This case study was prepared by **hcma** Architecture + Design to describe the schools' design approach and performance outcomes in service of sustainability. It describes how the project applied the LEED Green Building rating system to measure and verify performance, to communicate and contextualize the impacts of design on our environment, our health, and our future.

Green Building Case Study

PEXSISEṈ Elementary and CENTRE MOUNTAIN LELLUM Middle Schools

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PEXSISEṈ Elementary and CENTRE MOUNTAIN LELLUM Middle Schools were opened in the fall of 2022. The schools are located on a narrow and steep 6.47 ha site in the new development of West Hills in Langford B.C. The schools address the needs of a rapidly growing population in Victoria's West Shore communities and alleviate the growing enrolment pressures in the school district.

The elementary school is designed to accommodate 500 students from kindergarten to grade five and the middle school accommodates 700 students from grades six through eight. The middle school sits to the north end of the site, and the elementary school is at the south, with a central green space between them.

The site is imagined as a series of social spaces, both interior and exterior, formal and informal, that are linked together by a landscape spine, allowing visitors to meander and wander across the site. The social spaces along the spine are points of interest that include the interior heart of both schools, play spaces, athletic fields, a central green space, seating areas, and other gathering spaces.

The schools are designed to support learning everywhere across the facilities. Each school is divided into learning neighbourhoods with groupings of four to six classrooms and learning support rooms around flexible breakout spaces. Specialty classrooms at the middle school include a shop, science and art rooms, band and choral, foods rooms, life skills room, and a rooftop play space. The elementary school includes a daycare, garden, and outdoor learning areas. Classrooms balance suitable daylight levels with minimized solar heat gain through bay windows.

Committed to supporting our children into the future, sustainable design, accessibility and inclusivity are at the heart of the project. Both the site and the buildings were designed to align with the sustainability agenda, and the Leadership in Energy and Environmental Design (LEED) Green Building Rating System was used to evaluate and benchmark impact. LEED is a globally recognized framework for evaluating the environmental impact of buildings, promoting more efficient, healthier buildings for people and the planet. LEED prioritizes lowering demand for energy and water, renewable energy use, using fewer resources and materials, creating less waste and preserving land and habitat. Projects that pursue LEED are registered with the US Green Building Council, and performance is verified by the Green Business Certification Institute, a third party that awards a score based on how the building performs against established baselines and benchmarks. Projects that earn all prerequisites and at least 60 points are certified with a Gold rating.

The LEED rating system is organized in seven categories, each addressing specific environmental issues. The following narrative provides an overview of each category imperatives and the related strategies implemented by the project.

Landscape spine
Image credit: **hcma** Architecture + Design

Location and transportation

Location and convenient access to transportation options other than cars is an important way to improve air quality, health, preserve community space and improve the quality of the built environment.

The schools include covered bicycle storage to encourage students and staff to bike to school and leave their car home, promoting health and reducing carbon emissions associated with transportation.

Sustainable sites

The Sustainable Sites category assesses and encourages design strategies that recognize the vital relationships among buildings and ecosystems. It emphasizes integrating the site with local and regional ecosystems and preserving the biodiversity that natural systems rely on. The best sites preserve habitat, provide open space and maintain healthy water bodies. Low impact development methods that reduce heat islands, allow the hydrological cycle to function and provide habitat will improve our health and the planet's.
The schools design contributes to this category in multiple ways:

- The school's parking area is covered with pavers which are light in colour to minimize the heat island effect associated with darker, non-reflective surfaces. Studies show that lighter coloured paving materials can reduce both surface temperature and air temperatures, improving thermal comfort when the weather is hot.
- In addition, the pavement is permeable allowing rainwater to infiltrate the ground through the joints, rather than wash away as surface run-off. This strategy reduces soil erosion, filters out pollutants and recharges the water table, which is essential in a functional ecosystem. As the weather becomes less stable because of climate change, plants will benefit from the stable water supply during droughts and require less irrigation. Reducing rainwater run-off will limit the risk of flooding and improve water quality.
- Similarly to the parking pavers, the light-color of the roofing membrane limits the solar radiation absorbed, radiating less heat and reducing the heal island effect compared to traditional black membranes. And it keeps the building cooler too!
- A large food garden was installed next to the elementary school entrance. Vegetable gardens are an opportunity for the kids to learn about food production. Connection to nature also improve well-being and productivity.
- By utilizing the roof spaces as play areas, less hardscape surfaces are required on the ground, leaving more room for green spaces which promote biodiversity.

Water efficiency

The Water Efficiency section encourages managing the use of potable water holistically, evaluating both indoor and outdoor water use along with specialty uses and metering. An efficiency first approach to conservation and demand management is encouraged, followed by implementing use of non-potable water where applicable.

