# Canadian Consulting Engineering Awards 2019
# Project: Lower Churchill Project WebGIS
# Category: F Special Projects

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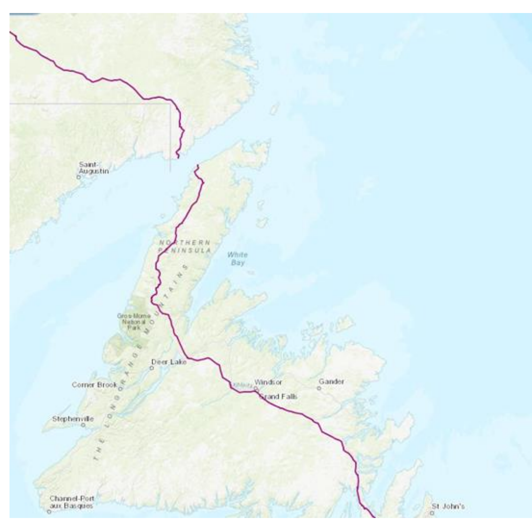

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# 1.0 Full Project Description

The Lower Churchill Project (LCP/the project) includes the construction of more than 1,500 km of transmission line and associated electrical facilities from Churchill Falls (Labrador) to Soldiers Pond (Newfoundland), and a hydroelectric generating facility at Muskrat Falls. Construction began in 2012 and the transmission line was completed in 2018.

For a project of this size, complexity and geographic extent, management of project spatial data is critical. Where numerous construction sites are widely dispersed in remote locations, through harsh terrain and meteorological conditions, it is often impossible to bring all interested parties together at each location. Under these conditions effective resolution of day-to-day construction and environmental issues, and coordination of field activities requires a robust spatial data management system.

## 1.1 Innovation

Wood's approach to these challenges was based on several key principles:

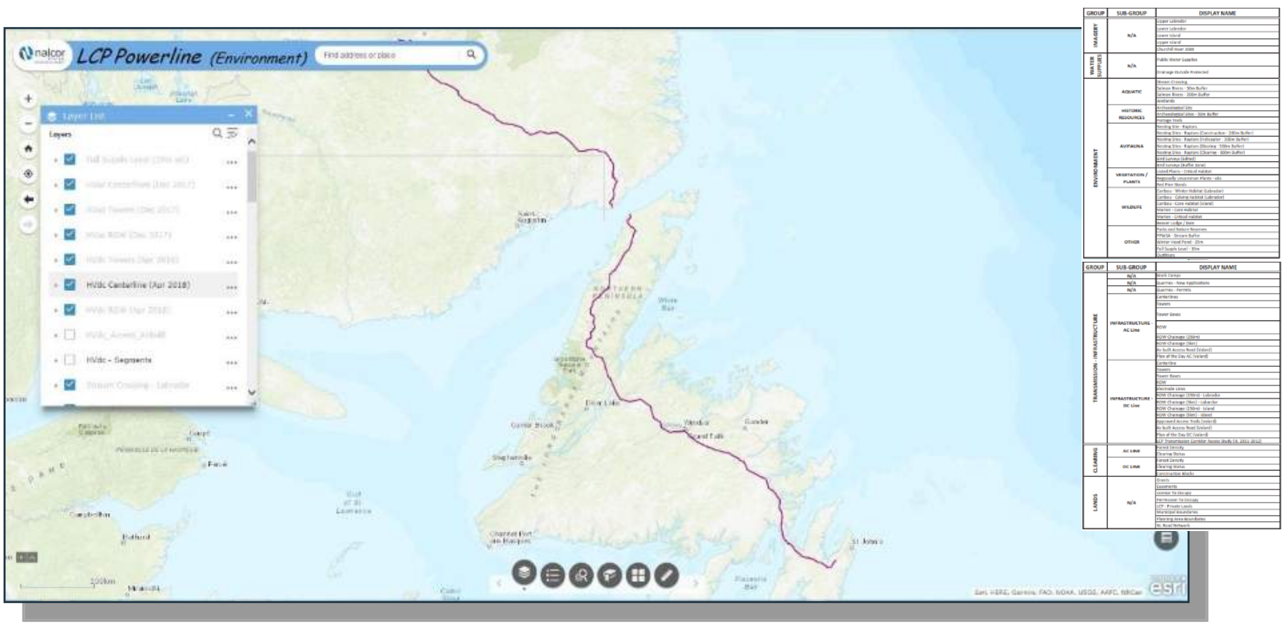
- ***Internet-based*** – to target the large geographic extent, numerous work locations and multiple independent computer networks.
- ***Phased approach*** – to help assess technical feasibility and utility incrementally, thereby minimizing risks and uncertainties given it was relatively new technology.
- ***Consultation*** – to ensure the needs of a wide variety of users were adequately considered.
- ***Automation*** – to help minimize data errors and improve efficiencies with large data volumes and strict project timelines.

