A study of walkability in two townships in Montreal: Town Mount Royal, a 1920's railway suburb and Bois-Franc, a New Urbanist development.

Sumeet Kulkarni

Urban Design and Housing
Peter Guo-hua Fu School of Architecture
McGill University, Montreal

Research Supervisor: Prof. Vikram Bhatt

August 2018

A report submitted to McGill University in partial fulfillment
of the requirements of the degree of Master of Architecture,
Urban Design and Housing

To my parents…

Abstract

Understanding factors affecting walkability by comparing usage patterns of a traditional neighbourhood development and a New Urbanist township, in the context of Montreal.

While the traditional neighbourhood models in cities were compact, low-rise, high density, mixed-use, human-scaled, and walkable; these attributes were lost in the automobile age. Since the late '50s, city designers and planners regulated walking out of our cities making them increasingly 'car-centric.' As lifestyle-related health issues put the spotlight back on the importance of active living, design movements such as New Urbanism have been at the forefront of reviving the desirable aspects of traditional neighbourhoods.

Although the Charter of New Urbanism aims to create environments that are inherently walkable, it does not discourage automobile usage. This leads us to question the success of New Urbanist towns in promoting walkability. The bulk of existing research on walkability focusses on urban areas, while the suburbs, where cities grow and where most New Urbanist developments occur, receive less attention.

Based on predominant parameters identified by existing literature on walkability, this research aims to study how pedestrians use different places outside the core city context of Montreal; within an old railway suburb and a New Urbanist town. For each township, pedestrian data was collected during the summer months, for three times per day and on all consecutive days for the week. Finally, such observations were analysed by overlaying graphical data from real-time GPS based websites.

Although both townships provide adequate pedestrian infrastructure as a prerequisite to walking, this study highlights that the parameters vital to walkable urban contexts may not play as critical a role in the suburban context. On the other hand, factors such as the physical configuration and road network of the town arguably contribute to more walkable environments. This contextual study did not determine either township to be more walkable and additional studies are required to serve this goal. Although situated in Montreal, the observations and findings of this study could be useful for other communities and suburbs across Canada.

Résumé

Comprendre les facteurs qui influencent la possibilité de marcher (marchabilité) en comparant, les modèles utilisés d'un quartier traditionnel en développement et d'une agglomération urbaine, dans le contexte de Montréal.

Alors que nos modèles de quartiers traditionnels dans les villes étaient compactes, de faibles élévations, de densités élevées, polyvalents, à l'échelle humaine et se prêtant à la marche; ses attributs ont été perdus à l'ère de l'automobile. Depuis la fin des années cinquante, les concepteurs et urbanistes ont réglementé nos villes de façon à accroître l'émergence de l'automobile. Comme les problèmes de santé liés au mode de vie font pointer à nouveaux les projecteurs sur l'importance d'une vie active, des gestes de conception tels que le Nouvel Urbanisme sont au premier rang de la revitalisation des aspects désirables des quartiers traditionnels.

Bien que la Charte du Nouvel Urbanisme ait donc pour objectifs de créer des environnements qui sont inhérents à la marchabilité, cela ne dissuade pas autrement l'utilisation de l'automobile. Ceci nous amène à mettre en doute la réussite des Nouvelles Villes Urbanistes à promouvoir la marchabilité. La plupart des études existantes sur la marchabilité se concentrent sur les zones urbaines tandis que les banlieues, où les villes grandissent et où les Nouveaux développements Urbanistes apparaissent, reçoivent moins d'attention.

Basé sur des paramètres identifiés dans la littérature existante concernant la marchabilité, cette recherche vise à étudier comment les piétons utilisent différents endroits à l'extérieur du centre du contexte urbain de Montréal; sur une vieille voie ferrée de banlieue et dans un Nouvelle Ville Urbaniste. Pour chaque municipalité, les données piétonnières ont été recueillies durant les mois d'été, trois fois par jour et tous les jours consécutifs de la semaine. Finalement, ces observations ont été analysées en superposant les données graphiques en temps réel avec GPS basé sur sites web.

Quoique les deux municipalités fournissent une infrastructure piétonnière, condition préalable à la marche, cette étude souligne que les paramètres essentiels favorisant la marche dans des contextes urbains ne jouent pas nécessairement un rôle déterminant dans un contexte périurbain. De plus, d'autres facteurs tels que la configuration physique et le réseau routier de la ville peuvent engendrer vraisemblablement plus d'environnements se prêtant à la marche. Cette étude contextuelle n'a pas déterminé si l'une ou l'autre des municipalités est plus accessible à la marche et des études supplémentaires sont nécessaires pour atteindre cet objectif. Bien que situé à Montréal, les observations et les constatations de cette étude pourraient être utiles à d'autres communautés et banlieues à l'ensemble du Canada.

Table of Contents

Acknowledgements

I would like to express my gratitude to my research supervisor, Prof.Vikram Bhatt, for his expert guidance, constant encouragement in letting me explore and find a form for my research, continued faith in me and for his infinite patience in dealing with my sporadic work style.

In addition to my supervisor, Professors Avi Friedmann, Nik Luka, and Robert Mellin have all contributed invaluably to my learning experience at McGill and everything they taught has directly and indirectly influenced this work. I could not possible thank them enough.

The generous Alvaro Ortega Award has, in no small measure, facilitated this research and I remain humbled and grateful to the benefactors for giving me this opportunity.

A special word of thanks is reserved for the staff at Peter Guo-hua Fu School of Architecture, and specifically Ms. Marcia King for her continued support in allowing me to successfully navigate this course.

Last, but not the least, credit goes to my partner and my family for their patience in dealing with my tantrums and always persuading me to focus and complete this report to the best of my ability.

List of Figures

Abbreviations

CMA: Census Metropolitan Area

FAR: Floor Area Ratio

GIS: Geographic Information Systems

GPS: Global Positioning System

TMR: Town of Mount Royal

TOD: Transit-Oriented Development

SFR: Single Family Residential

STM: Société de Transport de Montréal

Chapter 1

1 Introduction

1.1 Background

Walking, in an urban context, is a 'mode of experiencing place' while actively moving in an area for specific reasons. The design of the built environment directly influences this multifaceted activity and temporal practice.

The term 'walkability' is widely used to describe the ability to walk in a particular environment. However, according to the Oxford English Dictionary, 'walkability' is not a word and is thus frequently used to refer to different kinds of phenomena (Forsyth, 2015) which are contextual. Some discussions regarding walkability focus on environmental features or means of creating walkable environments, including areas being traversable, compact, physically-enticing, and safe (Forsyth, 2015). Spoon (2005) identifies the creation of 'walkable' communities as places, where the built environment is designed in a way to foster walking and bicycling to nearby destinations rather than requiring individuals to rely strictly on the automobile. However, in a general sense, the Oxford Dictionary (2014) defines 'walkable' as "Of terrain, a road, path, environment, and other means that are suitable, fit, or safe for walkers," and in use since 1736 (Oxford English Dictionary, 2014).

People walk for a multitude of reasons; mostly for utilitarian or recreational purposes. In doing so, they interact not only with the physical cartesian dimensions and form of built space, but also it's intangible experiential, social, economic, political, cultural landscape, and variables such as the presence of other humans. As Ewing and Clemente accurately state, urban design literature is inhibited by "highly subjective definitions"(2013). Any individual decision-making process related to walking involves subjective and not objective decisions which are biased by geographic location, personal prejudices, preferences, and notions. Such subjectivity makes any research venture highly contextual, making it harder to identify patterns or gain universal insights. Studies often consider an increased amount of walking as the measure of a walkable neighbourhood. However, from an urban design perspective, the success of a walkable environment should not merely be measured by the number or duration of walking trips, but also by the quality of those trips in terms of user experience.

Although studies show that we require daily physical activity to stay fit, our cities consider automobiles as their primary patrons and in consequence are more 'car-friendly' than 'pedestrian-friendly.' According to Kobos (2016), in the past couple of decades, we have regulated walkability out of our cities and towns. Thus, one could effectively argue that urban environments foster sedentary lifestyles. Current research establishes a clear

link between lack of physical activity and lifestyle-related diseases such as hypertension and diabetes (Wasfi, 2015). Further, to quote Aristotle, man is, by nature, a social animal. Ironically, our transition from a society of physical interaction to one of digital 'social' networks has accelerated social isolation (Child & Lawton, 2017). The advent of the internet has exacerbated the problem of both solitary and sedentary lifestyles, contributing to a diminishing social connection. At the crossroads to these problems, of sedentary and socially isolating lifestyles, lies active living. Hajna (2016) posits that people living in more walkable neighbourhoods lead healthier and socially active lives.

New towns and city neighbourhoods developed between the 19th and early 20th centuries dealt with lower population numbers and consisted of multi-functional compact developments with high densities, primarily to keep capital costs of buildings and infrastructure down. The automobile revolution was yet to occur, and walking was a cost-effective choice to horse-drawn carriages prevalent then. An unintended consequence of such factors was that traditional neighbourhoods were spectacularly successful in encouraging their residents to walk. Such neighbourhoods, planned according to traditional planning principles, with dense, compact, and walkable characteristics are known as 'Traditional Neighbourhood Developments' (TND's). Specifically, in the North-American context, the post-World War II development of infrastructure coincided with the mass production of the affordable automobiles, leading to an exponential growth in suburbs known as 'suburban sprawl'. Gradually, with favourable government policies, gas-powered automobiles formed the basis of town planning in the latter half of the 20th Century.

Consequently, in the '80s, the 'New Urbanism' movement emerged as a means to address and counteract such concerns by looking back and reviving the best aspects of traditional planning. It consisted of an approach that restored the planning and development principles of cities built in the preceding centuries, such as walkable blocks and streets, housing and shopping in close proximity, and accessible public spaces (Anonymous, 2016; "What is New Urbanism," n.d.). In other words: New Urbanism had human-scaled urban design as its primary concern, deriving its core principles from older traditional neighbourhoods. Walking as an activity is integral to the Charter of New Urbanism and the words 'walk,' and 'walkable' find at least five different mentions in it.

1.2 Hypothesis and Research Question

This section concerns the design of New Urbanist towns and automobile use. Since the planning of TND's occurred long before the automobile age, it's residents either walked or relied on public transport. However, this was not true for New Urbanist townships, which on the one hand, sought to revive the principles of older neighbourhoods and encourage pedestrianism, but on the other, did not expressly prohibit or disincentivise

automobile use. In sharp contrast, their designs responded to current parking needs and provided large parking lots and garages. Thus, the very availability of a convenient option potentially predisposed a majority of the population to automobile use.

The hypothesis was that the availability of such choice, between using an automobile or walking, was likely to compromise the goal of achieving a more walkable neighbourhood in New Urbanist townships. To ensure a wholesome study, this hypothesis was reviewed side-by-side against both a TND and a New Urbanist township. While TND's have been around for close to a century, most New Urbanist towns were built over two decades ago and thus, both offered ample empirical data to conduct a post-occupancy study.

Below are some of the sub-questions this research tried to address:

As stated in its charter, New Urbanism sought inspiration from TND's. Does it succeed in achieving its walkability goals?

What attributes of TND's and New Urbanist townships enabled their residents to walk? Are the factors identified in urban studies equally applicable in the suburban context?

These townships comprise of some common built and unbuilt spaces such as the town centre, residential zones, streets, and open spaces. How are these spaces used today?

Apart from generalised principles of mixed-use or walkable spaces, does the physical configuration of the township play a role in encouraging walkability?

Are walkability rates in New Urbanist towns higher or comparable to the traditional neighbourhoods they aim to revive?

1.3 Research Method

As with any research project, studying existing research and its limitations was a prerequisite. The literature review resulted in a comprehensive analysis of the principles associated with walkability and led to the shortlisting of parameters for field observations. The research method involved a data collection phase, followed by an analysis phase.

1.3.1 Data collection

The data collection related to both, quantitative as well as qualitative factors. Four sets of data were collected for the towns of TMR and Bois-Franc each to cross-validate, and reinforce observations and eliminate the bias of diurnal variations.

1.3.1.1 Physical information and statistics

The first step involved collecting statistics, and information on attributes of the townships such as size, location context, population demographics, the mix of land-uses, the types of residences, and road network connectivity. The impact of these variables on

the usability of unbuilt spaces within these townships was studied. This quantitative data also set the backdrop and established a baseline to relate these two townships.

1.3.1.2 Urban design qualities

The second step involved studying the townships for urban design qualities identified in the literature review. The spaces were assessed for qualities that affect walkability (Ewing & Handy, 2009) and included imageability, enclosure, human scale, transparency, and complexity. Such attributes were studied using physical observations, photographs, and diagrams.

1.3.1.3 Field Observations and maps

Town Mount Royal (TMR) and Bois-Franc Field were chosen to represent a TND and New Urbanist town, respectively. Observations on walking behaviour were made in each township to draw inferences based on observed pedestrian movement at predetermined locations.

The factors affecting walkability in urban areas are related to demographics, as well as spatial and functional variables. Thus, pedestrian behaviour in the case study projects needed to be studied for co-relations to draw any inferences. Given the limited timeline, observations were conducted in the summer months of May and June, when no inclement climatic factors were likely to bias the results. The field observations were conducted in two primary areas, namely: the town centre and the residential area lying immediately beyond the town centre within a 500 m radius. The sample dataset targeted the average resident who primarily lived, worked and recreated within these townships.

Observations were conducted consecutively for seven days to include both weekdays and weekends. Two-hour time ranges were considered for three sets of observations on the days of study, namely; morning 7:30 to 9:30 am, afternoon 12:30-2: 30 pm and evening 5:30 to 7:30 pm. Physical observations were conducted to identify pedestrian concentrations as well as movement. Since such concentrations were relatively low in comparison to a downtown metropolitan area, a threshold of 50 persons gathering or passing through a specific location was set for documentation. Areas, where pedestrian numbers exceeded this threshold, were identified and highlighted on a map with a red hatched circle. All observations were then aggregated for morning, afternoon and evenings showing the general locations of such concentrations while overlapping circles indicated even more pedestrians. Finally, all field observations were subsequently superimposed, resulting in a composite heat map of the whole township showing the highest pedestrian densities with a solid patch of colour. Higher pedestrian concentrations were depicted with a thicker band of colour which tapered off as the pedestrian numbers dropped. The areas where the threshold concentration was not met remained unmarked.

1.3.1.4 Realtime GPS-based website data

Since field observations were both subjective and specific to a time and place, an additional layer of data was included to validate such observations. Two websites readily offered data active transportation data aggregated over more extended periods; namely, Walk Score© and StravaLabs Heatmaps. By considering these as additional data sources, individual and circumstantial variations from physical observations could be rationalised.

Walk Score© is a website or an app that measures the walkability of any address using a patented system and assigns a numerical rating between 0 and 100, with 100 being a walker's paradise. Strava Labs overlays GPS and app-based active transportation inputs and displays the aggregated traffic in the form of a visual heat map. It is noteworthy that such data is not quantifiable since it relies on a graphical representation of traffic. The routes with more pedestrians or runners show a brighter colour, while the ones with lower traffic appear paler in comparison.

Although the data set from either Walkscore or Strava Labs was inconclusive by itself, it showed active pedestrian traffic monitored all year round and was worth reviewing in conjunction with field observations from this study.

1.3.2 Synthesis and recommendations

On completion of the data collection phase, all data was synthesised and overlaid with theoretical concerns identified in the literature review. This analysis led to a discourse on what appeared to work and what did not in promoting walkability, concluding with recommendations, as an outcome of this contextual study.

1.4 Research limitations

This study was based on field observations conducted on pedestrians available within the boundaries of the case studies and was contextual to Montreal. Hence, all observations were inferred as associations and not 'cause and effect' relationships. The study relied on the limited cohort present in the townships during the study, specifically concerning their age groups and socio-economic strata. Hence, the results were not weighted across all socio-economic backgrounds or age groups. Although it is possible, that pedestrians observed could be visitors to the township, this aspect is ignored as it was not physically possible to identify all such persons.

Given the contextual and subjective nature of this study, it could be argued that the activity patterns observed are biased by individual preferences and not wholly influenced or attributable to the built environment. The fieldwork was conducted only during the summer months, and this study is limited as such. It is worth noting that Montreal is a winter city and walkability is adversely impacted by late Fall through early Spring seasons.

Chapter 2

2 Literature review

2.1 Range of research available

Studies related to walkable environments are relatively recent and go back five decades. As the most widely available form of both transportation and physical activity, walking has been the focus of many studies (Saelens & Handy, 2008) but very few of them were conducted through the urban design lens.

Concerns about walkable environments only came to the forefront after the automobile monopolised urban landscapes. Society underwent rapid and drastic changes, some of which, either directly and indirectly, contributed to lesser physical activity and a sedentary lifestyle. Thus, in the late '80s and early '90s, the general thrust of the research was on walkability and urban design, and its correlation to the health of individuals. Such debates focused on creating walkable environments and improving walkability with the intent of reducing the obesity crisis and addressing concerns such as the lack of central city vibrancy to traffic congestion, environmental injustice, and social isolation (Forsyth, 2015). However, it was soon acknowledged that public health was not solely a byproduct of urban environments but many complex factors. Such insights led to a diffused focus by researchers, whereby associations of walkability were studied with health, environmental qualities, and subjective preferences.

A bulk of the research available remains focussed on downtown areas and is attributable to the fact that urban areas serve a larger population. In comparison, periurban and suburban zones have received lesser attention.

2.2 Types of research and methods deployed

Although walkability in urban environments has been studied for the last five decades, studies to 'quantify' qualities of urban environments are recent and began less than two decades ago. The different parameters used to assess such environments in various studies are summarised below.

2.2.1 Dimensions of walkability

Forsyth's study titled 'What is a Walkable Place?' explores the idea of walkability and proposes a conceptual framework to distinguish between the various definitions for what is considered a walkable environment. Such definitions vary substantially between interpretations leading to different design outcomes. By mapping the range of definitions, this review highlights potential conflicts been forms of walkability (Forsyth, 2015).

The first cluster of definitions includes themes or dimensions related to the community environment that facilitate the creation of a walkable environment. Generally, walk-

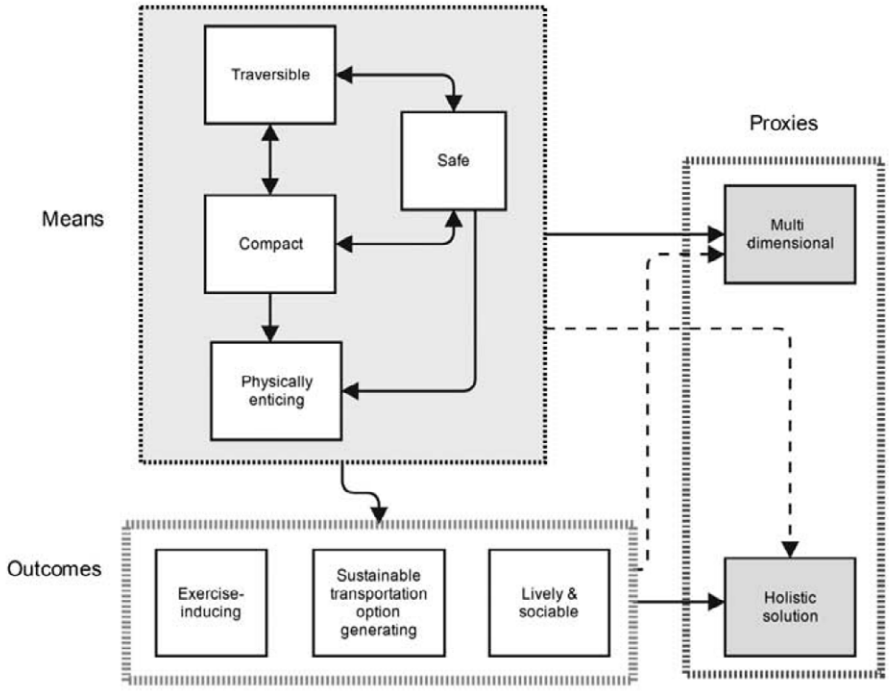


Figure 2.01: Framework linking definitions of walkability and walkable places.
(Credit: Forsyth,2015)

able environments have the necessary physical conditions to allow people to get from one place to another without significant impediments, for example, along relatively smooth paths. Compact communities provide short distances to destinations for those who are walking for utility. Another factor directly affecting walkability is the potential for harm to the pedestrian, both in terms of perceived, i.e. word-of-mouth as well as actual safety. Physically-enticing environments offer all pedestrian infrastructure such as sidewalks or paths, marked pedestrian crossings, appropriate lighting and street furniture, useful signage, and shaded walkways. They may also include engaging architecture, pleasant views, and abundant services attractive to those who have other choices for getting around and getting exercise (Forsyth, 2015).

The second set of definitions relates to the perceived outcomes of walking. A walkable environment is often attractive because it is lively and sociably pleasant, clean, and full of interesting people. Such definitions are much used in relation to shopping areas and mixed-use neighbourhoods (Forsyth, 2015). Also, walkability is seen to address both environmental preservation and social equity components of urban form and thus is a thoroughly sustainable transportation option. It saves energy and offers opportunities for those who cannot use cars because of age, income, or disability. It is also an exercise-inducing environment with features that lead to higher than average levels of walking, either in total or for transportation or exercise (Forsyth, 2015).

Finally, walkability is often used as a kind of proxy for a better design. These prox-

ies involve compilations of dimensions and broad claims about outcomes. Forsyth (2015) clarifies that it is possible to criticise them as definitions of walkability, and yet they are still included in the study as they are in common use. For some, walkability as a means is multidimensional and measurable. This kind of definition creates indicators of the conditions of walkability, just as other indicators define conditions of livability or development. For instance, walkability is, in many cases, a way of talking about environments that are simply better—representing a holistic solution to improving urban areas that are slower-paced, more human-scaled, healthier, and happier. Such a definition encompasses many of the other definitions in an integrated package that is less about walking as such and more about a qualitative place to be (Forsyth, 2015). Thus, this qualitative umbrella definition of walkability extensively covers most of the aspirational values desired by pedestrians.

2.2.2 'D' variables

Cervero and Kockelman (1997) describe the evolution of the so-called 'D' variables and their relation to pedestrian travel behaviour. The original three variables identified to characterise the built environment were density, diversity and design (Cervero & Kockelman, 1997). These were later expanded to include destination accessibility and distance to transit (Ewing & Cervero, 2001). The final variable added was 'demographics' and was considered to determine the independent effect of the built environment on travel behaviour. The built environment was then measured or operationalised as one or more of the six recognised 'D' variables. Overall, this research showed that the relative influence of each dimension of the built environment on travel demand was modest to moderate, though certainly not inconsequential. It thus supported the contention of new urbanists and others that creating more compact, diverse, and pedestrian-orientated neighborhoods, in combination, meaningfully influenced travel behaviour (Cervero & Kockelman, 1997).

2.2.3 'Measuring' urban design qualities

Focussing on perceptions instead of travel outcomes, a study conducted by Ewing and Handy (2009) 'objectively' attempted to measure the 'subjective' qualities of an urban street environment. To identify such urban qualities, 200 video clips of urban environments were made from dozens of cities across the United States. An expert panel comprising of urban design and planning experts was assembled from professional practice as well as academia to analyse fifty-one separate qualities. These were subsequently shortlisted to eight, namely; imageability, enclosure, human scale, transparency, complexity, legibility, linkage, and coherence. Of these 'unmeasurable' qualities, related to physical characteristics of streets and their edges, only the first five could be operationalised and hence were considered in their final study.

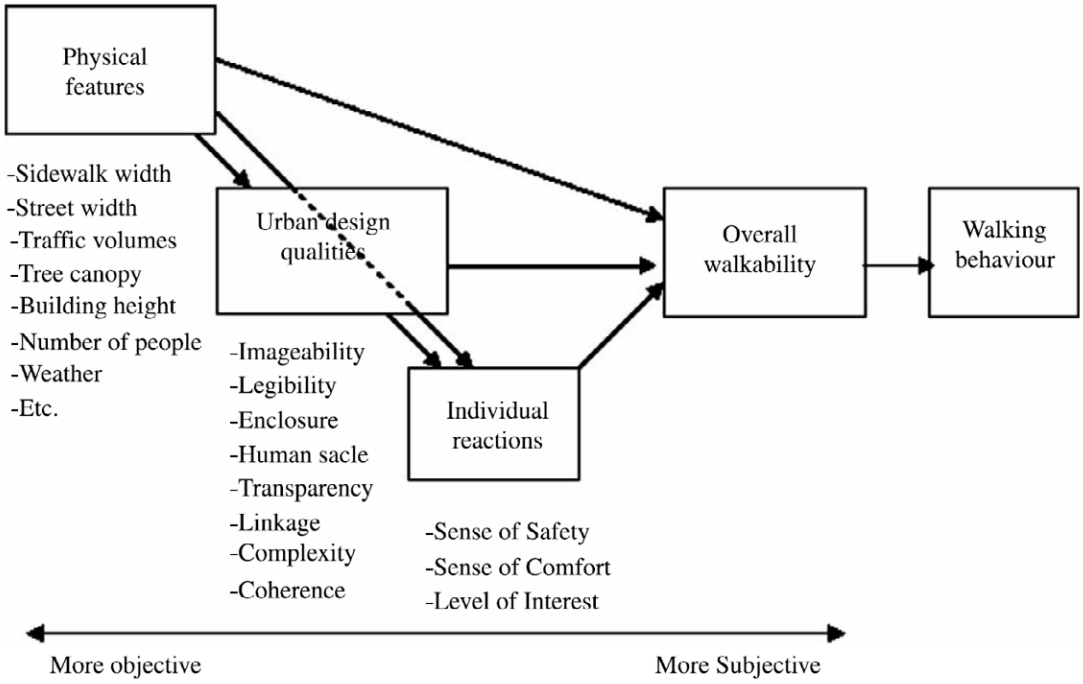


Figure 2.02: Ewing Handy conceptual framework to measure urban design qualities
(Credit: Ewing Handy,2009)

Ameli et al. (2015) use the following definitions for describing the terms above. Imageability is the quality of a place that makes it distinct, recognisable and memorable. An area has high imageability when specific physical elements and their arrangement capture attention, evoke feelings and create a lasting impression. Enclosure refers to the degree to which streets and other public spaces are visually defined by buildings, walls, trees and other vertical elements. Areas, where the height of vertical elements is proportionally related to the width of the space between them, have a room-like quality. Human scale refers to a size, texture, and articulation of physical elements that match the size and proportions of people and, equally important, correspond to the speed at which people walk. Building details, pavement texture, street trees and street furniture are all physical elements contributing to human scale. Transparency refers to the degree to which people can see or perceive what lies beyond the edge of a street and, more specifically, the degree to which human activity can be observed beyond the edge of a street. Physical elements that influence transparency include walls, windows, doors, fences, landscaping, and openings into midblock spaces. Complexity refers to the visual richness of a place. The complexity of an area depends on the variety of the physical environment, specifically the numbers and kinds of buildings, architectural diversity and ornamentation, landscape elements, street furniture, signage, and human activity (Ameli et al., 2015).

One of the primary objectives of the Ewing Handy study (2009) was to compare the operational and qualitative definitions, to arm researchers with parameters to measure the street environment and test for significant associations with walking behaviour.

