

Fact Sheet

GEOLOGICAL AND GEOPHYSICAL ANALYSES OF PERMAFROST AND GROUNDWATER CONDITIONS AT FORT WAINWRIGHT, ALASKA

PROBLEM

Groundwater conditions in discontinuous permafrost regions are complex. Reliable field methods to delineate permafrost and define the associated groundwater conditions have long been needed to interpret conditions between boreholes. Conditions at Fort Wainwright are beginning to be understood and must be defined for analyzing contaminant transport by groundwater.

SOLUTION

Ground-penetrating radar (GPR) operating from 100 to 44 MHz is being refined to improve near-surface resolution of permafrost and groundwater tables, as well as contaminant horizons. The refinements are mainly noise reduction through the use of fiber optic cabling and 16-bit data collection, stacking during data acquisition, and predictive deconvolution during signal processing. For deeper probing, GPR operating at 10 to 50 MHz is being developed and tested to define the permafrost table beneath deep perennial thaw, and the bottom of deep permafrost. The deeper penetrating work utilizes improved antenna design, fiber optic cabling, greater power and wider antenna separation to reduce near-surface clutter and focus on deep horizons.

RESULTS

Field tests have demonstrated that GPR can define (1) areas of deep perennial thaw; (2) thaw zones around leaking waste lines; (3) bedrock horizons within permafrost; (4) the vertical distribution of permafrost to 40-m depth; and (5) the distribution of groundwater aquifers. Contaminated groundwater is suspected of migrating above and beneath permafrost, including possible off-site migration. More than 100 km of data along transects located between Birch Hill and the Chena River have been gathered.

The deep permafrost horizons detected are due to groundwater at the base of the permanently frozen ground. An extensive drilling program has verified our findings and the data are being used to develop a 3-D model of groundwater conditions within the discontinuous permafrost across Fort Wainwright. Contaminant transport analyses are being based upon these results.

CONTACTS

Dr. Steven A. Arcone
603-646-4368
Fax 603-646-4644
sarcone@crrel.usace.army.mil

Dr. Daniel E. Lawson
603-646-4344
Fax 603-646-4785
dlawson@crrel.usace.army.mil

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Cold Regions Research &
Engineering Laboratory