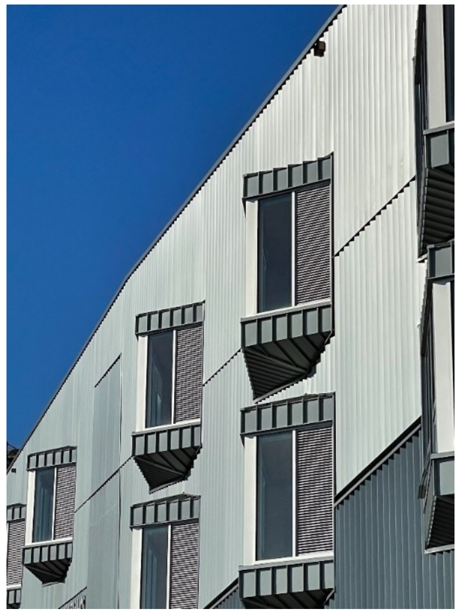
Only 3% of Earth's water is fresh. Most water used in buildings flows in as potable water and out as wastewater. Water is usually delivered via public supply system many kilometers from the site and then must be piped to a water treatment plant and likely discharged. The energy and material impact of this cycle is significant, the pass-through system reduces streamflow and depletes available fresh water.

Water conservation strategies in the schools include the use of efficient plumbing fixtures, which reduces water use by about 35%. That's about two million litres every year – almost as much water as fits in an Olympic-sized swimming pool.

The use of drought tolerant planting and efficient irrigation systems help to further reduce potable water use on site, by about 50%.

Food garden in front of the Elementary school.
Image credit: **hcma** Architecture + Design

01



02

03

01 Central Plant building, housing heating/cooling equipment serving both schools.
Image credit: Isaac Leblanc, SMCN

02 Bay windows in classroom
Image credit: **hcma** Architecture + Design

03 Photovoltaic array on the Elementary school roof
Image credit: Isaac Leblanc, SMCN

Energy and Atmosphere

Historic reliance on fossil fueled energy and relatively inefficient methods of heating and cooling our buildings is contributing significantly to the climate crisis. Globally, buildings contribute about 40% of greenhouse gas emissions to our atmosphere. Managing emissions from buildings, as well as designing them for resilience in a changing climate, is imperative to prepare for and adapt to the future. Passive and active strategies were thoughtfully applied to the schools to benefit from site conditions and optimize active equipment for efficiency. These strategies also improve occupant comfort and experience.

Some of the strategies implemented include:

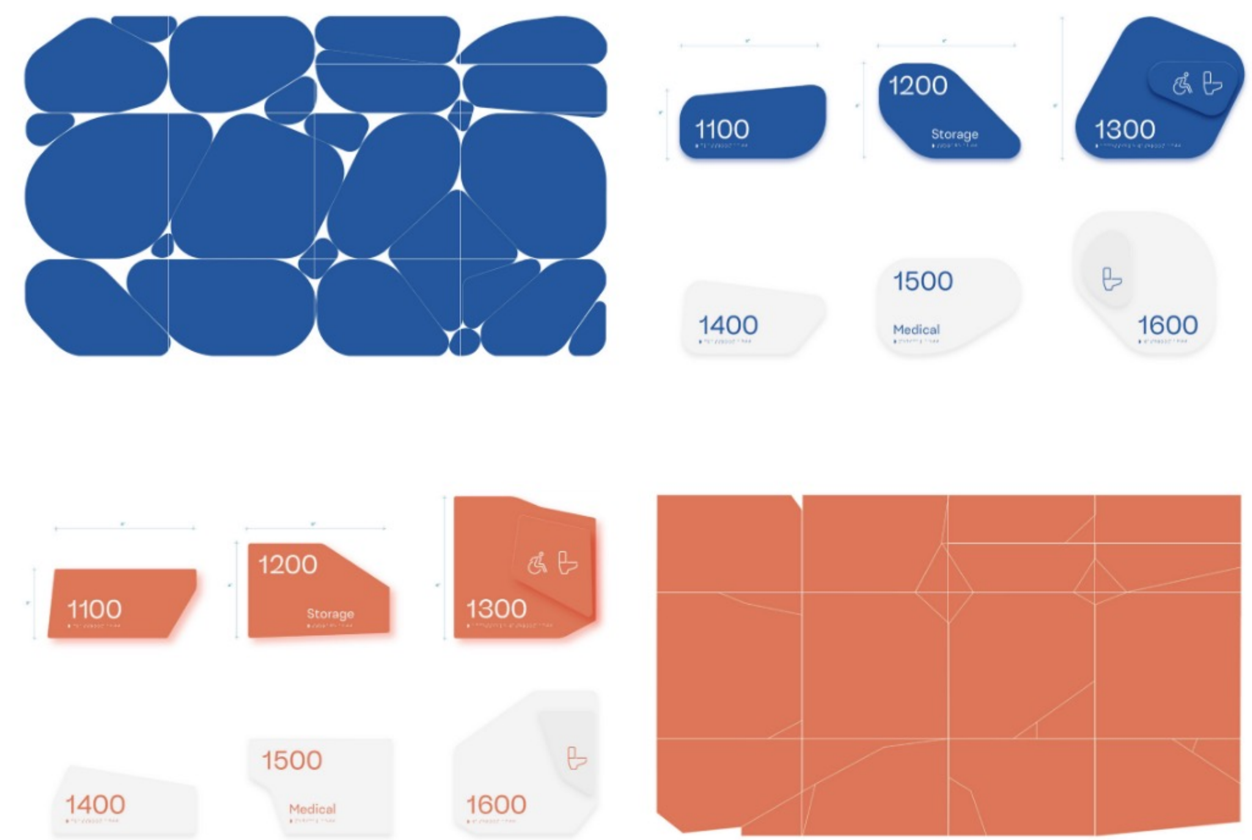
- To heat and cool the buildings, a networked approach optimizes equipment and infrastructure with a central energy plant that serves both the elementary and middle schools.
- The heating and cooling system relies on three water-to-water heat pumps located in the central plant and connected to about 10km of pipes buried under the playing fields. The heat pumps exchange heat between the geothermal field and a water loop, bringing hot and chilled water to each space, much more efficiently than conventional systems.
- No gas or fossil fuels are used to heat or power the schools, only electricity. Most of BC's power comes from low-emission hydroelectricity, so this system keeps operational emissions very low.
- The two schools are nestled in the slope to take advantage of the thermal mass that the ground provides, reducing heat losses to the exterior and maintaining a consistent indoor temperature longer. This strategy also allows for easy access at grade to both level one and level two for both schools.
- Indoor spaces can overheat when the sun pours in at a low angle from the east and west, early and late in the day. To mitigate this effect, classroom windows face north and south, and a portion of the glazing is angled towards the east to let the light and views in – but not the heat.
- All light fixtures are LED. Compared to traditional fluorescent lamps, LED lights are more energy efficient and reduce waste with a much longer lifespan. Fluorescent lamps also contain mercury, a toxic element that poses significant health risks and contributes to water pollution.
- Photovoltaics on the roof generate sufficient electricity to cover 10% of the schools' energy consumption.

Materials and resources

Materials and resources we use in buildings generate waste and carbon emissions associated with the extraction, processing, transport, maintenance, and disposal of building materials. We can reduce the impact of materials by evaluating their life cycle impacts and choosing products to optimize efficiency, lower emissions, and with better durability. Construction and demolition waste also contributes significantly to our landfills and many materials can be easily diverted for recycling or reuse.

Examples of strategies included in the schools' design are:

- The interior finishes installed in the schools were carefully selected for their ease of maintenance and durability.
- Room signage was designed to be cut out in shapes that maximized the use of a single sheet of material, resulting in pebble and rock-like profiles that is reminiscent of the site landscape.
- Materials that have transparent data about their environmental impact and their health impact were also prioritized.
- The construction process for the schools diverted about 80% of the construction waste, sending materials such as metals, drywall, concrete, and glass to facilities that divert these materials back into the material production cycle.



Room signage
Image credit: **hcma** Architecture + Design

Indoor Environmental Quality

Buildings with good indoor environmental quality protect the health and comfort of building occupants, can enhance productivity and decrease absenteeism. Considerations in the schools to improve indoor environmental quality include indoor air quality, lighting quality, acoustic design, and material health.

