2013

Diabetes Atlas
for the Region of Peel

Region of Peel
Working for you
Public Health

Diabetes Atlas for the Region of Peel

This study was supported by the Region of Peel - Public Health. It was also supported by the Centre for Research on Inner City Health (CRICH) at St. Michael's Hospital and by the Institute for Clinical Evaluative Sciences (ICES), which are funded by annual grants from the Ontario Ministry of Health and Long-Term Care (MOHLTC). The opinions, results and conclusions reported in this paper are those of the authors and are independent from funding sources. No endorsement by the supporting agencies is intended or should be inferred.

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The Centre for Research on Inner City Health (CRICH) is dedicated to reducing health inequities through innovative research that supports social change. CRICH is part of the Keenan Research Centre in the Li Ka Shing Knowledge Institute of St. Michael's Hospital, Toronto.

A MESSAGE FROM THE MEDICAL OFFICER OF HEALTH

David L. Mowat, MBChB, MPH, FRCPC

Do you know someone with diabetes? Unfortunately, almost everyone who reads this report will answer yes to that question. Diabetes is common; worse, rates are steadily increasing. In 2005, one in ten adults in the Region of Peel had been diagnosed with diabetes; by 2025, that number is likely to be one in six. We are particularly concerned in Peel because many of the growing number of new Canadians have a greater susceptibility to diabetes. Our population is also aging and, as the prevalence of diabetes increases steeply with age, this will increase the numbers of people affected.

Diabetes is a disease with serious consequences. It is a leading cause of vision loss, kidney failure, limb amputations and cardiovascular disease. Providing health care to those affected will present a significant challenge to our healthcare system.

Many Canadians live in low-density, car-dependent suburbs with poor provisions for active transportation and public transit. This an increasing concern for public health departments because of the growing body of research linking the built environment, physical activity, overweight and obesity, diabetes and cardiovascular disease.

Understanding and dealing with chronic disease through collaboration with our partners in planning and engineering is the new frontier for Public Health. This report not only helps us understand how our communities influence our health but will inform us in improving the overall health of future generations.

This report, prepared with the help of leading researchers in the field, tells us much about diabetes in Peel. Most of all, it shows us the importance of how we live and where we live in determining our chances of enjoying a long, healthy life.

Please contact us if you need more information, or if you wish to comment on the report or its implications.

GLOSSARY

Abdominal Obesity – The accumulation of fat within the abdominal region as indicated by a waist circumference > 102 cm (40 inches) in men and > 88 cm (35 inches) in women[1], although thresholds can vary depending on ethnoracial group. This pattern of obesity is associated with an increased risk of diabetes and cardiovascular disease.[2]

Access – In the context of this atlas, access reflects geographic access to a resource. Geographic access was measured in metres along the road network from a grid of "origin points" placed 150 metres apart across Peel region to various "destination" resources such as grocery stores, parks or doctor offices. The distance measured for these grid points was subsequently interpolated using Inverse Distance Weighting to create a raster image displaying access levels to a given resource for the entire study area.

Body Mass Index (BMI) – A method of measuring total body mass which factors in a person's height and weight according to the equation: BMI = weight (kg) / height $(m)^2$. A BMI score between 18.5 and 24.9 is considered healthiest on average; 25 to 29.9 is considered overweight; 30 and over is considered obese. Lower cut-off points are recommended for Asian populations as markers of increased health risk.[3]

Brownfield – Undeveloped or previously developed sites located within the existing built-up area that may be suitable for redevelopment. These sites are usually, but not exclusively, former industrial or commercial properties that may be underutilized, derelict or vacant. Some brownfield sites are contaminated and may require extensive remediation prior to redevelopment.

Building setbacks – The horizontal setback distance from a curb or property lot line to the nearest part of a building on the lot. Minimum building setbacks are often specified in municipal zoning by-law.

Built environment – The term generally used to refer to the man-made or modified physical context in which people live, learn, work and play, and includes features like roads, sidewalks, buildings, parks, recreational and retail facilities.

