



Permafrost Tunnel Expansion Project Update



Introduction

The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) along with University of Alaska (UAF) Institute of Northern Engineering (INE) have continued pre-construction work on the Permafrost Tunnel Expansion Project. Since beginning of the year, we have held our first design charrette in Anchorage with the Alaska District of the U.S. Army Corps of Engineering, drilled nine boreholes at the Permafrost Tunnel property, started to analysis the borehole core samples, and began site preparation for testing excavation methods this winter.

The project is beginning to generate both public (see attached article) and private interest including interest from the State of Alaska (see attached letter), as well as possible funding from one private foundation.

Borehole Drilling

The Alaska District, on behalf of CRREL, contracted GeoTek Alaska to drill nine strategically located boreholes at the Permafrost Tunnel property in early April 2010. These were needed to a) ascertain the location of bedrock beneath the sediments and b) determine if there was any adverse groundwater flow. The map of the drilling locations (below) shows the existing tunnel marked in yellow and the expanded tunnel and side tunnel locations marked in white.

The boreholes include nine deep holes for temperature monitoring and some shallow boreholes (mean 6' depth) for active layer temperature and soil moisture monitoring. The deep boreholes ranged from 27 feet to 117 feet in depth, and are scheduled for instrumentation with thermistor strings this summer.

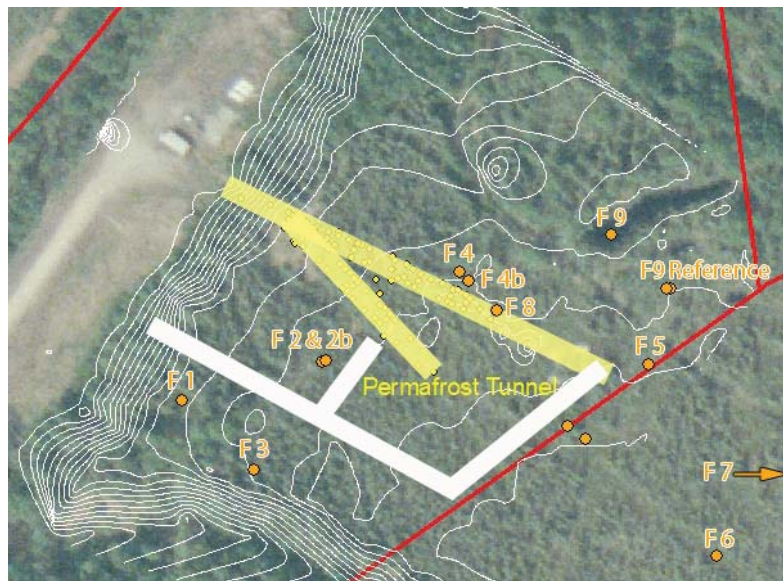
The permafrost cores, collected in plastic tubes and immediately sealed with rubber caps to avoid contamination, were taken into the tunnel for frozen storage. An analysis of the cores during drilling suggests an average stratigraphy of 55-60 feet of massive silt over 15 feet of gravel with the bedrock 75 feet below the ground surface. No ground water was encountered. Initial temperature measurements suggest a mean ground temperature of 30.5°F at depth. Detailed analysis of the 464 feet of cores along with age dating are being done by UAF researcher Mikhail Kanevskiy and expected to be completed this winter.

LIDAR Mapping

Airborne LIDAR mapping was conducted this April over the Permafrost Tunnel site. Aero-Metrics is currently processing the data with the results finished this summer. This will produce an overall topographic map of the property to which CRREL will add detailed surveys points in key areas to guide excavation.



Photo of core sample.



Map of boreholes (orange) with existing (yellow) and new (white) tunnel.



Photo of sampling in tunnel.

First Design Charrette

In February 2010, personnel from the Fairbanks and Anchorage offices of U.S. Army CRREL and UAF INE, along with mining expert Richard Hughes from the Office of Economic Development/Minerals of the State of Alaska, met with engineers and staff from the Alaska District of the Corps of Engineers in Anchorage. Design concepts and ideas on the Tunnel Expansion Project were further developed at the meeting. It was decided that the optimal tunnel cross-section was 12 by 12 feet in order to allow heavy equipment movement and facilitate geophysical investigation along with access for sampling. The mechanical and electrical utilities will be placed in a trench in the tunnel floor under a removable non-metal walkway with attachable light and outlet stands. CRREL and UAF researchers also provided details that are being used in a space utilization needs statement being developed by Alaska District architects for the Learning Center. In May, a preliminary conceptual design for the portal structure of the tunnel entrance was produced.



1938 Photo of Tunnel location marked with arrow. Altered Photo from Bradford Washburn Collection, Photo 2417, Archives, Alaska and Polar Regions Collections, Rasmuson Library, University of Alaska Fairbanks.

Testing Excavation Methods

We plan to use a roadheader for the excavation of the tunnel. This type of equipment is widely used in mining and tunnel excavation, but to date has not been used in ice-rich permafrost. While the Tunnel Committee is confident that the roadheader can conduct the excavation efficiently, we have decided to conduct a series of excavation tests this winter to ensure no surprises. A test site on the Permafrost Tunnel property is being prepared that has easy access to a frozen silt face and is away from any planned research. A small roadheader-like attachment, an Eco-Cutter 25 (top right), will be rented and mounted on a small backhoe to conduct efficiency and quality excavation tests, as well as investigation of optimal cutter tooth design. Researchers and experts will also study excavation rates, thaw problems, dust production, and heat given off by machinery.



Photo of Eco-Cutter 25.

Photo of borehole drilling.

Oral History Interviews

Much of records and tunnel data from the 1960s construction of the existing tunnel has been lost. Only final reports and a few in-house documents of general nature remain. These summarize lessons learned, but provide limited detail. Several participants from the work are still alive, so interviews will be conducted this summer in preparation of the new tunnel excavation. Their stories will also be valuable for permafrost and military history, as well having local interest as part of Fairbanks mining history (see left photo).

Accomplishments

Summer 2009	New interactive website launched http://permafrosttunnel.crrel.usace.army.mil/
Fall 2009	Start of pre-construction geophysics
February 2010	Initial design charrette
April 2010	Boreholes drilled LIDAR conducted
June 2010	Site prep for winter test excavations

Future Work

We plan to conduct the excavation tests as soon as cold weather (<10°F) allows. These tests will also be used to expose near-surface frozen materials for sampling and paleo-reconstructions.

Contract specifications for excavation of the new tunnel will be developed with the contract advertised by February 2011 for a December 2011 start date.

By the summer of 2012, above-ground facilities will be under construction, including the new laboratories, offices, Learning Center, and the above-tunnel boardwalks. If all goes well, the above- and below-ground facilities will be dedicated and opened for visitors in the Fall of 2013.