Community Above, Tracks Below

Redesigning the University of Waterloo's Mobility Hub

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The University of Waterloo (UW) is located in Waterloo, Ontario, and is ranked among Canada's top universities academically and by undergraduate enrolment [1]. In 2019, the Region of Waterloo's ION, a light rail transit (LRT) line running north-south through the cities of Waterloo and Kitchener, opened for service, with a station at UW. While the line is used primarily to run the LRT service, additional tracks were required to accommodate the Canadian National (CN) rail line that runs through the area along the route known as the Waterloo Spur [2].

A UW bus station designed independently of the LRT station to connect to the local Grand River Transit (GRT) bus system opened in 2022. The bus station features four platforms that provide connections to local GRT routes and regional GO Transit routes as well as ample parking for passengers and buildings. While the bus station is connected to the LRT station, they do not function together as a fully integrated mobility hub due to the lack of coordination between the two projects.

Significant population growth in recent years underscores a greater need for public transit infrastructure [3]. To accommodate this, UW will need to not only enhance the existing transit stations but integrate them with other planned campus developments. These include new buildings highlighted in the Campus Plan such as Mathematics 4 and Engineering 8 (E8), which are planned for construction adjacent to the LRT station [4], [5]. The ION will also be extended 17 km into Cambridge, Ontario as part of ION Stage 2, further increasing ridership [6].

Both the surrounding area's population growth and large-scale infrastructure developments present opportunities to redevelop the UW mobility hub; expanding its multimodal connections and increasing its role in the wider regional network.

The University of Waterloo also sits on the traditional lands of the Anishinaabe, Mississauga of the Credit, Haudenosaunee, and Attiwonderonk Peoples [7]. As such, the land is covered by the Dish with One Spoon covenant: this treaty emphasizes the need for shared responsibility with the land and peaceful coexistence with each other on the Great Lakes territory [8]. It is increasingly used as a guiding principle for urban planning [8], highlighting the need for sustainable development and shared vibrant community spaces.

^{[1] &}quot;Enrollment by university." Universities Canada.

^[2] C. Banger. "Timeline: Looking back at a 17-year journey to ION." CTV News.

^[3] H. Senoran. "Waterloo Region says international students behind big population boost." CTV News.

^{[4] &}quot;Engineering Strategic Plan." University of Waterloo.

^[5] M. Roschman, "Faculty of Mathematics breaks ground on Mathematics 4 building" uwaterloo.ca.

^{[6] &}quot;Stage 2 ION." Region of Waterloo.

^[7] T. Chung-Tiam-Fook. "Two Row and Dish With One Spoon Wampum Covenants." Evergreen.

^{[8] &}quot;Whose Land." Whose Land.

CONCEPT

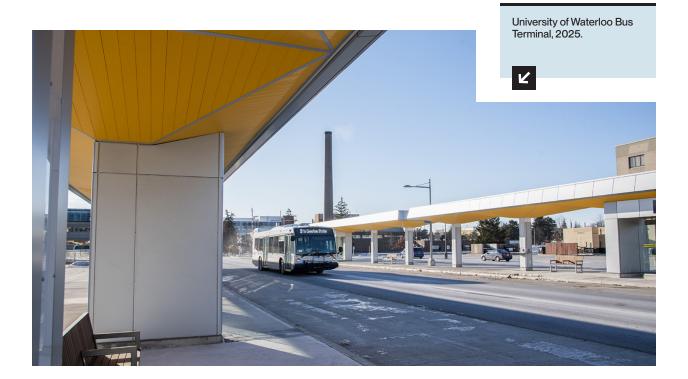
The University of Waterloo's mobility hub was intended to serve as a transfer hub between regional and local buses, as well as the region's ION LRT. It is a multimodal gateway to campus, connecting residences and amenities east of the ION LRT with the rest of the university. However, the current design faces multiple connectivity, mobility, accessibility, safety, and comfort issues that hinder its ability to serve as a transit hub and a community space. For example, the large parking lots surrounding the station isolate pedestrian spaces and could be an opportunity for further developments that add to the station's public realm. As such, UW's mobility hub should be upgraded to sustain long-term growth and serve as a focal point for the community.

The proposed redesign of UW's mobility hub will see the LRT station grade separated from the bus terminal to reduce conflicts between trains, buses, and pedestrians and increase safety and efficiency.

