



Above: Häggglunds amphibious vehicles are used in early stages of ice bridge construction.



Below: Ground penetrating radar towing arrangement. (Left: operator console shows ice depth and presence of small cracks at ice sheet bottom.)

Opposite page: Express lane for unloaded traffic on the Tibbett-Contwoyto Winter Road (March 2011).





**ICE ROADS, SUCH AS THOSE MADE POPULAR BY THE NEW TV SHOW “Ice Road Truckers,”** have recently captured the imagination of the general public. However, Canadian resource companies have used ice bridges for over a century to extract resources in areas where ground conditions make building and maintaining summer roads difficult.

The term ‘ice bridge’ refers to that part of the ice road that crosses a frozen body of water such as a lake, river or ocean. Crossings are often not ready to use until January and may be opened for two months or less.

Monitoring the ice frequently and comprehensively is vital to ensure the ice bridge is strong enough throughout the operating season. Ground penetrating radar, calibrated with a few boreholes, is currently the most economic and accurate way to do this.

The radar also provides a continuous profile of ice thickness as it is dragged behind a snowmobile, Hägglunds (see opposite page) or pickup truck. With the continuous record, operators can confidently determine minimum ice thickness, ice quality (e.g.



## Building Ice Bridges: Adapting Technology for Climate Change

The warmer, shorter winters caused by climate change are threatening to eliminate ice bridging as a viable technique. In response, some organizations are adapting ice bridge designs and operations.

The Tibbett-Contwoyto Winter Road, a well established Canadian ice road, celebrates its 30<sup>th</sup> anniversary this year. Starting near Yellowknife, the route extends 600 km north-east to four diamond mines and 87% of its length consists of ice bridges across a series of shallow lakes.

Nuna Logistics carefully manages driver training, the timing and composition of truck convoys on the road, and compliance with the rules of the road. Nuna Winter Road Services manages the road’s construction, monitoring and repair. EBA Engineering has developed ice thickness guidelines specifically for this winter road, and its engineers use the road as a test bed to improve ice bridge design, construction and operation.

Together these groups have achieved an excellent safety record. Over 2.3M tonnes of mine supplies have been trucked in on this route in the last 11 years at an average of 2750 tonnes per day. Trucking has been concentrated because the road opening has averaged only 67 days per year.

In the last five years, shorter winters have reduced operating seasons by two weeks or more and increased the importance of logistics control, accelerated construction techniques and a risk management approach to operations.

Risk caused by shorter winters is managed in the early construction stages with safe work practices and staged introduction of lightweight vehicles (snowmobiles, snowcats, Hägglunds) based on ice thickness.

presence of weak layers), the extent of cracking, and even whether the bottom of the ice sheet is being eroded by water currents.

Another recent advance in ice bridge building is how ice quality is defined. Older guidelines about safe ice thickness assumed manufactured ice was half as strong as naturally formed ice and, therefore, twice as much was required. However recent testing by EBA Engineering and others found that good quality ice can be manufactured by freezing water (with or without compacted snow) onto the ice bridge surface.

This new understanding is reflected in current techniques to accelerate ice manufacture. Nuna crews compact a snow layer on the ice surface before flooding and Northwest Territories’ government crews flood the surface with a spray of super-cooled water called “spray ice.” By spraying the water upwards, where it is chilled by the air before falling to the ice bridge surface, the water freezes much faster than if it were pumped directly onto the surface.

The latest provincial ice bridge guidelines allow higher acceptable risk levels when picking a safe ice thickness. Meaning that a thinner ice thickness is allowed if more intensive management practices are used. This approach improves safety and, perhaps just as importantly in the face of climate change, it reduces construction times for ice bridges. 🐾

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