Canadian Community Health Survey (CCHS) The Canadian Community Health Survey is a cross-sectional survey conducted by Statistics Canada to collect information related to health status, health care utilization and health determinants of Canadians. This survey uses a complex sample design that is intended to enable the generation of reliable estimates at sub-provinicial levels (health region or combination of health regions). Prior to 2007, data collection occurred every two years; since 2007, the survey has been administered annually.

Cardiovascular Disease – Diseases affecting the heart or blood vessels. This group of diseases includes coronary artery disease, stroke, peripheral vascular disease, hypertension, heart failure, arteriosclerosis, arrhythmia and congenital heart disease.

Census Tract (CT) – Areas created by Statistics Canada to delineate neighborhood-like communities. CTs are small, relatively stable geographical areas located in metropolitan areas that are as homogeneous as possible in terms of socioeconomic characteristics, such as similar economic status and living conditions.[4] There were 205 CTs in Peel region in 2006 and their total population ranged from 1,700 to 20,500 people, with an average of about 5,700 residents.

Choropleth (shaded) Map – A type of statistical or thematic map depicting a rate or ratio for a given attribute by representing ranges of values with different shades or colours.

Connectivity – Refers to how well-connected road, pathway and sidewalk transportation networks are, considering all network users including automobiles, public transit, bicycles and pedestrians. Barriers to connectivity include cul-de-sac street designs with few direct travel routes, and large arterial roadways and expressways with few intersections or crossings. A common measure of connectivity is 'intersection density' – the density of street intersections in a given area measured as the total number of 3-way or greater road intersections per area unit (e.g., 57 intersections per square km).

Density – A measure of a variable over an area unit, such as the number of persons per square kilometer. Density variables are often depicted on choropleth maps. In contrast, dot density maps are based on a different methodology which does not apply standardization by area.

Diabetes Mellitus – Diabetes is a chronic disorder characterized by elevations in blood glucose (sugar) levels that can lead to a number of long-term complications including blindness, kidney disease, nerve damage, and heart and circulatory problems. Diabetes includes type 1 and 2 diabetes, and gestational diabetes. Type 2 diabetes affects 90%–95% of all people with diabetes.

Diabetes Prevalence – The proportion of people in a population who have diabetes at a given point or period in time. In this atlas, diabetes prevalence is defined as the proportion of the Peel population aged 20 or older, in fiscal year 2007/2008 that had been diagnosed with diabetes, based on the Ontario Diabetes Database (see ODD definition below).

Dot Density Map – A type of statistical or thematic map depicting count or frequency attributes using dots, such as total population shown with one dot representing 500 people. In these maps, dots are usually placed randomly within an area (such as a census tract) and can represent one or multiple cases of a given variable.

Food Desert – An area where there is little or no access to healthy, affordable foods. Food deserts are of greatest concern in areas with a large proportion of socially or economically disadvantaged residents who may be more reliant on their residential areas for food shopping (e.g., because of limited access to private vehicles).

Food Environment – The food choices available to individuals in various settings of daily life, as well as the messages that encourage or discourage these choices from other individuals, institutions and media. The food environment is multidimensional and includes the following domains: the organizational food environment (e.g., school, work, home); the consumer environment (i.e., availability, quality and price of foods in stores and eating places); the community or local food environment (i.e., availability of and access to retail food stores and restaurants in communities); and the information environment (i.e., media and advertising).[5]

Geographic Information Systems (GIS) – A computer-enabled set of analytical methods, software and database tools that allow storage, manipulation, analysis and mapping of geographic attributes.

Glucose – The main sugar produced by the body or derived from food in the diet. Glucose is carried in the bloodstream to provide energy to cells in the body.

Greater Toronto Area (GTA) – The GTA consists of the regional municipalities of Durham, Halton, Peel, York, and the City of Toronto.

Hypertension – High blood pressure.

Infill – Development of new buildings or community facilities on vacant or underutilized land parcels within existing built-up areas.

Interpolated Grid Map – A type of statistical or thematic map depicting values of a numeric variable through shading of small grid cells covering the whole study area. There are usually only a number of points where true values of the attribute are known while values in the rest of the grid cells are interpolated from these known points.