This grade separation will require trenching the LRT from Columbia Street through University Avenue, ending at Waterloo Park, minimizing conflicts between the LRT and vehicular traffic. This approximately 1.75 km trench will be 7 m deep to accommodate both the LRT and limited overnight freight traffic moving through the Waterloo Spur. This includes a 500 m descent on the northern and southern ends to account for the 1.5% grade requirements for freight traffic. UW's LRT station would then be rebuilt under the bus terminal exit, with a new public plaza and stationhouse on top connected to the platform with stairs, escalators, and elevators. The trenched island platform would be 9 m wide to meet accessibility standards and passenger flow needs.

Enhancing Connectivity and Mobility

The current mobility hub struggles with balancing the needs of the different transportation modes. The redesign will also improve connections between all modes of transit, improving passenger flow and mode choice. The pedestrian realm that connects passengers with campus buildings, residences, and businesses will also be considerably enlarged to facilitate better connections to the UW campus. Micro-mobility facilities will be added and expanded with more bike parking and e-scooters. Bike and car sharing facilities will also be installed to promote mode choice.



University of Waterloo Multi-Modal Hub

Proposed Light Rail Trenching and Transit Hub Improvements





Improving Accessibility, Safety, and Comfort

A redesigned mobility hub at UW would also see improvements in accessibility, safety, and comfort. This would include improved seating and shelter areas. Additionally, more wayfinding and signage will also create more intuitive navigation.

Incorporating Indigenous Placemaking Principles

Indigenous placemaking is a theme highlighted throughout the redesign of the mobility hub, to create not just a transportation node but a focal point for the community. This includes more community and event space, Indigenous art and education, and native plants to enhance wellbeing.

URRENTISSUES

Report of the Connectivity and Mobility Challenges

🐴 Active Transportation

The existing trails surrounding the LRT and bus terminals are shared by pedestrians, cyclists, and other active transportation users. This layout increases congestion and the risk of accidents due to the proximity of the shared sidewalk and queuing areas, particularly at peak travel times. Inadequate lane delineation leads to confusion and reduces the efficiency of movement within the terminal, as users may use the wrong direction of the path or use the space to queue for buses.

The terminal currently has eight bicycle parking stands accommodating a total of sixteen bikes. This capacity is insufficient for a main transit terminal, particularly one that also serves as a key connection between UW, multiple bus routes, and the LRT. Existing bike stands are also poorly situated in pedestrian-congested zones, reducing security and convenience.

Similarly, the Region of Waterloo dockless e-scooter and e-bike share program has generated parking and organizational issues [9]. With limited designated parking infrastructure, the shared vehicles are often left on sidewalks and paths, impeding pedestrian flow and making it difficult for users to locate available vehicles.

Mobility Gaps

Despite the increased usage of rideshare and carshare transportation, there are no designated locations for these modes of transportation at the University. The absence of formal pick-up/drop-off (PUDO) spaces and car share parking diminishes access and imposes inconveniences on traffic flow around the transit hub.

Unlike other areas of campus with bridges for pedestrian connection, the transit terminal is not provided with a direct sheltered link to principal university buildings. This reduces accessibility, particularly during winter months when users will be seeking covered pathways to avoid poor weather. Additionally, the lack of a separate pedestrian-oriented connection forces greater traffic through the terminal, which increases conflicts with other modes of transportation and poses safety concerns.

் Accessibility and Comfort Challenges

Poor Wayfinding Facilities

Existing wayfinding is inadequate for the mobility hub's size. Existing displays and signage provide limited information without real-time updates on delays and detours. This creates a barrier for passengers without access to the internet. Wayfinding can also be improved to be more inclusive to those with visibility impairments.

^{[9] &}quot;Electric bike/scooter program renews and expands in 2025." Region of Waterloo.

* Environmental Discomfort

The mobility hub also remains uncomfortable throughout much of the year. The lack of benches forces most users to stand as they wait for transit while pedestrians are exposed to wind and rain due to a lack of windbreaks at the mobility hub's borders. During the winter, in particular, accessing the mobility hub is difficult even with regular snow plowing as pathways quickly accumulate slush. Moreover, the mobility hub itself lacks any washrooms: both transit users and bus operators are oftentimes seen walking extensive distances towards campus buildings outside of the mobility hub due to a lack of washrooms within the hub itself.

FY Safety

Even though the mobility hub already follows crime prevention design principles such as Crime Prevention Through Environmental Design (CPTED), safety can be improved with better landscaping and pavement design. The hub currently has clear sightlines and designated pedestrian paths which help with security. However, the waiting areas are not contrasted with their surroundings, making it unclear that these spaces are meant for users to take care of, a CPTED concept called territorial reinforcement. By improving landscaping and pavement design and adding more comfortable seating and amenities, these areas can feel more welcoming to pedestrians, encouraging a sense of ownership and consequently making them safer.

