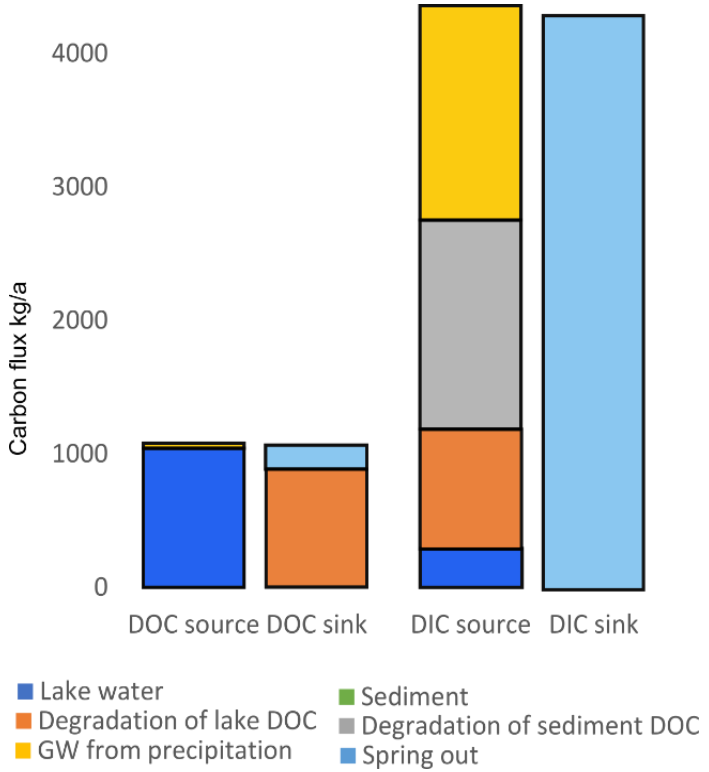
In the aquifer, 80–90% of TOC was removed.

Signs of organic matter accumulation in the aquifer were not observed

Redox conditions and iron and manganese concentrations varied seasonally and spatially.

The organic matter consisted of around 5000 compounds

The organic compounds removed in the aquifer were similar to compounds observed to be removed in chemical treatment surface water.



Average values of calculated carbon sources and sinks in the aquifer.

Conculsions

An aquifer can sustainably remove NOM from infiltrating water, without losing its efficiency.

The risk of iron and manganese release and oxygen depletion in groundwater should be taken into account in MAR projects to secure the groundwater dependent ecosystems.

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