Making Montreal's Indoor City Accessible for People with Disabilities

Matt Hagg
Master's student
School of Urban Planning
McGill University
Suite 400, 815 Sherbrooke St. W.
Montréal, Québec, H3A 2K6
Canada
Tel.: 514-398-4075
Fax: 514-398-8376
E-mail: matt.hagg@mail.mcgill.ca

Ahmed M. El-Geneidy (corresponding author)
Assistant Professor
School of Urban Planning
McGill University
Suite 400, 815 Sherbrooke St. W.
Montréal, Québec, H3A 2K6
Canada
Tel.: 514-398-8741
Fax: 514-398-8376
E-mail: ahmed.elgeneidy@mcgill.ca

Paper submitted for presentation and publication at the transportation research Board 89th Annual Meeting

July 2009

ABSTRACT

Indoor pedestrian networks are a facet of the built environment in many cities around the world. They can be built for many reasons, including separating pedestrians from motor vehicle traffic, providing a refuge from seasonal inclement weather, or monetizing otherwise unused floors of office buildings. In Montreal, an indoor city has been in existence since 1962 and has grown to a length of 32 km the downtown area. While previous studies have examined the network growth and its effects on the levels of accessibility to retail space within the indoor city, the results of these studies do not hold true for people with disabilities. This research examines the ability of a person with physical disabilities and/or mobility impairments to function within Montreal's indoor city. This is done through examining the existing indoor network and measuring the existing barriers that a person with disabilities faces when moving inside Montreal indoor city using a simple accessibility measure. Also in this research we develop several scenarios to determine the most important links that can substantially increase the accessibility levels for the people with physical disabilities. Results suggest that while certain segments are more accessible than others, the majority of the Indoor City is currently inaccessible to people with disabilities. The paper ends with a set of recommendations for upgrading key connection points to increase the level of accessibility inside the Indoor City; legislative improvements aimed at ensuring accessibility in future extensions and as part of any major renovations; organizational improvements, such as a dedicated Indoor City municipal department; and the launch of a RÉSO website.

INTRODUCTION

"The moral test of government is how it treats those who are in the dawn of life, the children; those who are in the twilight of life, the aged; and those in the shadows of life, the sick, the needy and the handicapped." Hubert H. Humphrey, former U.S. Senator

Montreal's Indoor City, often called the Underground City and officially known as RÉSO (réseau de ville souterrain), is one of the largest network of interconnected complexes in the world. This network links shopping malls, office towers, metro and train stations, hotels, apartments, and convention centres in the downtown area. It provides Montrealers with the ability to travel between any of these destinations without stepping outdoors. The Indoor City is well used by pedestrians looking to escape from Montreal's harsh climate, especially during the cold winter and hot summer days. As Montreal's downtown is located on a hillside, buildings that comprise the Indoor City tend to have a variety of levels, often with a tunnel entering the building on one level, but leaving towards the next building on a higher or lower level. Consequently, stairs are a common feature of the Indoor City; however, because the majority of the system was constructed before the advent of the concept of universal access, there are few elevators or ramps to be found in the tunnels connecting buildings.

The Indoor City network poses complications for people with physical disabilities. In addition, many of its components are especially inaccessible for people with mobility impairments. Having a full access to all services within the indoor city is a big challenge, if not an impossible one, for people with mobility impairments. Therefore, this study will examine the current level of accessibility of Montreal's Indoor City to the people with mobility impairments and suggest modifications in the existing network that could improve the level of accessibility for people with mobility impairments. Figure 1 is a map of Montreal's indoor City.