Placemaking

The existing bus terminal lacks third places—spaces where people can gather and socialize—alongside Indigenous placemaking elements and native flora [10]. Its current design fails to foster community engagement with the space and create a welcoming environment. Incorporating third places and Indigenous placemaking elements, such as public art and cultural references, would enhance the mobility hub's ability to serve as a vibrant community space on campus and align with local reconciliation efforts.

三 OBJECTIVES

The identified issues create guiding statements and principles that inform the redesign of the mobility hub.

1

Create an integrated and multimodal hub that meets the needs of students and residents.

2

Enhance accessibility, safety, and comfort for users of all ages and abilities.

3

Incorporate Indigenous placemaking and community development to create a focal point for the community and address reconciliation.

X SOLUTIONS

Active Transportation Improvements

Expanding the existing multi-use path on both sides of the terminal to include bike lanes would separate cyclists and e-scooter riders from pedestrian traffic. Marked lanes would enhance safety, reduce congestion, and make it easier to move through the hub.

^[10] B. Mutukistna, "The Benefits of Urban Native Plant Gardening: An Annotated Compilation of Peer-Reviewed Literature," University of British Columbia.

COMMUNITY ABOVE, TRACKS BELOW

A centralized, sheltered alternative mobility parking area near the LRT stop, i.e., in the parking lot of East Campus 2 (EC2), is suggested. This area would include secure bicycle lockers as well as communal e-bike and e-scooter docking stations. Relocating bicycle parking and docking stations off walkways would offer organized storage, prevent path congestion, and increase accessibility for customers. Furthermore, incorporating secure lockers would increase convenience, security, and weather protection for cyclists.

Mobility and Accessibility Enhancements

Apart from bicycle parking and docking stations, formal PUDO spaces and car share parking will be available in the alternative mobility parking area. The introduction of a formal car share program, such as the EVO service at the University of British Columbia, would improve mobility options and encourage multimodal travel [11]. Carshare also serves as an alternative to private vehicle ownership and is more affordable for those who travel by car infrequently.

A skywalk connecting the proposed E8 building and the Davis Centre (DC), with stair and elevator access to the LRT platform, will enhance connectivity. This would provide a covered, direct route between campus buildings and transit facilities, improving year-round accessibility and reducing pedestrian traffic within the terminal.

* Wayfinding Enhancements

Putting large digital signs throughout the station will supplement existing signage with live information on delays and diversions.

This will include a departures board, a 2D station map, and key emergency information. To maximize visibility, they will be positioned in high-traffic areas such as bus shelters and station platforms.

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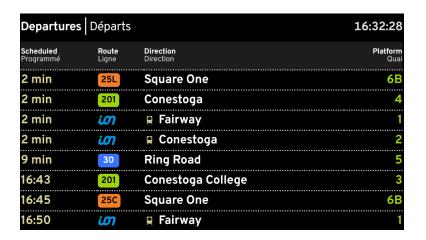
Design courtesy of Brayden Petersen. See the real-time display prototype here: https://uw-departures.vercel.app/ ↗











- [11] "Car Sharing." University of British Columbia.
- [12] Wayfinding Design Standard, MTX DS-03, Metrolinx.
- [13] "Wayfinding Harmonization." Metrolinx.
- [14] Accessible Design for the Built Environment, CSA B651-18, CSA Group.
- [15] "Accessible Paths of Travel within Buildings." Accessibility for Ontarians with Disabilities Act.

COMMUNITY ABOVE, TRACKS BELOW

Signs will match GO Transit design standards to facilitate smooth regional transfers [12], [13]. Local accessibility requirements such as the Accessibility for Ontarians with Disabilities Act and the Canadian Standards Association also require the presence of braille, tactile pavement, and high-contrast signage for a more inclusively-designed facility [14], [15].

Environmental Features

- Green roofs on bus canopies to manage runoff, mitigate pavement heat, and assist UW's sustainability efforts [16]
- → Covered canopies extending to cover all main pathways, crossings, and entrances into campus from the mobility hub
- → Electric snow-melting pavement to clear sidewalks and platforms
- → Acrylic windbreaks to reduce wind chill and snow drift
- → Additional benches to improve comfort

Additional Accessibility Features

- → Wheelchair boarding areas at bus platforms
- → Rectangular Rapid Flashing Beacons (RRFB) at high-traffic crosswalks
- → Public washrooms near bus stops and transit break rooms for operators
- → Pavement layout and landscaping to separate pedestrian paths
- → Staffed register desks during peak times to direct passengers
- → Elevators and stairways to promote accessibility between station levels
- → Power doors, ramps, wide walkways, and voice announcements





"Fabric of Place" Research and Technology Station, Waterloo, ON.

