

LESSONS LEARNED

DESIGN AND CONSTRUCTION PROCESS

The integrated design process was very successful in bringing clients and designers together. It was the best way to respond to the unique needs of each department in this multi-tenant building.

The contractor adopted the sustainable strategies outlined by the architect. An outstanding 95% of construction waste was diverted from landfill and minimal site disturbance was achieved.

OPERATIONS AND MAINTENANCE

Overall the building is operating as designed. Current operational staff have learned how to use the building capabilities to best advantage, such as pre-cooling the building ahead of a temperature rise so as not to get caught by a brown-out when every other building turns on their chillers at the same time. The sustainable strategies have been successful at allowing the building to operate relatively independently. Occupants are able to comfortably carry on their work in the office during -50° C weather, while nearby facilities are forced to close. The power failures so frequently experienced in Yellowknife (50x/yr) often pass unnoticed because the building power system takes over so quickly and seamlessly.

INNOVATIVE SYSTEMS

The BIPV system required an enormous amount of commitment. The technical challenges were overcome through collaboration between the client, NRCan, Visionwall, Manasc Isaac, and Keen Engineering. By replacing the originally designed shading devices and with funding through the Technology Early Action Measures programme, this highly successful system was built at no extra cost to the client.

The design team had a number of wishes that could not be realized on this project but with innovation and further research could be possible on future projects. The original design called for more PV cells. One row had to be eliminated as part of a cost-cutting measure when the Euro went up against the Canadian dollar. Hedging currency would have been a good idea in this case. Having Canadian capacity for manufacturing would have been even better.

The PV laminated glazing units were made by Saint Gobain Glass of Europe. This was unfortunate for a number of reasons –first, due to the environmental impact of all the additional shipping, and second, because of the difficulty in getting damaged units replaced by a European supplier.



GOING FORWARD

Good green buildings build on the experience of earlier successes and mistakes. Post Occupancy Evaluations are increasingly a fundamental part of meeting sustainable design objectives. The willingness of designers and clients to share experiences and findings will enable lessons to be learned more quickly and applied more broadly, furthering the merits of sustainable buildings.

“Community engagement is in the spirit of this place. This is a northern building with a northern energy, and yet it is unlike any other building in the north. More than the NWT Legislative Assembly, the Greenstone Building captures and celebrates the precious light –endless hours in the summer and brief fleeting hours in the winter: that is the north.”

Vivian Manasc, Project Architect

TEAM MEMBERS

Client	Public Works & Government Services Canada (PWGSC)
Architects	Manasc Isaac
Structural, Mechanical & Civil Engineers	AD Williams
Electrical Engineers	Keen Engineering
Landscape	Avens Associates
Quantity Surveyor	BTY (Alberta) Ltd.
Energy	GF Shymko & Associates
Building Operations	SNC-Lavalin Profac



GREENSTONE GOVERNMENT OF CANADA BUILDING

POST
OCCUPANCY
EVALUATION



The four storey, 7,200m² Greenstone Government of Canada Building in the City of Yellowknife, capital of the Northwest Territories, amalgamates approximately 200 federal civil servants from 15 separate federal departments. Made to integrate interior and outdoor environments, the building is a positive addition to the downtown core for both occupants and the general public. In addition to providing a superior level of energy efficiency, the sustainable elements address occupant health, comfort, productivity, and control. Greenstone is Manasc Isaac's first LEED® Gold project, and the first ever LEED® Certified building constructed in the Canadian North. The building has been occupied since October 2005.

SUSTAINABLE DESIGN ELEMENTS

- The four-storey building is a narrow triangular shape, maximizing daylighting within the constraints of the site.
- A large south-facing atrium creates a 'winter room' for the community and brings daylight into the centre of the building.
- 90% of the material from the demolition of the former buildings on the site was diverted from landfill. Whenever possible, recycled and recyclable materials were used in building construction.
- Fly ash, a waste product from coal combustion, is incorporated into the concrete, further reducing the embodied energy of the building.
- Carpet tile with a high post-consumer recycled content was used instead of rolled carpet, a choice that reduced waste during construction and for the entire building life cycle.
- The building envelope consists of a highly-insulated pressure-equalized rainscreen with stucco cladding, which uses less embodied energy than metal cladding.
- An award-winning Building Integrated Photovoltaic (solar energy panels) system, the largest in Canada when the building opened in October 2005.
- High-performance triple-glazed windows with fiberglass frames for reduced energy consumption.
- The roof is a partial green roof system, with planted, grassed and paved surfaces. The green roof collects rainwater for landscape irrigation and to reduce stormwater run-off.
- High-efficiency indirect lighting provides superior light quality and daylight integration while minimizing lighting energy use.

- Heating is provided by high-efficiency propane boilers. Propane was selected because it emits substantially fewer greenhouse gases than the alternative in Yellowknife – fuel oil.
- The raised floor air distribution provides a high level of energy efficiency, superior indoor air quality and occupant control.
- Solar domestic hot water heating provides most of the building's hot water.
- Solar shading devices reduce energy consumption and maintenance compared to mechanical cooling.
- Low-flow water closets and waterless urinals reduce water consumption by more than 30% compared to conventional fixtures.