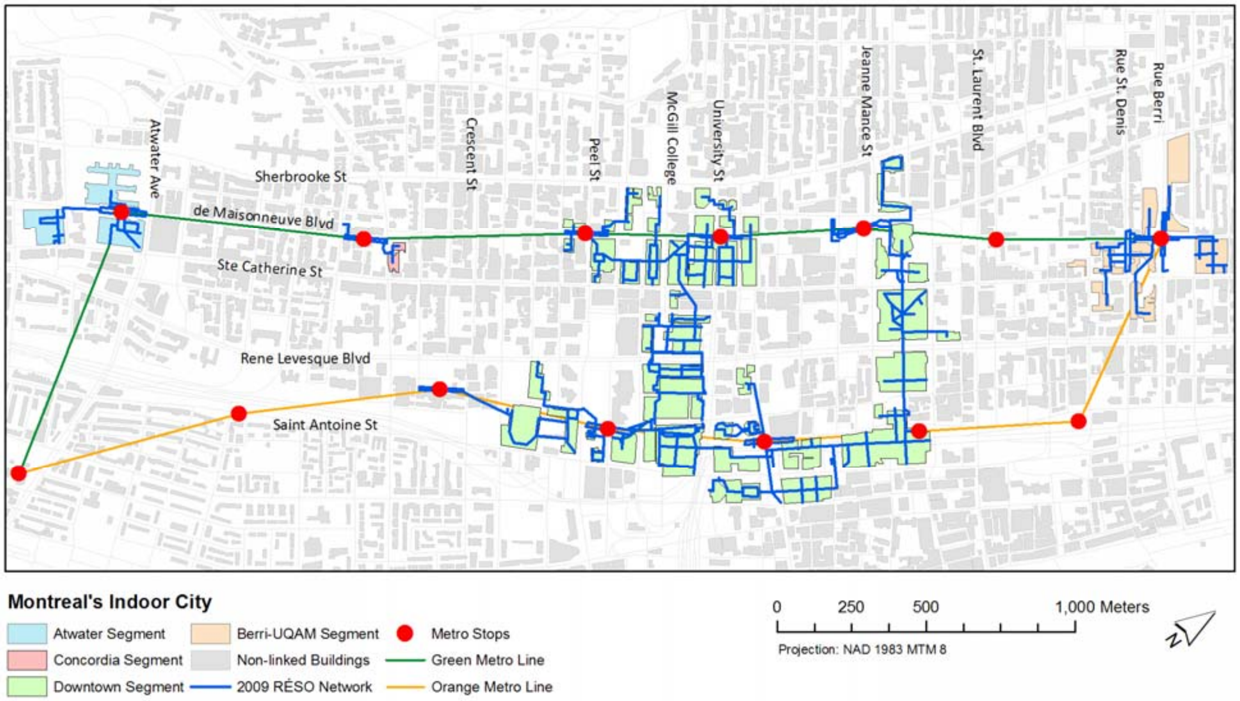

Figure 1 Montreal indoor city

This research paper commences with a brief historical background about Montreal's Indoor City, followed by the research methodology. An analysis section is then introduced where several scenarios are generated to show the power of changing the levels of accessibility along some key links and the extent these changes will benefit people with mobility impairments. Finally, a conclusion section is presented.

BACKGROUND

Indoor Cities

Numerous indoor pedestrian networks exist in cities around the world. These networks, which are often called indoor cities, underground cities or skyways, usually connect together buildings and transportation systems such as subways and parking garages, and allow pedestrians to travel between them without venturing outside. These networks can usually be classified into two different types: systems that are primarily underground, and systems that are primarily above grade, usually on the second stories of buildings. Montreal's indoor pedestrian network is unique because around half of the network is at or above grade. Pedestrian networks across the globe have developed as important indoor pedestrian environments that host a diversity of activities and purposes, especially in downtown areas. In Canada, Montréal's *Indoor City*, Toronto's *PATH* and Edmonton's *Pedway* underground pedestrian routes have gained fame, as have other systems all over the world such as *Forum des Halles* in Paris, Japan's *Crysta Nagahori*, and

Singapore's *CityLink Mall*. Above grade "skyway" systems are also common in North America, such as the Minneapolis' *Skyway,* and Calgary's *PLUS 15*.

Historically, there have been varying rationales behind the construction of indoor cities. In Canada, they were largely constructed to provide a refuge from climate extremes, while in other cities, such as in Houston as well as in those in Asia, the reasoning behind construction was primarily to separate pedestrians from automobile traffic as part of the segregation of street users for increased safety and efficiency [1, 2]. Elsewhere they have often been constructed to provide a quick route between mass transit stations and large trip generators.

Underground and indoor cities provide benefits for many stakeholders. They offer climate protection and shorter walking distances for pedestrians; increased property values and more opportunities for high-rent spaces for property owners; and they allow municipalities to show off a model of compact sustainable environment [3]. Increased visibility and exposure for retailers is also a key element in the underground city. After Montreal's Metro was constructed in 1966, retailers saw the advantage of opening up in the indoor city as they could rely on extensive traffic to and from the metro passing by their storefronts. Indeed, prior to the opening of the metro and the indoor city there was no below-ground retail space, but as of recently, 65% of all the retail space in Montreal's downtown core can be accessed via the indoor city [2, 4].

As of 2007, there were 30.7 km of corridors in the Indoor City, travelling through 69 buildings and used by over 230,000 people each weekday. From a transportation point of view, the Indoor City is very well connected, as it is directly connected to all four commuters and intercity train and bus stations, 10 of the 12 metro stations in the downtown area, and 38 parking garages with around 17,500 parking spots. Accordingly granting smooth access to people with disabilities is a must so they can have equal opportunities in term of access to retail and protection from severe weather conditions.

Access matters

Kéroul, a Quebec based organization that aims to making cultural and tourism attractions more accessible to persons with disabilities defines a person with a physical disability as the one who, either temporarily or permanently, have trouble with mobility due to his size or physical condition. It widens the definition to include people with deficiencies resulting from illness or accident and who consequently get around with the help of a wheelchair, crutches or a cane. Their definition also includes people who live with a visual or auditory impairment and people who tire easily due to overweight, pregnancy, age, and those living with arthritis or heart problems [5]. Nevertheless, it is a basic tenet of our society that persons with disabilities should have the right to access and use the same public space that other people can [6, 7]. Unfortunately, and despite the best efforts of advocacy organizations, this is not always the case.

In today's world, the built environment is usually designed for the perceived model pedestrian: that is, the young and able bodied [8]. This is problematic, because a growing percentage of the population is not able bodied and studies have found that the design of today's built environment generally does not meet the needs of persons with disabilities [7]. According to recent statistics, about 15% of the Canadian population has some sort of physical disability [9]. Combine this with the fact that temporary injuries or permanent disabilities that make it very difficult, if not impossible, to climb stairs will affect 70% of the population at some point during their lives, and perhaps we should adjust our thinking on what a model pedestrian should be [8].

In fact, any person can be disabled if the built environment is not designed according to his or her needs [6]. Public spaces are often socially produced in ways that deny disabled people the same levels of access as non-disabled ones [6, 10]. In a recent survey, over two-thirds of disabled respondents agreed that society was their main cause of disability, not their impairment [11]. Accordingly, it is the duty of transportation engineers and planners to work closely with people with disabilities and understand their needs and include them in the codes of public space.

It is expected, for example, that 50% of the population will be over the age of 55 by the year 2030 and as the baby boomers age, the amount of people with ambulatory and breathing difficulties is expected to rise, along with the number of persons using wheelchairs to shop [8, 11]. By designing for universal access, impediments such as stairs, heavy doors, steep ramps, and poor signage can be minimized and an environment that is truly open to everyone can be in place [11, 12].