Insulin Resistance – A state in which the body's tissues are unable to respond normally to circulating levels of the hormone insulin. This condition can occur many years before the onset of diabetes and may be associated with other abnormalities, such as high blood pressure, cholesterol problems, and cardiovascular disease. If the pancreas fails to make sufficient amounts of insulin to overcome its resistance, then blood glucose levels can rise, leading to elevated glucose levels and ultimately to type 2 diabetes.

Land-use Mix – Refers to the mixing of various land uses, including residential, retail, workplace and institutional, in relatively close proximity to each other within the same area or neighbourhood.

Manhattan Distance – A method of measuring a distance between two points in an area. This method is based on applying straight lines and right angles along horizontal and vertical path elements. It is a simplified method suitable for measuring distances along grid-based streets in urban areas.

Mean – The sum of the values in a sample divided by the number of values (also known as the average).

Network Analysis – A spatial method of calculating travel distance (or time) from one location to another along a pre-defined network, such as a road network. In this atlas, network analysis was used to calculate travel distances from a grid of origin points placed 150 metres apart across Peel to various resource destinations such as grocery stores or parks (see Access definition for more information).

Ontario Diabetes Database (ODD) – A population-based disease registry constructed using a validated algorithm based on hospitalizations and physician visits to identify individuals with physician-diagnosed diabetes mellitus in Ontario.[6]

Peel Health Data Zones (PHDZ) – Peel Health Data Zones are defined geographic areas within Peel which are smaller than the lower-tier municipalities of Mississauga, Brampton and Caledon. These data zones use census tracts as building blocks, and where possible, respect natural and man-made boundaries such as rivers, highways and municipal boundaries. In total, there are 15 data zones in Peel. Each of the 15 PHDZs was created to be relatively homogeneous with respect to health, socioeconomic and socio-demographic factors.[7]

Proportional Symbol Map – A type of statistical or thematic map depicting a numeric variable using shapes, most commonly circles, which are scaled in size according to the value of the depicted variable.

Rate Ratio – The ratio of two rates, i.e., the ratio of the probability of an event (e.g., developing a disease) occurring in one group of people compared with the probability of the same event in another group of people.

Recent Immigrant – People (excluding institutional residents) who obtained landed immigrant status between 1996 and 2006 (as defined by the 2006 Canada Census).

Region of Peel – Located directly west of Toronto and York regions, the Region of Peel includes the City of Mississauga, the City of Brampton and the Town of Caledon. The Region of Peel covers an area of 1,242 square kilometres and has a population of 1,159,405, based on the 2006 Canada Census.

Socioeconomic Status (SES) – This term describes a combination of social and economic factors experienced by a person or population, such as education and income. The term 'status' refers to the position an individual or group holds in a society's socioeconomic hierarchy.

Statistically Significant (result) – In this atlas, a result was considered statistically significant if it had a p-value of less than 0.05. Statistically significant results could have happened purely by chance but the probability is very low: chance findings are expected to occur less than five times if the study or analysis was repeated 100 times. Results that are not statistically significant may still be important, but there is a higher probability that they happened by chance.

Visible Minority – In this atlas, data on self-reported visible minority status came from the 2006 Canada Census. The census refers to visible minorities using the Employment Equity Act definition as "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour".

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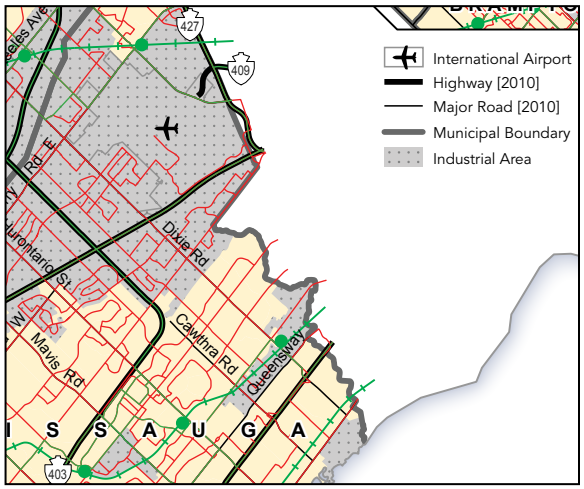
HOW TO READ THE MAPS

Maps are the main visual representation of spatial patterns of data and analyses covered in this atlas. Several types of general reference and thematic maps in this atlas may require some explanation in order to help readers interpret them correctly.

