Eco•Facts

The Churchill Northern Studies Centre is a new 28,000 sf self-contained living module for a non-profit client on a remote site 23 km from the Town of Churchill. The new facility contains sleeping accommodation for 88 persons including staff, visiting scientists and students working on year-round sub-arctic scientific, education, and climate change research. 5,000 sf of science laboratories, support facilities including a commercial kitchen, dining halls for 120 persons, fitness facilities, classrooms and administration offices compliment the existing building's renovated garage use.

Sited next to the historic rocket range, the new research station achieved LEED® SILVER certification, and was designed through an Integrated Design Process. The building strives towards exceptional energy efficiencies to keep yearly operational costs down and utilizes innovative technologies applicable to the Northern climate to reduce reliance on outside services and utilities.

Strategies include a super-insulated building envelope; central atrium for daylighting into the centre; and triple glazed fibreglass windows to allow maximum light in within a cold climate and provide views to the landscape. Other features that reduce the cost of local services include a combination of composting toilets with ultra-low flow toilets, ultra-low water use in cooking, and a grey water re-use system will reduce the use of potable water that has to be trucked in. An on-site water treatment system utilizing waterloo bio-filters; and a septic system that employs on-site naturally vegetated area beds will reduce the amount of sewage that needs to be trucked out.

Construction of the $19m new facility and renovation to the existing facility began in summer 2009. The centre opened its doors to researchers and visitors in August 2011.

Owner: Churchill Northern Science
Architect: Prairie Architects Inc
M&E Design: Enermodal Engineering
Structural: Crosier Kilgour & Partners
General Contractor: Penn-Co Construction
Project Manager + LEED® Coordinator: IDI Consulting

churchill **northern**
studies **centre**

to understand and sustain the north

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The following is a summary of the health, performance and environmental **aspects of the building based on criteria set out by the owners and recorded as a project charter:**

Design Challenges

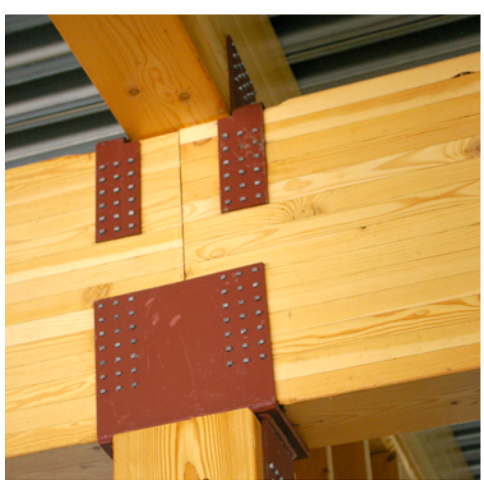
The site is remote and exposed, with only shrubby tundra vegetation and thin gravelly soils over shallow bedrock. There are no piped municipal services for water, sewer or gas. A 1-km power line connects electricity service but is frequently interrupted by winter weather. The facility houses a commercial kitchen, temperature controlled labs, classrooms, dorm suites, and computer labs which are all potentially large energy consumers.

The existing facility had to truck water 23km from town, then truck back the sewage resulting in a huge cost and considerable carbon emissions. A high degree of reliability and independence was therefore required for the essential services of water, wastewater, heat, and power.

Design opportunities

The long shape of the building is designed and orientated to allow the strong northwest winds to scour snow away from the building. This reduces the daily operating costs for snow clearing, a task required to ensure safety, as curious polar bears can access the facility by snowdrifts. Further scouring of snow around the building is facilitated by the tapered west end and rounded roof to wall transition. Lifting the building also allowed the second floor sleeping accommodation windows to be free from steel bear guards over the windows, reducing the feeling of imprisonment the existing centre had.

The form of the building was inspired by the utilitarian practicality of a Bombardier B12 snow bus of the 1950's as well as an insulated hood of a winter parka; tough on the outside and warm on the inside. The building is clad in pre-finished metal to meet the durability requirements for the climate, and is reminiscent of the original rocket range buildings. These elements, combined with the warmth of a glue-laminated structure, and views to the exterior, produce an appropriately utilitarian building with a warm sunlit interior for the staff and visiting researchers. The amount of glazing was limited to the minimum required to have views and sunlight reduce the need for artificial lighting during daylit hours, but balanced against the requirement to increase the capacity of the heating system for the long cold winter nights.