Placemaking

=↑ Third Places

Part of the Dish with One Spoon covenant is sharing in the land and fostering community. Open green spaces and community event areas, such as widened sidewalks for pop-up events, urban play spaces like hopscotch and chess tables, and dedicated space for lively commercial uses such as cafes and small retail shops, are planned to create vibrant third places where people can gather and socialize. There will also be opportunities for Indigenous education through signage in Anishinaabemowin and educational plaques.

Indigenous Public Art

There is a lack of public art in the existing mobility hub. Adding Indigenous art pieces from local Waterloo artists that pay homage to the territory and the peoples of this land would aid in efforts towards reconciliation, improve mental well-being, and public safety [17]. This would include murals, sculptures, and additional fixtures to enhance the existing bus shelters. Moreover, this builds upon the city and region's Indigenous public art programs, which aid in reconciliation and placemaking.

^{[16] &}quot;Green Roofs on Bus Shelters in Cities." Mobilane.

^[17] C. Young. "How Public Art Can Improve Quality of Life and Advance Equity." Housing Matters.

\$ Sustainability

The Dish with One Spoon covenant also emphasizes the connection with the land. As part of the redesign, more greenery will be included to promote sustainability and community wellbeing. Indigenous plants such as sage and sweetgrass (wiingaashk) will be planted to pay homage to smudging, a cultural tradition to Indigenous communities on the land, but will also provide effective water drainage and biodiversity [18]. Sugar maple trees (ininaatig) will also be planted to provide shade, improve air quality, and reduce the urban heat island effect of the current concrete-heavy mobility hub. Using native plants will promote biodiversity, pay respect to the land, reduce erosion, protect against flooding, and promote overall well-being [10].

Consultation

The Dish with One Spoon covenant emphasizes the collaborative sharing of resources and community building. As such, as part of the redesign process, consultation with stakeholders and Indigenous communities will be undertaken. This includes targeted information sessions with stakeholders with students, staff, faculty, and the wider community. Informed and ongoing consultations with the Anishinaabe, Mississauga of the Credit, Haudenosaunee, and Attiwonderonk nations would help inform Indigenous design elements and best practices. Consultations also provide a unique opportunity to create community visioning exercises through mechanisms like participatory budgeting and interactive mapping tools.

The vast majority of Canadian university campuses have underutilized surface parking lots that create an unpleasant pedestrian experience and hinder sustainable development. These parking lots often exist in conjunction with busy existing transit terminals, such as at the University of Guelph and at Ontario Tech University. Universities can leverage these spaces to better support the connectivity, accessibility, and placemaking of these mobility hubs.

Connectivity

The mobility problems of the University of Waterloo are not unique. The vast majority of Canadian university campuses in small-to-mid sized cities were built in the 1960s with a large supply of surface parking and share similar mobility issues with regard to parking, car share services, and connectivity. As such, these proposed solutions are highly transferable to other university campuses.

- → Bicycle Parking: The majority of campuses lack proper, secure, and weather-shielded bicycle facilities. A covered, centralized bike parking structure would be practical in universities where bicycles are among the primary transportation modes.
- → E-Scooter and E-Bike Parking: Many shared micro-mobility programs suffer from a lack of regulated parking spaces, leading to obstruction and safety issues. Allocating parking space for bikes and scooters, similar to UW, could help address such issues at other universities.
- → **Car Share Services:** An increasing demand for carshare services from students requires universities to repurpose existing parking spaces to accommodate carshare services.
- → Pedestrian Skywalks for Connectivity: Enclosed walkways connecting main transit hubs and academic buildings would be especially beneficial at universities situated in regions with long winters, improving accessibility and commuter experiences.

Addressing the identified mobility issues at the UW mobility hub is essential for improving safety, efficiency, and accessibility. The proposed solutions provide a framework for enhancing connectivity, reducing congestion, and promoting multimodal transportation. Furthermore, these recommendations offer a transferable model that can be adapted by other university campuses facing similar transportation challenges. By implementing these improvements, UW can serve as a leader in sustainable and efficient campus mobility planning.

^{[18] &}quot;Smudging Information, Resources, and Request Form." University of Waterloo.

Accessibility

Wayfinding

Since university campuses often simultaneously serve as regional transit hubs, standardizing wayfinding will make using transit more convenient [19], [20], [21]. Institutions with a significant number of intercity commuters such as York University, Toronto Metropolitan University, and the University of Toronto would benefit most from standardizing signage [20], [21].