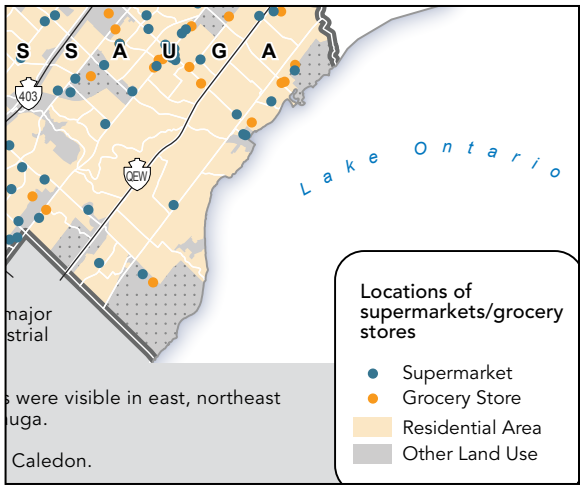
General reference maps and examples

These maps show where various elements are located within the study area (e.g., streets, grocery stores or land use categories). When reading a general reference map, one should keep in mind that symbols are only representing real features on the ground; they may be exaggerated in size or may follow a simplified outline of the real feature. Also, a single symbol may represent several objects simultaneously.

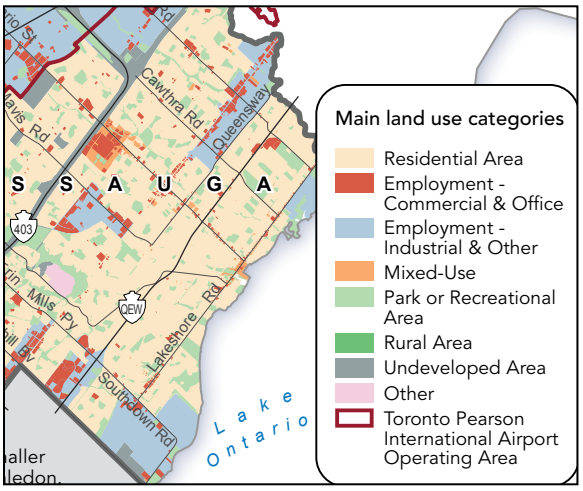
Example of a road network map



Example of a locations services map



Example of a land use map



Thematic (statistical) maps and examples

Thematic maps are the main way in which spatial patterns of variables (e.g., average annual household income, distribution of population) are displayed in this atlas. Thematic maps can be used to examine the magnitude of a variable or variables in different geographic locations and to compare spatial patterns of attributes across the study area or at various points in time.

There are four types of thematic maps in this atlas:

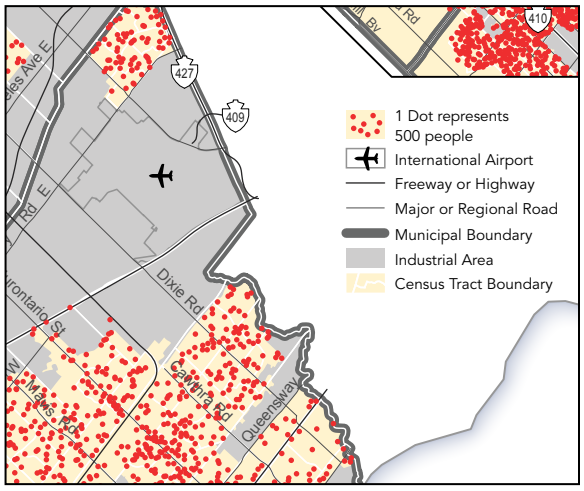
- Dot density maps
- Choropleth (shaded) maps
- Interpolated grid maps
- Graduated symbol maps

Dot density maps

Dot density maps usually display counts with each dot representing a specific value. In the example below, each dot represents 500 people. Dot density maps allow the reader to identify areas with higher or lower concentrations of the depicted variable. For example, in areas with a higher population density, dots are more numerous and appear closer together; lower population density is indicated when dots are less clustered and more spread out. Dot density maps are very useful in identifying areas which may be in need of some type of intervention. For example, based on a dot density map showing numbers of people

with diabetes in a given area, a health services planner could propose potential locations for new diabetes programs or outreach clinics.