Wood's solution, based on the above principles, was development of an ArcGIS Online-based webmapping system. The primary online application, *LCP Powerline*, contained more than 70 spatial data layers and high-resolution imagery and was integrated with field data collection apps. Other web applications were developed to meet more focused user-specific requirements. Innovative aspects of the system included:

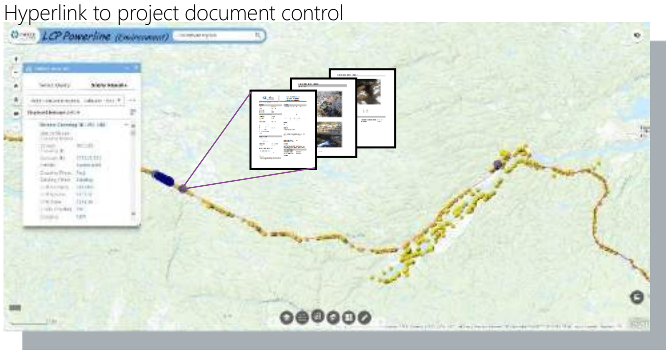
- Design of work flows incorporating the system's Collector field data collection app that allowed for real-time field inspection and data collection, using pre-configured data with dropdown boxes and other data controls, and linked photographs.
- Direct links from the primary *LCP Powerline* webmap viewer to authoritative reports and documents within the Project document control system.
- Direct links from the primary *LCP Powerline* webmap viewer to data layers in the main contractor's online database, ensuring that the most up-to-date data on the contractor's progress was available to users.
- Provision of access to internal project staff, and also to external contractors and government regulators, and in some cases to external stakeholders, ensuring that all interested parties were seeing the same information, within clear spatial context.

- Development of management dashboards that provided near real-time information to managers responsible for monitoring progress.
- Access to detailed information on map features (eg. individual stream crossings, transmission towers), including photographs of the feature.
- Development of other focused applications that allowed users to carry out specific tasks, thus putting some traditional GIS tasks (eg. production of maps, simple editing and analysis, QA/QC) in the hands of non-GIS users who were closer to the data and more readily able to interpret it.
- Provision of dedicated monitors within the Project's Emergency Operations Centre, providing real-time access to the location of all Project assets and infrastructure and to other emergency infrastructure and services in the effected region.

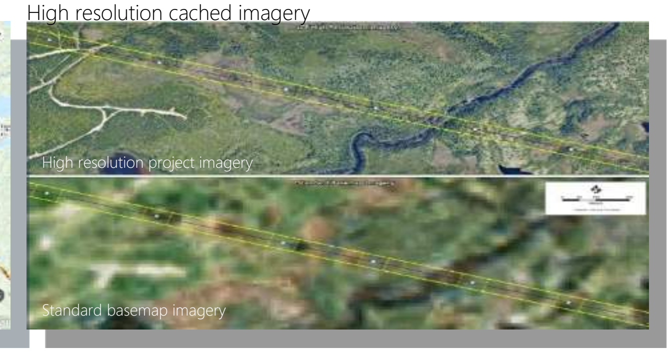
70+ DATA LAYERS




Hyperlink to project document control



High resolution cached imagery



## 1.2 Complexity

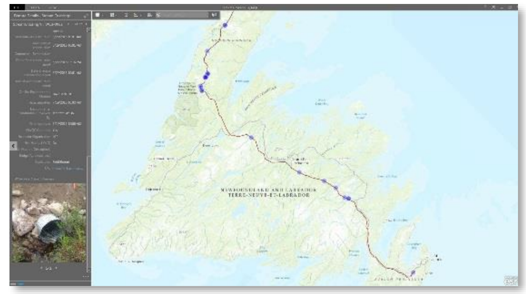
Challenges with the project's management of spatial data were largely related to the geographic scope and extent of the project:

- Approximately 1,500 km of transmission right-of-way (ROW) and 1,350 km of access roads.
- Major project sites were widely dispersed and often remote.
- Thousands of individual construction sites (stream crossings, tower locations).
- Hundreds of project field workers, contractors and government regulators.
- Numerous directly affected communities and stakeholder groups.
- Environments of harsh terrain, extreme weather, remote wilderness and sporadic internet connectivity.

***Stream Crossing Inspections:***
Nalcor was required to adhere to strict regulations for all stream crossings. To demonstrate adherence required robust management of stream crossing inspection data. This was challenging for several reasons:

1. Large number of crossing locations (>2,700).
2. Difficult to access remote locations through harsh terrain and frequent extreme weather.
3. Lack of internet connectivity through large areas of transmission route.
4. Requirement for 3 separate inspections (pre, active and post-construction), often conducted by different inspectors.
5. Frequent route changes throughout clearing and construction phases.
6. Requirement for hard copy reports for quarterly reports to regulator.

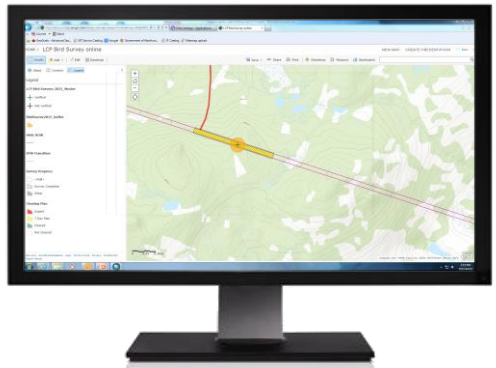
The original inspection process involved several manual steps, which created significant data quality issues. Wood designed and implemented an automated process which involved configuration of an iPad-based application (Collector for ArcGIS), linked to the Project's online webmapping system. Details of inspections, including photographs could be viewed on a web-based map in near real-time by other inspectors and by other users with access to the internet. The application allowed data collection to occur in offline mode. These functions greatly improved the currency, completeness and accuracy of data. The requirement for hard copy reports was met through development of a custom report and an automated procedure which populated reports for each crossing inspection with data and photographs collected in the field and uploaded to the online mapping system.



***Avifauna Surveys:***

Nalcor was required to minimize impacts on nesting birds in its transmission right-of-way clearing activities. They hired Wood to conduct field surveys of nesting sites in advance of clearing activities so that nest sites could be identified, flagged and protected from disturbance. Timing was a significant challenge, as clearing had to be completed no later than 2 weeks after the nest survey for a particular area of the right-of-way. If clearing contractors were unable to complete clearing work within the two-week window, a re-survey of the area would be necessary. This required considerable coordination between clearing contractors and surveyors. Management of spatial data was a key component of this.

The Collector field data collector app was again invaluable. It enabled the flow of data both ways: (i) bird surveyors would have access to a map which highlighted areas of the ROW to be cleared within pre-set future time periods (e.g. areas of planned clearing within the next two days might be highlighted in red on the map; areas of planned clearing 1-2 weeks out might show a hatched pattern); (ii) clearing contractors would have access to already surveyed areas of the right-of-way, symbolized with colors representing days left in the 2-week window, as well as buffer sizes around identified nests for different bird species. Maps containing this data were maintained by GIS staff at the office and populated with data in near-real-time form the survey teams and the clearing contractors. With several teams of bird surveyors active at any one time, many clearing work sites and frequent changes of plans depending on weather conditions, access and other project factors, easy access to data, in near real-time, in an easy to use map view, for surveyors, contractors and coordinators back at the office was indispensable.



## 1.3 Social and / or Economic Benefits

*The webmap* system contributed social and economic benefits to the project related to safety, transparency, quality and cost.