Integrated Design Process

The Churchill Northern Studies Centre used to occupy an old, poorly insulated steel building that had been part of the old rocket range of the Churchill Military base. When energy and water costs threatened to cease the centre's operation, a new and sustainable solution was required.

While the project team was eager and experienced in sustainable practices, there were many challenges ahead. The location, 23km from the town of Churchill, is without sewer or water services and is also located where three biomes converge; marine, northern boreal forest, and tundra. The remote site where permafrost exists year-round forced the project team to think outside of the box when it came to system selection and design of the building.

The project set out with an ambitious LEED Platinum target, however the realities of the location were quickly realized in the IDP process that renewable technologies for the energy system were not going to be appropriate in the remote location or a cost-effective option.

The team spent 2 intensive days at the commencement of the project to define the project charter that would guide the design for the remainder of the project. The 10 guiding principles are:

SUSTAINABILITY: To target a LEED Platinum sustainability level with LEED silver as a minimum for the new building. The ultimate goal to be carbon neutral.

MAXIMIZE SELF RELIANCE: To become less reliant on outside resources to reduce operating costs and improve internal stability in a harsh climate and to be able to invest more in people and programs.

HERITAGE PRESERVATION: To preserve the historical significance and heritage of the existing building within the old Churchill Research Range.

SAFETY: To provide a safe and secure facility for all users especially relating to the severe winter climate and the presence of polar bears.

DEMONSTRATION CENTRE: To design the new building as a demonstration and research facility itself telling a story about sustainability as an extension of the current science research. Walk the talk, enhancing the client experience.

FLEXIBILITY/ADAPTABILITY: To create a dynamic environment that allows for expansion and change for a variety of future research and educational programming.

SIMPLICITY: To create a place centered on simplicity of function, operations and maintenance, character and materials.

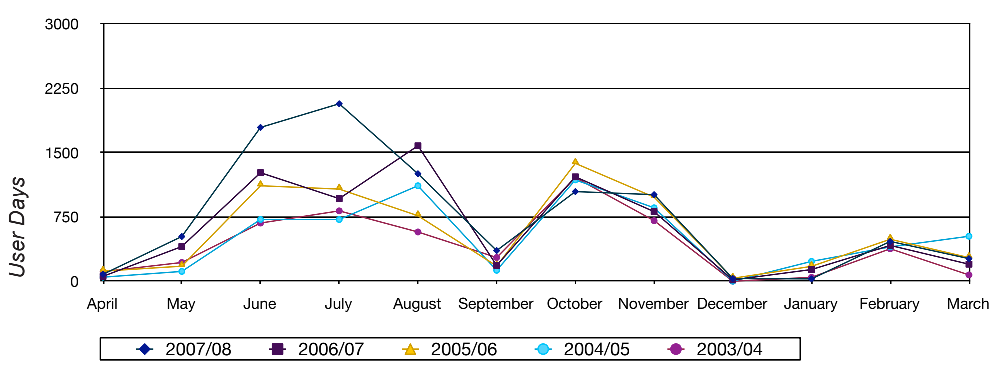
INTERACTION: To foster a positive and dynamic interaction between researchers, staff, students and visitors for a cross fertilization of ideas and people.

COMMUNITY: To strengthen the existing connection between CNSC and the wider community in Churchill and to find the commonalities in the diversity of people.

COST EFFECTIVE: To meet building program and operating requirements within the defined budget.

Occupancy Implications

In order to truly establish requirements for heat, ventilation, and water use, it was necessary to examine occupancy in great detail. The chart below illustrates that the peak occupancy, and therefore peak load, was in Summer months. The connection made between peak occupancy and the nearby lake being thawed at the same time had a direct impact on the water design for the building. By determining the occupancy (or user days), the team was able to size equipment appropriately for the specific user group expected in the building (as opposed to working on assumptions and over-sizing).



Occupancy Load

Heating & Ventilation

The four main building ventilation systems have heat recovery – a challenging accomplishment in an environment where HRVs are very vulnerable to freezing. The main ventilation system is an innovative reversing flow heat exchanger made in Manitoba and featuring 85% heat recovery efficiency and no requirement for defrost. The other HRVs, serving the dining room and kitchen, labs, and composting toilets, rely on electric pre-heaters to keep them out of defrost mode and optimize their heat recovery performance. The reversing-flow heat exchanger supplies up to 1175 L/s of ventilation, depending on demand, and does not require any preheat.