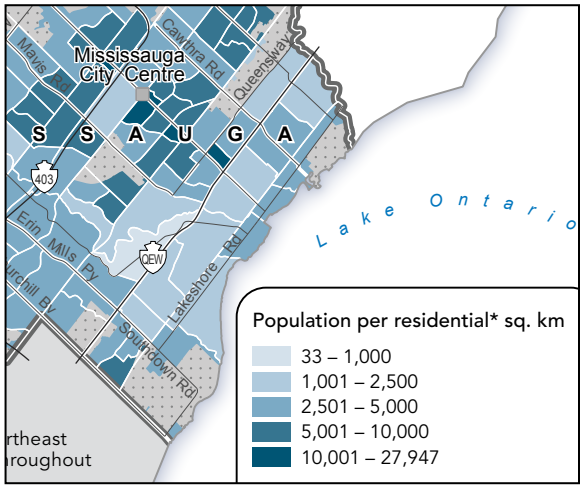
Example of a dot density map



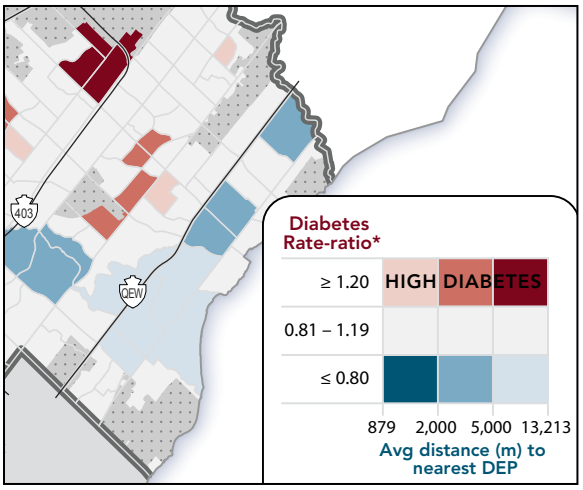
Choropleth maps

Choropleth maps (also known as shaded maps) use different shades or colours to depict data values. Each colour generally represents a range of values, as shown in the map legend. A typical choropleth map depicts higher values of the depicted variable in darker shades/colours. Shaded maps usually represent rate or ratio variables rather than raw counts or amounts.

Example of a choropleth (shaded) map



Example of a two-variable choropleth map



Two-variable choropleth map

This type of map depicts the spatial relationship between values of two variables using several colours and highlights areas of Peel which have the highest and the lowest values of each of the two variables. Each colour represents a specific combination of values of the two variables.

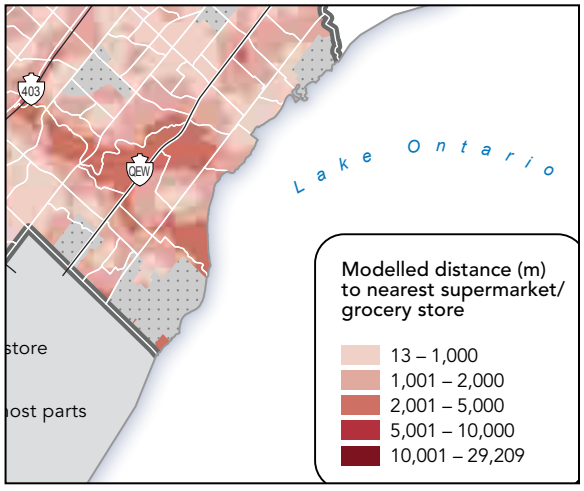
In the above example, the legend displays two variables: the variable along the Y-axis is the diabetes rate-ratio (a ratio that compares diabetes rates in each Peel census tract to the overall rate in the Greater Toronto Area or GTA), while the variable along the X-axis is the average distance to the nearest diabetes education program (DEP). When examining the legend horizontally, the three red-shaded squares along the top row represent areas with the highest diabetes rate-ratios (≥1.2, which denotes census tracts with diabetes rates at least 20 per cent higher than the overall GTA rate). The three blue-shaded squares along the bottom row represent areas with the lowest diabetes rate-ratios of 0.79 or lower (which denotes census tracts with diabetes rates at least 20 per cent below the GTA rate). Squares shaded in a single grey colour along the middle row represent areas with medium-level diabetes rate-ratios (0.8 - 1.19). When examining the legend vertically, the three squares along the left column represent areas with the shortest distances to the nearest DEP (879 – 2,000 metres), while the right column represents areas with the longest