Ewing conducted additional validation studies to review which of the five urban design measures (of imageability, enclosure, human scale, transparency, and complexity) influenced the amount of pedestrian activity on 588 street segments in New York City (Ewing & Clemente, 2013). The study showed transparency to be the most critical quality affecting the number of pedestrians on the street in urban (downtown) areas. Despite the unprecedented nature of the study quantifying qualitative parameters, it was based in New York City, which is amongst the most walkable cities in the world. The question was whether the results would be valid in less dense cities, peri-urban areas, or suburbia? As if in answer this question, Ameti et al. (2015) conducted a similar study in Salt Lake City, which resembles most mid-sized cities in North America such as New Orleans, Buffalo, Richmond, and did not share the characteristics unique to New York City. It identified 'imageability' as equally important to 'transparency' to catalyse pedestrians. In contrast, paths and alleys in New Urbanist neighbourhoods showed increased utilitarian walking instead of leisure walking behaviour (Baran et al., 2008) where a stimulating environment seemed markedly less important.

The conceptual framework underlying the study of qualitative factors considers the role of perceptions as they intervene (or mediate) between the physical features of the environment and walking behaviour. Urban design qualities are different from qualities such as a sense of comfort, safety or level of interest that reflect how an individual reacts to a place or assesses the conditions there, given their innate attitudes and preferences. Hence, this research evaluated the urban environment for five operational qualities that were shown to affect walkability (Ewing & Handy, 2009).

Kevin Lynch (1960) defined imageability as a quality of a physical environment that evoked a strong image in an observer. It included both tangible and intangible elements such as the presence of people, identification of historic buildings, courtyards, plazas, parks, buildings with irregular silhouettes, ambient noise level, major landscape features, and the like (Ewing & Handy, 2009).

The term enclosure refers to the height of built forms on either side of pedestrian spaces. Outdoor spaces are defined and shaped by vertical elements, which interrupt viewers' lines of sight (Ewing et al., 2006). As numerous urban design theorists have articulated, a sense of enclosure results when lines of sight are blocked strategically to make outdoor spaces seem room-like, and thus inviting (Ewing & Handy, 2009). In an urban setting, a sense of 'enclosure' is formed by lining the street or plaza with unbroken building fronts of roughly equal heights along with a framed view of the sky.

Experts have differing definitions of what confirms to human scale. Alexander et al. (1977) state that any building over four storeys tall is out of human scale. Lennard & Lennard (1987) set the limit at six storeys while Blumenfeld (1953) at three storeys. In

taller buildings, Roger Trancik (1986) proposed that lower floors should spread out while upper floors step back before they ascend, giving human-scale definition to streets and plazas.

In the context of Urban design, transparency is the ability of a pedestrian to visualise activities occurring behind a street façade. While a shopping street with display windows inviting passers-by to look in could be considered a classic example, it could be expressed more subtly, by allowing pedestrians to imagine, and not directly see. The ultimate expression of transparency is when internal activities are externalised or brought out to the sidewalk (Llewellyn-Davies, 2000) such as outdoor dining and merchandising. Transparency is most critical at the street level because this is where the most significant interaction occurs between indoors and outdoors. While a highly reflective glass or large building setbacks are known to detract from transparency, factors such as interior lighting, distinctive signage, alleyways are known to reinforce it.

Complexity is related to the number of noticeable differences in the built-form to which a viewer is exposed to per unit time (Rapoport, 1990). Human beings are most comfortable receiving information at a rate we can process. Too little information produces sensory deprivation, while too much creates sensory overload. The environment can provide low levels of usable information in three ways: elements may be too few or too similar or be too predictable for surprise and novelty, or too unordered for comprehension. The most significant factors contributing to complexity are the number of people, number of buildings and their colours and the presence of outdoor dining and public art.

2.2.4 Street design features

A study in 588 blocks of New York City identified 20 street design features that attracted walkers. These included everything from building age, height, colour to the presence of courtyards and outdoor dining, and public art. After adjusting for the fact that some streets have more (or less) foot traffic based merely on locational qualities, three of these twenty features were correlated with higher pedestrian counts (Ewing et al., 2016; Fulton, 2017) as listed below.

Active uses: These were streets with lots of high-traffic buildings (defined as a place that more than five people entered or exited during the observation period) or active fixtures (such as parks, restaurants, schools, and the like) relative to their amount of inactive features (such as parking lots, churches, or construction sites (Ewing et al., 2016).

Street furniture or items: These included interactive elements (such as tables and chairs, benches, vendors, ATMs, bus stops, parking meters, and bike racks) as well as more inert objects (such as street lights, fire hydrants, trash cans, newspaper or mailboxes) (Ewing et al., 2016). It is, however, noteworthy that the provision of street furniture

acted as a catalyst along with other design features and by itself, did not attract pedestrians.

Transparency or First-floor windows: This design feature indicates the average proportion of the ground floor covered in windows versus its overall façade surface area. It remained significant even after discounting the presence of retailers on the ground floor (Ewing et al., 2016)—meaning the appeal likely goes beyond pure window-shopping.

An additional study based on GIS inputs validated these findings (Purciel et al., 2009). However, again, New York City is amongst the most urban, dense and walkable cities in North America and is unique in every sense; hence, these results cannot be considered valid universally.

2.2.5 Planning features

To test the above results in a more typical context, unlike New York City, it was extended to cover Salt Lake City, which is a relatively typical suburban and auto-dependent city in the United States (Ameli et al., 2015). Negative binomial models revealed that FAR (Floor Area Ratio), population density and land-use diversity were significantly related to pedestrian counts. More interestingly, transparency was again highly significant, along with imageability. Imageability was measured as a proportion of historic buildings, the number of courtyards, plazas or parks, the presence of outdoor dining and several such variables in comparison to the overall street façade. To create an environment that can facilitate walking within the neighbourhood, an appropriate and complementary mix of land uses is required (Lynch, 1960).

2.2.6 Pedestrian features

In 'Unpacking Walkability,' Adkins et al. present the findings of a study combining environmental audits and a survey-based respondent mapping tool to test the influence of micro-scale built environment characteristics, including 'green street' stormwater management features, on resident perceptions of walking environment attractiveness. It concludes that this method is sensitive enough to unpack a concept such as walkability into individual part characteristics. Findings from an ordinary least square (OLS) regression model indicate that in a predominantly single-family residential context, well-designed green street facilities, as well as other features such as parks, separation from vehicular traffic, and pedestrian network connectivity can significantly contribute to walking environment attractiveness (Adkins et al., 2012).

2.2.7 Attributes of walkability

Southworth (2005) identified six characteristics that explicitly affected walkability, namely; connectivity, linkages to other modes, fine-grained and varied land-use

patterns, safety, quality of the path, and path context (e.g., visual interest, landscaping, spatial definition, and others). The study determined that at the micro-scale, these built environment characteristics related to safety, comfort, and level of interest and thus enabled pedestrian activity.

2.2.8 Operationalising Walkability

In 'Measuring Urban Design: Metrics for Livable Places,' Ewing and Clemente (2013) attempted to derive a quantifiable understanding of why certain streets attracted more people. They tried to formulate 'operational definitions' of established urban design qualities and related the essence of such attributes through physical elements of the built environment.

Alfonzo (2005) went a step further and tabulated walkability factors under various categories, such as:

a. Dependent variables such as walking together for recreation, as a modal split and such others.

b. Individual variables such as age, sex, weight, health preconditions and the number of cars in a household. Such variables were purely demographic and statistical.

c. Group level variables such as walking dogs, club membership, social support, and others.

d. Regional level variables such as coastal cities, climate, topography, and others.

e. Physical environment characteristics such as safety, the presence of infrastructure that enables walking, type of neighbourhood and others.

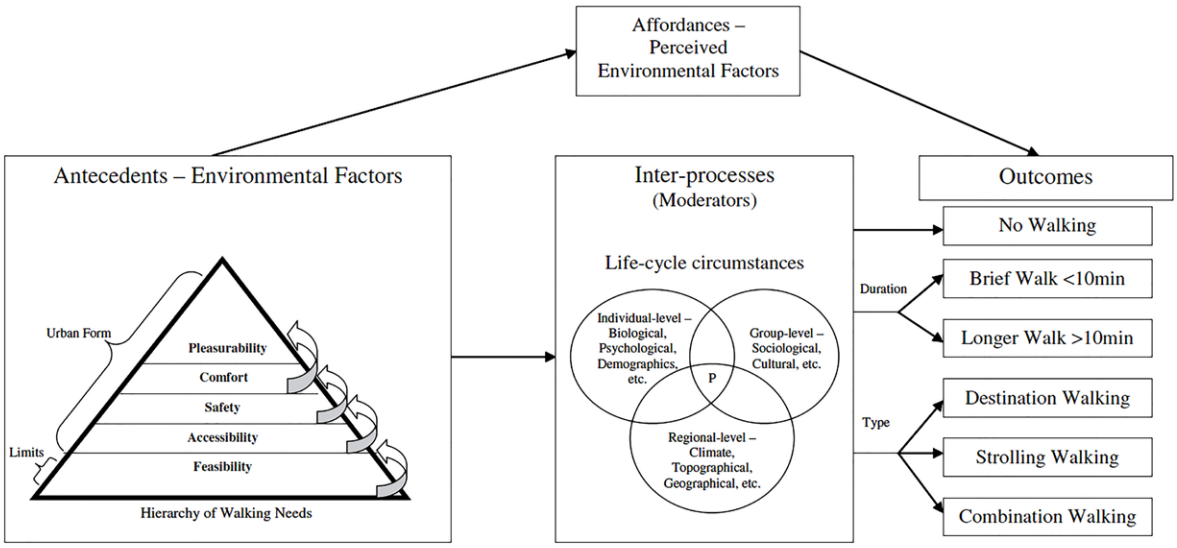


Figure 2.03: Hierarchy of walking needs within a socio-ecological framework
(Credit: Alfonzo, 2005)

This research showed that factors most often associated with the microscale built-environment—safety, comfort, and pleasure—influence decisions to walk only after more basic needs of feasibility (e.g., an individual's ability) and accessibility (e.g., somewhere to go) were met. Alfonzo's hierarchy hypothesis appeared to be supported by empirical evidence showing that micro-scale characteristics tend to have a relatively minor influence on travel behaviour compared to macro characteristics such as destination proximity, density and connectivity (Adkins et al., 2012; Cervero & Kockelman, 1997; Saelens & Handy, 2008)

2.2.9 Space Syntax and Spatial analysis

Space syntax theory describes and measures the relational properties of urban space (Hillier & Hanson, 1984; Hillier et al., 1993) quantitatively. Such relational properties rest on the assumption that long sightlines, fewer turns, higher connectivity, and a high ability to reach a point, from every other point in space, are desirable.

Similar to the current research, a study conducted in Tel Aviv (Lerman & Omer, 2016) analysed four dimensions of urban areas which potentially influence pedestrian movement between an older, traditional community of the city with a newer, contemporary district for the:

a. Spatial dimension based on the road network structure;

b. Functional dimension of land uses such as retail fronts;

c. Physical dimension of road sections and,

d. the Demographic dimension of population and employment densities.

The study, based on Space syntax using GIS software, revealed that urban environment features were associated with pedestrian distribution at the street level based on the type of urban area. Thus, older areas had more, and the contemporary ones had less pedestrian traffic. Pedestrian volume was found to have a heavy-tailed distribution, meaning most areas carried low volumes while a few roads carried the highest amounts.

The spatial dimension is associated with the highest level of pedestrian movement, across multiple regressions employed in this research (Lerman & Omer, 2016). This finding was consistent with the results of previous studies (Jiang, 2009; Raford & Ragland, 2005). The most significant statistical connection to the pedestrian movement was strongly associated with street-based connectivity, which was not based on space syntax analysis. This finding may have pointed to the fact that pedestrian movement in urban space was not based on visual perception alone, as is often claimed in space syntax related research (Hillier & Iida, 2005). The planning of the road network, which is inher-

ently static and difficult to change, was very critical to draw pedestrians (Lerman & Omer, 2016). This observation was compatible with other diagnoses in this field (Hillier, 1997; Marshall, 2004).

The demographic data showed that the older areas had a higher activity density (residential and employment densities combined) than their contemporary counterparts and hence witnessed more pedestrian traffic. The analysis of correlations between the features of the built environment and pedestrian movement distribution revealed a strong relationship between the two. The spatial structure served as the basis for pedestrian movement. Hence, it showed that commercial activity developed along the roads with high pedestrian movement and not just the other way around.

The commercial activity, in turn, helped to intensify pedestrian movement in its vicinity and thus had an economic multiplication effect on the city movement economy (Hillier, 1997). Modern urban planning assumed that a clear road hierarchy would reduce the number of pedestrians using major roads and would keep them walking on internal (and thus safer) neighbourhood streets. However, this was not the case, and people tended to walk on the major roads when the activity density along such roads was higher.

This study stated that the limited research areas considered may have led to very particular results specific to its context. Hence, these findings were read in conjunction with the Ewing Handy attributes (2009) for the scope of the present research.

2.2.10 GPS based sources - Walk Score and Strava Labs Heatmap

Walk Score is a website that indicates the walkability of any address by assigning it a figure, using a patented system. Front Seat Management, LLC originally developed Walk Score® to calculate neighbourhood walkability using a web-based algorithm for a 1-mile (1.6 km.) radius area around an address. For each such address, 'Walk Score' analyses all the walking routes to nearby amenities. The scores assigned to the various categories are summed and normalised into a continuous score ranging from 0 to 100 (higher scores indicate better walkability). Walk Score uses publicly available data and places added by the Walk Score user community (Duncan et al., 2016). It divides amenities available into various categories, including educational, retail, food, recreational, and entertainment while using a distance-decay algorithm. The decay function assigns points to more distant facilities, with no points given after a 30-minute walk ("Walkscore Methodology," n.d.). If the closest establishment of a specific type is within 0.25 miles (400 m.), Walk Score assigns the maximum number of points for that type. No points are awarded for destinations more than 1 mile (1.6 km.) away, and each destination type is weighted equally. Walk Score also measures pedestrian friendliness by analysing population density and road metrics such as block length and intersection density. Data sources include Google,

Education.com, Open Street Map, Government census data, Localeze, and places added by the Walk Score user community. It considers amenities such as Grocery stores, Restaurants, Coffee shops, Bars, Parks, Schools, Shopping centres, entertainment options, and pharmacies.

Walk Score has been validated against functional categories of the built environment such as retail destinations, service destinations, parks, street connectivity, residential density obtained from Geographical Information Systems (GIS) (Duncan et al., 2016). Walk Score has also been associated with people's perception of their built environment (e.g., perceived physical activity facilities) (Carr et al., 2010). Thus, Walk Score assigns a numerical value to a dimension not seen on a map; such as the activity density and functional richness of a place. Such a score does imply actual pedestrian activity in a neighbourhood and thus remains only an indicator for walking potential in a neighbourhood.

Crowdsourced user data from popular fitness apps can also provide insights into usage and activity levels through the aggregation of user data. Strava, a San Francisco-based mobile application company, has developed an app that lets users track their walking, cycling and running activities using GPS. In addition to the app for smartphones and other mobile devices, Strava offers a data product called "Strava Metro" that includes Shapefiles and database files (DBFs) containing aggregated user data. These data can be viewed and analysed in desktop GIS environments, while the general public can explore visualisations of compiled datasets on the Strava Labs website (Smith, 2015). The data from Strava Metro enables deep analyses by planning organisations to make impactful, data-driven decisions, whether planning and building new infrastructure or measuring impact and behaviour change after the completion of a project ("Strava Labs Metro, FAQ," n.d.). The website shows traffic aggregated over the last two years in the form of a 'heat map' which is updated monthly with new traffic data. The colour mode of the heat map can be customised, and the map used for the current study shows no colour for areas with negligible or insignificant pedestrian traffic, blue for some traffic and shades of red for high or a significant amount of traffic. The colours increase in tone and intensity from blue to red to show a corresponding increase in pedestrian activity.

With reference to the current study, such data has several limitations. First, it does not distinguish between a pedestrian, a jogger and a bike rider. Another is that the data is unquantifiable and thus only available for visual comparison. Furthermore, since it relies on GPS data, specific age groups, or people who do not carry smartphones are likely to be excluded from the results indicated. Lastly, while fitness-conscious users only form a subset of the target group of the study at hand, such cumulative data can still provide insights into active transportation patterns. This is so because the route choices and usage patterns of both, fitness-conscious folk and pedestrians, are not entirely mutually exclusive.

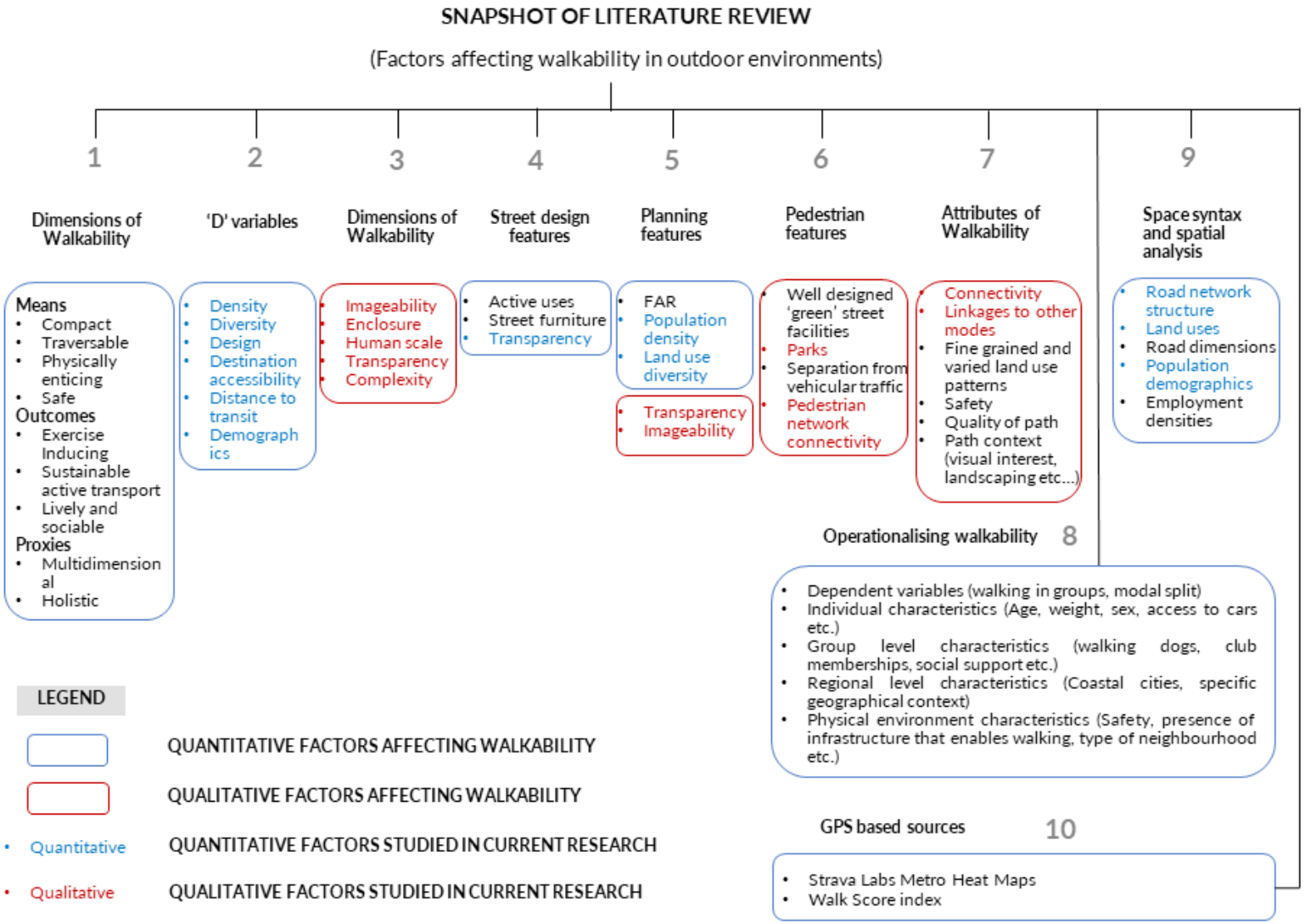


Figure 2.04: Snapshot of literature review and factors affecting walkability in outdoor environments (Credit: Author, 2018)

2.3 Synthesis

The previous research and theories available cover extensive ground and bring many valid parameters to the forefront. Density, spatial connectivity, urban form, land-use mix, urban infrastructure that facilitates walking, and subjective personal considerations are all commonly identified in several studies. While some research focuses on an empirical and statistical analysis of pedestrians, others compare a theoretical framework with observed behaviour or direct feedback from surveys. This current research project is set apart from previous research efforts as it overlays the findings from multiple sources, within the contextual limitations of the case studies, for a wholesome review.

Forsyth (2015) considered the most logical categorisation for the different phenomena that are known to lead to walking, namely: means or conditions, outcomes or performance, and proxy for better urban places. On the other hand, Alfonzo (2005) considered multiple factors such as dependent variables, individual, group, regional and physical environment characteristics. While Alfonzo's segregation carries immense value, the simpler categorisation proposed by Forsyth is more compatible with the present research. Most of the literature reviewed highlights the contextual and subjective factors limiting the results of these studies, both in establishing theoretical constructs as well as obtaining data from field studies.

As an overview, the literature review exercise identified some common factors such as land use, development densities, residential mix, and connectivity or spatial analysis. The issue of transparency of facades recurred in several research efforts and needs further study. Thus, all five of these 'unmeasurable' characteristics (Ewing & Handy, 2009) were considered within the scope of the current research.

In addition to analysing the case studies for these common factors, the theoretical data was supplemented and examined with field observations of actual pedestrian behaviour. Finally, data obtained from independent GIS and GPS-based websites were overlaid with theoretical arguments, as an added means to validate inferences based on observed pedestrian behaviour.

Chapter 3

3 Case studies

3.1 Choice of case studies

To satisfy the requirements of this research endeavour, the projects chosen for case studies had to meet specific criteria. These projects had to be within the same geographical context and with well-defined boundaries. By comparing developments within a single metropolitan region, regional variations in lifestyles were eliminated and unlikely to adversely bias the study. The projects needed to have a boundary to ensure that the design characteristics of either a TND or a New Urbanist town would be applicable for field studies. The projects also had to be outside of the downtown context and accessible, both in the sense of availability of statistics and data related to them as well as easy physical access for photography and fieldwork.

Montreal ranks amongst the most walkable cities in North America (and the third most walkable city in Canada). Owing to its long history, Montreal as a city has developed organically over time and harbours a diverse mix of residents. Some of its inner suburbs are amongst the earliest railway suburbs in Canada while market forces have ensured that the city always is in the process of reinventing itself. As examples, the decommissioning of the Cartierville Airport in the late '80s resulted in the development of Bois-Franc, while today, older neighbourhoods such as Griffintown continue to be redeveloped and densified with apartment blocks.

At the centre of the island of Montreal, two townships lie less than three kilometres apart and are well suited for the study at hand. The first, Town Mount Royal (TMR), has remarkably preserved its original character as a traditional neighbourhood development (TND) and while the second township, Bois-Franc, was built on New Urbanist principles after the decommissioning of the Cartierville airport. Thus, Town Mount Royal and Bois-Franc were identified as case studies, since they satisfied all the selection criteria listed above.

3.2 Town Mont-Royal (An older neighbourhood developed as a railway suburb)

3.2.1 Quantitative factors

3.2.1.1 Background and statistics

The Town of Mount Royal (abbreviated TMR) is an independent suburb of Montreal that was created in early 1910, on what was then the northern boundary of the city by the Canadian Northern Railway company. It was a real estate project to finance the construction of a three-mile tunnel under the mountain to downtown Montreal. TMR owes its design specifically to noted Montreal landscape architect Frederick Todd and,

Figure 3.01: Location of Town Mount Royal in Montreal Island
(Base image credit: Google Maps, 2018)

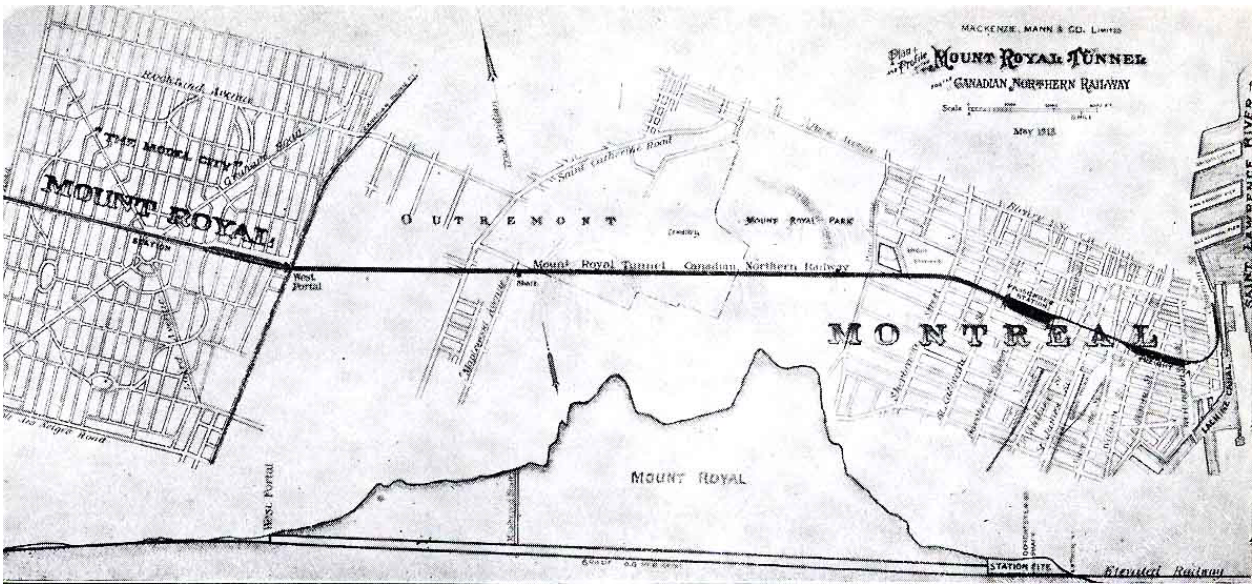


Figure 3.02: TMR - Layout proposed as a railway suburb to Montreal (1912)
(Image credit: http://www.arch.mcgill.ca/prof/sijpkes/CAANS-2010/CarteDuTunnelMontRoyal.jpg)

more generally, to the planning professionals and urban reformers of the time, such as Frederick Law Olmsted, Jr, with whom Todd interacted. The design of the town was not only influenced by the Garden City and Garden Suburb movement in Great Britain, but also by the City Beautiful Movement in the United States (Fischler et al., n.d.).

The township amalgamates three distinct planning concepts, namely; the gridiron plan, the diagonal boulevards of the City Beautiful movement and the curvilinear street pattern advocated by Frederick Law Olmsted (in Riverside, Chicago, US). The configuration, with public transit stations at the centre of development, is identical to Peter Calthorpe's Transit-Oriented Development (TOD) model, which ironically was proposed 80 years later. By developing higher densities close to a transit hub, a TOD aimed to reduce the adverse effects of sprawl by decreasing reliance on the automobile. This model has endured over a century and has preserved its original character owing to strict enforcement and adherence to design by-laws, despite interfacing with contemporary developments along its boundaries. This town was conferred with the status of 'National

Historic Site of Canada' in the year 2008.

