SAB Mag | Canadian Green Building Awards

UNIVERSITY OF WATERLOO ESC THIRD FLOOR RENOVATIONS

PROJECT SUMMARY

The ESC Level 3 Renovation at the University of Waterloo transforms 28,309 sq. ft. within the existing Earth Sciences & Chemistry building into a modern, high-performance graduate research environment. Originally constructed in the 1960s, the building had undergone decades of incremental upgrades, resulting in fragmented laboratories, inefficient circulation, and aging mechanical infrastructure. Rather than pursue replacement, the project extends the life of the structure, preserving significant embodied carbon while modernizing performance and safety.

The renovation reconfigures the floorplate around eight research labs, graduate work areas, and faculty offices organized along a new daylit single-loaded corridor that improves visibility, collaboration, and spatial clarity. Key constraints included maintaining building occupancy, integrating new systems within congested legacy infrastructure, and preparing the facility for future campus-wide decarbonization initiatives.

Sustainable strategies include: a geothermal-ready low-temperature hydronic heat pump system, rooftop Dedicated Outdoor Air System (DOAS) with energy recovery, high-plume exhaust, variable-airflow fume hoods with sash sensors, and envelope upgrades to improve thermal performance. Heat recovery and reduced exhaust volumes significantly lower energy demand in a traditionally high-intensity laboratory typology.

The project is designed as net-zero ready and aligns with the University's long-term carbon reduction strategy.

MAIN PROJECT DESCRIPTION

Strategic Decisions

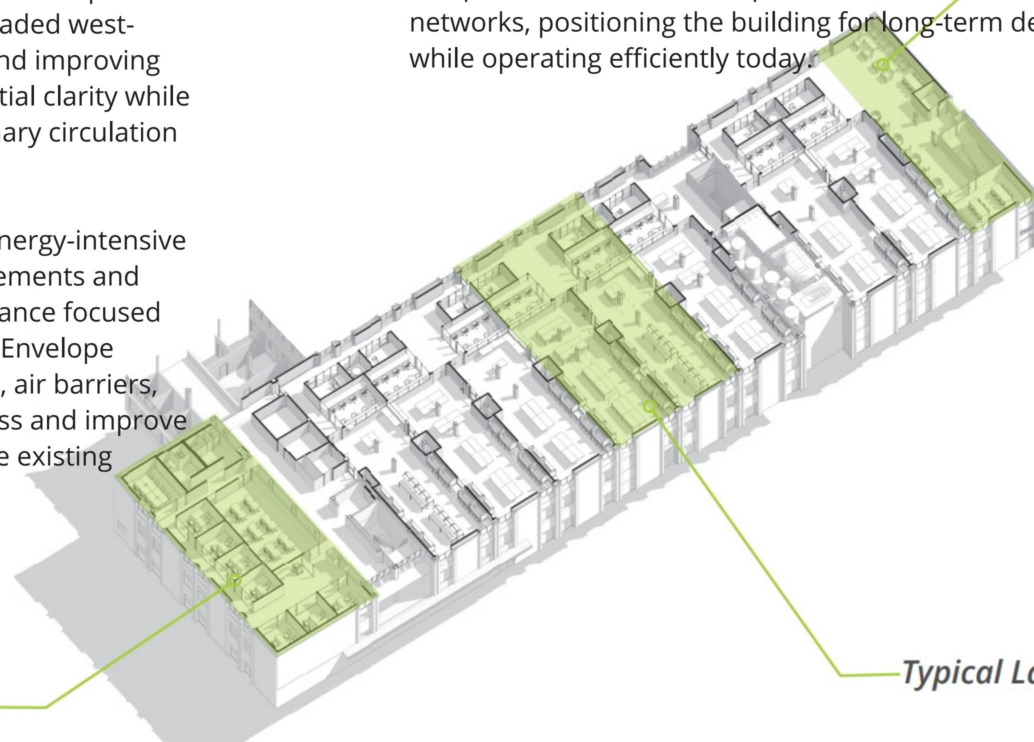
The ESC Level 3 renovation embraces the ecological and economic value of renewing existing infrastructure. The Earth Sciences & Chemistry building represents substantial embodied carbon and cultural significance within the University of Waterloo campus. Extending its life rather than replacing it was a foundational sustainability decision.