It was not until the 1990s that universal design began to be acknowledged as an important principle in Canada. While this was recognized by governments around the world, including the U.S. and the U.K., which passed national disability acts in 1990 and 1995 respectively, Canada has yet to implement national disability legislation. Nevertheless, local building codes have, for the most part, begun to require newly constructed publicly accessible buildings to be accessible to persons with disabilities. This is common around the world, where, in many cases, only new buildings and buildings that are undergoing major renovations are required to become accessible [7]. Even though, by most definitions, the Indoor City would be recognized as public space, and would logically have to comply with public space accessibility legislation, legally it is much more complicated than that, and the indoor city might best be described as "quasi-public space".

The City of Montreal owns just 10% of the indoor city, with the rest owned by the private sector along with other public entities, such as the federal government and Hydro Quebec [13]. This ownership arrangement is problematic in terms of devising building and architectural standards and regulations for the indoor city as there are currently no set rules or guidelines that govern the entire system. The result is that the RÉSO has become a series of connected private-public space with each part of the Indoor City designed and operated differently [14, 15]. This was noted in

1985 when a study by Brown and Sijpkes [16] stated that the Indoor City was a haphazard arrangement with no clear motivations or plans for growth. Accordingly wayfinding was considered an issue and the city took responsibility for signage.

The Montreal Metro system forms an integral part of the Indoor City and is connected to it at many points. Montreal is one of the last major cities in the world to implement accessibility improvements in their Metro system. In Europe, for example, most public transit systems are already fully accessible, and those that are not must meet a 2015 deadline to become fully accessible [17]. Montreal's deep level Metro stations dating from the 1960s through 1980s are problematic in that they simply were not designed for wheelchair accessibility.

It has only been recently that the Societé de transport de Montréal (STM), operator of the public transit authority, has changed its stance on paratransit. Previously, in a policy dating from 1991, the STM had simply encouraged persons with disabilities to use low-floor buses and paratransit where necessary; however, in recent years the STM has committed to universal design, and improvements are now slowly being phased in across the system [18]. The accessibility plan, including the construction of elevators and the acquisition of new accessible metro trains is behind schedule, however, so it will likely be years before any other stations that are connected to the Indoor City are made accessible [19]. Once the metro is accessible to people with mobility impairments, the city will be under pressure to make the Indoor City accessible to them as well.

Indoor Cities and Skyway Systems

Unlike Montreal's Indoor City, most of the Toronto's PATH network is accessible to persons with disabilities. Although many of the connections are not always immediately apparent, there are usually automatic doors, ramps and elevators available, even if one must travel slightly out of their way. Toronto's PATH Manager, estimates that 95% of the PATH network is wheelchair accessible, and noted that the City is encouraging private property owners to upgrade non-accessible segments of the PATH [20].

Other North American indoor cities are similarly accessible to persons with disabilities. For example, the City of Edmonton indoor pedestrian network, which was approved in the late 1970s, had foresight in suggesting that ramps be provided for people with disabilities and for baby carriages [21]. Nevertheless, this advice was not always followed. To remedy this, the city decided to require all air leases to provide accessibility to people with disabilities unless technically infeasible [22]. As a result, most of Edmonton's pedestrian network is wheelchair-accessible today.

In the United States, Houston, Texas, which has one of the largest tunnel systems in the U.S., is largely wheelchair accessible, a trait that stems from a 1977 report of the Houston Planning Department which mandated that all future tunnels should be fully accessible to persons in wheelchairs. Exceptions included previously existing buildings that were accessible through the tunnel level, but that did not have elevators connecting the tunnel to the building above [1].

Overall, the trend worldwide is towards indoor cities that are as fully accessible as possible, although some cities have made more progress towards this goal than others. Judging solely by the literature alone, Montreal has a long way to go before it can catch up to the level of universal accessibility that can be found in other indoor cities around the globe. Accordingly, prioritizing the changes in the existing network is a key element in the process of making Montreal's Indoor City accessible to people with mobility impairments.

METHODOLOGY

A field study of the Indoor City was conducted in June, 2009 to gather information on accessibility barriers, such as segments accessible only via stairs or escalators, or ramps that are too steep to navigate with a mobility device. Data that was collected included the locations of all stairways, including the number of stairs in each location; escalators, in one or both directions; ramps, including those that were satisfactory and others that were too steep; elevators; doorways with and without wheelchair buttons; and any other barriers which are located on the main path of the Indoor City. Also, data was also collected on the ability to travel between the Indoor City and street levels of each connected building. This data was then integrated in a geographic information systems (GIS) environment with an indoor city network that was developed by the TRAM research group.

This new GIS network was then used to produce accessibility measures that illustrate the current levels of accessibility for persons with and without mobility impairments. Accessibility is a measure of potential opportunity [23]. Accessibility is measured here using the cumulative opportunity measure, which was among the earliest ones to be developed and the simplest to calculate [24, 25]. Cumulative opportunity reflects the number of opportunities available from a predetermined point within a certain travel time or travel distance. In our research, we will not be limiting the measure by a distance. We will measure the amount of retail space that can be reached from certain points within the indoor city.

The network will then be analyzed to determine the optimal locations in which to implement new accessibility measures in order to increase the level of accessibility for persons with mobility impairments. Several methods were employed to do so, such as re-connecting the network in locations where simple door improvements such as a wheelchair button could make the connection accessible, or reconnecting the network where ramps could easily be installed. In other cases, a trial and error approach was used to determine the minimum action required in terms of cost that could produce the maximum benefit possible in terms of increase in accessibility. This was used for key locations where the installation of an elevator could drastically increase the level of accessibility in the network. Several options have been produced to discuss further in the following section.

ANALYSIS AND DISCUSSION

The amount of retail and office space has grown over time in the Indoor City, as well as the links between these spaces. A total of 66 buildings have been linked into the Indoor City network between 1962 and 2006, connecting a total of 45,372,176 square feet of office space and 3,907,662 square feet of retail space. While this growth has lead to an increase in the number of opportunities that can be reached, this is not true for a person with physical disabilities. In fact, the primary finding of this field study is that it would currently be a frustrating and time-consuming exercise to try and navigate the Indoor City in a wheelchair or mobility device. While almost all of the individual buildings of the Indoor City are accessible on their own, travelling between them without returning to street level is often quite difficult.