The street grid of TMR was skewed with respect to the street grid of the city Montreal, to provide greater solar exposure to the residences within. The parks and open recreational spaces in the township are linked together by concentric roads in a circuitous closed-loop form. The Railway line splits the town into two halves with the Transit station right at its centre and diagonal boulevards connecting this centre to the corners of the township. The built form density tapers out from the centre towards the periphery, with the highest density next to the transit station at its core, and the lowest density towards the fringes of the town. The town centre includes commercial zones, and a large open park and sports club. The Boulevard Decarie, to the West of the main township, splits the Industrial and mixed-use land uses from the residential areas of the town. The current study excludes this Industrial and Mixed-use zone for two reasons. First, since the Autoroute geographically disconnects this part of the township from its central core, walkability across these parts is virtually non-existent. Second, this Industrial and Mixed-use component has undergone significant land use revisions over time owing to ongoing development trends, thus ceasing to represent its the original founding principles and is unlikely to contribute to the study at hand. At the time of this study, large malls and modern apartment complexes are being developed in this zone which does not qualify as a traditional neighbourhood and thus irrelevant to the objectives of this study.

The key statistics of TMR are as below (source: StatCan, 2016):

Gross Land Area: 746 Ha. including both Residential and Industrial Zones

Residential Zone:	539 Ha.	
Industrial and Mixed-Use Zone:	207 Ha.	
Population:	20,276 persons	
Gross Population density:	2,693 habitants / kilometer squared.	
Residential Mix:		
Single Family Residential:	2505 Nos.	34%
Attached and Duplex Residential:	1548 Nos.	21%
Apartments (Less than five storeys):	2432 Nos.	33%
Apartments (More than five storeys):	880 Nos.	12%
Total Units	7365 Nos.	100%

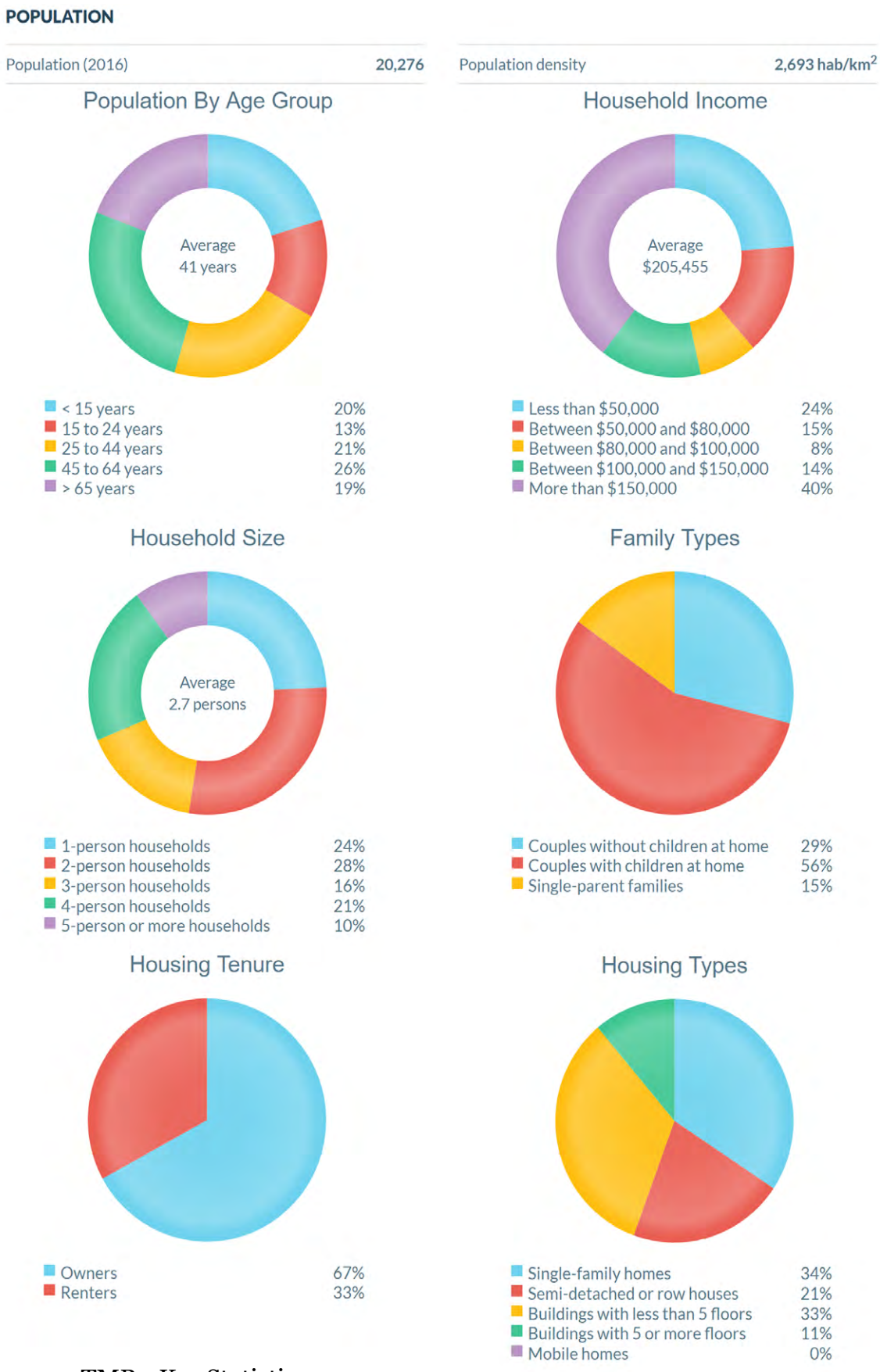


Figure 3.03: TMR - Key Statistics
(Image credit: Centris.ca, 2016 based on StatsCan 2016 census)

Tenement Densities, common to both projects studied, consider the following numbers:

High Density: 80 Units/ Ha. (includes Apartment blocks)

Medium Density: 33 Units/ Ha. (includes Attached and Duplex residential Units)

Low Density: 17 Units/ Ha. (includes Single Family Residential Units)

The average household size is 2.7 persons. Single and two-person households contribute to more than half the residents in TMR. Couples with children at home form 56% of the total residents and single-parent families add 15% to their numbers. Thus, children and activities related to them, play an important role in TMR. Demographically, age-wise, the population is almost equally divided with 54% of the residents being young (ages of 1 and 44 years) while middle-aged residents and senior citizens form the remaining 46%.

The median household income within TMR is C$ 148,340 versus a median income of C$ 69,228 in Montreal Combined Metropolitan Area (CMA). Thus, the residents of this township have more than twice the average income of other Montreal residential neighbourhoods. Such affluence reflects in both, the size of the housing units as well as the housing tenure and lifestyle. Single-family and semi-detached residential units, together, form the largest part of the residential mix with 55%, and 67% of the residents respectively, owning their residential properties. More importantly, increased affluence leads to increased automobile ownership (UN study, 2006) and is known to result in decreased walkability rates. 68% of Town Mount-Royals residents use their car to commute to work (StatsCan, 2016). Such high usage is also directly evident with most of single-family residential and detached units, which have at least two or more garages each.

3.2.1.2 Physical layout and characteristics

To appreciate the nuances of the Town Mount Royal (TMR) plan, it is essential to understand the factors that shaped the original concept. Accompanying the growth of Montreal, mounting urban problems such as traffic congestion, slum formation in the downtown core, speculative development at the city's edge challenged both civil authorities and private interests to accommodate the growing pains of the metropolis. In searching for suburban solutions, the public and private voices in Montreal argued extensively about the possibilities of new or satellite town formation on the expanding periphery of their city (McCann, 1996).

Like C. B. Purdom's vision, the ideal for some was the co-operative Garden City; for others, a City Beautiful design; or for the speculator, the less creative, but efficient, grid-iron plan. One outcome of this debate was a unique, hybrid pattern – a corporation-inspired municipality, part Garden City, part Garden Suburb - all set within a City Beautiful

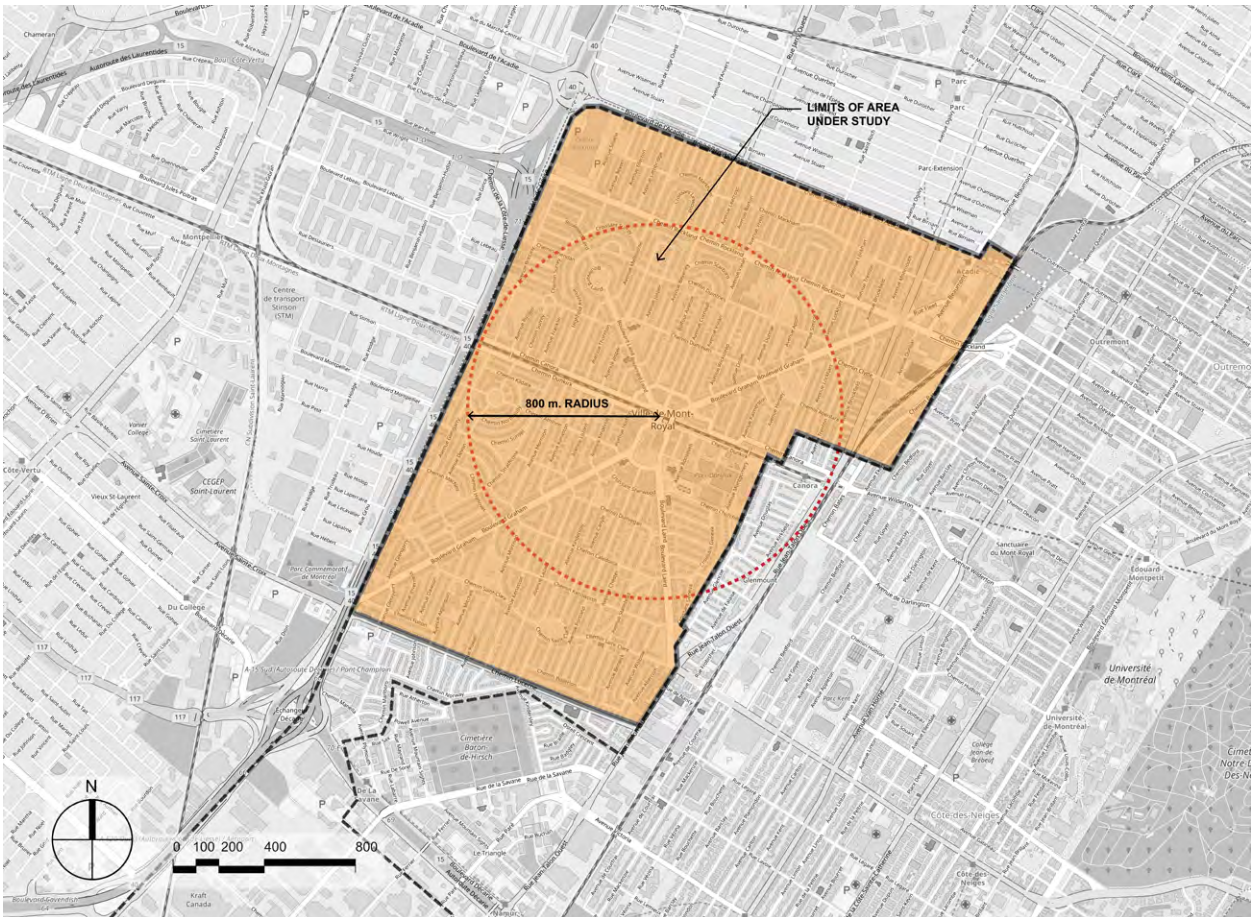


Figure 3.04: TMR - Limits of area considered for current study
(Base image credit: Google Maps, 2018)

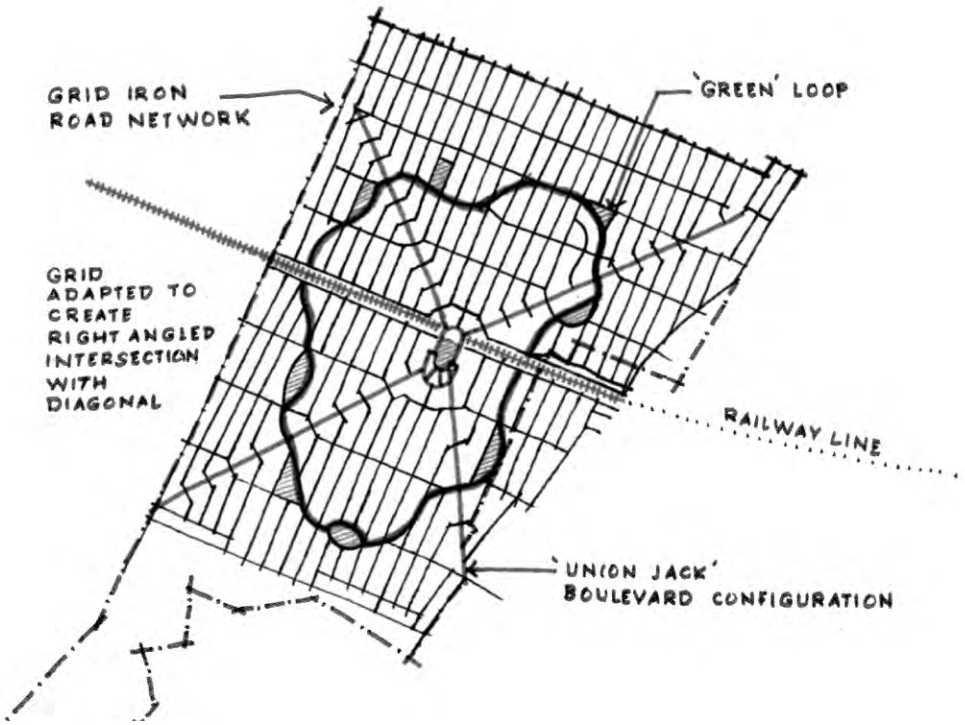


Figure 3.05: TMR - Concept diagram of a loop road linking green spaces
(Image credit: Concept sketch by Todd, resketched by author.)

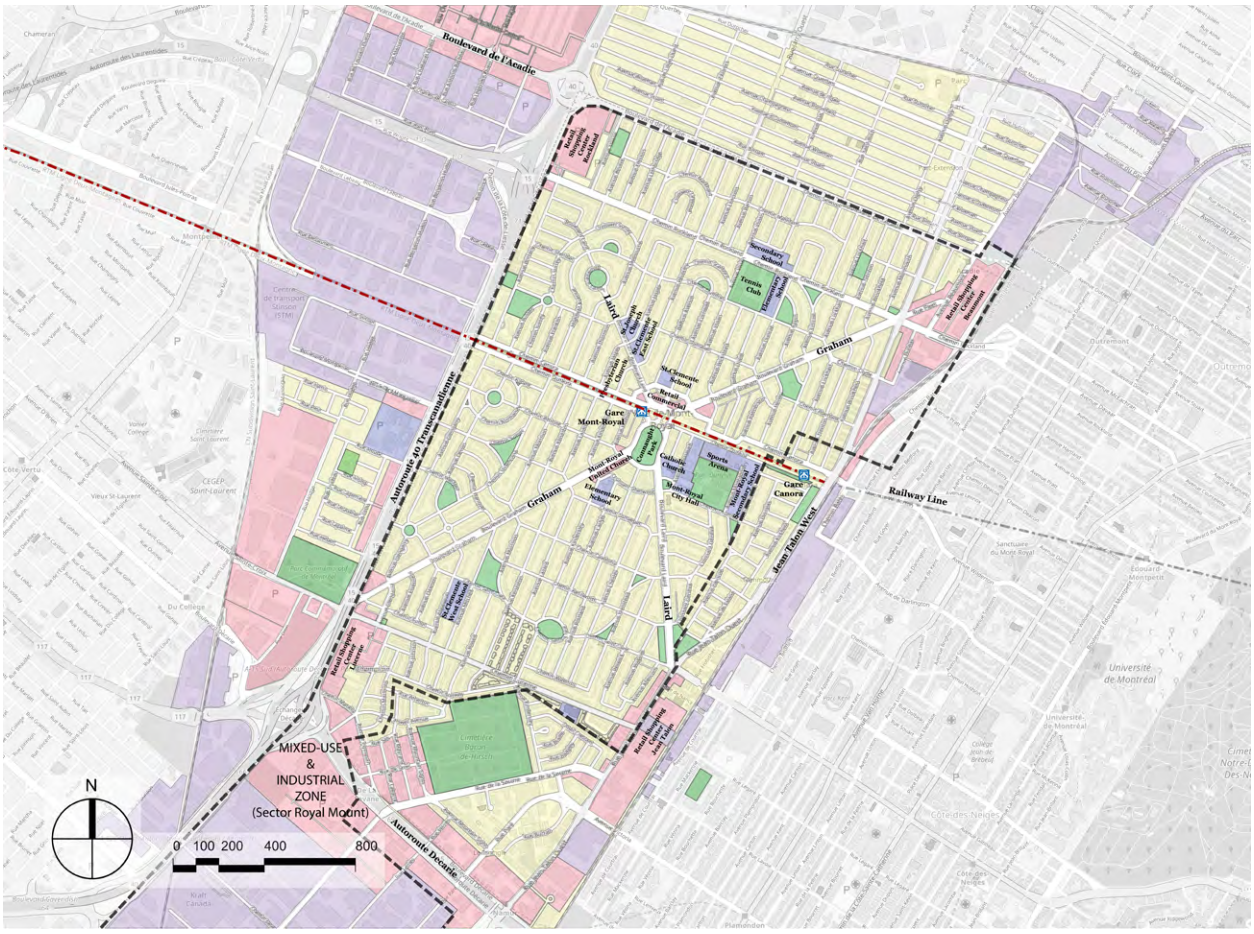


Figure 3.06: TMR - Spatial configuration map
(Base Image credit: Google Maps, 2018)

frame. Thus, the genesis of TMR was as an early railway suburb, first conceived in 1910 by the Canadian Northern Railway and incorporated by provincial legislation two years later as the Town of Mount Royal. Although Todd's design for Mount Royal was modified in several ways when put to the land surveyor's test – increasing lot sizes here, changing road intersections there – its overall form was not altered (McCann, 1996).

Some Apartment buildings are built on plots of 5,000 sq.m, while the largest plot sizes for Single-family residential (SFR) units are between 22 to 27 m. wide and 27 to 30 m. deep (600-800 sq.m.). The neighbourhoods within accommodate slightly smaller lot sizes (400-600 sq.m.) for SFR units with dimensions ranging between 15 to 22 m. width and 27 to 30 m. depth. The smallest SFR lot sizes are located farthest from the main avenues, and they range between 10-12 m. width and 24 m. depth (250-300 sq.m.). The semi-detached lots range between 15-21 m width and 27 m. depth (around 320 sq.m.) and are located just off the main avenues and along with the peripheral areas. The most common Rowhouse plots have a frontage of 27 m. with a depth of 10-12 m. Thus, within the low overall density of the residential areas, the avenues hold the low and medium densities, while the interior areas of the town are slightly denser.

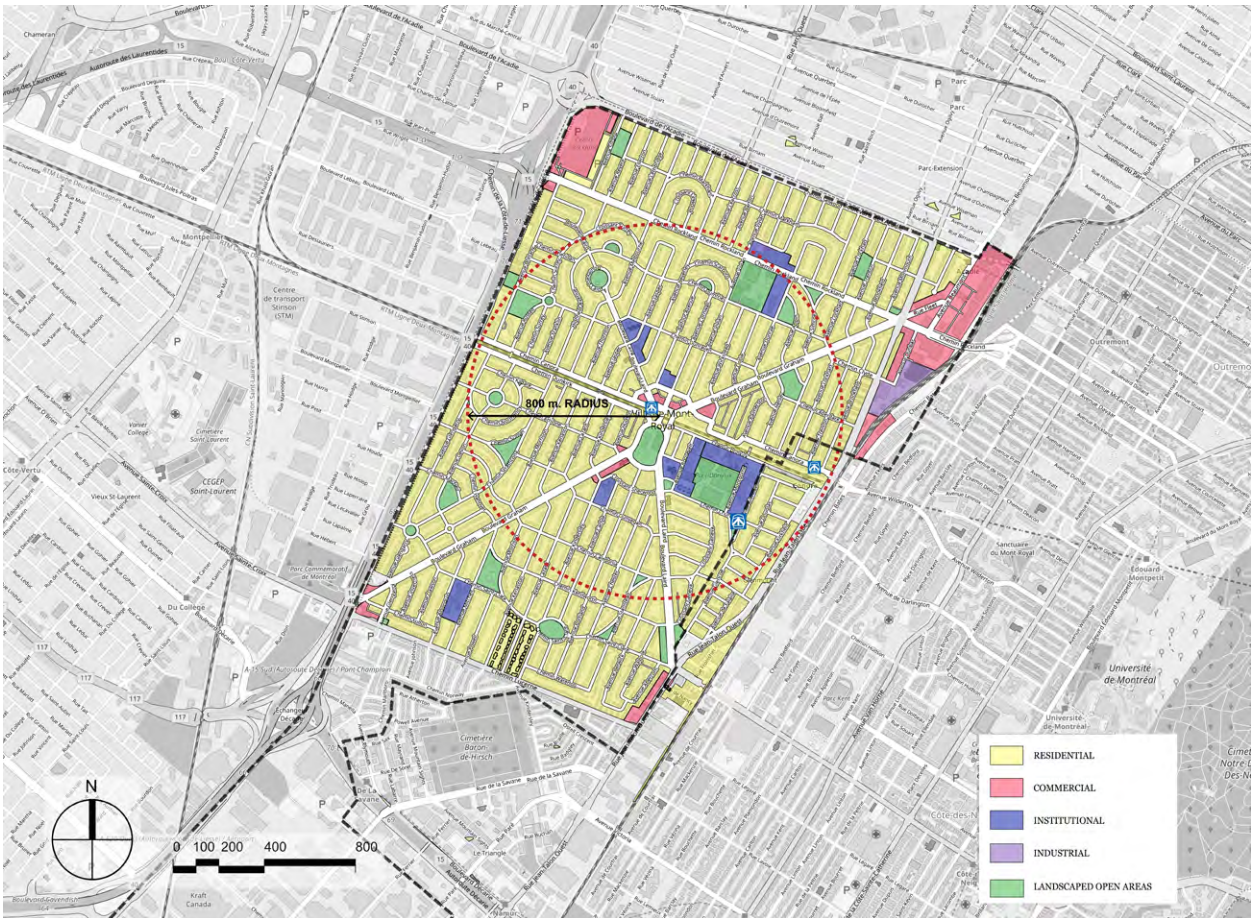


Figure 3.07: TMR - Current Land uses map
(Base Image credit: Google Maps, 2018)

3.2.1.3 Land Use mix

Large volume arteries bind the parallelogram form of the residential component of the township with Autoroute 40 and Chemin Lucerne to the North and West, and with Boulevard de l'Acadie and Rue Jean-Talon to the East and South respectively. The most dominant land use prevalent in the township is residential. It includes varying densities and forms of units such as single-family residential, attached twin units, attached duplex, rowhouses, and apartment blocks. The commercial units lie around the transit station, at the geometric centroid of the town. The Institutional land use includes several schools, both elementary and secondary, as well as religious buildings distributed close to the town centre and peppered around the entire township. The Town Hall, the Library and Clubhouse lie close to the town centre.

The central open space, named as the Connaught Garden, is surrounded by high-density buildings adjacent to the Autobus and train stations. The diagonal boulevards lead away from the convergent centre towards the four corners of the township, maximising accessibility. The internal roads form concentric loops around the centre and

open out onto the diagonal boulevards. The 'green' loop, with a series of decentralised gardens linked by a circuitous road, lies roughly halfway between the centre and the fringes.

Mixed land use, referring to a combination of residential and commercial functions, was conspicuous by its absence in the original plan of the town.

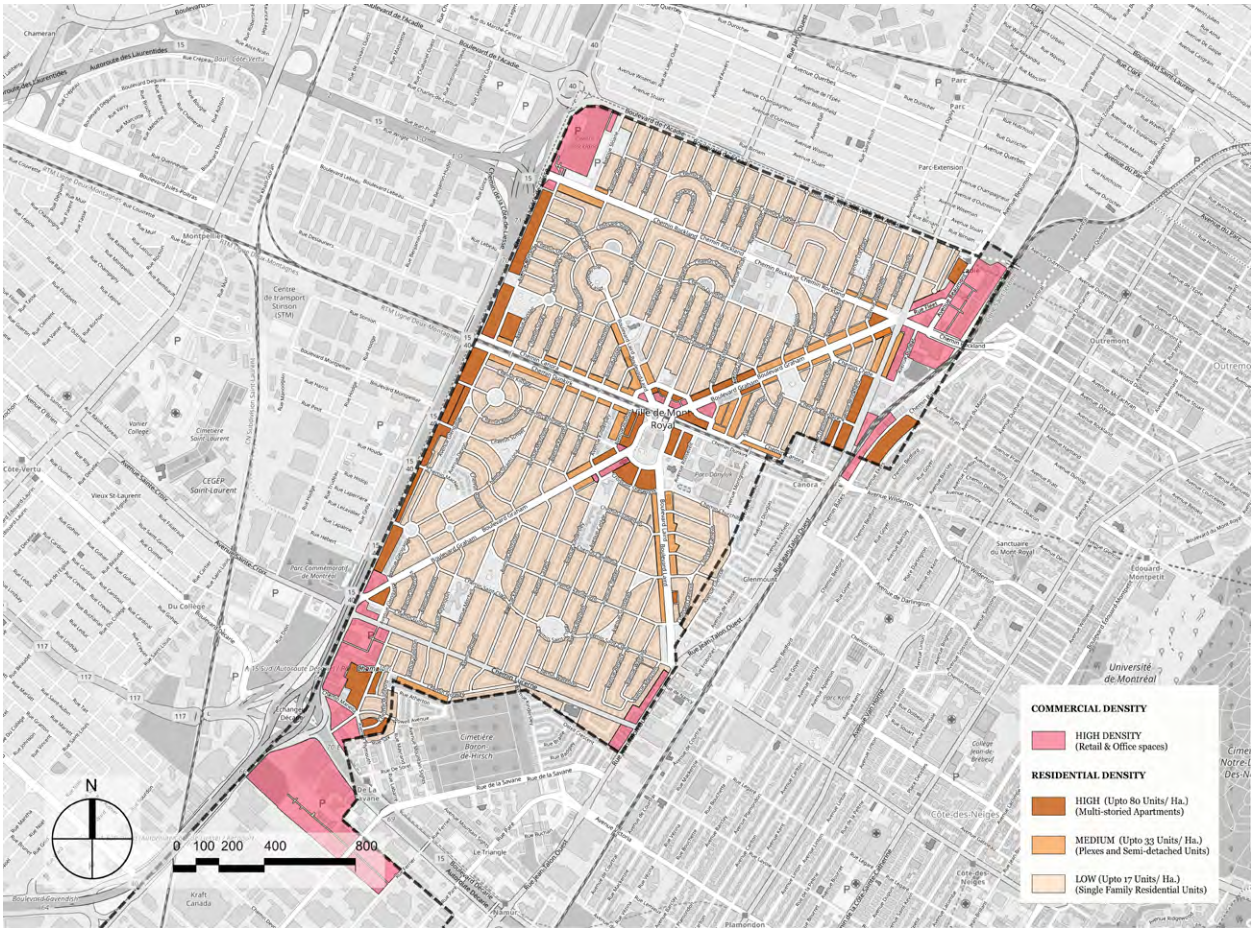


Figure 3.08: TMR - Development Densities map
(Base Image credit: Google Maps, 2018)

3.2.1.4 Development density and residential mix

Overall, the gross density of the township is extremely low, owing to its suburban origins. However, not unlike the principles of a TOD, relatively higher density is concentrated around the town centre, the transit hub, some segments of the primary boulevards as well as the arterial roads at the periphery of the township.