Having an accurate, up-to-date visual record of project assets and activities helped planners, managers and field staff to understand the physical environment in which field staff would be deployed and to better anticipate potential safety issues.

Having the webmap available on call in the Emergency Operations Centre also helped the emergency operations team respond to safety or environmental issues quickly and with easy access to the most recent data related to physical project locations, project activities, access routes and proximity to emergency infrastructure and services.

Providing direct access to the webmap and specific web applications for external regulators and stakeholders allowed them to understand project activities, progress and regulatory compliance in a more direct and up-to-date way than a more traditional approach involving preparation of hard copy maps and documents containing summary data that was often out-of-date by the time it was compiled, prepared and distributed. For example, regulators responsible for monitoring stream crossings could now view information and photos on a map minutes after it was reviewed and submitted electronically by a field inspector, instead of waiting for data to be complied and submitted in hard copy at the end of each quarter. Similarly, members of the Independent Expert Advisory Committee examining issues related to methylmercury could better understand some of the issues with direct access to an online map of the reservoir containing detailed imagery (before and after clearing), clearing limits, land cover data, roads, etc.

Automation of data collection, submission and mapping, including use of controls such as pre-set data collection forms and templates significantly enhanced data quality directly, and indirectly by providing an early opportunity for independent review and oversight by regulators and external stakeholders.

### 1.4 Environmental Benefits

A project area spread across more than 1500 km of harsh terrain, wildlife habitats, and significant wilderness areas, in proximity to numerous small communities has great potential for environmental impacts. Knowing where environmentally sensitive areas are located and their full extent is critical to minimizing impacts. *LCP Powerline* was critical to this understanding. It allowed planners and managers at the various office locations, as well as field staff working on numerous work fronts to understand where these environmentally sensitive areas were located in relation to where work was taking place, and to make appropriate adjustment to work locations and schedules as necessary. Examples of the benefits associated with *LCP Powerline*:

- It clearly delineated protected water supplies and ensured that activities incompatible with protection of public drinking water were avoided in those areas.
- It displayed sensitive winter and calving habitat of threatened caribou herds in Labrador as well as the current location of individual radio-collared caribou and ensured that construction activities were halted in these areas during times when caribou were especially vulnerable to disturbance.
- It displayed location of raptor nests along the transmission right-of-way. Buffers were established and displayed to clearly identify the area around each nest that had to be avoided for specified project activities (e.g. construction, clearing).
- It allowed for time-sensitive coordination between field surveyors and clearing contractors and protected birds from disturbance during important nesting periods.
- It allowed for careful and effective monitoring of more than 2700 stream crossings and protection of downstream public water supplies and aquatic habitat.

### 1.5 Meeting Client's Needs

Nalcor's goal was to build a major hydroelectric generating facility and transmission line in Newfoundland and Labrador, with minimal cost, minimal environmental impact and maximum positive social and economic impact. Wood facilitated this, in partnership with Nalcor, through development of *LCP Powerline* and related web-based applications by providing access to a wide range of data on project infrastructure, environmental constraints and related project data to a variety of interested groups, both internal and external to the project, through an online map-based format. Examples of how this was achieved include:

- Enabling efficient oversight of stream crossings – the normal regulatory process would require separate permits for each individual crossing, under the provincial Water Resources Act. The province does not have the capacity to process this volume of permits; however, by providing direct online access to data on each crossing in a timely manner, the Project was granted a single authorization covering all crossings. This resulted in significant cost savings for both the regulator and the Project.
- The switch from a manual stream crossing inspection process to an automated process, linked directly to the online webmapping system resulted in significant cost savings. The

field portion alone took an estimated 20% of the time, per inspection, required for the original manual process. Other savings associated with an automated QA/QC application, improved data quality and improved management oversight were not quantified.

- Development of a tower construction progress dashboard - this online dashboard provided maps and charts of tower construction progress in near real-time via direct links to field inspection data. It provided improved oversight and monitoring by management and improved response to variances.

- Streamlining and adding flexibility to environmental communications.
- Significant time savings due to information availability and automation of processes.
- Simplifying and standardizing of field data.
- Improved availability to interested parties seeking information.