Given that many segments of the Indoor City were built a generation ago, much of its public space and building connections were built without any thought to universal accessibility. Consequently, certain segments of the RÉSO will likely never be universally accessible as it would simply not be feasible to retrofit them from a cost and engineering perspective.

By cross-referencing Indoor City buildings, their date of construction, and the number of accessibility barriers we can measure the level of accessibility by age of construction. It is important to note through our observation we found that buildings constructed and/or linked to the network in 1999 or later that are universally accessible ones. The connections between buildings that were built prior to this date are only accessible if the two buildings are located on the same level enabling simpler connections. Even so, some buildings connected after 1999 still did not provide accessible connections.

Network Analysis for People with Disabilities

In comparing origin-destination matrices between the regular network, and the network accessible by persons with disabilities, a huge difference can be seen. Whereas in the regular downtown network, a person with no disabilities can reach any other connected downtown building, in the disabled network, a person with disabilities can just reach a handful of other buildings. Figure 2 shows the existing level of accessibility for a person without disability. It is important to note that in here we are looking at the amount of retail areas that are accessible through walking in the indoor city without the need to use a metro or to cross a street.

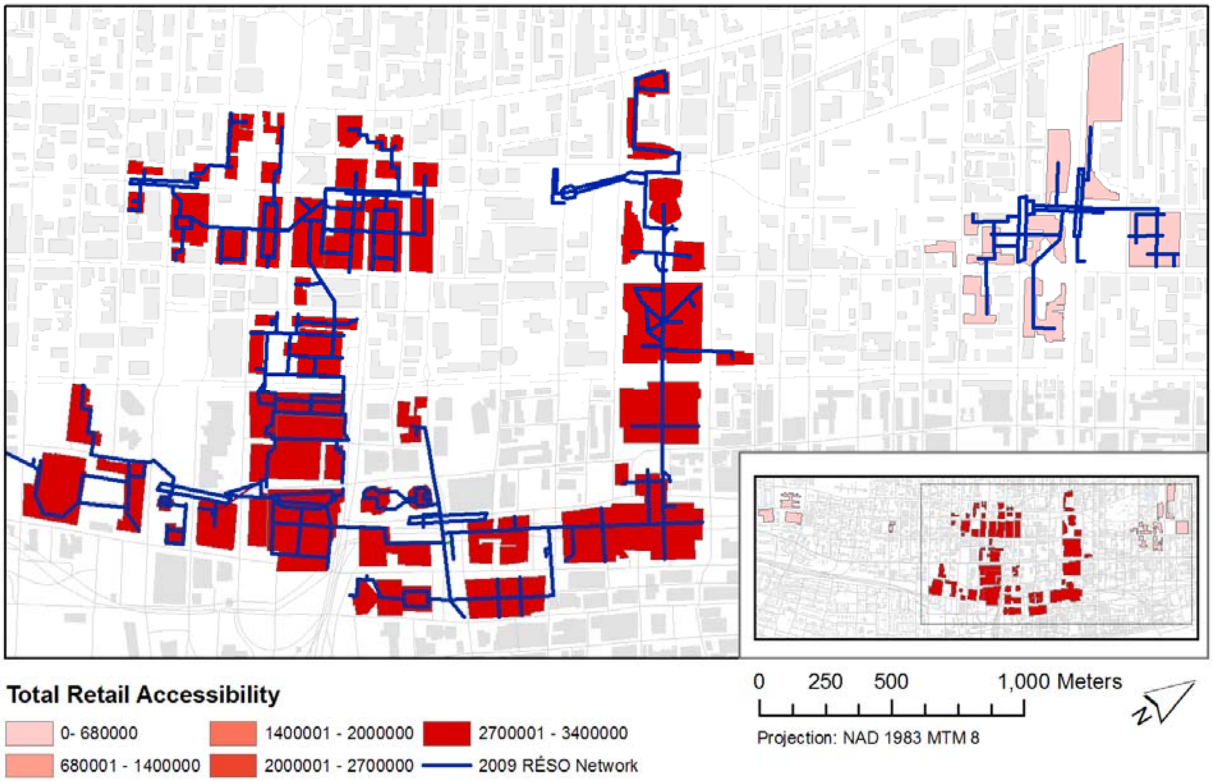

Figure 2: Map depicting the amount of retail space that can be accessed from individual buildings within the network. One can reach any building in the downtown network from any other downtown building.

Currently, the most accessible section of the Indoor City for persons with disabilities is in the north-western segment along the Ste-Catherine Street shopping district and includes ten linked accessible buildings. The eastern Indoor City segment is the second most accessible with six linked accessible buildings. Figure 3 shows the difference in the level of accessibility between a person without any mobility impairments and a person with a physical disability. It is totally clear that the Indoor City is not accessible and the difference map clearly shows the current situation and the amount of efforts needed to overcome the disadvantages the challenges imposed over the people with physical disability.

Figure 3: Map showing the difference in accessibility for persons with disabilities between the base network and the current disabled network.

To make the entire Indoor City 100% accessible for persons with physical disabilities several barriers need to be bypassed. Creating a barrier-free Indoor City would require the construction of at least 17 ramps and at least 40 new elevators and mini-elevators, along with 38 locations where automatic doors activated by sensors or wheelchair buttons would need to be installed. Implementing all these improvements would be quite expensive.

We identified sixteen locations where no impediments exist other than doorways. Accordingly, installing automatic doors controlled by wheelchair access buttons can lead to an increase in the level of accessibility by 24%, compared to the existing level of accessibility for people with disabilities. As shown in Figure 4, while this increase in accessibility is small and results in little visible change on the map, it is a necessary precursor to other improvements, such as new ramps and elevators, which result in greater increases. Therefore, this improvement has been made before implementing all other improvements on the following maps.