For the commercial buildings, the developments along the town centre carry a Floor Area Ratio (FAR) of 4.2, dropping off to 1.2 at the outer edges of Connaught Park (*Plan D'Urbanisme - De La Ville De Mont-Royal*, 2017). The residential buildings bear varying values of permissible FAR and heights. These are distributed into three zones; high-density carrying a minimum of 80 and a maximum of 150 units/Ha., medium-density restricted to 33 units / Ha., and low-density permitting for a maximum of 17 units

/ Ha. As shown in the statistics, the single-family residential lots have an average area over 3000 s.f. Such large lots, which mandate a well-maintained lawn, are aligned along the main diagonal boulevards towards the periphery of the township. The semi-detached units and a few row houses lie along the auxiliary lanes deeper within the township, while the apartment blocks with higher tenement density lie close to the Transit station.

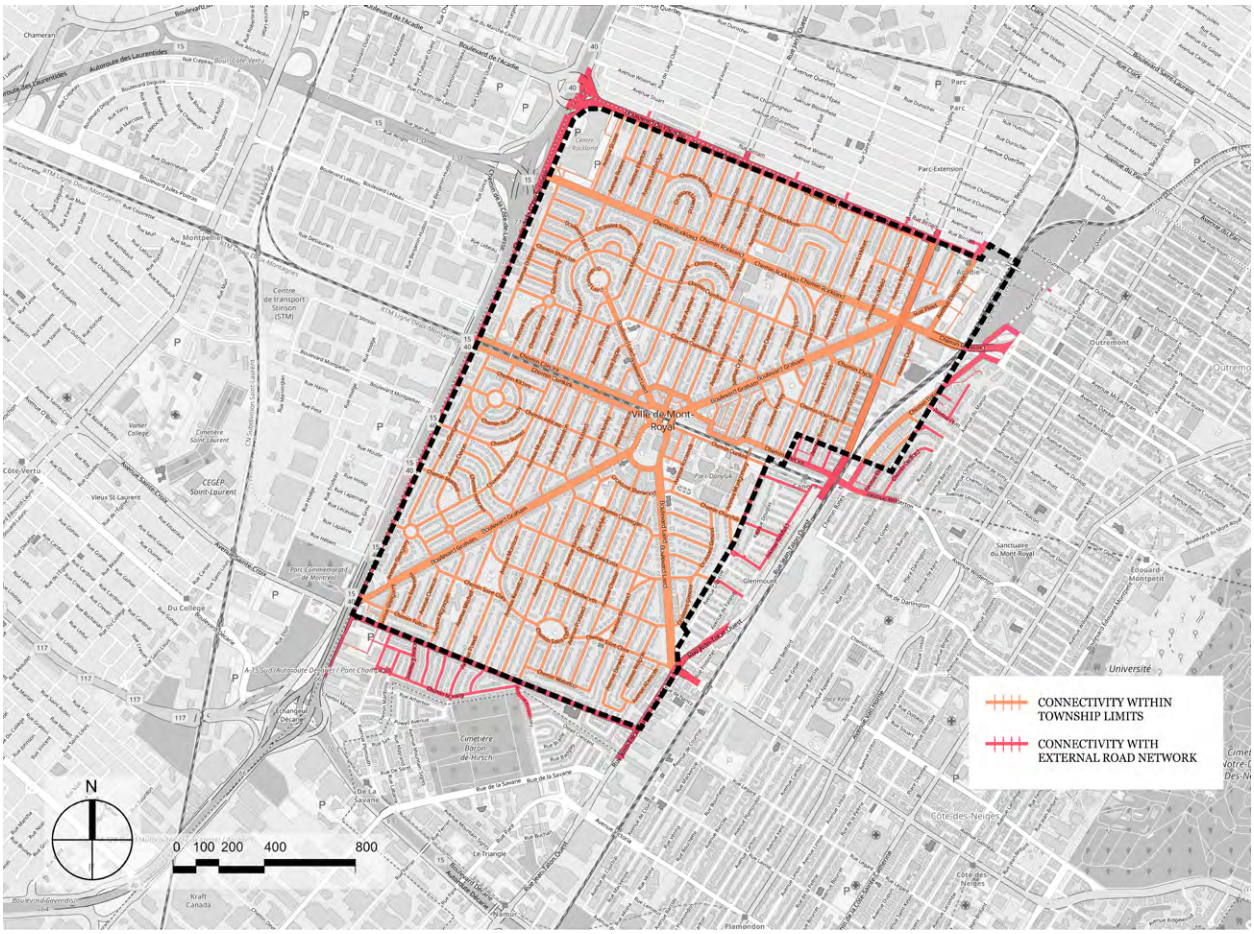


Figure 3.09: TMR - Road Connectivity and continuity map showing connections between internal and external networks. (Base Image credit: Google Maps, 2018)

3.2.1.5 Connectivity analysis

Street connectivity is the number of three or more-way intersections within a neighbourhood buffer, where a higher number of intersections indicates better connectivity between origins and destinations (Hajna et al., 2015). The presence of an Autoroute to the North of the township effectively cuts off access between the town itself and the Industrial and commercial activities across it. The other three sides are adequately pervious to traffic and are well suited to pedestrians and offering significantly more connectivity into the adjacent urban fabric. The residential area under study with its 8.9 km. of perimeter roads has 49 intersections with the road network outside the town. Thus, the average distance between junctions is 182 m. The high availability of entry and exit points, coupled with the fact that these intersections connect deep within the township without

any cul-de-sacs, provides innumerable permutations and combinations to traverse the town. Also, some of the connections are major thoroughfares, such as Boulevard Graham which forms an essential link to the Dorval Airport from East Montreal, contributing significantly to the volume of thoroughfare traffic. High intersection ratios, short street lengths, maximum connectivity invariably lead to high pedestrian volumes (Lerman & Omer, 2016)

Industrial land uses lie around the residential zone with retail and block commercial at the corners, contributing to a rich activity index along the periphery. Even within a 10-minute walking distance (400m), a higher diversity in activities allows a person to achieve multiple tasks in a single trip, bringing function induced walking into play. Despite catering to a high volume of through traffic and open borders, TMR still works like a gated community and most of its pedestrians live within the town.

Figure 3.10: TMR - Imageability, Town Centre Aerial view looking North
(Credit: Google Maps, 2018)

Figure 3.11: TMR - Imageability, Town Centre Chemin Canora (Credit: Google Maps, 2018)

3.2.2 Qualitative factors

3.2.2.1 Imageability

The diagonal boulevards leading to the central commercial and ample central open space are remarkable and singular in character. The town centre with its commercial uses and high floor space index results in larger building volumes. Along with

Figure 3.12: TMR - Imageability, Town Centre Connaught Park (Credit: Author)

Figure 3.13: TMR - Imageability, Annunciation Parish Laird Boulevard (Credit: Author)

Figure 3.14: TMR - Imageability, Unbuilt spaces - Town Centre Connaught Park (Credit: Author)

the commercial, the institutional buildings next to the town centre such as the churches and schools, together form a distinct and imageable landscape. As floor space density directly manifests in the built form, it's gradual decrease is evident while traversing from the town centre to the outer residential areas. The residential plot owners built their homes according to their individual tastes over the years, so there exists a wide variety in the scale, style and architecture of the villas. The building elevations and profiles are not monotonous but adequately interesting enough to engage passersby.

As the largest category of land use, the residential types and their forms define the character of TMR. The most significant aspect of TMR is the sequence of spaces between commercial, institutional, residential and more importantly, the unbuilt spaces, such as parks and open spaces which tie them all together. Thus, TMR can be considered to rank moderately high on imageability.

3.2.2.2 Enclosure

The recommended proportions of building height to the width between buildings vary between 1:2 to 1:6 (A. B. Jacobs, 1993). The lesser the ratio, the higher is the sense of enclosure for pedestrians. The Town centre has a ratio of width to height of 1:20 along its longer axis, while the wide boulevards have a ratio of 1:6. Despite these high ratios, the

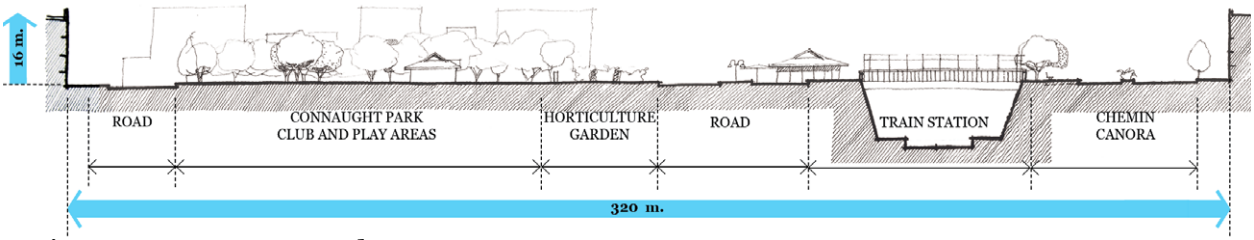


Figure 3.15: TMR - Enclosure, Town Centre Sketch Section (Credit: Author)

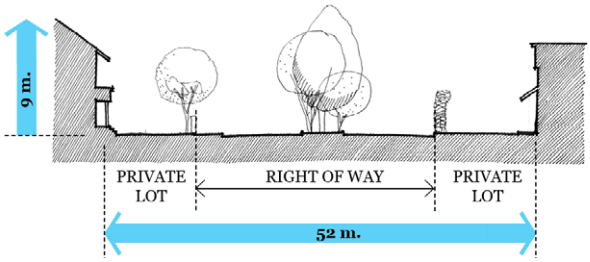


Figure 3.16: TMR - Enclosure, Boulevard Laird - Enclosure ratio and value added by trees and a planted median (Credit: Author)

Figure 3.17: TMR - Enclosure, Boulevard Laird (Credit: Author)

Figure 3.18: TMR - Enclosure, Boulevard Laird Tree wall and Median (Credit: Author)

Figure 3.19: TMR - Enclosure, Town Centre Boulevard Croissant (Credit: Author)

sense of enclosure is still high. This is attributed to the exceptions listed by Ewing and Handy which contribute to a sense of enclosure, such as the avenue of trees, planted medians, high hedges lining the properties, and on-street parking. All of these are present in TMR, contributing to a higher pedestrian perception of 'enclosure.' This sense of enclosure continued even through the unbuilt spaces of TMR such as its parks. Thus, the urban spaces within TMR provide a high sense of enclosure owing to the various elements that populate these spaces.

3.2.2.3 Human scale

The highest buildings in TMR exist around the Town centre and are six storeys tall. Despite the height, the buildings themselves are spread out and broken down into smaller footprints. Along the town centre, the upper floors step back from the facade, making the buildings appear lower at pedestrian height, thus accentuating the human scale. The setbacks enhance the feeling of openness.

Figure 3.20: TMR - Human scale, Town Centre commercial (Credit: Author)

Figure 3.21: TMR - Human scale, Town Centre Chemin Canora (Credit: Author)

At the pedestrian level, the 3 to 4 m. high storefront windows, appropriately scaled signages, avenues of trees, awnings, canopies and presence of street furniture reinforce the sense of human-scaled spaces. On the other hand, the residential areas with two and three storeys are more intimate and appear more inviting as they conform to even more relatable proportions.

Figure 3.22: TMR - Transparency, Town Centre commercial (over 45% glazed store fronts) (Credit: Author)

Figure 3.23: TMR - Transparency,Town Centre commercial (Credit: Author)

Figure 3.24: TMR - Transparency, Town Centre Chemin Canora (Credit: Author)

3.2.2.4 Transparency

Based on the literature review, transparency of facades at the pedestrian level correlates to higher rates of walkability. Observations show that the Ground levels of facades of the commercial buildings in the town centre are roughly 45% glazed. This exposes the world of activity within the building to the outside and is known to draw pedestrians. However, in TMR, only restaurants and stores exhibiting their

wares, such as bakeries, florists have well maintained and organised storefronts. Commercial entities such as Banks, Pharmacies seem to block the glazed frontage of their space either for privacy reasons or to gain more display surface within the store. The buildings 'fold' at the pedestrian level without a continuous, monotonous façade and are punctuated by alleyways and back exits. The vibrant, noisy environment spills on the street with its outdoor seating and signage extending onto the pavement. Thus, overall TMR can be considered to have high transparency in its town centre.

It should be noted that owing to privacy concerns, the construct of transparency does not apply to residential enclaves. Private owners use the exact opposite strategy such as using hedges, high picket fences and other such means to enhance their sense of privacy and safety.

Figure 3.25: TMR - Complexity, Town Centre commercial (Credit: Author)

Figure 3.26: TMR - Complexity, Residential types (Credit: Author)

3.2.2.5 Complexity

Since several buildings of the TMR Town centre were reconstructed over the years, there exists some variety in forms, heights, colours, and textures of the built form. TMR has architectural controls applicable in this town related to storefronts, signage and materials and while this results in a harmonious looking street elevation, it distinctly compromises the complexity of such facades. Apart from the buildings themselves, the changing street furniture, restaurants with outdoor seating, signage seem to attract the highest number of people seen in the town.

In the residential areas, the single-family and semi-detached units appear distinct, built by their respective owners in their preferred styles, namely, Faibourg, Garden city, English Manor, French Canadian, bungalows, cottages or split-level (*Zoning Regulation #1441, Ville de Mont-Royal*, 2017). Such types vary according to the phase in which they were constructed. Often the facades are not visible from the street at all, and only the silhouette of the residence is visible. Some have tall shrubbery to internally achieve a sense of a shielded, private space, while others have a completely open garden with low-

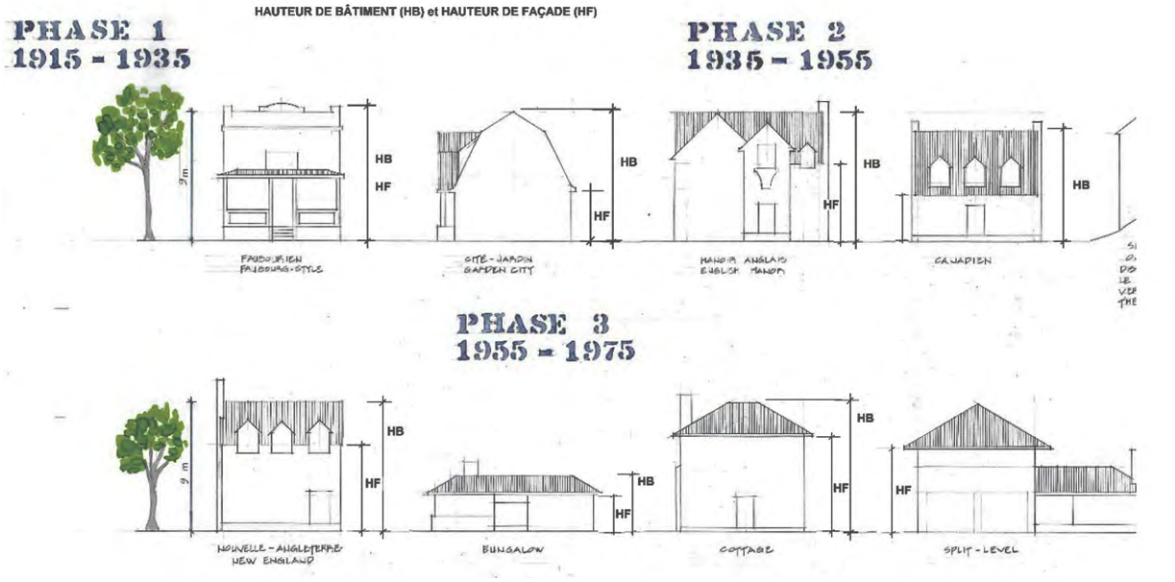


Figure 3.27: TMR - Complexity, Residential types showing heights of facade and buildings (Credit: Zoning Regulation #1441, Ville de Mont-Royal, 2017)

rise vegetation. So, in summation, given the moderate variation of visual elements in the Town centre and the residential zones, TMR is deemed to score moderately for urban design complexity.

3.2.3 GPS based data sources – Strava Labs and Walk Score

Real-time data from websites such as Strava Labs and Walk Score graphically indicate high pedestrian traffic and the location of amenities within walking distance of a neighbourhood, respectively. As a tertiary means of review, the data from these websites are compared with data collected through the case studies.

The first map shows the heat map obtained from Strava Labs Metro. The colour mode of the heat map can be customised, and the one included in this report uses a light background for clarity and is valid as of July 2018. The map indicates that the most significant volume of active traffic passes through Boulevard Graham from the South-East corner of the township through its Northern corner. Boulevard Laird shows a lesser volume of traffic than Boulevard Graham and is potentially owing to the existence of a bike path along Boulevard Graham. As observed, the presence of people attracts more pedestrians. Also, traffic across the town from North to South, and also along the Western parts of the town seems markedly pronounced than other areas. Pedestrian traffic around the school areas seems slightly higher than average. The rest of the residential areas and the Parks show minimal movement.

In calculating its walkability index, Walk score considers the distances from the relevant address to amenities available in a neighbourhood. In TMR, such amenities lie between the Commercial and Institutional land uses at the centre of the township and

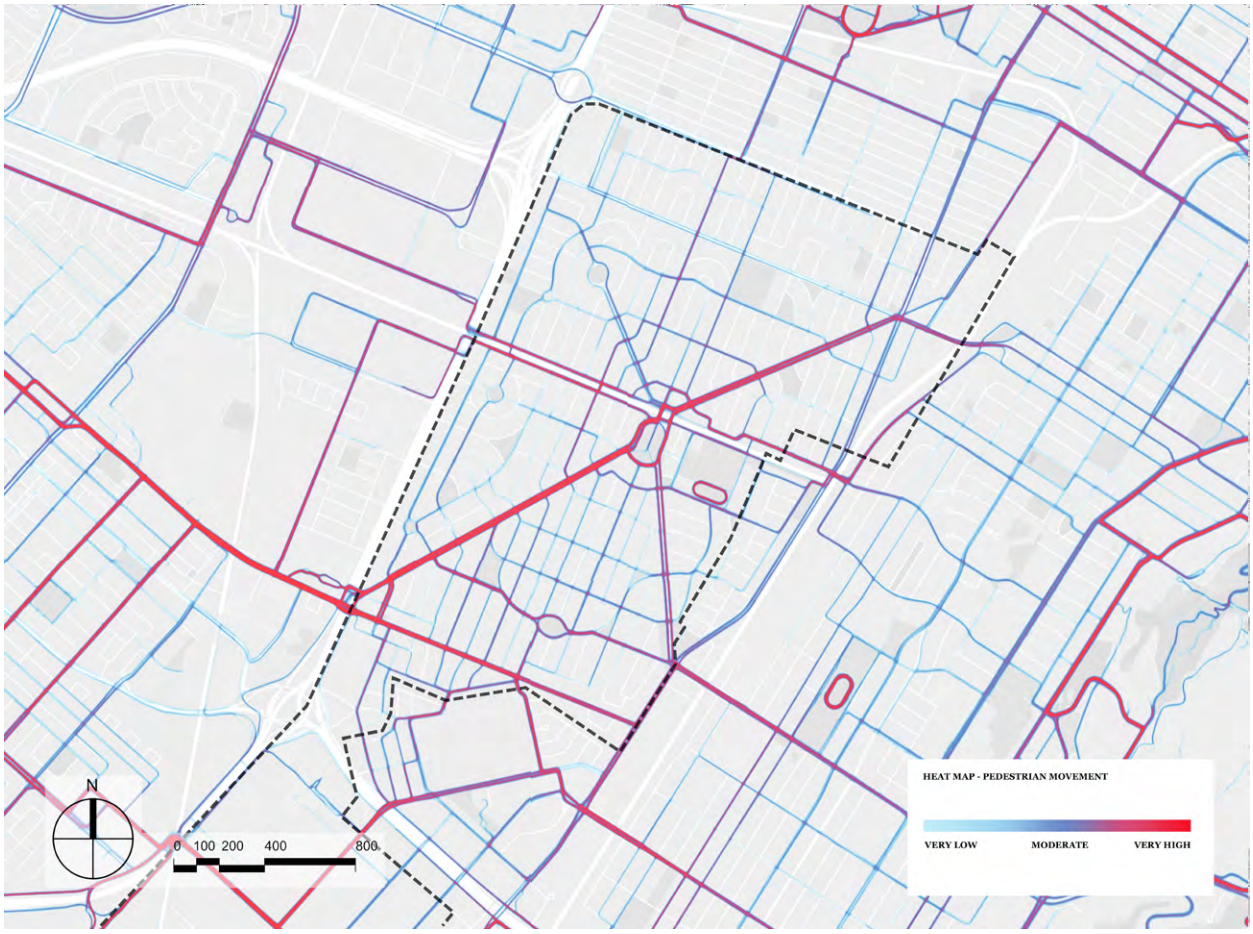


Figure 3.28: TMR - Strava Labs Metro Heat Map (Credit: www.strava.com/heatmap)

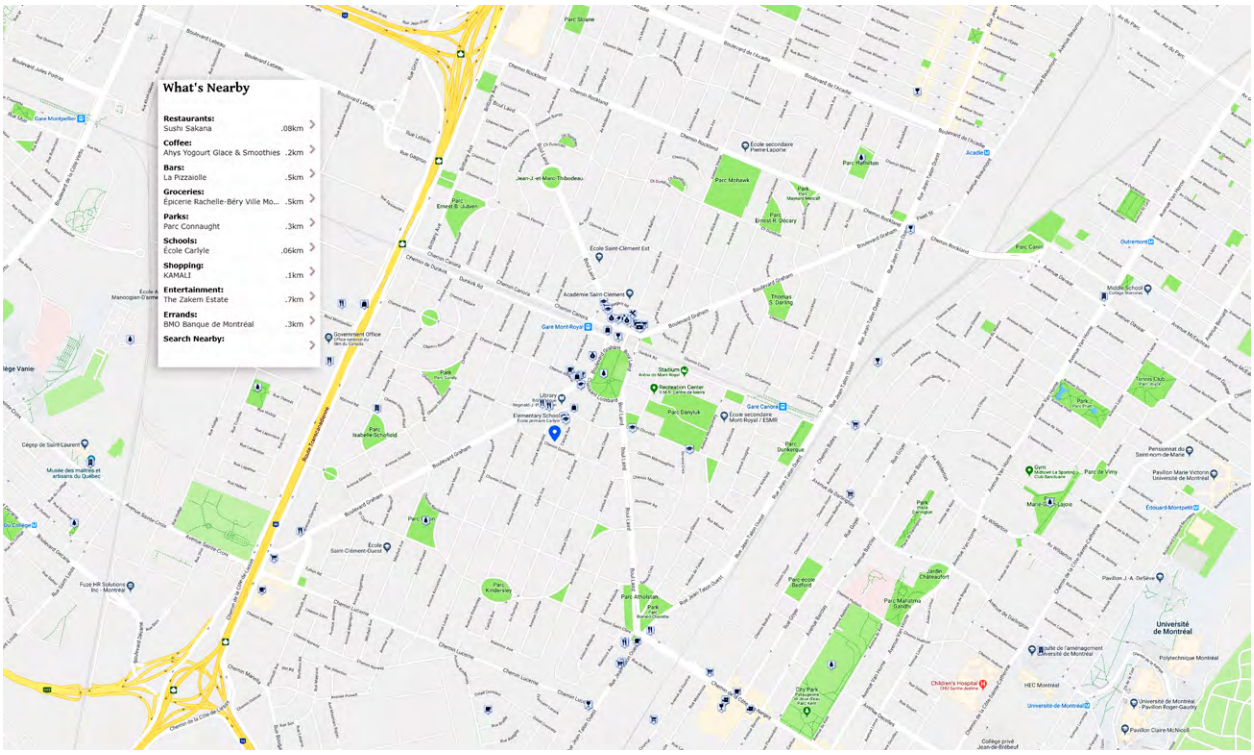


Figure 3.29: TMR - Walk score map showing distance and location of amenities (Credit: www.walkscore.com)

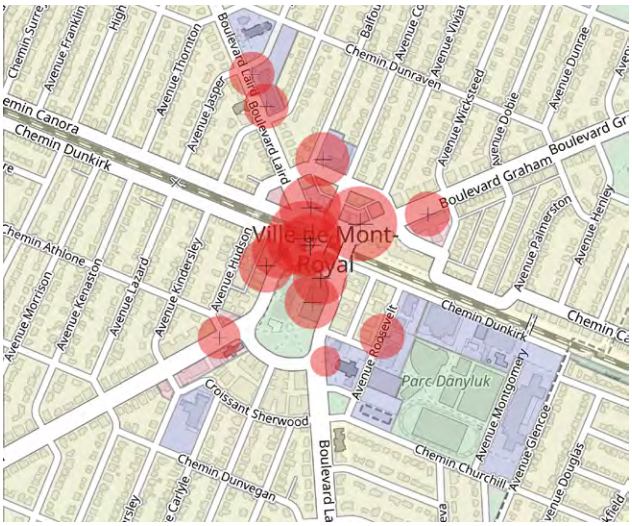


Figure 3.30: TMR - Pedestrian concentrations - Morning (Credit: Author)

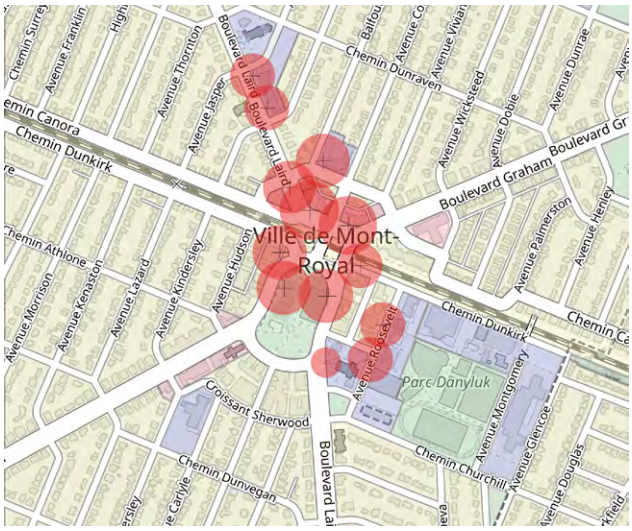


Figure 3.31: TMR - Pedestrian concentrations - Afternoon (Credit: Author)

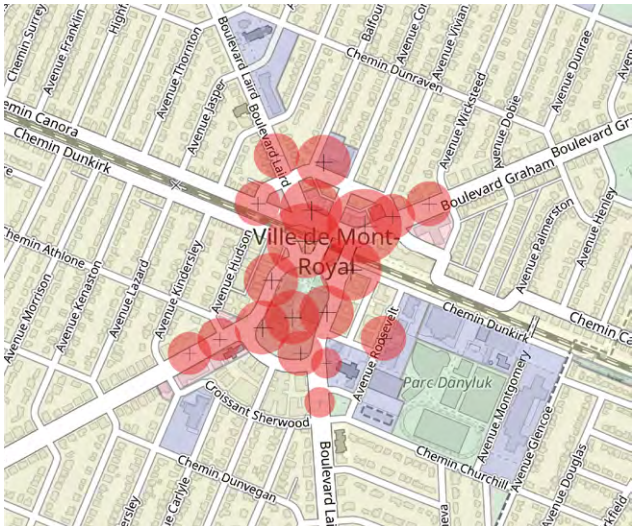


Figure 3.32: TMR - Pedestrian concentrations - Evening (Credit: Author)

its periphery. Every facility, from a school to a restaurant or a park, is within a 700m distance, resulting in a high Walk Score of 76 where all errands can be carried out on foot. In comparison, the city of Montreal which is the third most walkable city in Canada - behind Vancouver and Toronto - carries an average Walk Score of 70. So TMR is marginally more walkable than the Montreal metropolitan region, as a whole. Thus, the data from this website reinforces the pattern of pedestrian traffic observed in the town.