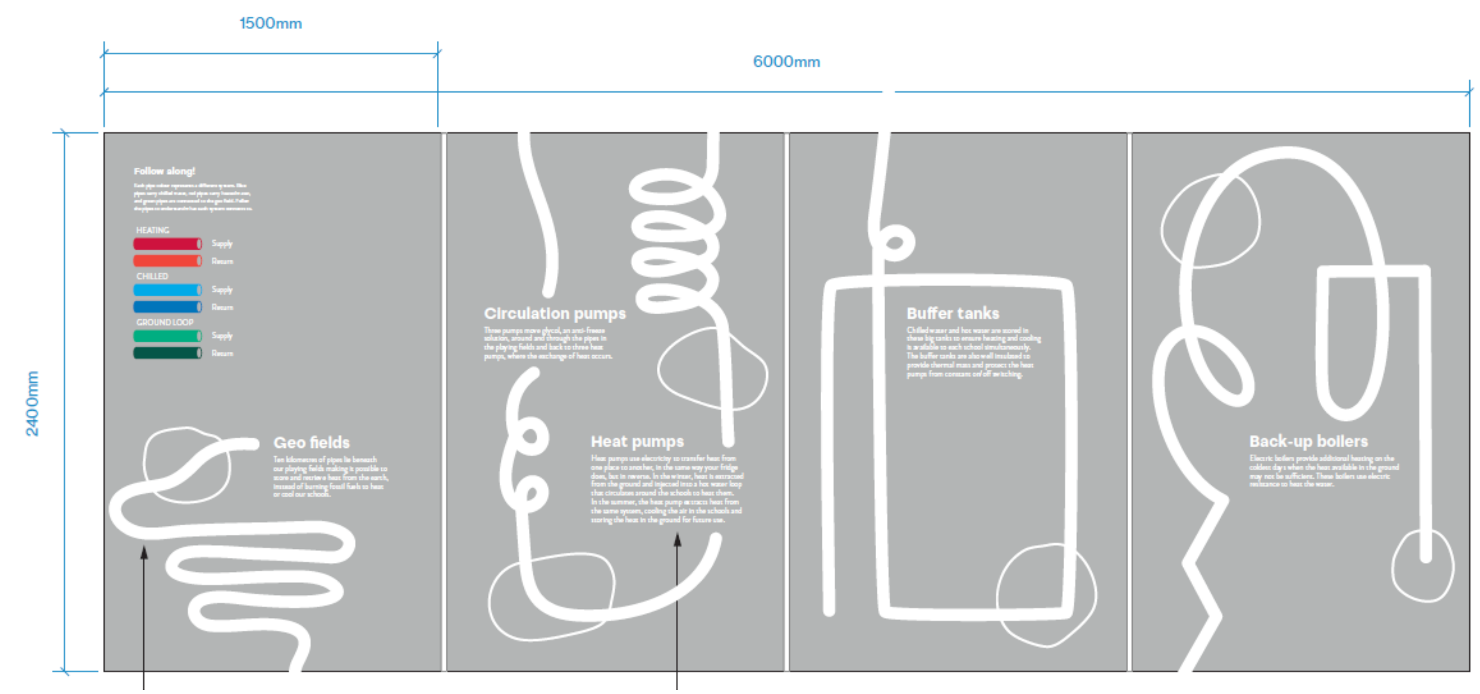
Strategies implemented under this credit category include:

- Thermal comfort in the gymnasiums is maintained in part by the large circulating fans. The fans increase air velocity to accelerate the cooling effect on your body, which is a very energy efficient way to provide cooling.
- Each classroom has a dedicated unit ventilator to provide fresh air and create a healthy learning environment. Outside air is filtered delivering high quality indoor air. CO2 monitors and occupancy sensors control the supply of air to make sure adequate fresh air is supplied when the spaces are occupied.
- Many common paints, floors, carpets, cleaning products, and manufactured wood products contain pollutants called volatile organic compounds (VOCs). Some of these products can off-gas and slowly release pollutants over time. Over long periods of exposure, breathing in VOCs can lead to eye, nose and throat irritation, liver and kidney damage, and headaches. We selected low-emitting materials for the school, with low or no VOCs.
- The colour palette was selected to complement daylight in each space. The north wing of the school features warmer colour to balance the cooler north light; the south wing has cooler tones to balance the warmer light from the south. The classrooms feature soft neutral tones to bring calm and promote concentration, and gathering spaces display more stimulating accent colours.

Central Plant – interior view
Image credit: Isaac Leblanc, SMCN

Innovation

A signage program was implemented throughout the site to educate users and visitors on the sustainability features of the project. The central plant includes a viewing window with a graphic describing the systems. All ductwork and piping are colour-coded and neatly laid out to facilitate comprehension of the systems.



Graphic applied to central plant viewing window
Image credit: **hcma** Architecture + Design

Project metrics

	Metric	Project Performance
Energy	Total Energy Use	70 kWh/m^2y
	Energy Use Reduction from LEED Baseline	44%
	Energy Source breakdown	99% Electricity/1% Natural Gas
	Renewable Energy Generation	77,220 kWh/y
	% Renewable Energy Generation	10%
Carbon	Greenhouse Gas Intensity (GHGI)	0.93 kg $CO^2/m^2.y$
	GHGI reduction from LEED Baseline	40%
	Refrigerant Carbon Emissions	0.6 kg $CO^2/m^2.y$
Water	Outdoor water use reduction from LEED Baseline	51%
	Fixtures water use reduction from LEED Baseline	37%
Site	Open Space	41%
	% Vegetated area	35%
Materials	Construction Waste diversion	79%

We are **hcma**. We believe human connections are the best path to solving the fundamental problems of our time.

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