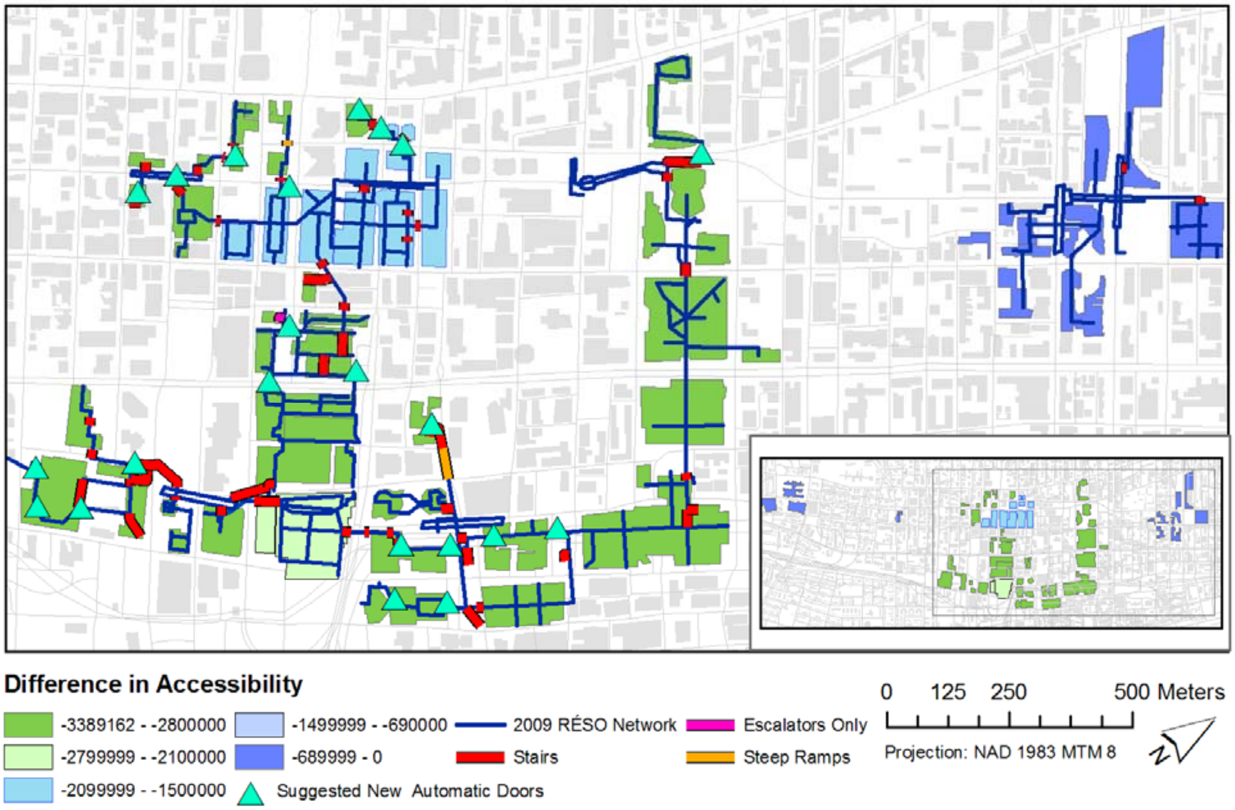

Figure 4: Map showing the difference in accessibility for persons with disabilities between the base network and the disabled network with suggested new automatic door locations.

Further suggested accessibility improvements were determined using a trial and error approach to locate segments of the Indoor City that would require a minimum amount of investment, yet produce the maximum benefit. This approach was focused on connecting the busiest segments of Indoor City, which is located in the heart of the "U" shape section.

The single greatest improvement in universal accessibility in the Indoor City would be made by upgrading the corridor between the north and south-western segments. This connection is one of the most significant links in the entire Indoor City as it completes the western connection between the green and orange metro lines and unites what were previously two separate networks; however, from the point of view of a person in a wheelchair, this connection does not even exist, as persons with disabilities must exit to street level to travel between the two sections [15]. Connecting this section of the Indoor City improves the level of accessibility by 113% compared to the existing level of accessibility for people with disabilities. This is a huge impact as it effectively doubles the connected space that people with disabilities can access, with just one improved link.