3.2.4 Field Observations and maps

The field observations were conducted in accordance with the methodology described earlier. The below descriptions list the general trend of space usage observed during such observations. The three separate ranges of observation per day showed different behaviour and some times, different classes of users in action.

Mornings (7:30 am to 9:30 am):

The township lives up to its original concept of an old railway suburb and showed pedestrians converging to the train station, presumably to get to their workplaces in Montreal downtown. Some stray number of residents took the train in the opposite direction, to Deux Montagne or Mascouche. The AMT trains take 10 minutes to reach Gare Centrale and run in the direction of downtown Montreal at a frequency of 30 minutes during peak hours and 80 minutes during off-peak hours. The bus station, existing along Connaught Park,

saw a crowd of people queuing up and waiting for Autobuses. Very low numbers of senior residents were seen spending time in the Park. Areas around the schools also witnessed some pedestrian traffic but comprised mostly of students who were dropped off in private cars. The restaurants, next to the train station and across Chemin Canora, witnessed a deluge of residents dropping by to pick up coffee and have a hasty breakfast. Some retail stores were open but were not patronised in these early hours. Youth and teenagers seem to assemble at the Tennis courts in the Club next to Connaught Park. They spent at least an hour on these premises. The Children's play area was empty. Health-conscious early morning joggers and walkers were seen to favour Boulevard Graham. In the residential areas, a few residents seemed to walk up to the Autobus stops on Boulevard Laird and Boulevard Graham to take buses to various destinations, but apart from them, not much movement was observed.

Afternoons (12:30 pm to 2:30 pm):

The train stations witnessed negligible traffic. The restaurants around the train station were packed with residents coming over in cars, to meet others and have lunch. Pedestrians seemed to have set out to carry out multiple tasks; such as spend some time in

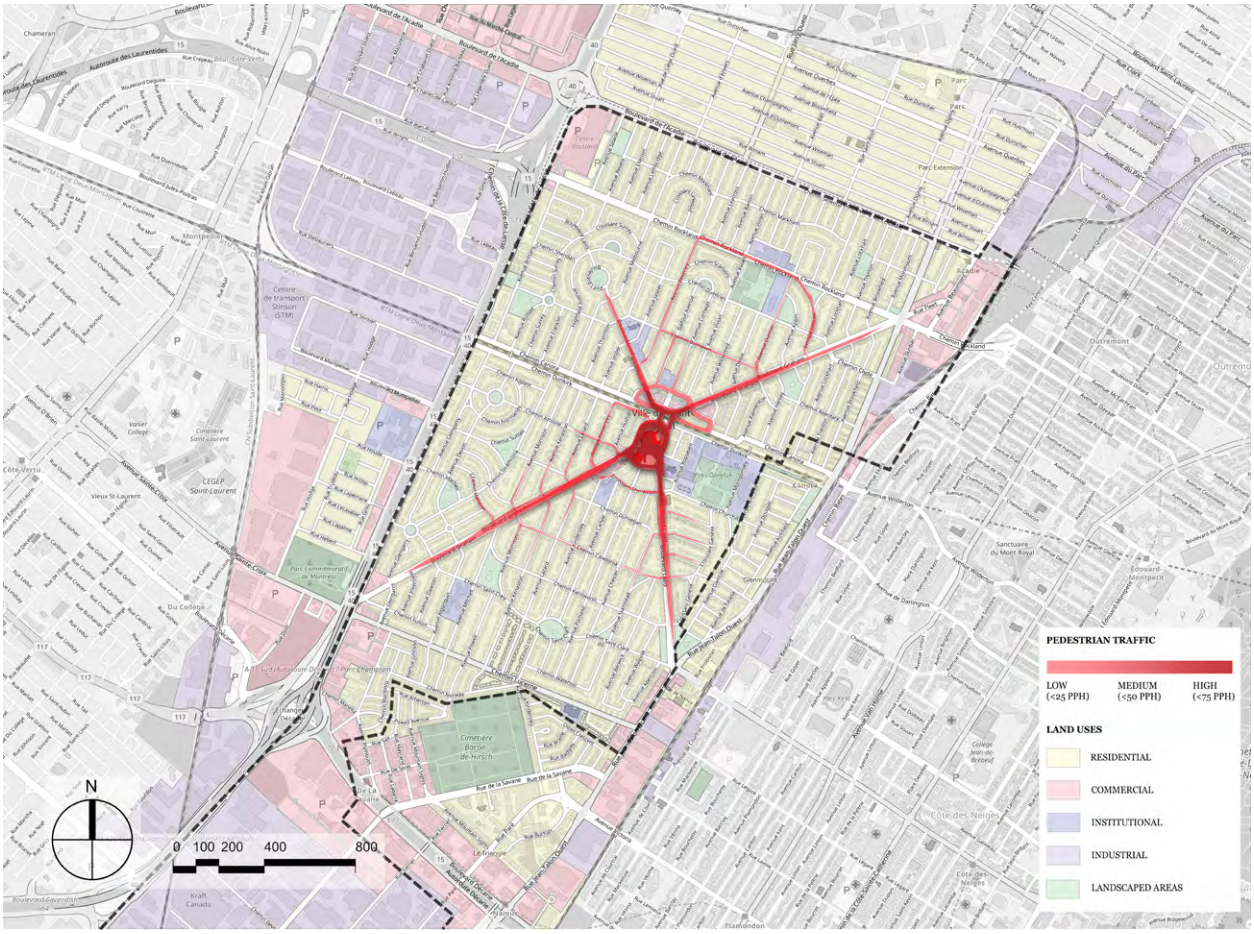


Figure 3.33: TMR - Aggregated Pedestrian concentrations in areas of study
(Credit: Author)

Figure 3.34: TMR - Pedestrians Chemin Canora (Credit: Author)

Figure 3.35: TMR - Pedestrians Croix Lombard (Credit: Author)

the park, pass by the grocery store or visit the bank. Some pedestrians were witnessed escorting children back from school. In comparison to the morning hours, the Playgrounds and Tennis courts hosted more residents and were more abuzz with activity. Post noon, more senior citizens appeared to set out and were content reading a book or socialising, with others of their age group, in the park. Nobody seemed to walk out in the residential zones, even within their lots, nor was anyone seen in their private yards. The chain of smaller gardens around the township was also empty.

Evenings (5:30 pm to 7:30 pm):

The evenings were when the highest number of pedestrians were observed. As far as travel was concerned, the reverse traffic was witnessed from the train and bus stations. The pace of most residents seemed to be more relaxed, as they did not have a schedule to meet. People stopped to talk more, stroll or even sit informally in the park. The highest number of senior citizens was witnessed in the evening, either walking about in groups or sitting in the park. The playgrounds were most active, and queues were formed around swings and slides. The tennis courts and the club also had residents drop by, presumably after work. The Restaurants appeared to have their busiest hours in the evening with people either snacking or having early dinners. Some commercial units, such as grocery stores and fitness centres, had maximum traffic during these hours. A few numbers of residents were witnessed in the residential areas, walking to or from the town centre to their residences. No activity was witnessed around institutional buildings.

3.2.5 Summary

With the combination of commercial functions and a transit node at its centroid, the geometric diagonal configuration of its primary arterial roads and the 'chain' of green spaces linked in a concentric pattern are unique to Town Mount Royal. It is clear that

Figure 3.36: TMR - Public Transportation network connectivity (Credit: Author)

TMR owes its success to a combination of factors:

The land use distribution, with some retail commercial at the centre and block retail at the periphery of the township, allowed more significant numbers of patrons to come along the boulevards, without swamping the town with traffic. Thus, most residential areas remain segregated from higher volumes of traffic. The bus and train connectivity to the township appeared to work remarkably well. A large number of pedestrians were visible in the town centre area. Although the town centre supports commercial activities such as grocery stores, banks, restaurants, pharmacies, bakeries, dry cleaners, and fitness centres, the diversity of the activities taking place along its fringes far outweighs the meagre provision of commercial units at its centre. It was noteworthy that the concept of mixed land use did not exist in the original proposal of the township. Single land use adjacencies were considered on individual plots versus stacking them up vertically. The higher density of the town centre and the judicious incorporation of commercial functions served the original premise of the township very well.

Both the town centre and general residential areas studied show two distinct patterns of usage:

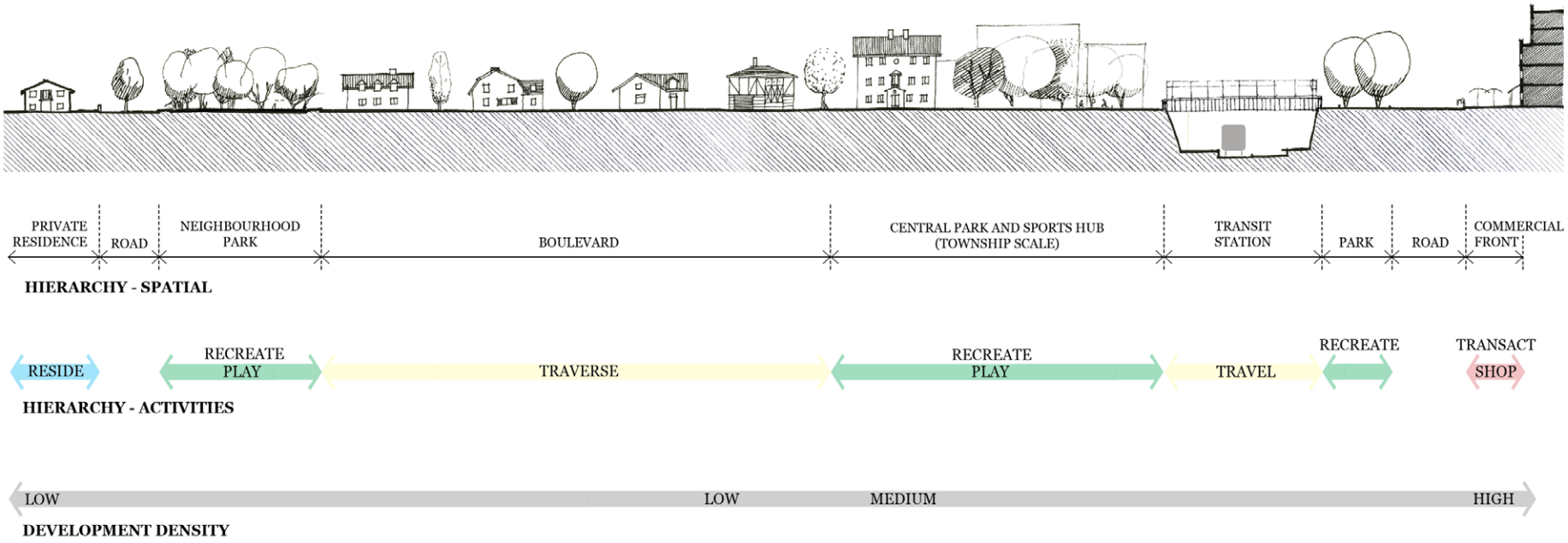
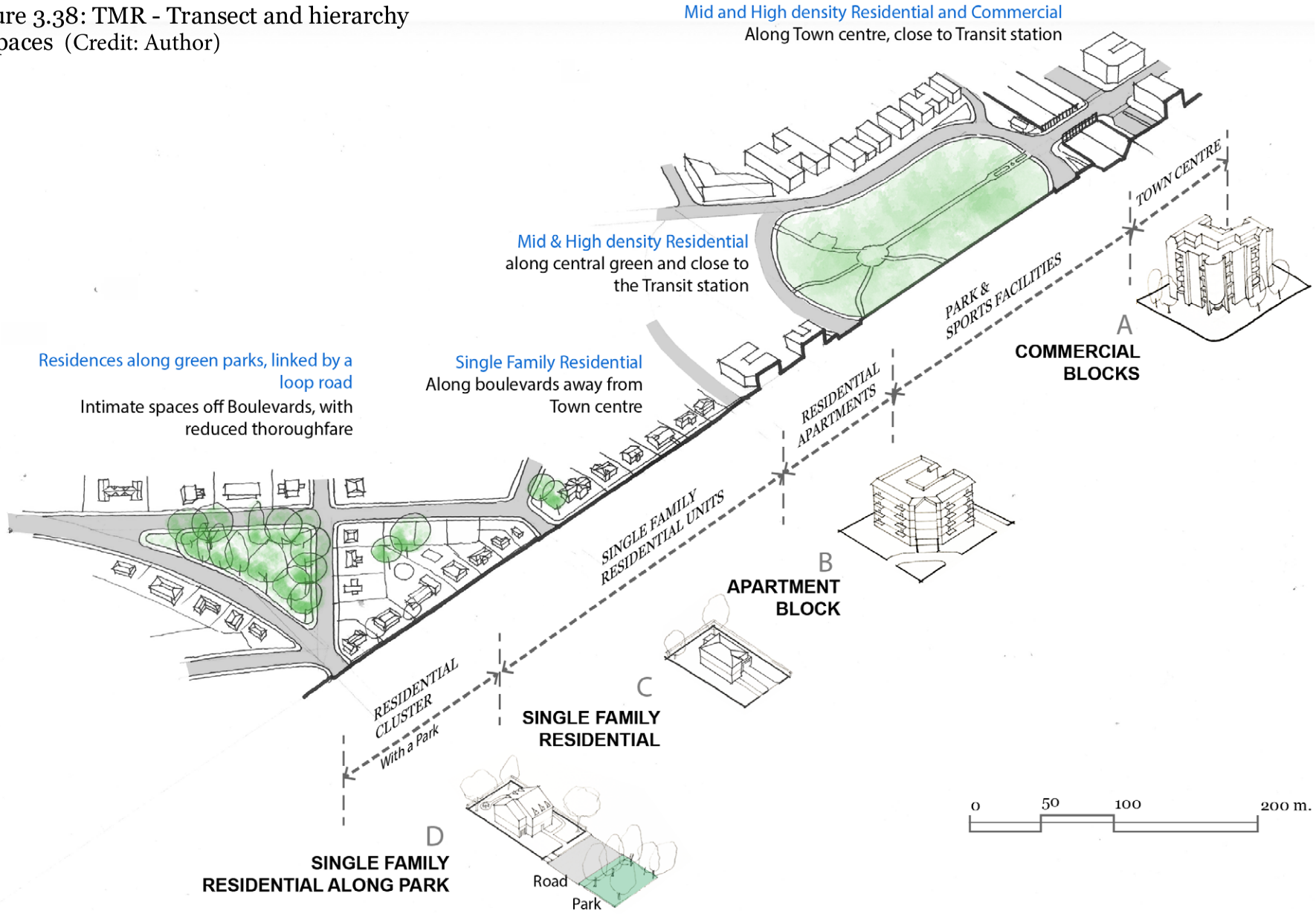


Figure 3.37: TMR - Hierarchy of spaces and usage (Credit: Author)

Figure 3.38: TMR - Transect and hierarchy of spaces (Credit: Author)



In the general residential areas, the residents showed a diffuse and intimate character of usage, resulting in pedestrian traffic counts which were below the thresholds of observation. A few residents were seen walking in the residential zone, either socialising with neighbours or making trips to their local park. The private home and its precinct (including the neighbours and the public open space) constitute a local domain which is less influenced by factors such as age demographics or qualitative factors of urban design listed before (transparency, imageability, etc.). However, the main influences that affect space usage are social relationships between neighbours, safety, and privacy. The traditional 'Garden city' concept of a linked series of gardens works remarkably well, with residents from the vicinity using such spaces in an intimate manner.

On the other hand, the town centre is a better representation of public usage and urban design principles distinctly influence pedestrian behaviour in this context. Although 59% of the township residents use automobiles to traverse to work (Statcan, 2016) owing to the general affluence of the residents, the number of residents using public transport (25%), active transport (14%) and both (2%) are higher than the city average of Montreal. Such increased use of public transit is notable and is a consequence of the town's railway suburb origins as well as the high connectivity offered by public transport networks. The town centre is used by residents to meet their immediate or day to day shopping needs, while the large-scale commercial shopping complexes at the corners of the township are used to conduct bulk shopping, and the residents spend more time there on weekends. Owing to this behaviour, the retail commercial in the town centre witnesses low activity on weekends, except in the sports club. A majority of the residents appear to drive out of the township to other large-scale commercial and recreational activities missing from the town such as malls and cinemas.

Although the residential areas show predominantly recreational walking behaviour, the town centre shows a mix of utilitarian and recreational walking.

3.3 Bois-Franc (A New Urbanist township)

3.3.1 Quantitative factors

3.3.1.1 Background and statistics

In March 1990, Bombardier Real Estate Services was offered a mandate to transform 200 hectares of runway land used by Canadair in Cartierville, northwest of Montreal, into an innovative real estate project. The defunct airport freed up prime land in a very desirable neighbourhood. Inspired by a New Urbanism approach and following a series of comparative studies of similar projects in the U.S. and Europe, the concept for the Bois-Franc residential project was born.

A real estate division called Bombardier Immobilier was set up, with Fred Corriveau acting as its President. He put together a team of experts to develop the Master Plan for Bois-Franc, comprising of Daniel Arbour and Associates and Louis Sauer, an architect and planner from Philadelphia, US. The Client required the Masterplan to accommodate a wide range of market segment and housing types, create a distinct visual image and develop a clear communal identity along with a flexible construction program.

Figure 3.39: Location of Bois Franc, Saint Laurent in Montreal island
(Base image credit: Google Maps, 2018)

Figure 3.40: Bois-Franc - Aerial rendering of concept proposal looking North-West. (Image credit: Sauer, 1994)

Townhouses, rather than detached single family units were to be the dominant housing type, and at least 60% of the area of the property was to be earmarked for private development (Sauer, 1994). While the township was inspired by study trips undertaken to various large-scale townships such as Seaside in Florida, Reston in Virginia, Celebration in Orlando and Savannah in Georgia; local examples such as Plateau Mt.Royal were also used as references (St.Jean & Huot, 2013).

In the late '80s, prevailing development patterns of building dispersed suburban housing and the process of reurbanising cities by destroying older traditional housing, frustrated and united like-minded professional planners, architects, urban designers, and engineers to shape New Urbanism. (Source: CNU website). The movement was formally recognised as New Urbanism in 1993, and it promoted planning values of mixed-use development, transit-oriented development, traditional neighbourhood design, integrating design standards into affordable housing, and designing complete and beautiful streets. Although New Urbanism does not turn its back on the automobile and all of its requirements, it encourages the creation of a harmonious, green and humane environment with an active lifestyle.

The pre-existing runway configuration led to a unique profiled site with a large green space spanning across its length. The commercial centre lies just off its geometric centroid, along the Place des Nations, next to the Bois-Franc Park. The unconventional road network within is neither radial nor concentric but forms a system of loops around green squares that tie back to the four main arterial avenues; namely Alexis-Nihon, Pourier, De Saint-Exupéry and Ernest-Hemingway**.**

The main township is squarish in proportion, sized at 1.6 km wide and 1.66 km deep, bound by Boulevards Henri-Bourassa to the North, Cavendish to the West, Marcel-Laurin to the East and Thimens to the South. However, its long, eastern offshoot is physically disconnected by Boulevard Cavendish, with virtually no walking activity across. For this reason, the present study was limited to this central, undivided area of the township.

The initial Masterplan was to build 10,000 dwelling units to support a population of 20-25,000 persons; however, slow sales in the initial years forced Bombardier to alter the development. The development area was reduced by creating a golf course on 84 hectares of land while the rest of the construction was phased. In June 2002, when the project opened, the number of dwelling units proposed had significantly dropped to 2,400 units. Eventually, the other phases picked up, and the population continued to rise steadily to this date. The aforementioned golf course was shut down in 2012 and was reclaimed for private development, as proposed in the original master plan. The principles of New Ur-

banism govern that the centre of the town should have the highest development density, which then drops off towards the periphery of the township. However, this pattern is not strictly applied in Bois-Franc as Sauer designed the land around the Lakes District to have the highest density, followed by the area along the transportation corridors and then the land surrounding the squares.

The Statistics Canada website offers numbers for the entire borough of Saint Laurent, and not specifically the Bois-Franc township itself. Hence, the demographics listed for Bois-Franc in the realestate website 'nexthome.ca' are considered for this study.

The key statistics of the township are below:

Gross Land Area:	197 Ha. including both Residential and Industrial Zones	
Residential Zone:	163 Ha.	
Industrial Zone:	34 Ha.	
Population:	9,150 persons	
Gross Population density:	4,644 habitants / kilometer squared.	
Residential Mix:		
Single Family Residential:	70 Nos.	1.9%
Semi-detached:	1548 Nos.	4.0%
Town Houses:	1520 Nos.	41.5%
Back-to-back Units:	56 Nos.	1.5%
Multi-family:	737 Nos.	20.1%
Apartments:	1130 Nos.	30.9%
Total Units	3659 Nos.	100%

The average household size is 2.6 persons. Single and two-person households contribute to 55% of Bois-Franc residents. Couples with children at home constitute 53% while single-parent families form 18% of the total residents. Thus, 71% of households have children. In terms of age, 60% of the residents are between the ages of 1 and 44 years of age. Middle-aged and senior citizens form the remaining 40%.

The median household income of Bois-Franc residents is C$ 143,574 versus a median income of C$ 80,712 in the borough of Saint Laurent or C$ 69,228 in Montreal Combined Metropolitan Area (CMA). Thus, the residents of this township have a signifi-

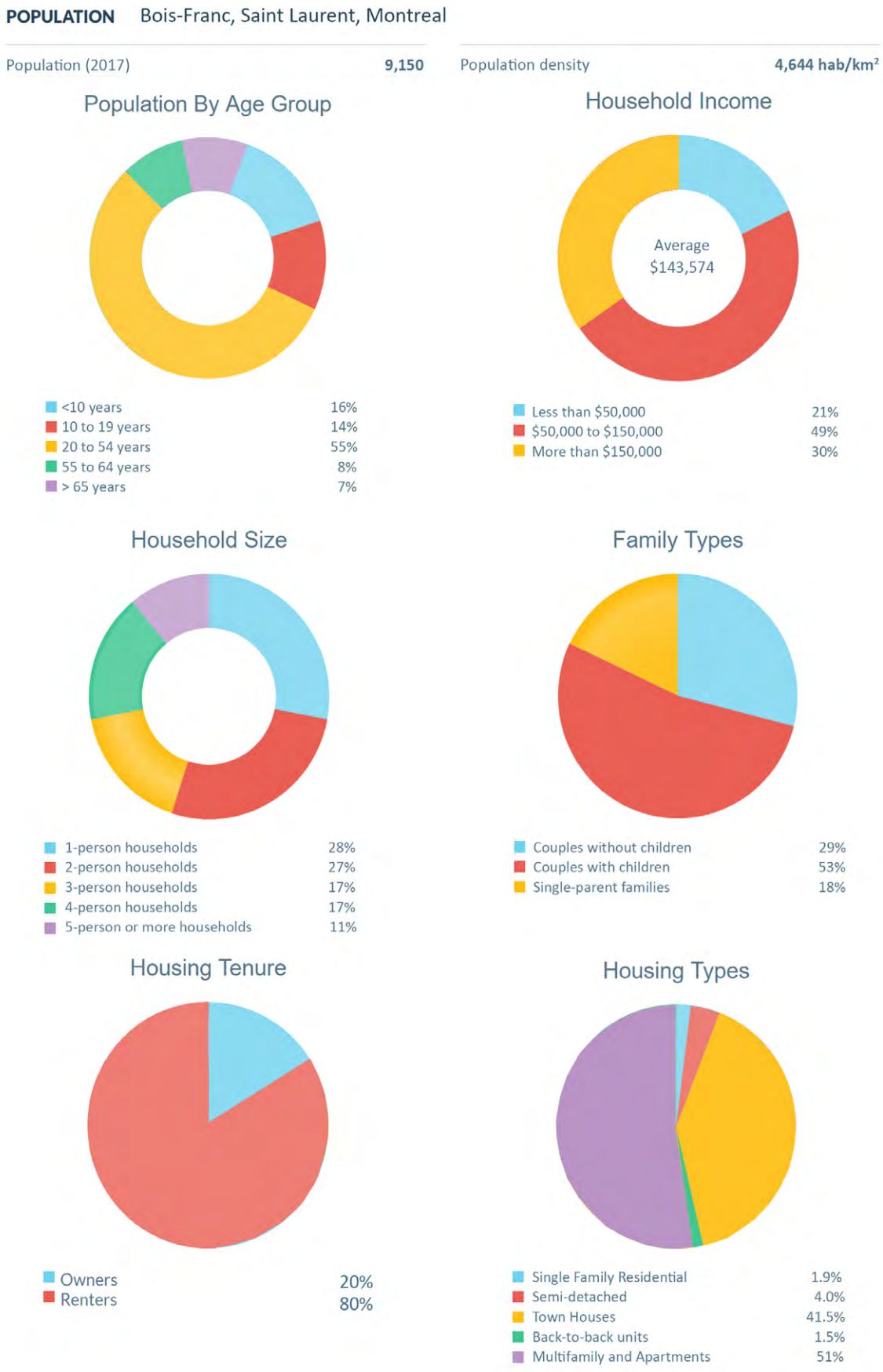


Figure 3.41: Bois-Franc - Key statistics
(Image credit: https://nexthome.ca/new-homes-for-sale/qc/montreal/#neighbourhood-demographics)

cantly higher income profile than the average Montreal resident. Such wealth reflects in both, the size of the housing units as well as the housing tenure as 81% of the residents of this township own their homes. More importantly, increased affluence leads to increased automobile ownership (*Healthy Transport in Developing Cities*, 2009) and is known to result in decreased walkability rates, as is evident with the ample parking garage beneath most residential units.

Bois-Franc was planned around its parks and shared spaces, including the town square and local shops. The notable design initiatives of this township included the elimination of frontal garage doors and for underground parking spaces to be accessed through side entries of the building blocks. Thus, reduced on-street parking and the absence of frontal garage doors on any residence resulted in a street design that slowed down motorists and was pedestrian-friendly.

3.3.1.2 Physical layout and characteristics

In creating the Masterplan for Bois-Franc, Sauer sought to develop parks and squares within the township, like 'rooms within rooms'. The historic quarters of Savannah, Georgia with its genteel courtyards, and Amsterdam with its canals and colourful row houses also served as an inspiration to Sauer. The street pattern is novel and not based on either a simple grid or radial or concentric pattern, but a combination of these.