Building controls are designed for reduced operating costs, while still being relatively simple and easy to operate. The basic approach is to turn equipment off when not in use. For example, ventilation is supplied by multiple, dedicated units which slow down or stop when any individual unit is not needed. Local controls include occupancy sensors, CO_2 sensors, timers, and variable motor speed drives. The project engineers and controls contractor can access the building automation system via internet when they are off-site for monitoring and trouble-shooting.

A commercial kitchen serving three meals a day to 100 people can be extremely energy intensive, due to large amounts of cooktop ventilation, hot water use, and appliance energy. The best-in-class range hood ventilation at CNSC is low-flow and variable speed, responding to the amount of cooking and providing only the amount of exhaust and makeup air required. Solar wall panels pre-heat the large volume of fresh air for the kitchen and cafeteria, supplemented by a dedicated energy recovery ventilator which even recovers heat from the dishwasher exhaust. Even waste heat from the computer room is circulated to the underfloor plenum for heating, rather than being directly exhausted or air conditioned.

Composting Program

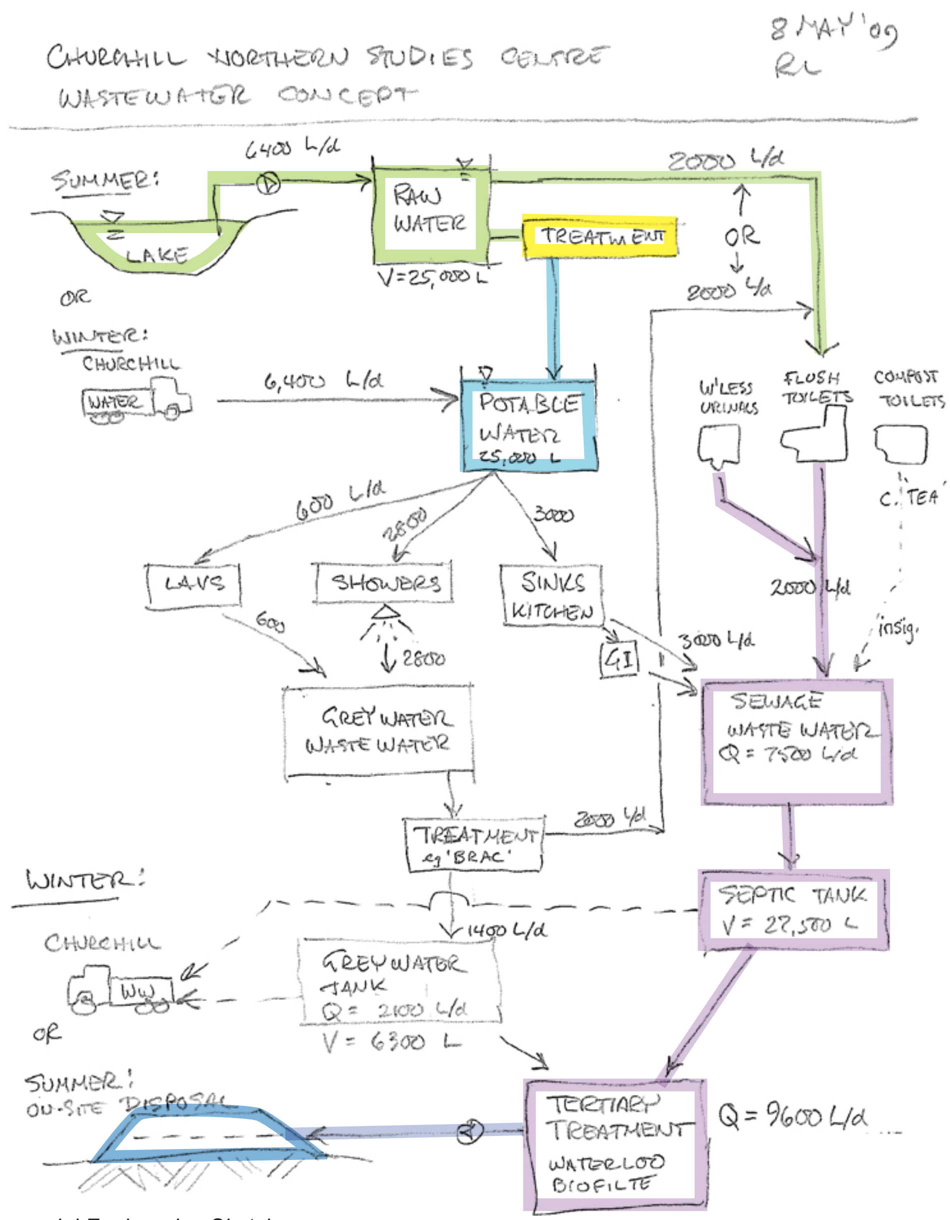
In addition to the centre's four composting toilets, staff have implemented a composting program. The centre expanded their efforts by including organic matter referred to as "greens". This includes material such as kitchen waste, coffee grinds and tea leaves. Used paper towels from bathrooms, known as "browns" is also collected for the program. During the summer months these materials are added to an outdoor compost heap located in a secured container - it is important to keep this type of material away from curious polar bears. Temperature probes have been added to the heap in order to monitor composting progress during the winter months. During this time, the centre switches over to eight indoor vermicomposting bins. The final broken down material is used for various gardening projects. A waste audit conducted over 5 weeks found that compostable material represented just over 20% of all waste material at the centre.