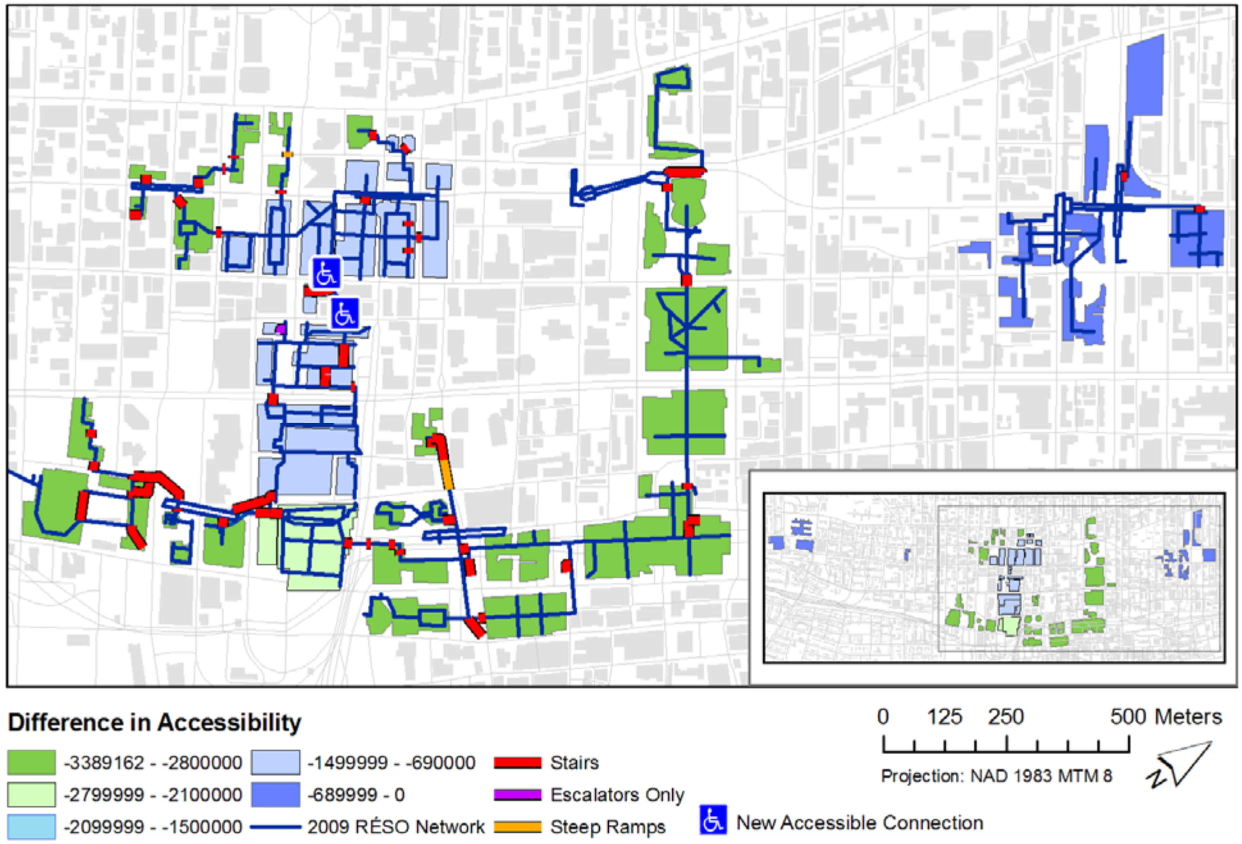

Figure 5: Map showing the difference in accessibility for persons with disabilities between the base network and the disabled network with Eaton Centre to Place Ville Marie accessible

There are four critical locations in the Indoor City. If they are made accessible, the result is the greatest increase in universal accessibility. Implementing accessible improvements in these four locations would increase accessibility by 396% as shown in Figure 6. Implementing these improvements will allow the busiest segments of the Indoor City to become accessible to persons with disabilities. This change will allow most of the Indoor City to have the same level of accessibility for everyone and represents the most cost effective approach to making this vital public space more accessible. The remaining buildings that continue to be inaccessible for people with disabilities in this approach are, with a couple of exceptions, buildings that would have little impact on the accessibility of the overall network.

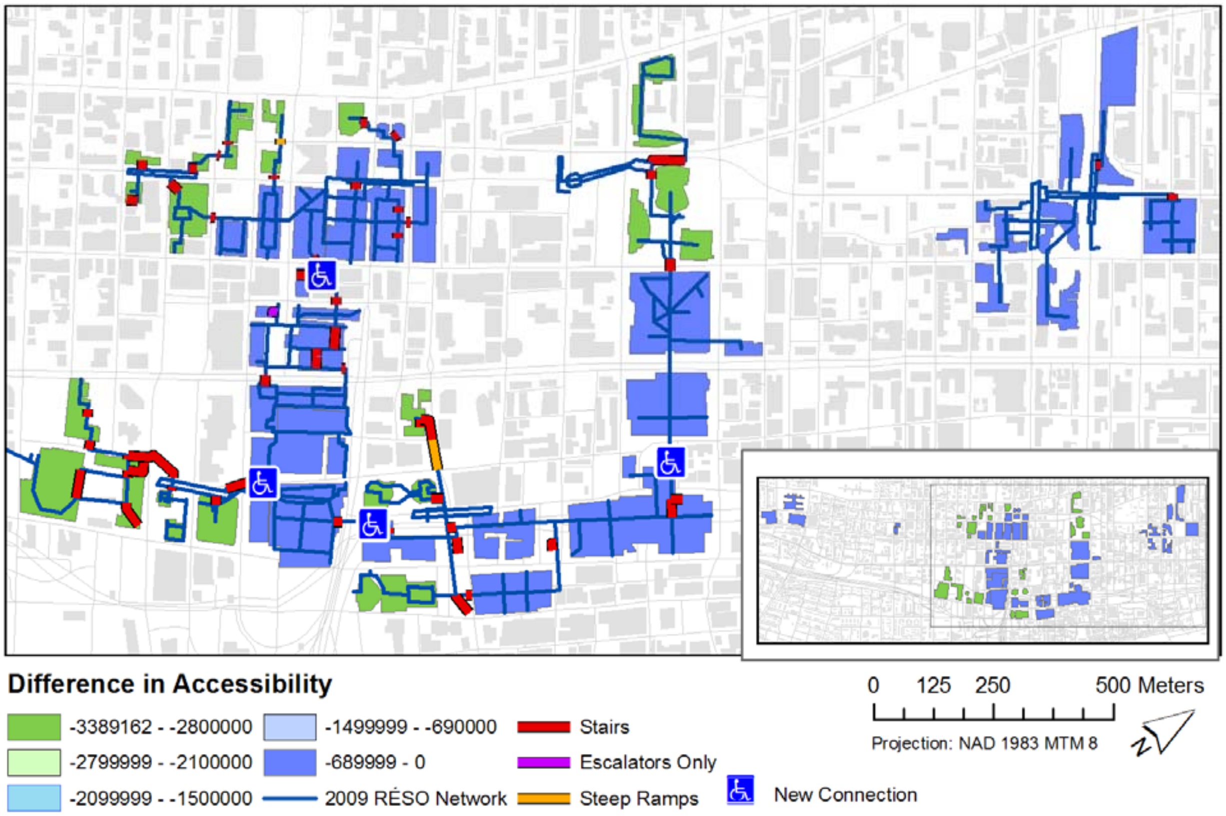

Figure 6: Map showing the difference in accessibility for persons with disabilities between the base network and the disabled network with four key locations made accessible

Metro Accessibility

The ongoing project to enhance the accessibility of STM's metro system will also help increase access for persons with disabilities within the Indoor City. Elevators are currently under construction at two downtown stations which will provide an accessible connection between the central and eastern Indoor City segments when completed.

