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ATKINS

"IN EACH UNKNOWN, THERE'S A KERNEL OF OPPORTUNITY. THE KEY IS TO PLAN, MEASURE, MONITOR AND MODEL POSSIBLE OUTCOMES BASED ON WHAT YOU DO KNOW"

Plan Design Enable

ROADS INTO THE WILDERNESS

For energy companies exploring in the Alaskan tundra, **an ice road may be the only way to travel**. But building these roads is complex, often dangerous and could have a long-term impact on the environment. What is being done to safeguard sustainability and wildlife while opening up routes into some of **the most remote parts of the world**?

20%

of the US's total oil and gas reserves are in Alaska, but accessing them is an enormous challenge

remote routes

ICE ROADS IN ALASKA

Approximately one-fifth of the US's total oil and gas reserves are found in Alaska but accessing them is an enormous challenge – both environmentally and economically. The reason is that much of this lucrative energy resource is located on the North Slope that borders the Arctic Ocean. With very few roads in that remote region and much of it split up by waterways, it's extremely difficult to explore. Often the only option is to create ice roads during the winter months.

An ice road is a stretch of temporary roadway mapped out on frozen tundra bays, rivers, lakes and even seas. They connect land, waterways and winter roads. As summer approaches they simply melt away, resulting in little environmental impact. The following winter the ice road construction process starts again.

However, to build these roads, large volumes of water are required every year, and the process of acquiring that water from nearby lakes must be measured and justified. Ice roads cannot upset the water balance and so deprive other users of the water such as local tribes and fish in the lakes. In an era of changing climate, the need to pay close attention to the impact of ice roads on the tundra water budget is critical. Indeed, the local water balance is explicitly considered in the state regulatory processes that permit their construction.

Watching the wildlife

Construction also needs to consider any impact on the state's native flora and fauna, which include endangered species such as polar bears and Arctic grayling. Routes must be planned with care and respect, identifying pathways that can be followed safely, at the lowest cost and with minimal impact.

Atkins in North America is working with the University of Alaska Fairbanks under a grant from the US Department of Energy to help ensure route planning and road building are cost effective and environmentally sustainable.

Called the North Slope Decision Support System (NSDSS), it is an innovative web-based tool that will allow key stakeholders in ice road construction to plan routes together, thereby making the planning and approval process more transparent.

A recent development for the NSDSS is a partnership with the Encyclopedia of Life and the US National Science Foundation to create an endangered-species location service, which will be used to ensure that routes avoid the habitats of endangered species as much as possible.

Route finding

With a three-year grant from the US Department of Energy's National Energy Technologies Lab, Atkins hopes to inform the road building process with the NSDSS. A wealth of different data sets has been integrated – from academic institutions such as the University of Alaska, as well as geographic information system software developer ESRI and the Geographic Information Network of Alaska.

A key data set is "general circulation models" (GCM) outputs. Produced by research centres around the world, these models constitute the current best guess as to how the global climate will change over the next century.

"By combining global forecasts with local measurements, the web service brackets future weather at the local level," explains John C Hampson, vice-president of national water resource technologies with Atkins. "Using these forecasts you can calculate water budgets to confirm that there will be enough water to build the ice road. You have to leave enough water in each lake on the route so you don't harm any lake ecosystem."

Other information in the system includes field data measures at sites on the North Slope, historical ice road routes and a region-wide database of lake information. The last of these includes details on permits that have been granted for each lake, species of fish within the lake and lake depth. The system also stores the analyses created by ice road planners and scientists. All of this data is stored in a system of federated databases – a "cyberinfrastructure". Using a central catalogue service, the system gains quick access to all of this data via a simple online search tool.

Branching out

This information can then be accessed and modified by all the various stakeholders in the ice road construction process, from energy companies and regulatory agencies to local communities and environmental groups. By sharing knowledge and information, they can arrive at an optimum route that meets the needs and considers the experience and objections of all concerned.

The central issue for ice road construction is that the stakeholders have different objectives. Energy companies want to create the most efficient road. Regulatory agencies and environmental groups want to ensure that the road has minimal impact on the tundra. Local tribes want to preserve their culture and way of life. The NSDSS ice road planning tool uses a unique algorithm to find routes that help each of the stakeholders meet their varying objectives.

Atkins' senior project manager and co-principal investigator on the project, Stephen Bourne, explains that the algorithm, created in collaboration with Texas A&M University, is based on the "food-locating tendencies of ants". Ants have been observed to find the most efficient routes for getting food from a source back to their nest. Using "virtual ants", the algorithm will sift through the route options to identify those that minimise the cost and environmental impact.

The goal for the current project's completion is September 2011 but the Atkins engineering team is also keen to expand its application as soon as possible. "Using general circulation models, we can get estimates of how the climate will change for the next century," Bourne says. "In Alaska we want to explore what impact a changing climate will have on the ice road process over the next 30 years. But these GCMs are global and the NSDSS concept can be exported to help tackle similarly tough climate challenges in other parts of the world."