Place des Nations is the central commercial zone, conveniently located within a 10-minute walk of most residences within the township. A fountain lies at the centre of a

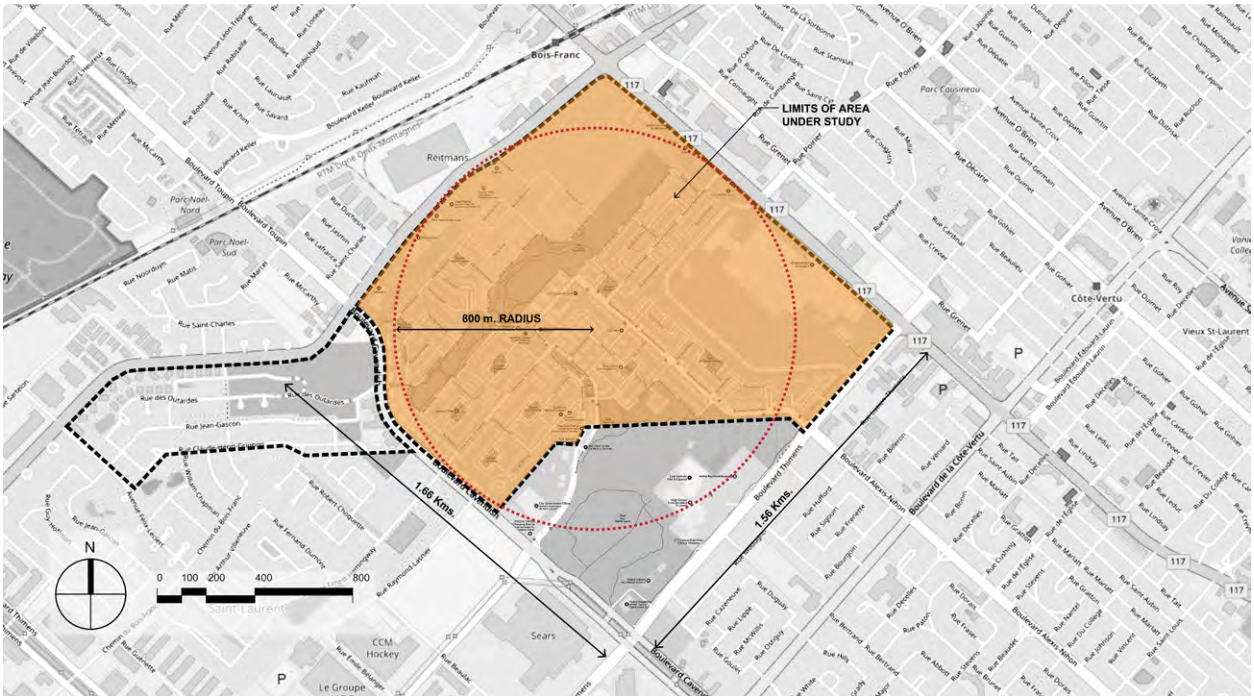


Figure 3.42: Bois-Franc - Limits of area under consideration for current study
(Base image credit: Google Maps, 2018)

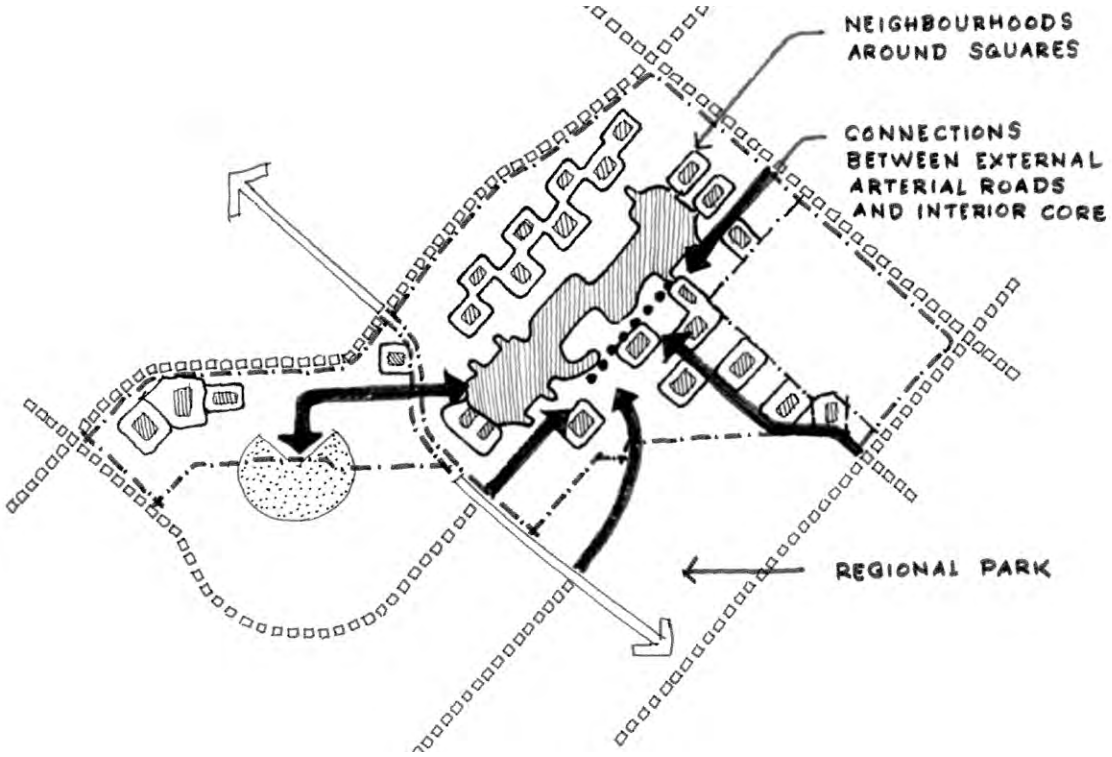


Figure 3.43: Bois-Franc - Concept diagram of neighbourhood squares
(Image credit: Concept sketch by Sauer, 1994; resketched by author)

Figure 3.44: Bois-Franc - Spatial configuration map
(Base Image credit: Google Maps, 2018)

grand European piazza with a look-out tower and commercial retail stores around. The outlets cater to basic needs and include a Café, a pharmacy, a dental clinic, a restaurant, a hair salon and a grocery store. Towards the rear of the Plaza lies the Challenger Reception Hall, which is used by residents to host private functions.

23.9 Ha is allocated to Public parks and 10.5 Ha. to water bodies, forming 12% and 5% of the project area respectively. Sauer identified water as the primary theme for Bois-Franc (Vannelli, 2009). The green spaces are located in eleven separate locations and vary between open green spaces with benches, parks with playground equipment, and small neighbourhood squares. Marcel-Laurin Park, a 4.9 Ha. Regional Park just outside the southern periphery of the township includes all the sporting facilities and an arena.

Buildings are between two and six storeys and have a mandatory frontage setback of 3.0 m from the lot line to ensure continuity of street facades. The original development guidelines do not permit corner stores, buildings over 12 storeys high, habitable areas below ground level and garage doors to be visible from public streets. Also, shingle roofs are mandatory.

3.3.1.3 Land Use mix

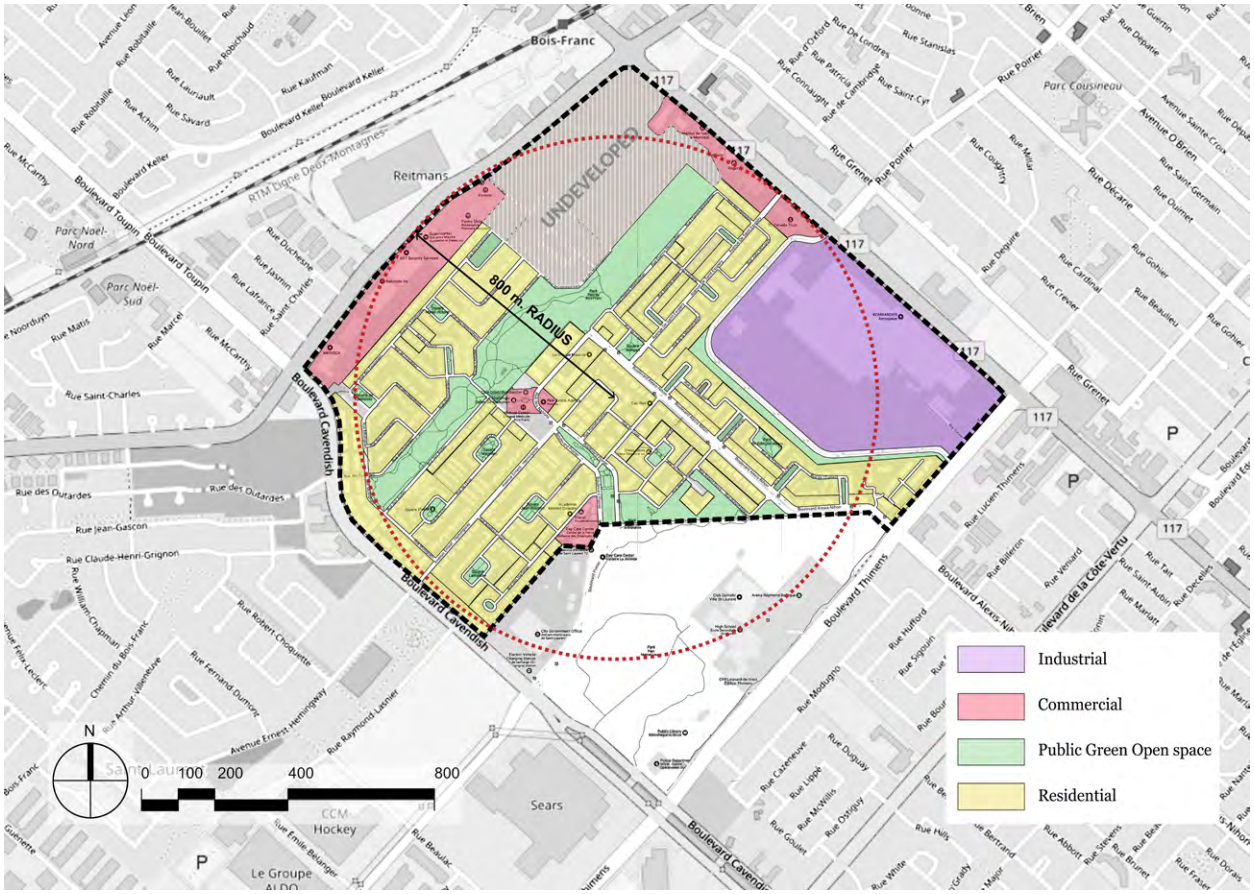


Figure 3.45: Bois-Franc - Current Land uses map
(Base Image credit: Google Maps, 2018)

Bois-Franc includes Residential, Commercial, and Industrial land uses in addition to parks and open spaces. The Residential mix includes Single-family residential, semi-detached units, townhouses, multi-family units, back-to-back units and apartment blocks. Townhouses comprise more than 40% of the total dwelling units. Although the residential clusters are segregated by residential type, their configuration in plan combines them randomly to avoid creating distinct enclaves based on socio-economic class.

The Commercial zone lies along Rue De Nations, at the cusp of the two main Boulevards entering the township - Alexis-Nihon and Pourier respectively. There is no Institutional land use within the township limits. Public facilities such as a district library, a Police station, and a high school are located along Boulevard Thimens, while a Civic office is located along Boulevard Cavendish. Large retail facilities lying to the North, along Boulevards Henri-Bourassa and Marcel-Laurin, are accessed from outside the limits of the township. These arterial roads carry heavy traffic, and in consequence, are not pedestrian-friendly. The principles of New Urbanism strongly advocate mixed-use functions; however, the township of Bois-Franc does not include any mixed land uses.

3.3.1.4 Development Density and residential mix

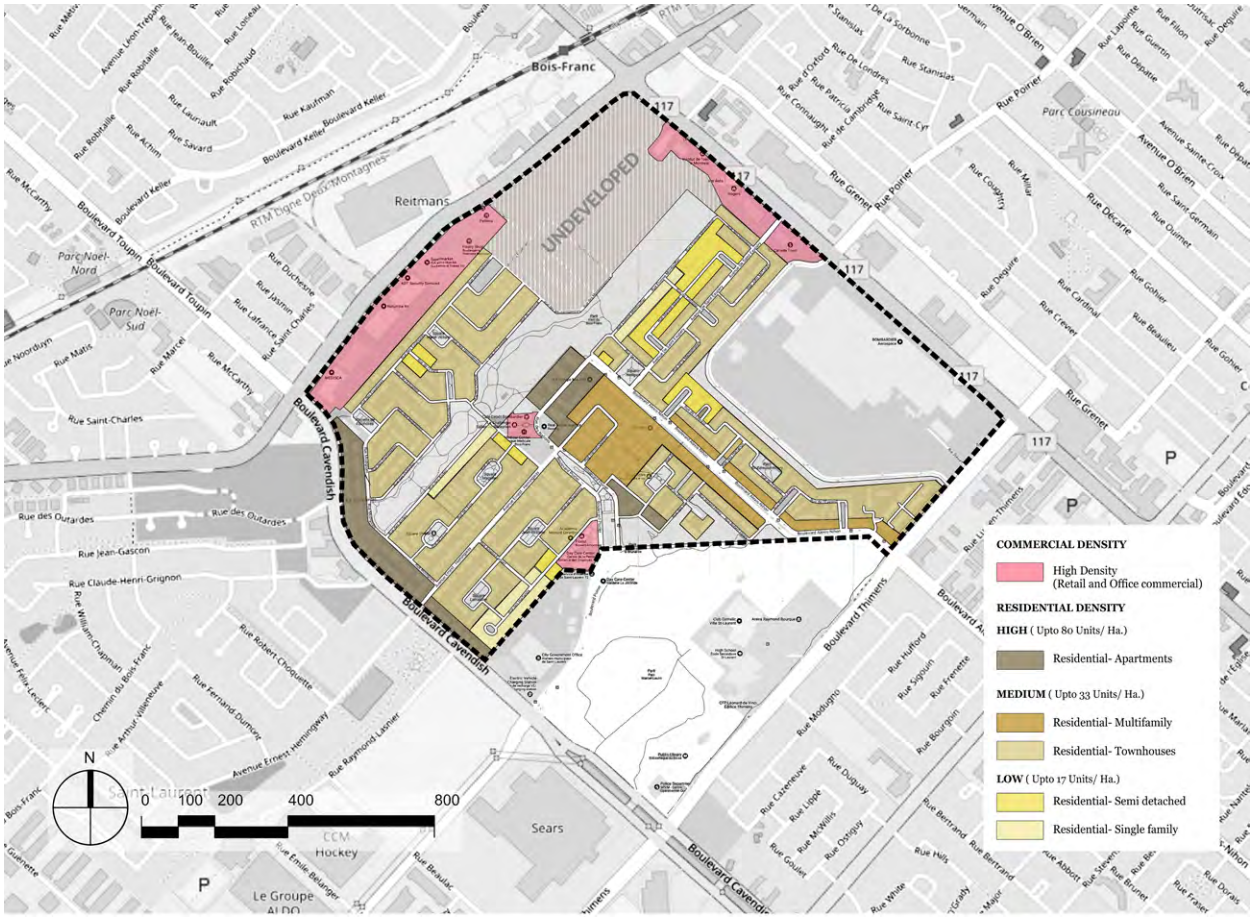


Figure 3.46: Bois-Franc - Residential mix and development densities map
(Base Image credit: Google Maps, 2018)

Regarding population per square kilometre, Bois-Franc is significantly denser than the rest of the borough of Saint Laurent. The increased density is owing to the compact form of development resulting from smaller lot sizes, closely spaced buildings and tighter street sections. Sauer, known as the architect of 'low-rise, high-density housing' (Saggio, 2013) proposed townhouses as the predominant housing component and thus avoided recreating the typical suburban developments comprising detached, single-family dwellings on large lots. Although detached dwellings can be found in Bois-Franc, their numbers are less than 2% of the total number of units. The bulk of the development comprises of semi-detached, row house, and apartment units.

The gross population density has risen from 2,646.4 per sq. km. in the mid-'90's to 4,644 persons per sq. km. today. In response to the upswing in market demand, new retail commercial, apartment buildings, along with townhouses, are proposed in the northern zone of the township and construction continues to this day. Hence, the gross population of the township is set to increase even further after new residents occupy these units.

3.3.1.5 Connectivity analysis

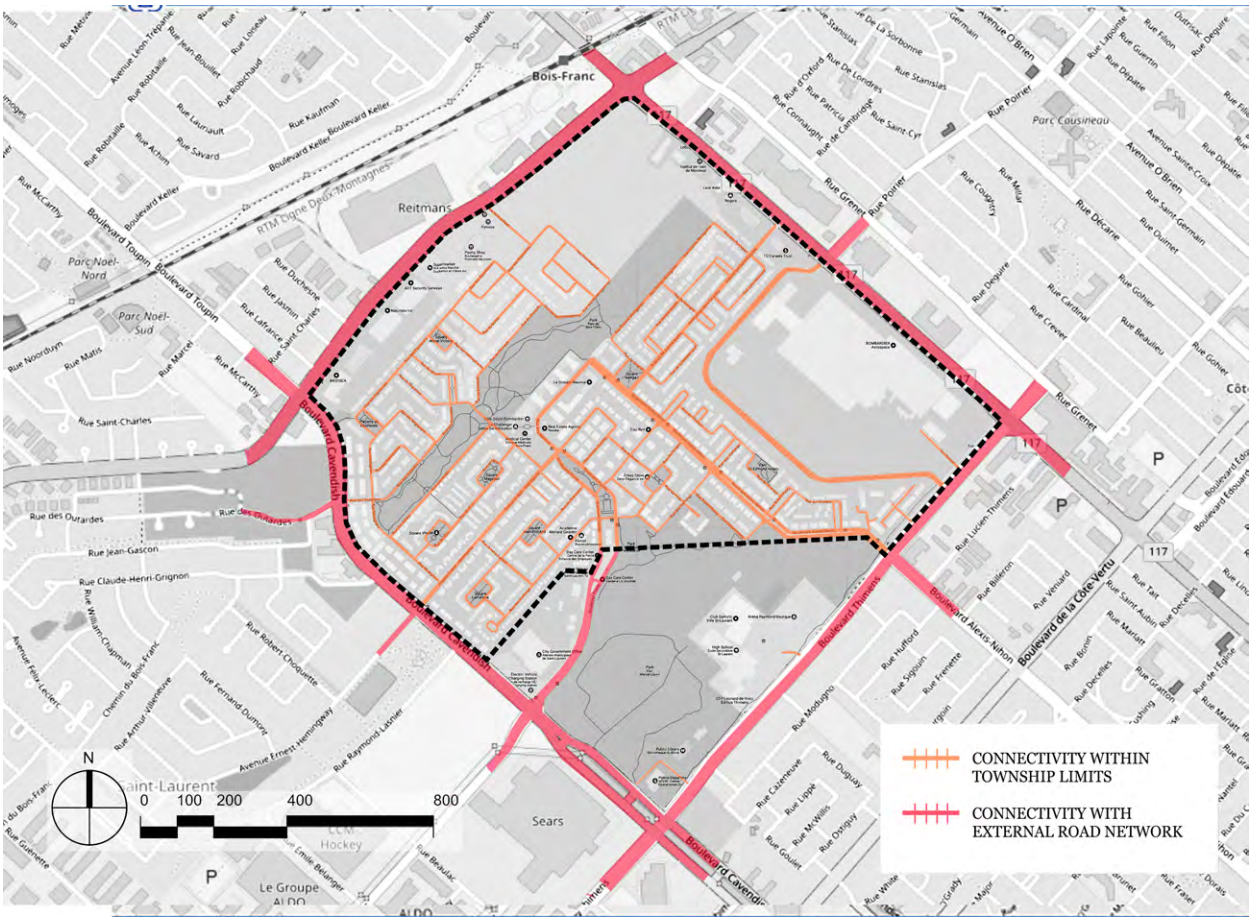


Figure 3.47: Bois-Franc - Road Connectivity and continuity map showing connections between internal and external networks. (Base Image credit: Google Maps, 2018)

Street connectivity is defined as the number of through connections the roads within the township have with the road network outside the town limits. The higher the number of such connections, the higher is the likelihood of witnessing increased pedestrian activity. Since the site was previously an airport, no thoroughfare was envisaged, and roads from the adjacent urban fabric were deliberately disconnected. However, even after the project was taken up for development, the unconventional road network within the township could not be successfully integrated with the existing road network across the site perimeter. This results in significantly less thoroughfare and connectivity across the site boundary. Consequently, the large-scale commercial and the institutional functions along the site periphery are only accessible by first leaving the site and traversing through high traffic arterial roads. For this reason, such areas lie outside the 20-minute walking distance and residents mostly use their cars to reach them.

The six-km perimeter of the area of the town under study has only five numbers of through connections with the internal road network of the town and three simple connections (T junctions) with the peripheral road. Thus, the average distance between such connections is 1.20 km. Such high distance between nodes puts most of these exits out of the 20-minute walking distance and again, is a deterrent to pedestrians.

The streets are set out in an unusual pattern, which makes getting from one street to another like navigating a maze (Semenak, 2009). Although such a street pattern succeeds in segregating larger volumes of traffic from residential enclaves, it discourages thoroughfare and results in the need to traverse longer distances to get from one point to another. Thus, Bois-Franc functions as a predominantly gated community with little of no thoroughfare and most pedestrians within it being residents.

3.3.2 Qualitative factors

Figure 3.48: Bois-Franc - Imageability, Town Centre Aerial view looking South-East
(Credit: Google Maps, 2018)

Figure 3.49: Bois-Franc - Imageability, Residential Townhouses (Credit: www.boisfranc.com, 2018)

Figure 3.50: Bois-Franc - Imageability,'La Grand Place' (Credit: Montreal Gazette)

Figure 3.51: Bois-Franc - Imageability, Residential Townhouses around a square (Credit: Author)

As with the previous study, qualitative factors are known to influence walkability but are not as 'measurable' as the aforementioned quantitative factors.

3.3.2.1 Imageability

Although the building elevations and layouts show some variations, the strict architectural design guidelines in force ensure that the buildings look as if they belong to the same family. Some architectural features such as the steeply pitched roof planes of the top floors in apartment blocks, shingle roofs on all low-rise buildings, the absence of parking garages on building fronts, all reinforce and contribute to a sense of harmony in the underlying design palette. The lookout tower in Place des Nations is a distinctly unique feature and helps orient residents of the township. The presence of large-scale green areas, the unique theme of each green square and the distinctive character of each neighbourhood enhances the memorability and experience of walking within the township. Also, many streets have different types of housing on either side, thus making the pedestrian experience varied and engaging.

Thus, Bois-Franc can be argued to rate 'moderate' or 'medium' for imageability criteria.

3.3.2.2 Enclosure

The term enclosure refers to the height of built forms on either side of pedestrian

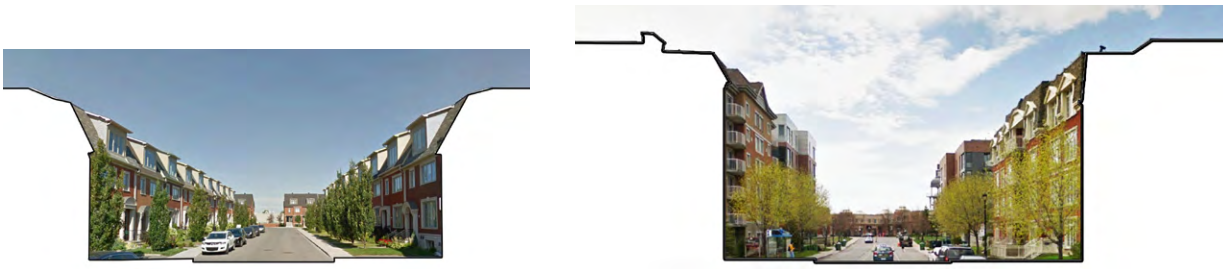


Figure 3.52: Bois-Franc - Enclosure, Typical Residential street (Rue De Migrations, left and Rue des Nations) (Credit: Author)

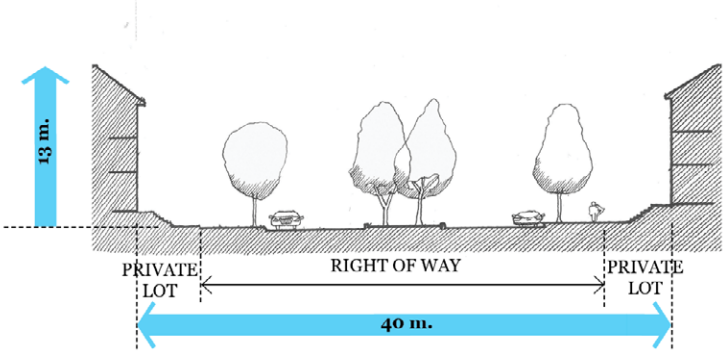


Figure 3.53: Bois-Franc - Enclosure, Sectional proportions Alexis-Nihon (Credit: Author)

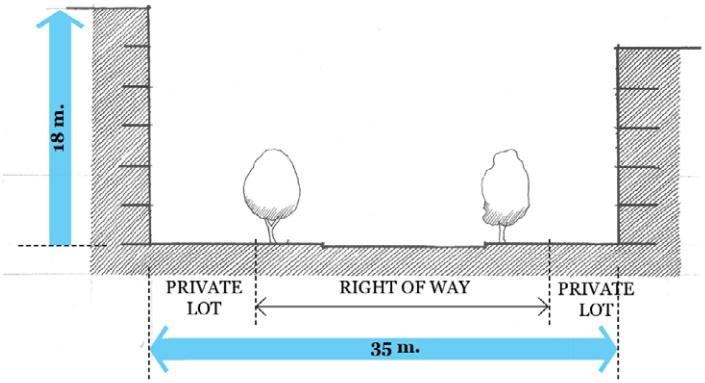


Figure 3.54: Bois-Franc - Enclosure, Sectional proportions Rue De Nations (Credit: Author)

spaces. The recommended ratio of building heights to street width varies between 1:2 to 1:6 (A. B. Jacobs, 1993). It is noteworthy that the ratios proposed by Sauer in Bois-Franc all fell within this range. His design intent of having tighter street spaces and a controlled facade line gives a strong sense of directionality and enclosure. The main Boulevard Alexis-Nihon has a ratio of 1:3, while Rue De Nations, close to Place des Nations, has 1:1.94 and a typical residential street with townhouses on either side has 1: 2.72. Based on the pedestrian experience within the township and the conformance of enclosure ratios to values defined by previous research, Bois-Franc scores high on enclosure criteria.

3.3.2.3 Human scale

There seems to be a consensus in previous research that any building over four

Figure 3.55: Bois-Franc - Human scale, Town Centre commercial (Credit: Author)

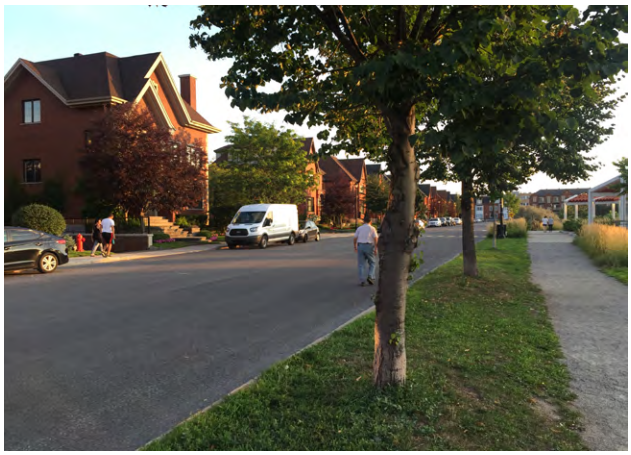


Figure 3.56: Bois-Franc - Human scale, Rue de Andes (Credit: Author)

Figure 3.57: Bois-Franc - Human scale, Townhouses at Rue de l'Ecu (Credit: Author)

Figure 3.58: Bois-Franc - Human scale, Fountain at Rue de l'Ecu (Credit: Author)

storeys height does not conform to human scale. While most of the built forms in Bois-Franc are between two and four storeys, the tallest buildings, i.e., the Apartment blocks are six storeys in height. Although these are limited in number and tighter street sections are associated with them to enhance the sense of enclosure, they still do not relate to the human scale. However, the garden squares and the spaces between the three-storey residences successfully create intimate spaces for the residents to traverse, interact and unwind. Residents have repeatedly stated that they appreciate the cosy, residential atmosphere with a park just outside their home (Semenak, 2009) that encourages them to enjoy the outdoors and to socialise with their neighbours.