Figure 7 shows a comparison between two possible changes to the network for people with disabilities with the metro taken into account. The upper map (A) shows that while making the metro stations themselves more accessible will certainly help to increase accessibility, the increase is not as great as one would expect, as many of the neighbouring buildings surrounding and connected to each station are not accessible to people with disabilities. While the increase in accessibility of 141% that is shown in Map A does seem like a lot when compared to the existing level of accessibility for people with disabilities, it pales in comparison to the increase shown in the lower map (B). Map B shows that accessibility would be greatly enhanced by the upgrading of the four key locations, as previously mentioned, as well as upgrading one additional metro connection, with a total increase in accessibility of 646% when compared to the existing level of accessibility for people with disabilities.

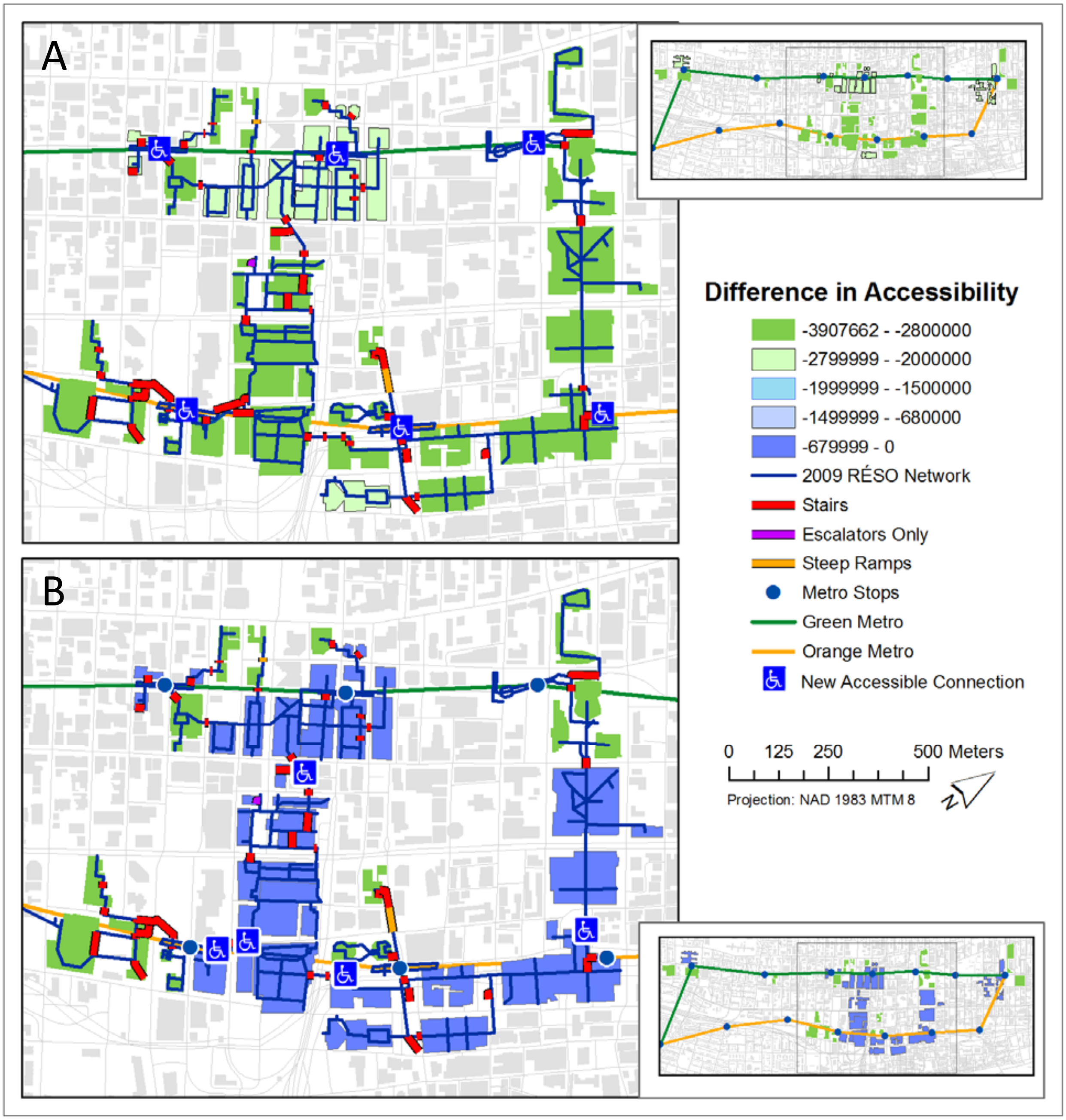

Figure 7: Map showing the difference in accessibility for persons with disabilities between the base network and the disabled network with all Metro stations accessible.

Conclusions and Recommendations

At the current time, Montreal's Indoor City is largely inaccessible to persons with physical disabilities. This has been allowed to occur mainly because much of the Indoor City was built before universal accessibility became a mainstream issue, and before accessibility legislation was implemented. While future additions to the Indoor City will likely be accessible, upgrading current facilities is an expensive proposition, so key connections such as the one demonstrated in Figure 5 should be prioritized in any accessibility-related renovations. A few simple and cost effective solutions do exist, however, such as upgrading doors with automatic openers, and implementing new signage to illustrate alternate routes for persons with disabilities. Legislative and organizational improvements will also go a long way towards ensuring that the RÉSO becomes more universally accessible in the future.