The project reconfigures a fragmented 1960s laboratory floor into a cohesive research environment organized around a clear circulation spine. A major architectural move replaced a dark double-loaded corridor with a single-loaded west-facing corridor, introducing natural daylight and improving wayfinding. This reorganization enhances spatial clarity while reducing the need for artificial lighting in primary circulation zones.

Because laboratory buildings are inherently energy-intensive — particularly due to 100% outside-air requirements and high exhaust volumes — sustainable performance focused on reducing loads before upgrading systems. Envelope enhancements, including improved insulation, air barriers, and high-performance glazing, reduce heat loss and improve occupant comfort within the constraints of the existing structure.

Active systems amplify these passive gains. A new low-temperature hydronic loop built around simultaneous water-source heat pumps allows heat recovery between zones, redistributing energy from cooling-dominant spaces to those requiring heating. A rooftop Dedicated Outdoor Air System (DOAS) with glycol runaround energy recovery recovers exhaust heat and reduces ventilation energy demand. Variable-airflow fume hoods with automatic sash sensors significantly reduce one of the building's largest traditional energy loads.

The systems are designed to be geothermal-ready and compatible with future campus low-carbon district energy networks, positioning the building for long-term decarbonization while operating efficiently today.



Community

The ESC Level 3 renovation redefines how research space supports academic community within an aging science facility. Previously, the floor was fragmented by narrow double-loaded corridors and isolated lab suites accumulated through decades of piecemeal upgrades. The redesign organizes eight research laboratories, graduate work areas, and faculty offices around a single-loaded, daylit corridor that serves as the social spine of the floor.

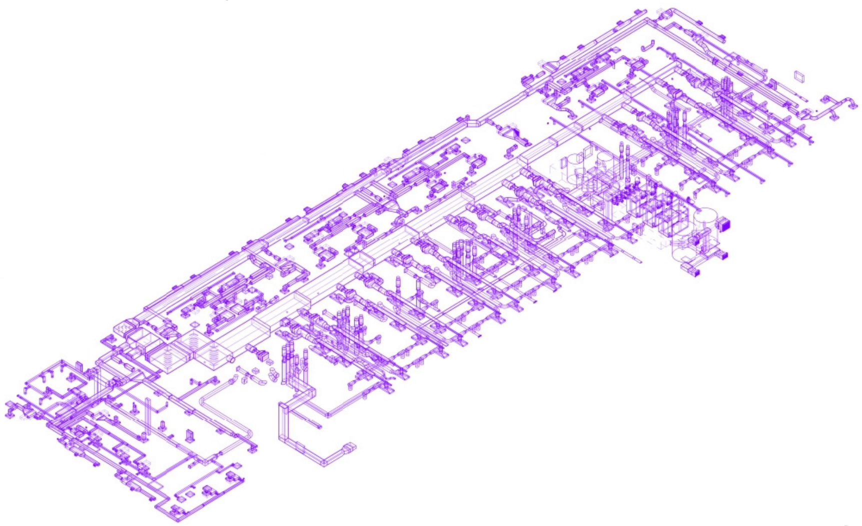
This architectural shift transforms circulation into collaboration. Informal meeting zones and touchdown spaces are positioned along the glazed west façade, bringing daylight into shared spaces and encouraging interdisciplinary exchange. Transparency between labs and corridor improves visibility, safety, and collegial interaction.

Site Ecology

As an urban campus retrofit, the primary ecological strategy was preservation and performance enhancement rather than site alteration. Retaining the existing structure preserves substantial embodied carbon and avoids the environmental cost of demolition and new construction.

Envelope improvements—including upgraded insulation, improved air barriers, and high-performance glazing—reduce heat loss and improve comfort within the constraints of a mid-century concrete structure. Mechanical renewal further strengthens ecological performance. A rooftop Dedicated Outdoor Air System (DOAS), tri-stack high-plume exhaust system, and glycol runaround energy recovery loop significantly reduce energy consumption in a 100% outside-air laboratory typology.

The hydronic system operates on a low-temperature loop designed to mimic geothermal performance and allow future connection to campus low-carbon district energy networks. By aligning infrastructure with long-term decarbonization planning, the project enhances ecological performance beyond its immediate footprint.