Water & Wastewater

The most significant measure in water savings is two large composting systems serving waterless toilets and urinals. An innovative ventilation system using a heat recovery ventilator provides continuous exhaust from the composter, with the toilets themselves acting as the exhaust fans for the washrooms. The system is water-and-energy efficient, keeps the washrooms odour-free, and thanks to a healthy population of red wriggler worms, automatic moistening system, compost tea removal, and the aerobic decomposition process, requires very little maintenance.

Lake water is pumped 2 km to the site in summer and treated with settling, simple cartridge filters and UV to drinking water quality. Two 13 000 litre tanks can store drinking water trucked from town in winter when the lake is frozen. Untreated lakewater is distributed through separate non-potable water piping to flush-type toilets, hose bibs and drain trap primers to reduce the need for drinking water, and also to utilize greywater recycled from lavatory and shower wastewater. Drainwater heat exchangers recover heat from the showers and lavatories to preheat domestic hot water.

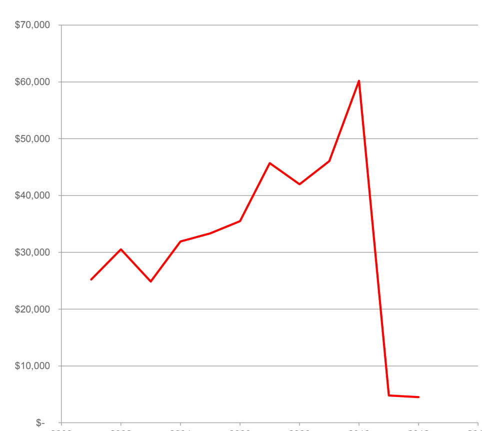
The CNSC implemented a user policy for preference to use the composting toilets, as well as all showers are equipped with 45 second push button timers, with a strict 4 push limit policy on shower use.



Enermodal Engineering Sketch

Does it work?

Data collected by Richard Lay, Mechanical Engineer on the project, in Feb 2013 suggests that the design is functioning as intended (and in some cases, better!). Water and sewage costs are down from $40,000-60,000 to less that $5,000/year. Approximately six hundred cubic meters (or 80%) of all water is being treated on-site. This has reduced the water bill to 10% of what is had been in past years! Similarly, 70% of all sewage was found to be getting treated on-site which has also reduced the sewage hauling bill to less than 10% of what it had been in past years. This project was one of Prairie's first projects to follow the Power Smart prescriptive path for new buildings.



Water & Sewage Cost

Churchill Northern Studies Centre
P. O. Box 610
Churchill, Manitoba, Canada R0B 0E0
Phone: 204 675.2307
www.churchillscience.ca

The building achieved LEED® Silver certification in 2015.

Prairie Architects Inc.
101-139 Market Avenue
Winnipeg, Manitoba R3B 0P5
t. 204.956.0938
administration@prairiearchitects.ca

Eco•Facts written and designed by Prairie Architects Inc. with input from Enermodal Engineering