POST OCCUPANCY EVALUATION

Post Occupancy Evaluation (POE) is a formal way of evaluating the actual performance of an occupied building compared to the design goals. The results of a POE are used to inform the design of future buildings. Manasc Isaac has made Post Occupancy Evaluation a standard practice in its sustainable building design.

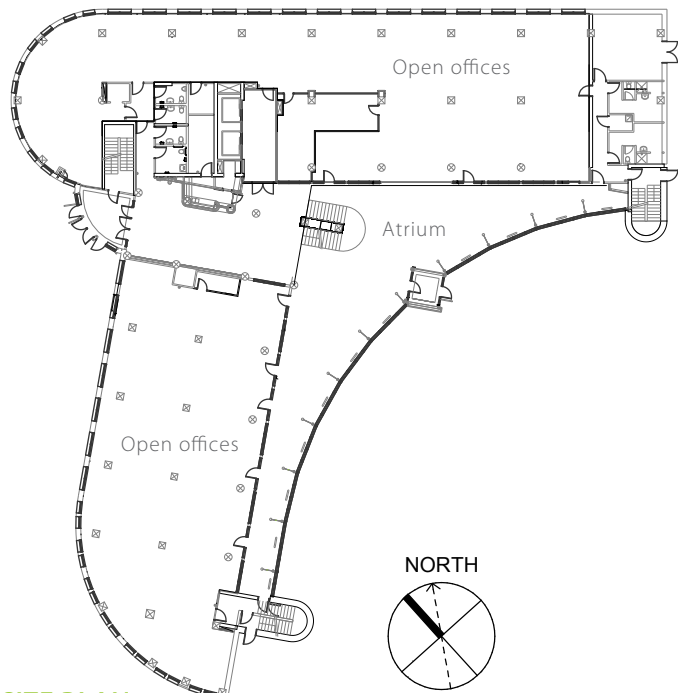
This report takes a look at the actual performance results of the Greenstone Building and occupant satisfaction two years into the building's occupancy. Representatives from the Greenstone Building and the partners of Manasc Isaac participated in a seminar with the building manager to evaluate the integrated design process, successes, and opportunities for improvement in building operation. All occupants of the building were invited to report on their own experiences by means of a voluntary web-based survey. Actual energy and water usage came from one year of utility billing records for the entire building.

ENERGY PERFORMANCE

The integrated design process aimed to provide cost-effective, energy and resource efficient design solutions. The Greenstone Building is designed to achieve 45% better energy usage than current American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standards. It runs on propane rather than on natural gas. Propane was selected because it emits substantially fewer greenhouse gasses than the alternative in Yellowknife – fuel oil.

For the fiscal year ending March 2008, the building used 0.39 GJ/m². The design building used 0.22 GJ/m² compared to a building built to the Model National Energy Code for Buildings standards that used 0.30 GJ/m². Although the actual consumption is higher than the design model, it is important to note that LEED® models are intended to estimate the value of the building's energy efficiency measures and not necessarily to accurately predict the absolute level of total utility usage in a building. The models do not include non-regulated components such as plug loads, process energy, garage ventilation, exterior lighting, elevators and other miscellaneous energy uses, which are included in the total actual energy consumption of the Greenstone Building.

MAIN FLOOR PLAN



SITE PLAN



GREENSTONE AND LEED®

Sustainable building design and building performance, including occupant comfort and satisfaction, go hand in hand. As such, the Leadership in Energy and Environmental Design (LEED®) Canada rating system is an important part of the post occupancy evaluation process.

The Greenstone Government of Canada Building is an innovative model for high-performance built environments in extreme climates. Greenstone is Menaces Isaac's first LEED® Gold rated project (2007), a major accomplishment for the first LEED® certified building constructed 'north of 60'.

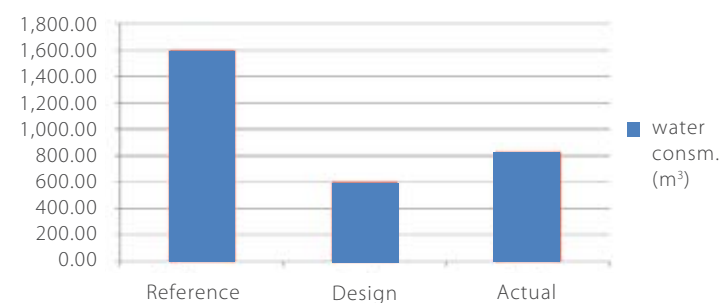


WATER CONSUMPTION

In the design of the building, every effort was made to minimize the consumption of water and water heating energy. Rainwater collection reduces the volume of potable water used for landscape irrigation. The washrooms have dual flush toilets and low-flow metering faucets. The use of solar hot water heating equipment assists in minimizing the building's energy load.