Light & Air

Daylight was introduced strategically to transform occupant experience and reduce energy demand. Replacing the double-loaded corridor with a single-loaded configuration along the west façade brings natural light deep into circulation and collaboration spaces. Glazed partitions between labs and shared zones further distribute daylight.

Ventilation and air control were completely modernized. A new rooftop DOAS delivers conditioned outdoor air while recovering energy from exhaust through a glycol runaround loop. Laboratories utilize variable air volume systems and low-flow fume hoods operating at reduced face velocities, equipped with automatic sash sensors that minimize airflow when idle.
Fan coils with pressure-independent control valves and low-pressure venturi air valves provide precise temperature and pressurization control, ensuring laboratory safety while reducing energy demand. These systems significantly lower ventilation loads—traditionally the largest energy driver in laboratory buildings.


INORGANIC CHEMISTRY
INORGANIC CHEMISTRY
PROCESS WATER. DO NOT DRINK.
FLAMMABLE
KEEP FIRE AWAY

Wellness

The renovation improves physical and psychological wellbeing through daylight, clarity of movement, and environmental stability. The new corridor configuration enhances visibility and wayfinding, reducing stress and improving safety.

Thermal comfort is enhanced through the low-temperature hydronic heat pump system, which allows independent heating and cooling by zone while redistributing recovered energy between spaces. Improved air quality and stable pressurization support both occupant health and research integrity.

Material selections prioritize durability and low emissions. Existing terrazzo flooring was retained where possible, reducing material waste and preserving institutional character, while new finishes—including recycled-content rubber flooring—support comfort and longevity.

Water Conservation

Although primarily a laboratory retrofit, the project integrates water efficiency through upgraded plumbing fixtures and optimized mechanical systems. The low-temperature hydronic loop reduces reliance on steam-based heating systems, indirectly lowering water and energy demand at the campus central plant.

System design also anticipates future integration with campus-wide infrastructure, improving long-term efficiency and reducing resource intensity.

Operating Energy Present & Future

Laboratory buildings are among the most energy-intensive building typologies due to high ventilation and exhaust requirements. This renovation targets load reduction as the first principle of performance improvement.

Key strategies include:

- Low-flow fume hoods with automatic sash sensors
- Variable airflow control and air monitoring
- Glycol runaround energy recovery loop
- Simultaneous water-source heat pumps operating on a low-temperature loop
- High-efficiency DOAS with heat recovery

The heat pump system achieves a heating COP approaching 6, significantly outperforming traditional electric boiler systems. Heat recovery between zones reduces overall energy input, while exhaust heat reclamation further lowers ventilation loads.

The mechanical system is geothermal-ready and compatible with future campus district energy decarbonization. This future-proofed infrastructure positions the building to reduce operational carbon intensity over time without major reinvestment.

Materials & Resources

Material strategy prioritized retention, durability, and reduced embodied impact. The project preserves the primary structural system and significant interior elements, including terrazzo flooring, minimizing demolition waste.

New materials were selected for longevity and recycled content, particularly in laboratory flooring and casework systems. Standardized yet modular casework simplifies future reconfiguration, extending lifecycle performance and reducing future material consumption.

Careful coordination minimized structural load increases, avoiding unnecessary reinforcement across the existing 1960s building. A targeted mechanical addition was introduced only where necessary to accommodate new buffer tanks, balancing performance gains with structural stewardship.

Building Life Cycle Considerations

The renovation approach recognizes the ESC building as renewable capital. By modernizing infrastructure rather than replacing the facility, the project significantly reduces lifecycle carbon compared to new construction.

Operational carbon reduction is achieved through load reduction, heat recovery, and electrified systems compatible with future low-carbon district energy. Embodied carbon savings are realized through structural preservation and selective material reuse.

Mechanical systems are designed for adaptability, supporting future campus energy transitions without requiring replacement. This long-term flexibility ensures continued relevance as sustainability standards evolve.

Education & Information Sharing

As the first phase of a campus-wide renewal, the project demonstrates how mid-century laboratory buildings can be transformed to meet contemporary research and decarbonization goals. The mechanical systems introduce advanced technologies—low-temperature heat pumps, sash sensors, energy recovery loops—previously uncommon on campus.

By modernizing infrastructure while maintaining active occupancy, the project serves as a model for deep laboratory retrofits in institutional settings. It establishes technical benchmarks and spatial standards that will guide future phases of renewal across the ESC complex.