WP7 Water resources

Action 7.4 – Handbook

Recommendations for the consideration of permafrost in drinking water resources management

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Recommendations for the consideration of permafrost in drinking water resources management

(1) Introduction

There is still little knowledge on the impact of climate change on alpine permafrost and how the enhanced melting of permafrost ice influences the discharge patterns and water quality of alpine headwaters. Rising air temperature has caused the release of highly concentrated melt water from active rock glaciers. In response to the enhanced release of ions and heavy metals in high altitude lakes, which are sourced by melt water from rock glaciers, the water chemistry can be fundamentally changed. In particular, the high concentrations of Ni which were found in melt water draining from active rock glaciers and glaciers at Schnalstal (Ötztal Alps) may strongly exceed the limit of drinking water. The ice content of alpine permafrost like rock glaciers is still little known. The hydrological regime of active rock glaciers is, however, strongly driven by the amount of water stored as ice in permafrost ground. To study the hydrological regime of permafrost affected areas and their response to climate change the discharge, water temperature, electrical conductivity and water chemistry (anions, cations, heavy metals) of springs should be measured and compared to glacial melt water streams and springs not impacted by permafrost.

The calculated water balance of the Lazaun cirque (Schnals Valley) showed that only a small part (ca. 1,4%) of the total runoff from the whole cirque originates from melting rock glacier ice.

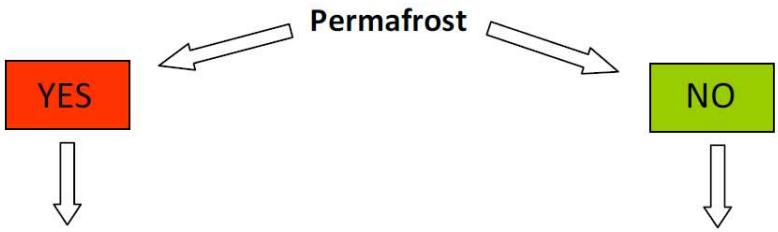
Springs derived from glaciers or alpine permafrost should be studied carefully concerning water quality (anions, cations, heavy metals, bacteria), suspension load, temperature and discharge before such springs are used for drinking water supply.

(2) Overview for the consideration of permafrost in drinking water

First you should check for the presence of active rock glaciers in the surroundings of the interested spring (**geomorfological analysis**). Then check the **permafrost distribution map**, if the catchment area lies within the potential permafrost area.

Generally there should not be problems with catchment areas below 2.000 m a.s.l.

The following check list might give an overview of the steps to be followed before using a spring in high mountain areas for drinking water supply.



Analyses of the water in addition to the applicable regulations:

Follow the ordinary iter for drinking water (applicable regulations)

Water temperature

T > 2°C	permafrost unlikely
T 1-2°C	permafrost possible
T < 1°C	permafrost very probable

Water chemistry

- Do analyses in late summer/autumn because the influence of melting is heaviest in this period.
- Analyse for Mg, Ca, sulfate, Mn, Ni, Al
- Examples of drinking water limits:

Al	0,2 mg/l
Ni	0,02 mg/l

Electrical conductivity

Allows to estimate the amount of dissolved solids but it dependends also from the geology of the bedrock, therefore we cannot give a threshold value.

Water able for drinking

Water NOT able for drinking

Search for another spring not affected by melting permafrost.

Mitigation possibilities:

- **Dilution** of the contaminated water to reach the drinking water limit
- Installation of **filter systems** if there do not exist other possibilities for drinking water supply (e.g. refuges)