Most of the built form in the township averages around three storeys in height, thus Bois-Franc rates high for having an environment scaled to human proportions.

3.3.2.4 Transparency

It is important to note that the Commercial zone within Bois-Franc is not directly abutting an arterial road but is set back from the street around a plaza. Also, this com-

Figure 3.59: Bois-Franc - Transparency, Town Centre commercial (over 48% glazed store fronts (Credit: Author)

Figure 3.60: Bois-Franc - Transparency, Residential - Townhouses (Less glazing) (Credit: Author)

Figure 3.61: Bois-Franc - Transparency, Modern Apartments Rue de Nations (Credit: Author)

Figure 3.62: Bois-Franc - Transparency, Older Apartments Rue de Nations (Credit: Author)

mercial zone is distinct and a separate enclave – without any immediate adjacency to residential. An average of 48% of the façade is transparent between the Ground and the first floors of the Commercial buildings. The high level of transparency in the façade ensures visibility to all the activities conducted in the buildings around the plaza. The seating and signage that spill into the plaza further contribute to the transparency of the commercial buildings and seamlessly blend indoors and outdoors in good weather. For obvious reasons of privacy, the residential units and townhouses rank low on the transparency scale. Although there is less use of vegetation for screening, the low glazed surface area in residential units contributes to a higher sense of privacy. Some residential apartment buildings have common lobbies and lounges along their facades, and such areas are entirely

glazed and thus, visually open to the road.

Thus, the Commercial zone ranks high while the residential zone scores low on the transparency scale.

3.3.2.5 Complexity

While strict architectural controls in Bois-Franc ensure that all building elements and fenestration appear harmonious, the variety that would naturally occur in a township that grows organically over time is missing. The result today certainly looks coordinated; however, the complexity of buildings is compromised, and they appear in some ways monotonous. Although the most recently developed built forms in the township bear a

Figure 3.63: Bois-Franc - Complexity, Aerial view looking North-West
(Credit: Bois Franc website)

Figure 3.64: Bois-Franc - Complexity, Rue des Nations
(Credit: Author)

Figure 3.65: Bois-Franc - Complexity, Rue de l'Ecu
(Credit: Author)

modern appearance, there is still not much complexity amongst the buildings when they are seen juxtaposed together with the older parts of the township. And although it binds the township together, in terms of the colour palette, the consistently visible taupe and brown-beige combinations in residential and commercial zones appear monotonous.

Given the low overall variety and predictable nature of built forms in Bois-Franc, it ranks low for built form complexity.

3.3.3 GPS Based data sources – Strava Labs and Walk Score

The Strava Labs heat map for Bois-Franc shows the highest pedestrian traffic along Boulevard Cavendish. Similarly, high traffic is also shown along Boulevard Alexis-Nihon from the South East side to the Avenue Ernest Hemingway along the South West. Such traffic was seen extending from Parc Saint-Laurent up to Parc Philippe-Laheurte, while the secondary roads, along this primary route, showed a markedly lower number of users.

The residential enclaves with Parks at their centre indicated virtually no pedestrian traffic. This pattern shows not only that the segregation intended in the original concept works, but also that fewer people walk to and from their homes. There is also neg-

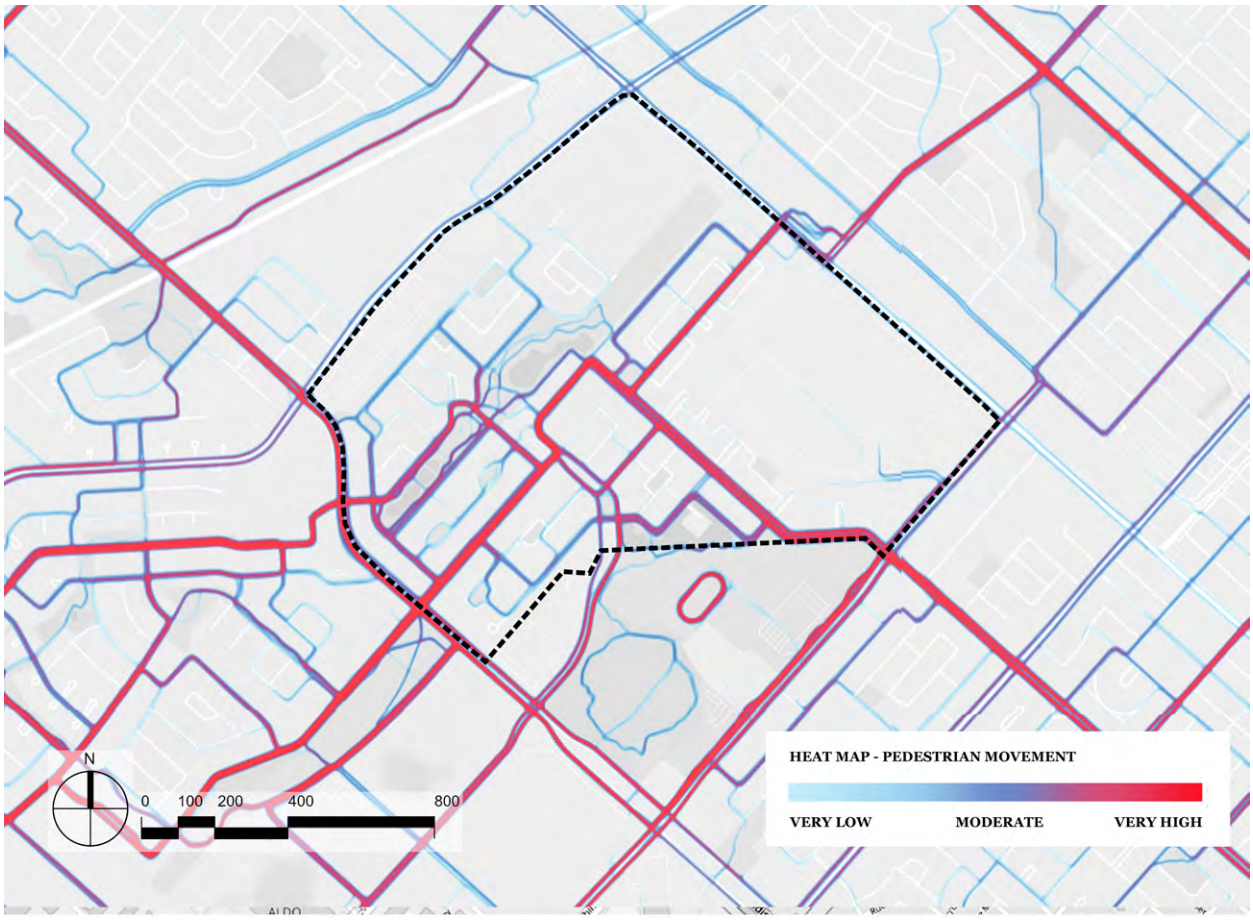


Figure 3.66: Bois Franc - Strava Labs Heat map
(Base Image credit: Strava Labs, 2018)

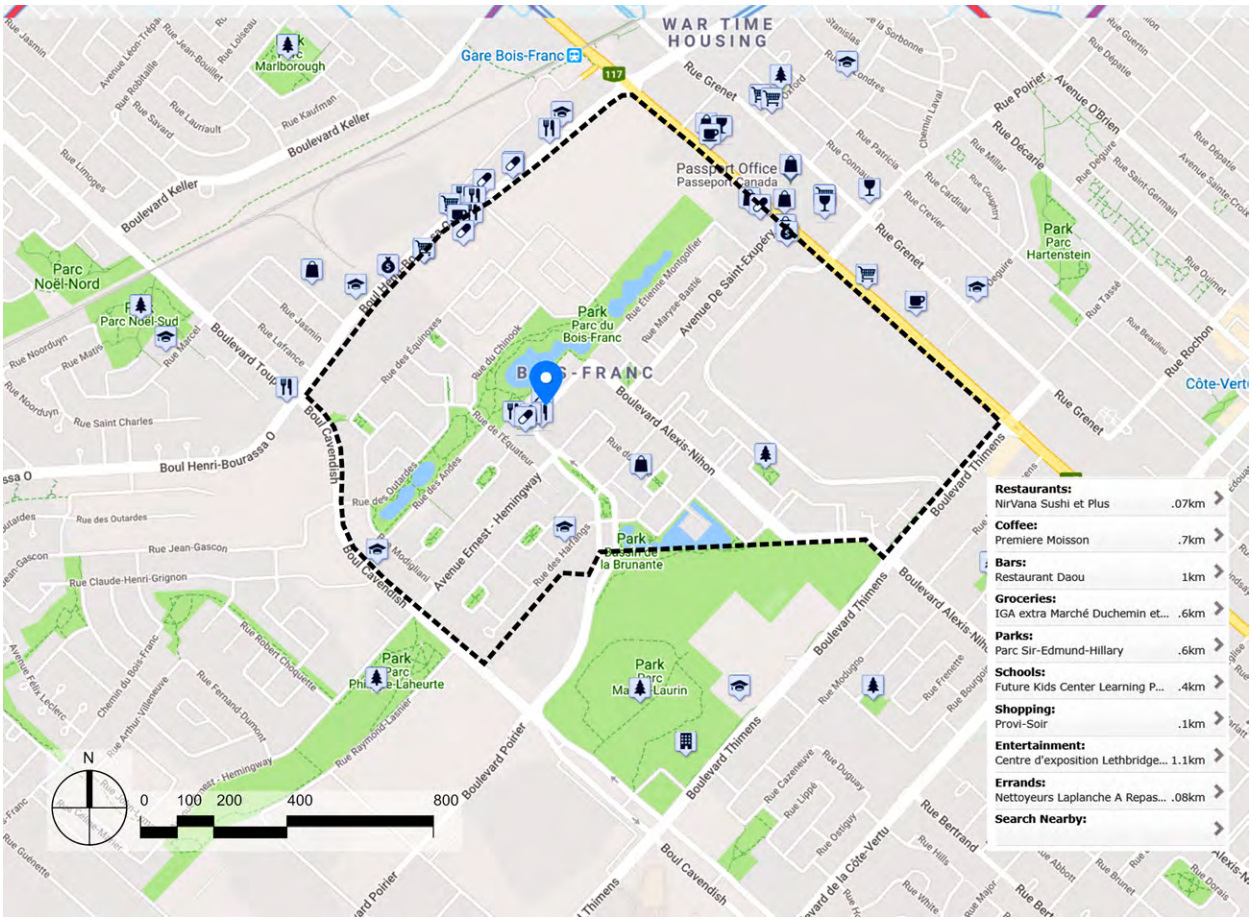


Figure 3.67: Bois Franc - Walkscore map
(Base Image credit: Walkscore, 2018)

ligible traffic from the township to Gare Bois-Franc, owing both to the significant walking distance involved and the presence of a high traffic corridor (Boulevard Henri-Bourassa Ouest) between the township and the train station. On the other hand, some pedestrian traffic is seen from within the township to the periphery, perhaps as the Autobus network is strongest along the perimeter of the township. Given the absence of a Metro station close by, the Autobus is likely to be the preferred mode of public transportation. The nearest Metro station is a terminus (Côte-Vertu), which is also served by the bus network from within and the periphery of the township.

Both parks, Park Du Bois-Franc within the township and Parc Marcel-Laurin on its periphery, show noteworthy traffic indicating that they are patronised well. However, given the scale of these parks, such cannot be attributed solely to the residents of Bois-Franc alone and is likely to include residents of adjacent communities.

The Walk score index of the peripheral areas of Bois-Franc is very high at 84, considering the proximity to most amenities and the train station located to the North. However, the index drops off sharply for addresses situated deep within the township. For example, at Place des Nations, the score stands at 56 – which is poor and even lower than

the Montreal average. Thus, the lack of amenities and low inner core connectivity of the township significantly lowers the overall score.

The data from Walk score shows that all the amenities within the township are within the 800 m. walking distance, except for the closest entertainment options which are available at 1.1 km from the centre of the town. Additionally, the map also shows that most of the amenities are to the North-east and North-west of the township, while the ones in the town centre at Place des Nations only serve basic needs. Many of the amenities in the north lie across Boulevard Henri-Bourassa and Boulevard Marcel-Laurin. If this data is read along with the heat map from Strava Labs, it appears that very few pedestrians cross these arterial roads to access amenities across them, thus implying the increased use of cars. But this pattern does not seem to recur along the south-eastern and south-western roads, as a larger volume of pedestrian traffic is seen in these areas. This observation could also be explained by the fact that the northern part of the site is under construction and may be currently off-limits to pedestrians. Hence, this behaviour needs to be re-studied upon the completion of development in the northern quarter.

3.3.4 Field Observations and maps

Similar to the case study of Town Mount Royal, observations were conducted in the summer months of May and June and in two primary areas, namely: the town centre at Place des Nations and the residential area immediately beyond within a 200 m radius around the town centre. The general trends observed per study period are listed below.

Mornings (7:30 am to 9:30 am):

Residents travelling to their workplaces walked from their residential pockets either onto the main streets of the township or to those on the periphery to reach the closest public transportation network available (Autobuses). A small number of residents of Bois-Franc appeared to cross Boulevard Henri-Bourassa to access the AMT train station.

Figure 3.68: Bois Franc - Ongoing construction along Parc Bois-Franc North end
(Image Credit: Author)

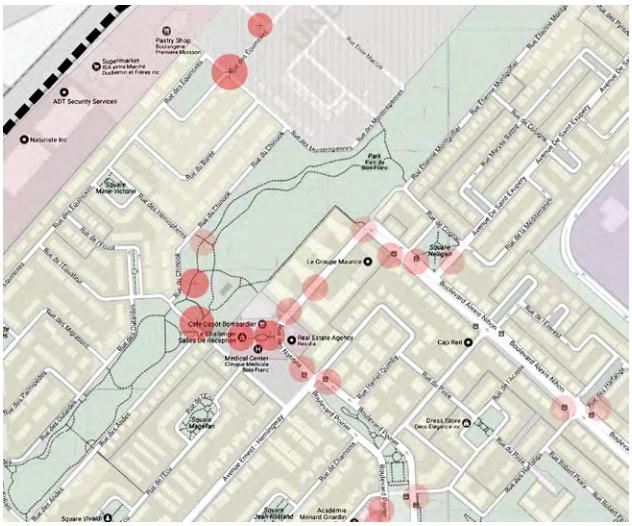


Figure 3.69: Bois-Franc - Pedestrian concentrations, Morning (Credit: Author)

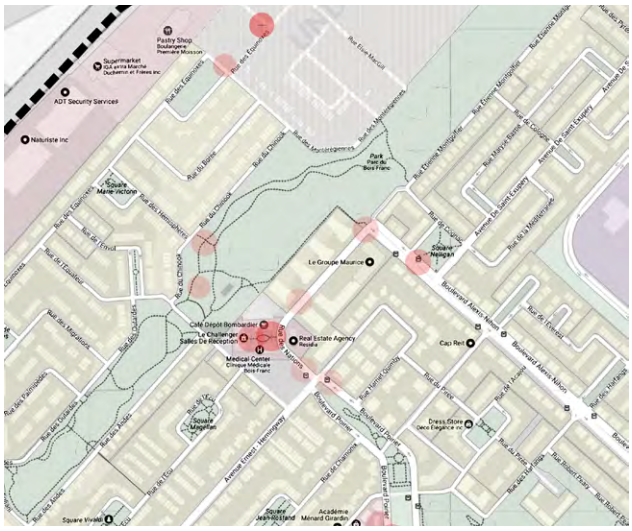


Figure 3.70: Bois-Franc - Pedestrian concentrations, Afternoon (Credit: Author)

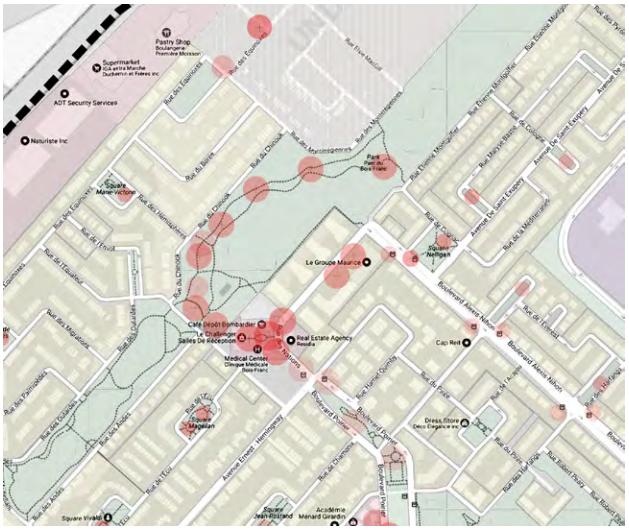


Figure 3.71: Bois-Franc - Pedestrian concentrations, Evening (Credit: Author)

The AMT trains take 20 minutes to reach Gare Centrale and run in the direction of Montreal downtown at a frequency of 30 minutes during peak hours and 80 minutes during off-peak hours. For this reason, residents may have preferred Autobuses for their commute, as they offer more destination flexibility and run at a frequency of 10 minutes and 30 minutes at peak and off-peak hours, respectively. A small number of the school kids were seen walking through Marcel-Laurin Park to the Secondary school located across it. There was no activity seen in the Park squares, as everyone seemed to be in a rush to get to their destination. Senior citizens, leisure walkers, dog walkers and joggers were divided between Parc Bois-Fran and Marcel-Laurin Park, but Marcel-Laurin Park appeared to draw more visitors. This could be attributed to either the larger size of the Marcel-Laurin Park or the ongoing construction activity along Parc Bois-Franc driving residents away from it.

Afternoons (12:30 pm to 2:30 pm):

Between all observations, the least pedestrian traffic was observed in this time interval. A few residents departed or arrived by the Autobuses and walked to or from their residences. No pedestrian traffic was observed to and from the AMT station. Senior Citizen groups gathered in Place des Nations for refreshments, and a few young adults were seen around in the Café's, grocery stores, a coiffure salon, pharmacy and a clinic. The Car Park areas next to the Place des Nations was nearly empty, indi-

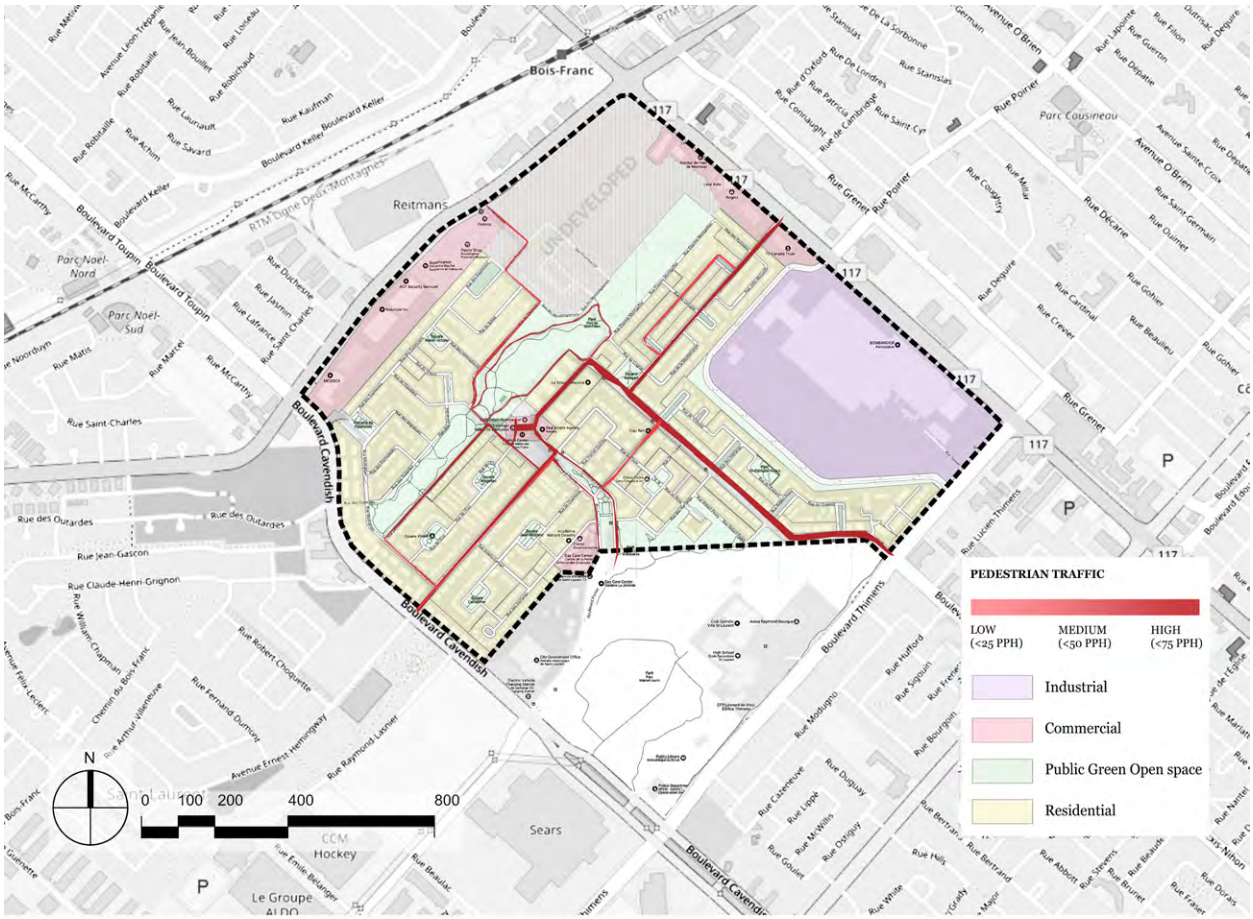


Figure 3.72: Bois-Franc - Aggregated Pedestrian concentrations in areas of study (Credit: Author)

cating everybody seen in the Plaza ad commercial zone was likely to have walked there. Practically nobody appeared to use either the Bois-Franc park or the Park squares post noon, except for a few young mothers and young adults.

Evenings (5:30 pm to 7:30 pm):

Figure 3.73: Bois-Franc - Pedestrians Boulevard Poirier (Credit: Author)

Figure 3.74: Bois-Franc - Pedestrians Croix Lombard (Credit: Author)

Pedestrians appeared to be most active during this time interval, with the highest numbers observed between 6 to 6:30 pm. Most young residents, using public transport, returned from their workplaces by the Autobus, while a few returned by train. The low numbers of middle-aged and senior residents seen using public transport points to the fact that these age groups prefered personal automobiles. A spurt was observed in the number of walkers, joggers and dog walkers indicating this to be the preferred time for recreational walking. A significant number of senior citizens were seen in the Park Bois-Franc and Place des Nations reading books, socialising or having refreshments. The adjacent parking lots were close to full capacity. The usage of Park squares also was highest in the evening hours with patrons likely to be from the immediate vicinity. Even in terms of automobiles, less through traffic was observed. On both the weekends that field observations were conducted, there was at least one social event on each evening at the Challenger Hall and residents, dressed in their finery, appeared to attend them. A few residents were seen walking to and from the Sports facilities and Library located around Parc Marcel-Laurin.

3.3.5 Summary

The concept of having an unconventional road network for Bois-Franc with a large park within the township serves its residents well. The residents appear to love the proximity of the Park square to their homes and seemed to use it to interact with other residents. It remained empty for the most part of the day, but young children and their mothers were observed using it in the evenings and even more so on weekends. The concept of 'eyes on the street', with direct sightlines to the park from each home, enhances the sense of the park being a safe space.

There are no institutional or mixed-use zones within the township. New Urbanism advocates the provision of mixed-use land use as well as the mixing of various housing types. The development at Bois-Franc does not comply with either of these aspects. The retail commercial within the township caters to fairly basic needs. The large-scale commercial zone along the Northern corner is not accessible from within the township, and residents need to exit the limits of the township to access these. Such roads carry heavy vehicular traffic and act as a deterrent to pedestrians, thus encouraging residents to use personal automobiles to access these areas. The same logic applies to the Institutional and civic uses aligned to the South of the township. The AMT railway station too lies outside the 20-minute walking distance, thus discouraging pedestrians.

The minuscule number of detached and semi-detached units (<2%) and the high number of apartment buildings (>30%) result in a reasonable tenement density of 4,644 units per sq.km. Since it was designed as a private township, Bois-Franc's planners did

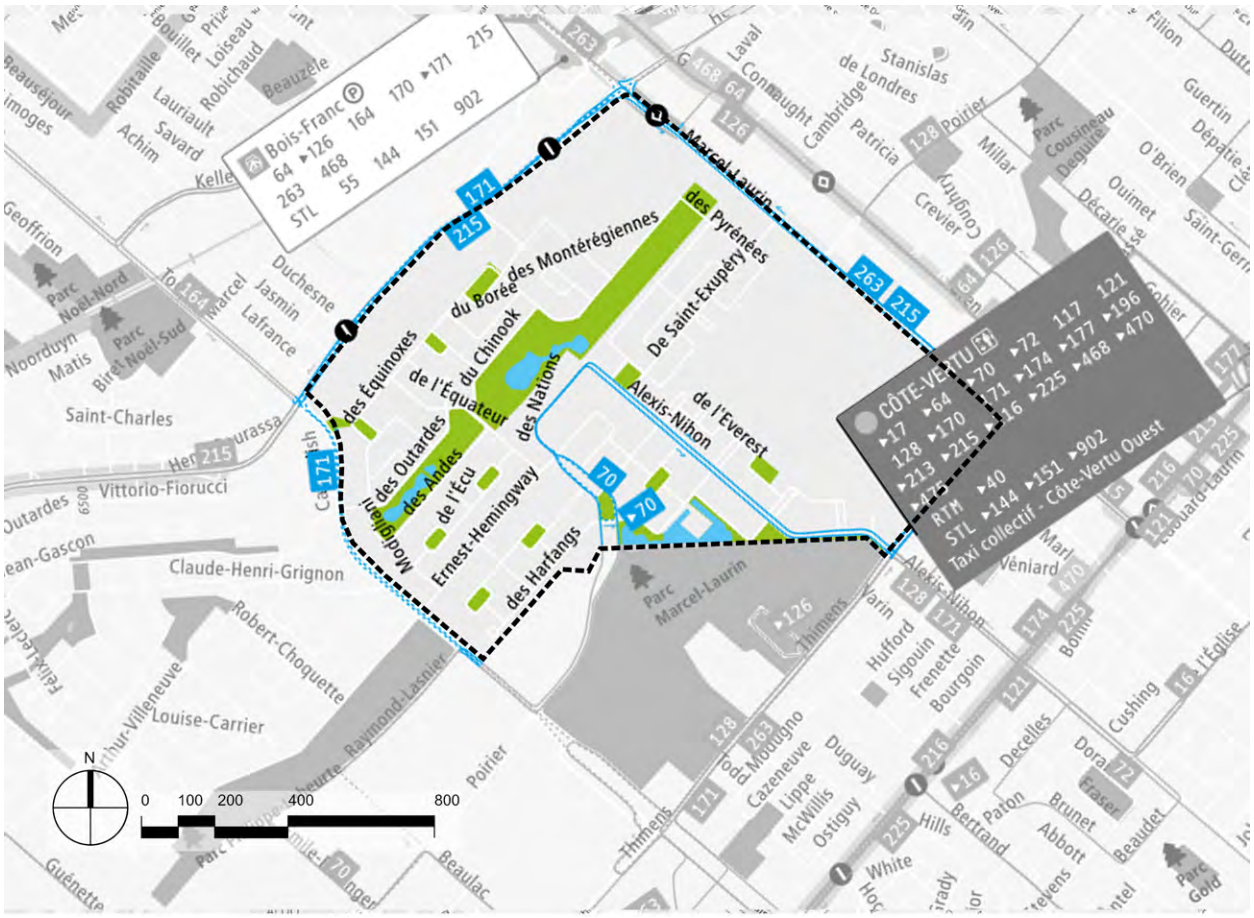


Figure 3.75: Bois Franc - Public Transportation network connectivity (Credit: Author)

not make an effort to blend it with its adjacent neighbourhoods. So, despite its novel internal road network, its connectivity with the road grid outside its borders remained weak. While the architectural guidelines of the town enhance the sense of harmony with common design elements and a coordinated colour palette, the aspects of imageability and complexity remain compromised. The tight streets and the shallow front setbacks create a good sense of enclosure and human-scaled spaces throughout the township. The moderately high transparency of the facades in the Place des Nations quickly drops off in the private residential enclaves, for reasons of privacy.