This study has shown the power of adjusting one single connection in the Indoor City and to what extent this connection will benefit people with physical disabilities. The efforts of making the subway system accessible will also help in connecting all the parts of the network. Yet some barriers still exist after a person with physical disability leaves the subway station. Although upgrading the connections between buildings in the Indoor City can be a difficult proposition and expensive, these upgrades are essential, as was shown in the analysis section.

The municipal or upper levels of government could set up a program to subsidize or even completely fund accessibility improvements within the Indoor City. This would allow the City to achieve its goal of making the indoor city accessible without creating too much financial burden on the private sector. Also this process can be done over time and combined with building renovations and other maintenance projects where possible.

Improvements could also be made to the existing wayfinding system. Currently, the Indoor City can be a confusing place, with a labyrinth of passageways leading to all corners of the downtown core. To make wayfinding easier, Montreal should implement digital maps, easily allowing tourists and those unfamiliar with the Indoor City the ability to type in their destination and be shown a map with an option to print out directions.

Better accessibility regulations and standards are needed for the Indoor City. While the Ville Marie borough is responsible for developing the RÉSO's wayfinding system and publishing an official map, the municipal government currently does little else in regards to the Indoor City. In order to achieve universal accessibility, more centralized planning and coordination is recommended, along with improved legislation specifically targeting the Indoor City to ensure this.

REFERENCES

1. City of Houston, *Houston Downtown Tunnel System*, C.P. Department, Editor. 1977.
2. Zacharias, J., *Modeling Pedestrian Dynamics in Montreal's Underground City*. Journal of Transportation Engineering, 2000. **126**(5): p. 405-412.
3. Besner, J., *The Sustainable Usage of the Underground Space in Metropolitan Area*, in *ACUUS 2002 - Urban Underground Space: A Resource for Cities*. 2002: Torino, Italy.

4. Boisvert, M., *From Connexity to Connectivity: Enhancing the Efficiency of Interior Walkways with the Current Extensions of Montreal's Indoor City*, in *ACUUS 2002 - Urban Underground Space: A Resource for Cities*. 2002: Torino, Italy.
5. Kéroul. *About Us - Tourism and Culture for People with Restricted Physical Disability*. 2009; Available from: http://www.keroul.qc.ca/en/mission/.
6. Evcil, A.N., *Wheelchair Accessibility to Public Buildings in Istanbul.* Disability and Rehabilitation: Assistive Technology, 2009. **4**(2): p. 76 - 85.
7. Imrie, R. and M. Kumar, *Focusing on Disability and Access in the Built Environment.* Disability & Society, 1998. **13**(3): p. 357-374.
8. McMillen, B., *Policies, Resources and Programs for Providing Accessible Pedestrian Systems in the USA*, in *Walk21 3rd International Conference: Steps towards livable cities*. 2001: San Sebastian, Spain.
9. Kéroul, *A Growth Market: Behaviours of Tourists with Restricted Physical Abilities in Canada*, Kéroul, Editor. 2001.
10. Kitchen, R. and R. Law, *The Socio-Spatial Construction of (In)accessible Public Toilets.* Urban Studies, 2001. **38**(2001): p. 287-298.
11. Bromley, R.D.F., D.L. Matthews, and C.J. Thomas, *City Centre Accessibility for Wheelchair Users: The Consumer Perspective and the Planning Implications.* Cities, 2007. **24**(3): p. 229-241.
12. City of Montreal, *A Barrier-free City: Montréal has Universal Accessibility at Heart*. 2007b.
13. Madger, J., *Underground is Mostly Sound*, in *The Gazette*. 2008, March 1: Montreal.
14. Byers, J., *The Privatization of Downtown Public Space: The Emerging Grade-Separated City in North America.* Journal of Planning Education and Research, 1998. **17**(3): p. 189-205.
15. Sijpkes, P. and D. Brown, *Montreal's Indoor City - 35 Years of Development*, in *7th International Conference on Underground Space*. 1997: Montreal.
16. Brown, D. and P. Sijpkes, *Critiquing the Underground City*. Planning, 1985. **51**(3): p. 16-17.
17. Baillargeon, S., *Des Ascenseurs Pour Cinq Stations du Métro Montréalais*, in *Le Devoir*. 2007, June 12: Montreal.
18. STM. *The STM and the Métro Accessibility Challenge* 2009; Available from: http://www2.stm.info/English/info/a-travaux.htm.
19. Comité sur l'accessibilité du métro de Montréal, *Rapport du Comité sur l'Accessibilité du Métro de Montréal*. 2003, June 27.
20. Saunders, M., *Response: PATH Wheelchair Accessibility*, M. Hagg, Editor. 2009.
21. City of Edmonton, *Pedway Concept Plan*. 1977.
22. City of Edmonton, *Downtown Pedway Network Review*. 1989.
23. El-Geneidy, A. and D. Levinson, *Access to destinations: Development of accessibility measures*. 2006, Minnesota Department of Transportation: Minnesota. p. 124.
24. Vickerman, R.W., *Accessibility, attraction and potential: A review of some concepts and their use in determining mobility*. Environment and Planning A, 1974. **6**: p. 675-691.
25. Wachs, M. and T. Kumagai, *Physical accessibility as a social indicator.* Socioeconomic Planning Science, 1973. **7**: p. 327-456.
26. Lee, J., *Beijing Attempts to Make City More Accessible*, in *Vancouver Sun*. 2008, Aug 22: Vancouver.

27. Paskal, C., *Below the Surface: Even Underground, Montreal's Culture Lives and Breathes*, in *National Post*. 2001, July 14: Don Mills, Ont.