The metered annual building water consumption for fiscal year from April 2007 to March 2008 was 830.14 m³ with a monthly average of 69.18 m³. The design domestic water consumption estimate is 601.34 m³ and the reference estimate (based on current best practices) is 1595.42 m³. Although water consumption during this period was slightly higher than design, The Greenstone Building still uses only 52% of the water of a comparable building.

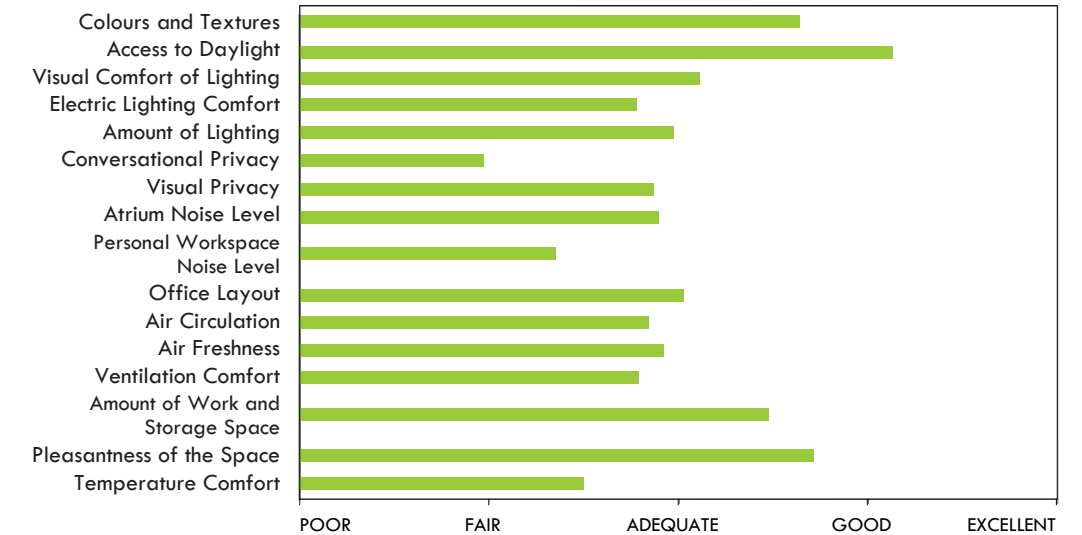
Greenstone Water Usage for April 2007 - March 2008



OCCUPANCY SURVEY & INTERVIEW

All occupants working in the building were invited to participate in a web-based survey. The survey provided occupants with the opportunity to comment on their satisfaction with various elements of the building, including layout, temperature, air quality, lighting and acoustics. The survey generated a response rate of 38 % (38 occupants out of a possible 100) within the week it was open.

Of those who responded to the survey, 79% have worked in their space for one year or more. Most responses come from those working in cubicles and in an open work environment. More than 70 percent of respondents spend 21 hours or more per week in their workspace.



KEY FINDINGS : LIGHTING & DAYLIGHT

- The majority of respondents rate access to daylight as good or better, with 47% rating their access to daylight as excellent.
- 68% of respondents use task lighting in their workspace and 76% of building occupants make active use of window blinds to control the amount of sunlight in their space. One occupant commented: "I prefer the natural light whenever it is available and have a tendency to turn off the lights in the office when the sun is shining in through the atrium glass wall".

KEY FINDINGS : AIR QUALITY

- Nearly 83% of occupants responded that they control operable windows near their workspace and 22% make use of the operable windows in the atrium.
- More than 72% of respondents can use the air vents located in the access floor to adjust the ventilation in their workspace.
- 61% of occupants rate ventilation comfort as adequate or better with 34% citing air freshness as good or better. One building occupant commented that "the day light and airiness is wonderful".

KEY FINDINGS : ACOUSTIC QUALITY

- Acoustics are a challenge in the open space. Open areas were felt to be too noisy: "Noise levels are high due to reflected sound and lack of real sound dampening" commented one building occupant.
- 69% rated conversational privacy as less than adequate.
- The majority of survey respondents are in open environment workspaces and were more likely to rate their noise level as less than adequate in comparison to their colleagues in private offices; 63% of those in cubicles rated noise as poor or fair.

KEY FINDINGS : THERMAL COMFORT

- 50% of occupants rated temperature comfort in their workspace as less than adequate.
- Control of building temperature was a challenge that has been addressed by the building operators.

BUILDING INTEGRATED PHOTOVOLTAICS

The Greenstone Government of Canada Building has a unique Building Integrated Photovoltaic (BIPV) system. Designed for cold climate application, it is the largest curtainwall-integrated BIPV system in Canada.

Integrating PV arrays into high-performance curtainwall systems is challenging and depends on the goodwill and collaboration of many different parties. Many institutional, technical and economic barriers will require far more work to enable this innovation to go mainstream.

The graph to the right illustrates the energy produced by the BIPV system over the course of one year.

Photovoltaic Production April 2007 - March 2008