Real-time updated digital signage should be a priority for large, complex transit hubs at institutions such as the University of Guelph, University of Calgary, University of British Columbia, and the University of Alberta [20]. Campuses with transit stations, such as the uOttawa and Carleton University, or campuses with planned light rail terminals, such as McMaster University, also require improved wayfinding to reduce passenger confusion [20], [21].

Environmental Comfort

Universities should integrate climate adaptation components into transit nodes as more intensive weather conditions evolve [22]. For example, green rooftops will be a key part in mitigating heat from asphalt, improving air quality, and achieving environmental sustainability goals [16]. Campuses in high-snowfall regions like The University of Alberta and McGill University should implement electric or hydronic snow-melting systems to ensure year-round accessibility [23].

Representation Accessibility Issues

With the number of university students with disabilities doubling from 2000 to 2020, transit stations must be prioritized for accessibility [24]. This entails tactile signage, tactile routes, and audio announcements. Moreover, universities with large transit stations should be accessible to students with visual impairments and mobility issues to enhance inclusive transportation systems [20]. By doing so, Canadian universities can make their mobility hubs more accessible, improve transit availability, and set a national example for accessible and sustainable transportation infrastructure.





École de Technologie Supérieur, Transit Shelter in the Rosemont-La-Petite-Patrie Borough at the Intersection of Sherbrooke Est/Pie-IX. 2024.

^[19] Y. Zhang, X. Chen, and J. Jiang, "Wayfinding-Oriented Design for Passenger Guidance Signs in Large-Scale Transit Center in China," Wayfinding-Oriented Design for Passenger Guidance Signs in Large-Scale Transit Center in China, vol. 2144, no. 1, pp. 150–160, Jan. 2010, doi: 10.3141/2144-17.

^[20] S. Aono, "Identifying Best Practices for Mobility Hubs," TransLink.

^[21] L. Cohen. "The science of wayfinding—a formula to increase transit ridership." Stantec.

^[22] R. McSweeney and A. Tandon. "Mapped: How climate change affects extreme weather around the world." Carbon Brief.

^{[23] &}quot;Hydronic vs. Electric: Choosing the Right Snow Melting System." Pipelife.

^{[24] &}quot;For Disability Pride Month—We Highlight Our Work on College Campus Access Issues." U.S. Government Accountability Office.

^{[25] &}quot;Advancing Reconciliation and Indigenization at Canadian Universities." Universities Canada.

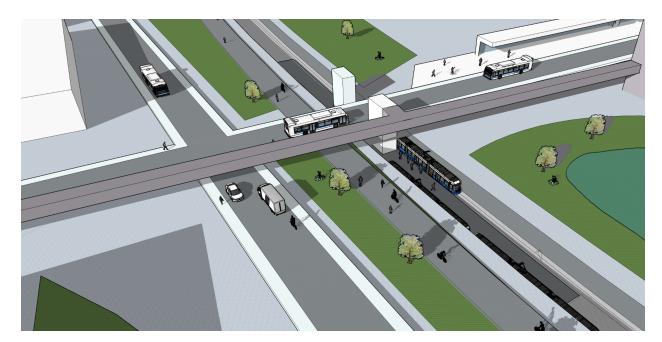
Placemaking

As universities across North America address Indigenous reconciliation, there will be continued efforts to integrate Indigenous culture and practices in public spaces. Using the Indigenous placemaking themes in this redesign and the Dish with One Spoon covenant as a guiding principle will help create mobility hubs that are vibrant, active, and can integrate Indigenous culture.

Almost every single university in Canada has a plan to address Indigenous reconciliation on their campuses, with many integrating it into their campus plans [25]. Institutions such as York University and the University of Calgary, which both have mobility hubs, would benefit from the integration of Indigenous placemaking principles to address reconciliation, build better community spaces, and foster relationships with their Indigenous communities. At the end of the day, mobility hubs are public spaces: integrating Indigenous placemaking and community building better highlights their roles as focal points for communities.

© CONCLUSION

The proposed redesign of the University of Waterloo's mobility hub envisions a hub that is well connected to the greater community, accessible to all, and fosters Indigenous placemaking principles. Grade separation with the trenching of the ION LRT offers a unique opportunity to rethink the connections to campus and the mobility features of the hub. This includes features to diversify mode choice, improve wayfinding, and integrate the hub with the university. These proposed principles and design elements can be used at other universities, especially those in Canada that face similar climate, mobility, and planning challenges with their existing mobility hubs. By creating an integrated multimodal hub that centres accessibility, safety, and community development, the University of Waterloo's mobility hub can become a place with COMMUNITY ABOVE, TRACKS BELOW.



1

Artist's rendering of redesign.

Design courtesy of Elizabeth Casemore.