The Strava Labs heat map shows how active traffic is effectively cut-off to the Northern parts of the town, while the Walk Score map shows that the central area of the township is just over the 10-minute walking distance from the commercial zones at its fringes. The location of the AMT train station exceeds the 10-minute walking distance, and the average resident would take longer to walk there than the time taken to commute by train from Gare Bois-Franc to Gare Centrale (20 minutes). This fact, combined with the additional wait time for the train itself, is the likely reason for a lesser number of residents choosing the AMT network. And, despite the limited route choice offered by the Autobus routes, it still remained the preferred mode of public transportation.

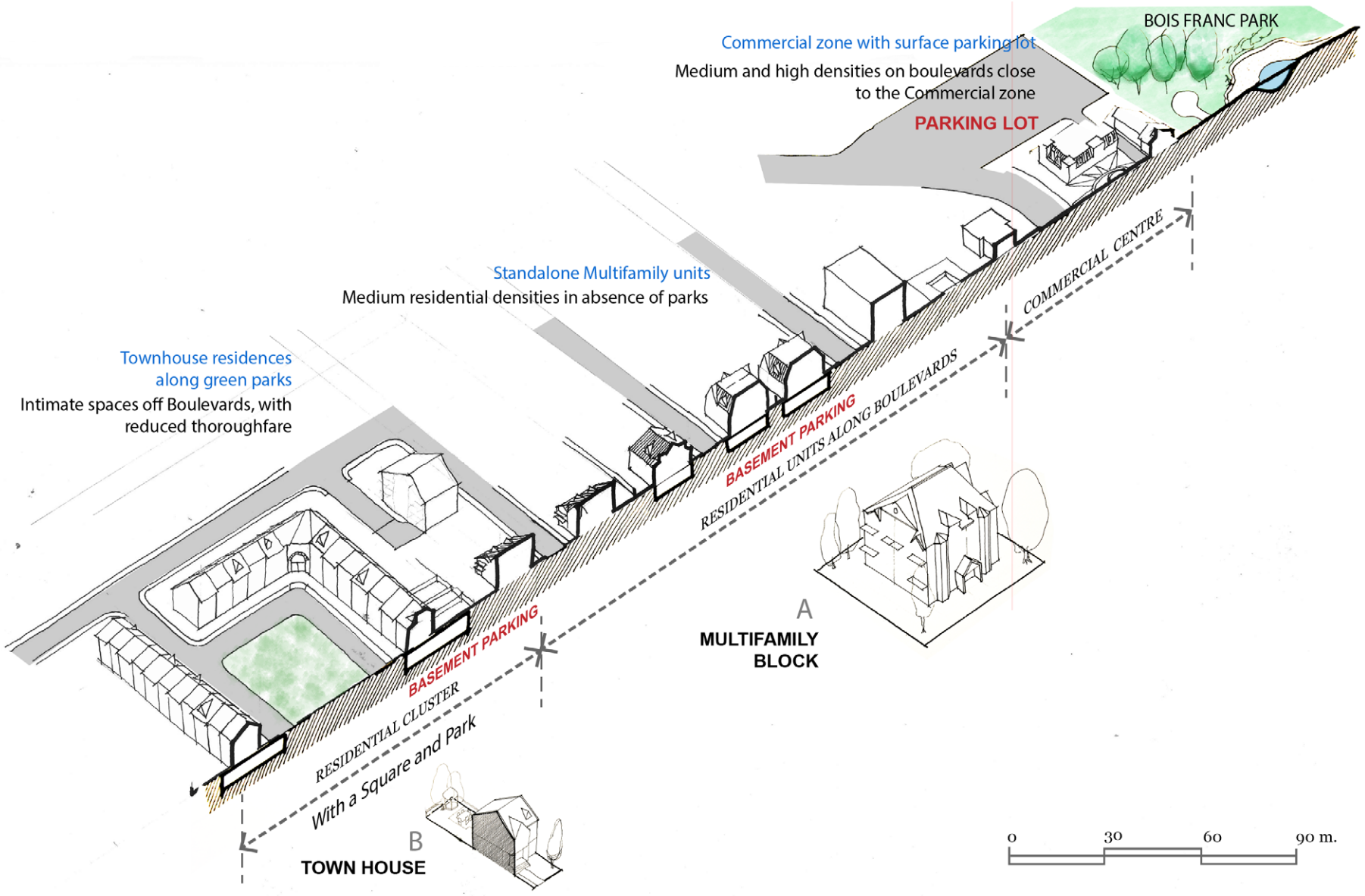


Figure 3.76: Bois Franc - Transect and hierarchy of spaces (Credit: Author)

Since Bois-Franc was developed long after the automobile boom occurred in the ’60s, it is characterised by the presence of large, common parking garages under residential buildings and open parking lots next to retail commercial units within the town. A high presence of cars and car usage was seen in the township, which is a likely consequence of the high median income of its residents. 73.9% of the residents use their private cars to work (Statcan, 2016) while all other modes combined (walking, public transport, bicycle) only add up to 26.1%.

In the residential areas around the garden squares, the residents use public spaces in a personalised way, in a more intimate manner, resulting in pedestrian traffic counts below the thresholds of observation. The low pedestrian numbers, coupled with diffused sporadic usage patterns as well as the methodology used, made it harder to document concentrations of pedestrians on field observation maps. The private home and its precinct constitute a local domain, where public space usage is influenced by social relationships between neighbours and concerns of safety and privacy, rather than qualitative factors of urban design listed before (such as transparency, imageability, etc.). The original concept of segregating residential enclaves from other vehicular traffic works very well, as traffic along internal parks is both, low in volume and speed.

Parc Bois-Franc and Place des Nations act as the predominant gathering spaces for the township which are used well all through the week and on weekends. The large scale commercial and institutional uses outside the township seem to draw away residents from the township and are mostly accessed by automobiles. The Industrial land used by Bombardier is an island in itself with a road network around its periphery that disconnects it entirely from its surroundings.

In summation, the semi-isolated township, with its train station and commercial facilities out of walking distance for the main bulk of the residents, leads to increased private automobile use.

Chapter 4

4 Synthesis and recommendations

4.1 Synthesis

Knowing that the principles of New Urbanism were derived from TND's, this research looked at how walkability worked in a New Urbanist Town and a TND. Studying walking behaviour in suburban conditions was challenging since the numbers of pedestrians observed are significantly lower than those found in downtown environments. Hence, the term 'more' or 'less' pedestrians is relative to the numbers generally observed in such environments.

Such differences relate to their sizes, spatial organisation, road networks, the hierarchy of built and unbuilt spaces, development density and land use organisation. Given such differences, the field studies reveal marginally higher pedestrian behaviour in TMR, for a variety of reasons.

At face value, it would be challenging to study or correlate projects together when they were built 80 years apart, embodied different values and approaches to urban design. However, TMR and Bois-Franc were both developed as special townships by private corporations to respond to specific needs, were based on sound concepts and planning principles and both used green spaces strategically at the core of their planning unit. As of this date, these projects also shared a similar resident demographic profile and were committed to preserving the original vision of their planners, and yet they were based on distinctly different design concepts. Thoroughfare beyond a project's boundaries is known to contribute largely to walking behaviour (Ng et al., 2015), and while both townships have different porosities along their periphery, they undoubtedly remain gated and exclusive communities.

Alfonzo (2005) states that safety, comfort, and pleasure—influence decisions to walk only after more basic needs of feasibility (e.g., an individual's ability) and accessibility (e.g., somewhere to go) are met. It would be safe to say that both townships offered adequate pedestrian infrastructure and equally satisfied concerns of safety, comfort and pleasure. Both townships had sidewalks that were physically segregated from high-speed traffic, comfortable to walk on with large shaded stretches and were equally pleasing in either a good or bad sense. These aspects, which are known to be critical to foster a walkable environment, were reasonably satisfied in both townships and were thus not investigated in-depth as a part of this research endeavour.

4.1.1 Analysis of observations

In an overarching sense, the literature review and primary observations conducted

in either township can be synthesised across different concerns as below.

4.1.1.1 Physical layout and characteristics

Both the townships had different scales, with the residential zone in TMR being 2.7 times larger in area than the main contiguous area of Bois-Franc and yet, the population in TMR was only twice that of Bois-Franc. Thus, at the time of this study, Bois-Franc clearly had a higher population density between the two townships.

In terms of physical characteristics, both townships have different design layouts and spatial configurations. The field studies showed that the configuration of the town, and in particular the street grid, critically impacted the number of pedestrians. The union jack configuration of TMR offered the right mix of activities with a transit node, a commercial zone and sports hub at its centre. Despite its low overall development density, such a diverse activity hub at the geometric centre of the township, equidistant from all corners, is what likely drew more pedestrians in TMR. In comparison, despite its innovative layout, Bois-Franc did not show the same level of pedestrian activity, perhaps owing to its unconventional and discontinuous street grid. Also, the connectivity of the internal street network of TMR with the road networks of the surrounding urban fabric encouraged thoroughfare resulting in increased pedestrian activity. In summation, the physical configuration of the township and street connectivity were crucial quantitative factors that appeared to draw pedestrians.

4.1.1.2 Land use, development densities and road connectivity

Despite its relatively large size, the land use distribution of TMR is better suited for pedestrians since each part of the township has its residences, green space, transit node, retail commercial and schools within a 800m walking distance. In Bois-France, each neighbourhood has its green space, but utilitarian necessities such as public transit node, convenience retail and schools are not equidistant from all parts of the township and hence not accessible by walking. For this reason, more recreational walking behaviour was observed in Bois-Franc, unlike TMR where both utilitarian and recreational walking were seen.

The need for mixed land use is repeatedly stated in different studies (Benfield, 2012; Lerman & Omer, 2016; “What is New Urbanism,” n.d.) and is undoubtedly an essential factor to encourage walkability. However, neither TMR or Bois-Franc have mixed land uses and yet are more walkable in comparison to the average neighbourhood in the Montreal CMA. Hence, in the context of this study and the observations conducted in the townships, no bearing of mixed land use could be associated with walking behaviour.

Bois-France did not implement transect principles prescribed by the theory of New

Urbanism in the real sense; hence no decreasing trend of development density is apparent from its town center. In TMR, the gradation of development density is clearly visible when traversing from its town centre to the periphery of the township and this works very effectively with the transit node located at its centre. In theory, higher population densities are associated with increased pedestrian activity. Although the population density in Bois-Franc is twice that of TMR, Bois-Franc still showed decreased activity in relation to TMR. Hence, the population density, in isolation, did not prove to be a conclusive indicator of walkability.

Since TMR was not designed for automobiles, its lack of parking spaces and its excellent public transport network connectivity contributes to lesser automobile use by its residents. In the case of Bois-Franc, with convenience retail at the limit of comfortable walking distance, ample provision of parking lots, and relatively poor public transport connectivity, resulted in its residents showing increased automobile use.

Street connectivity was markedly better in TMR, owing to its overlay of two grids. This results in its residents being able to walk from any corner of the township to any other corner in any number of permutations and combinations. Yet, the segregation from mainstream traffic was well achieved, and such traffic appeared to be predominantly restricted to the diagonal boulevards. Although Bois-Franc also appeared to segregate its high volume traffic from pedestrians, its loop-like road network leads many of its residents to find it confusing to walk through the township (Semenak, 2009). This could be another contributing factor to the low number of pedestrians observed.

It is worth mentioning here that both the projects studied were virtual gated communities, and the pedestrians within these townships were most likely to be residents since thoroughfare was highly improbable.

4.1.1.3 Qualitative factors

TMR performed better than Bois-Franc in achieving imageability and complexity, while the sense of enclosure was better achieved in the streets of Bois-Franc. The spaces in both townships responded very well to the human scale and achieved similar transparency in their commercial centres. Based on observational data, the Ewing-Handy factors - of imageability, enclosure, human scale, transparency, and complexity - remained relevant to the town centre but appeared to have very little influence on the residential zones of these suburban environments. This outcome could be attributed to the fact the Ewing & Handy (2009) studies were conducted in the urban context, where the impact on walkability was very high. But in the suburban setting of this research, while they remained relevant, such factors seemed to play a less critical role in impacting walkability.

4.1.1.4 GPS based data sources

Pedestrians attract pedestrians. Even though GPS data aggregating websites represent people who not just walk but also cycle and run, the data from such sites remain relevant. This is because the reasons for route choice (safety, comfort and pleasure or engagement) fundamentally stay the same for any user choosing active transportation. In a broader sense, such data still represents preferred pathways and higher activity routes. Thus, even with their limited relevance to the project, both the GPS based sources, namely Walk Score and Strava Labs Metro, considered for validating field observations, weigh on and reinforce this study.

4.1.2 Inferences

At the end of this research endeavour, the field observations and subsequent analysis showed that a higher number of pedestrians were observed in TMR. However, it is pertinent to note that this contextual study did not determine either township to be more walkable, and additional studies are required to serve this goal.

Within the limitations of this research, the New Urbanist project showed more pedestrians than a comparable neighbourhood within the limits of Montreal CMA. Thus, it can be stated that the project of Bois-Franc, as a New Urbanist township, is somewhat successful in its goal of achieving a more walkable environment.

Previous, as well as this research, showed that the Ewing-Handy attributes studied do have a tangible impact on walkability in an urban context. However, not all the parameters analysed appeared to have an equal effect in the suburban context. As an example, while relevant in an urban setting, the parameter of transparency did not appear to have a direct bearing on walkability in suburban environments.

4.1.3 Recommendations

Promoting walkability involves much more than merely increasing density, adding retail uses or implementing urban design qualities in isolation. Instead, fully developed, high-quality, meaningful place-making at intimate scales attract pedestrians and make walking more enjoyable (Ameli et al., 2015). In this sense, although the New Urbanism charter may be seen as a checklist to be ticked off and satisfied, the creation of a walkable environment demands an approach that is more than a sum of its parts.

This approach not only requires the expertise of a design professional responding to a Client brief for a specific project but a cross-disciplinary collaboration between planners, landscape architects, civil engineers and environmentalists to look beyond a project site and its contextual relation with the urban fabric beyond.

Recent press coverage claimed that New Urbanism is dead (Fulton, 2017) as its

concerns have become so mainstream that it no longer is a distinctly separate movement. This idea may be a good indicator of the maturity of the planning industry and to its inclusionary and evolving goals. Although the Charter of New Urbanism makes valid points which are worth implementing, some points need to be critically emphasised to obtain the desired results. Such points need not be taken in any specific order of importance but are nonetheless crucial for suburban or peri-urban developments:

4.1.3.1 Selective applicability of qualitative aspects to neighbourhood planning

Once the needs for safety, comfort and pleasure are met, not all aspects of planning reviewed in this study have an equal impact on neighbourhood design leading to the creation of a walkable community. While the quantitative aspects studied; namely, land use mix, development density and street connectivity; are all applicable to residential clusters, this is not the case with qualitative aspects as some aspects carry more weight than others. While imageability, complexity, human scale and enclosure remain important for residential neighbourhoods, the element of transparency is least applicable since it directly conflicts with the human need for privacy. A designer is faced with the need to perform a balancing act between the need to protect individual concerns of privacy and the need for 'eyes on the street' (J. Jacobs, 1961) to enhance the sense of security and well being of a pedestrian.

4.1.3.2 Better road connectivity network within the township

Thoroughfare within the town is critically important to encourage movement within new developments. Unless the project allows people from the township to freely pass from one part to another and vice versa, the walkability of such an urban environment shall be compromised. The number of pedestrians is likely to be directly proportional to the number of through connections as well as the number of route choices available to them within and beyond the limits of the township. This outcome can only be achieved by coordinated efforts between Urban designers, Urban Planners and Transportation planners. The reason the road network of a township assumes criticality is that once it is planned and implemented, it remains more or less unchangeable. Hence critical, interdisciplinary thought is needed before developing it. As shown in this research, it remains a feature of understated but vital importance.

4.1.3.3 Diversity of uses

New Urbanism encourages mixed land uses and the mixing of residential types in a residential block. Unfortunately, both the townships studied do not offer these and hence their association with walkability could not be directly examined. However, the relationship between the diversity of uses and walkability is highlighted in many studies

(Lerman & Omer, 2016). As an alternative to mixed land use, different land uses juxtaposed in a single neighbourhood unit could achieve the same results as a single mixed-use zone. Such studies show that for functional walking, the higher the activity diversity, the more the pedestrians - as each trip accomplishes more tasks and thus is more productive to undertake. Planners and designers should, therefore, achieve high functional diversity while planning a zone.

4.1.4 Endnote

Benfield (2012) has a list of ten valuable measures to create a walkable place. These include putting cars in their place, mix uses, get the parking right, let transit work, protect the pedestrian, welcome bikes, shape the spaces, plant trees, make friendly and unique buildings and choose the right items to fund. Although prescribed for an urban context, this short list summarises the critical elements a designer should address to create a walkable environment in any context.

As Southworth (2005) aptly summarises, the idea of walkability needs to be implemented at the city level and integrated with planning policies for a total pedestrian environment. A district with reduced speed of traffic is undoubtedly a better draw for pedestrians, and this requires the efforts of both urban and transportation planners.

Although this research takes a prescriptive note, it remains a medium to highlight associations observed within the limited scope of this study. Such recommendations are not absolute in themselves but are intended to be implemented in conjunction with other features highlighted by other research.

Bibliography

Adkins, A., Dill, J., Luhr, G., & Neal, M. (2012). Unpacking walkability: Testing the influence of urban design features on perceptions of walking environment attractiveness. *Journal of Urban Design, 17*(4), 499-510.

Alfonzo, M. (2005). To Walk or Not to Walk?: The Hierarchy of Walking Needs. *Environment and Behavior, 37*(6), 808-836.

Ameli, S. H., Hamidi, S., Garfinkel-Castro, A., & Ewing, R. (2015). Do Better Urban Design Qualities Lead to More Walking in Salt Lake City, Utah? *Journal of Urban Design, 20*(3), 393-410. doi:10.1080/13574809.2015.1041894

Anonymous. (2016). How New Urbanism neighbourhoods easily improve suburban growth. Retrieved from https://albdev.com/how-new-urbanism-neighborhoods-improve-suburban-growth/

Baran, P. K., Rodríguez, D. A., & Khattak, A. J. (2008). Space syntax and walking in a new urbanist and suburban neighbourhoods. *Journal of Urban Design, 13*(1), 5-28.

Benfield, K. (2012). 10 Techniques for Making Cities More Walkable. Retrieved from https://www.citylab.com/solutions/2012/12/10-techniques-making-cities-more-walkable/4047/

Carr, L. J., Dunsiger, S. I., & Marcus, B. H. (2010). Walk score™ as a global estimate of neighborhood walkability. *American journal of preventive medicine, 39*(5), 460-463.

Cervero, R., & Kockelman, K. (1997). Travel demand and the 3Ds: density, diversity, and design. *Transportation Research Part D: Transport and Environment, 2*(3), 199-219.

Child, S. T., & Lawton, L. (2017). Loneliness and social isolation among young and late middle-age adults: Associations with personal networks and social participation. *Aging & mental health*, 1-9.

Duncan, D., Méline, J., Kestens, Y., Day, K., Elbel, B., Trasande, L., & Chaix, B. (2016). Walk Score, Transportation Mode Choice, and Walking Among French Adults: A GPS, Accelerometer, and Mobility Survey Study. *International journal of environmental research and public health, 13*(6), 611.

Ewing, R., & Cervero, R. (2001). Travel and the built environment: a synthesis. *Transportation Research Record: Journal of the Transportation Research Board*(1780), 87-114.

Ewing, R., & Clemente, O. (2013). *Measuring urban design: Metrics for livable places*: Island Press.

Ewing, R., Hajrasouliha, A., Neckerman, K. M., Purciel-Hill, M., & Greene, W. (2016). Streetscape features related to pedestrian activity. *Journal of Planning Education and Research, 36*(1), 5-15.

Ewing, R., & Handy, S. (2009). Measuring the unmeasurable: Urban design qualities related to walkability. *Journal of Urban Design, 14*(1), 65-84.

Ewing, R., Handy, S., Brownson, R., Clemente, O., & Winston, E. (2006). Identifying and Measuring Urban Design Qualities Related to Walkability. *Journal of Physical Activity and Health, 3*(s1), S223-S240. doi:10.1123/jpah.3.s1.s223

Fischler, R., Gordon, D. D., & Newman, G. (n.d.). *TMR Handout - Council for Canadian Urbanism*. Retrieved from http://www.canadianurbanism.ca/wp-content/uploads/2012/07/CanU-Case-Study_Town-of-Mount-Royal.pdf

Forsyth, A. (2015). What is a walkable place? The walkability debate in urban design. *Urban design international, 20*(4), 274-292.

Fulton, W. (2017). The 'New Urbanism' Movement Might Be Dead. Retrieved from http://www.governing.com/columns/urban-notebook/gov-new-urbanism.html

Hajna, S. (2016). *Neighbourhood Walkability and Pedometer and Accelerometer-assessed Walking in Canadian Adults*. McGill University Libraries,

Hajna, S., Ross, N. A., Brazeau, A.-S., Bélisle, P., Joseph, L., & Dasgupta, K. (2015). Associations between neighbourhood walkability and daily steps in adults: a systematic review and meta-analysis. *BMC Public Health, 15*(1), 768. doi:10.1186/s12889-015-2082-x

Healthy Transport in Developing Cities. (2009). Retrieved from Geneva: http://www.who.int/heli/risks/urban/transportpolicybrief2010.pdf

Hillier, B. (1997). Cities as Movement Economies. In *Intelligent environments* (pp. 295-344): Elsevier.

Hillier, B., & Hanson, J. (1984). *The social logic of space*. Cambridge [Cambridgeshire]; New York: Cambridge University Press.

Hillier, B., & Iida, S. (2005). *Network effects and psychological effects: a theory of urban movement*. Paper presented at the Proceedings of the 5th international symposium on space syntax.

Hillier, B., Penn, A., Hanson, J., Grajewski, T., & Xu, J. (1993). Natural movement: or, configuration and attraction in urban pedestrian movement. *Environment and Planning B: Planning and Design, 20*(1), 29-66.

Jacobs, A. B. (1993). Great streets.

Jacobs, J. (1961). *The death and life of American cities*.

Jiang, B. (2009). Ranking spaces for predicting human movement in an urban environment. *International Journal of Geographical Information Science, 23*(7), 823-837.

Kobos, S. (2016). Want community, build walkability.

Lerman, Y., & Omer, I. (2016). Urban area types and spatial distribution of pedestrians: Lessons from Tel Aviv. *CEUS Computers, Environment and Urban Systems, 55*, 11-23.

Llewellyn-Davies, E. P. (2000). The Housing Corporation. *Urban Design Compendium*.

Lynch, K. (1960). *The image of the city* (Vol. 11): MIT press.

Marshall, S. (2004). From streets to patterns. In *Streets and Patterns* (pp. 235-258): Routledge.

McCann, L. D. (1996). Planning and building the corporate suburb of Mount Royal, 1910-1925. *Planning Perspectives, 11*(3), 259-301.

Ng, S., Lau, W., Brown, F., Tam, E., Lao, M., & Booth, V. (2015). Walkable city, living streets. *T CHIN*, 201.

Plan D'Urbanisme - De La Ville De Mont-Royal. (2017). Retrieved from http://www.ville.mont-royal.qc.ca/sites/default/files/documents/1440_purb.pdf

Purciel, M., Neckerman, K. M., Lovasi, G. S., Quinn, J. W., Weiss, C., Bader, M. D., . . . Rundle, A. (2009). Creating and validating GIS measures of urban design for health research. *Journal of environmental psychology, 29*(4), 457-466.

Raford, N., & Ragland, D. R. (2005). Pedestrian volume modeling for traffic safety and exposure analysis.

Rapoport, A. (1990). *The meaning of the built environment: A nonverbal communication approach*: University of Arizona Press.

Saelens, B. E., & Handy, S. L. (2008). Built environment correlates of walking: a review. *Medicine and science in sports and exercise, 40*(7 Suppl), S550.

Saggio, A. (2013). *Louis Sauer, The Architect of Low-rise High-density Housing*: Lulu. com.

Sauer, L. (1994). Creating a Signature Town: The Urban Design of Bois Franc. *Plan Canada, 34*(5), 22-27.

Semenak, S. (2009, 26 Sep 2009). Sociable by design. *Montreal Gazette,* pp. G1-G3. Retrieved from https://www.pressreader.com/canada/montreal-gazette/20090926/282514359579667

Smith, A. (2015). Crowdsourcing for Active Transportation. *Institute of Transportation Engineers. ITE Journal, 85*(5), 30.

Southworth, M. (2005). Designing the walkable city. *Journal of urban planning and development, 131*(4), 246-257.

Spoon, S. C. (2005). What defines walkability: Walking behavior correlates. *MS project, City and Regional Planning, North Carolina University, Chapel Hill, North Carolina*.

St.Jean, B., & Huot, M. (2013). *Case Study Bois Franc, Ville St. Laurent*.

Strava Labs Metro, FAQ. (n.d.). Retrieved from https://metro.strava.com/faq/

Vannelli, J. (2009). New urbanism in practice : an analysis of five greater Montreal area neighbourhoods.

Walkscore Methodology. (n.d.). Retrieved from https://www.walkscore.com/methodology.shtml

Wasfi, R. A. (2015). *The Influence of the Urban Built Environment on Utilitarian Walking and Body Mass Index: Trip Diary and Longitudinal Studies of Canadians*. McGill University,

What is New Urbanism. (n.d.). Retrieved from https://www.cnu.org/resources/what-new-urbanism

Zoning Regulation #1441, Ville de Mont-Royal. (2017). Retrieved from http://www.ville.mont-royal.qc.ca/sites/default/files/documents/1440_purb.pdf