distances (5,000 – 13,213 metres). In this kind of map, the most desirable conditions are depicted by the darkest blue shade (in the above legend, this is the square in the bottom left corner). In the above example, areas shaded in the darkest blue indicate the combination of the lowest diabetes rate-ratios and the shortest range of distances to the nearest DEP. The opposite holds true for areas shaded in the darkest red (in the above legend, this is the square in the top right corner). These areas have the combination of the highest diabetes rate-ratios and longest range of travel distances to a DEP.

Interpolated grid maps

Interpolated grid maps can depict counts as well as rates and ratios. In locations where values of the depicted variable are not known, the values are interpolated based on known data points from other locations. This can be done using various methods. Inverse Distance Weighting was the method chosen for this atlas in order to create a raster image displaying access levels to a given resource for the entire study area. In this atlas, we used a grid of "origin" points placed 150 metres apart across Peel to various "destination" points in order to evaluate geographic access to various resources such as grocery stores, parks or doctors' offices. Access was measured in metres along the road network. On a typical interpolated grid map, darker shades represent longer distances to resources while lighter colours represent shorter distances.

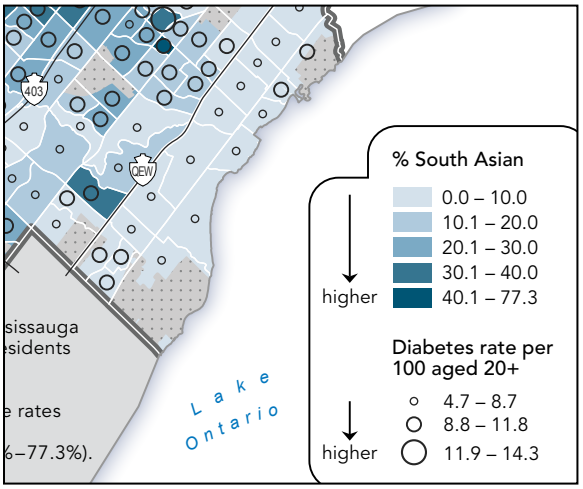
Example of an interpolated grid map



Graduated symbol maps

Graduated symbol maps depict rates or counts by assigning a specific symbol size to a value or a range of values of the depicted variable. Larger symbols represent higher values. In this atlas, graduated symbols appear as a layer of circles representing one variable on top of a choropleth layer representing another variable. By using two different mapping techniques together, the viewer is able to examine patterns of two different variables on one map.

Example of a graduated symbol map, overlaying a choropleth map



Chapter 1

Setting the CONTEXT

INSIDE

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HIGHLIGHTS

Issue

- The Diabetes Atlas for the Region of Peel focuses on factors related to diabetes at the neighbourhood level in Peel region, Ontario, Canada.
- This chapter provides background information about type 2 diabetes and related risk factors. It also explores the reasons for choosing to examine diabetes at the neighbourhood level in Peel.

Setting the Context

Peel region has a large and rapidly growing population and very high levels of immigration from areas of the world that are home to people at high risk of diabetes. Peel is also geographically diverse with many urban, suburban, rural and industrial areas. However, the majority of Peel's residents make their home in sprawling suburban developments located far from workplaces and retail stores. This type of community necessitates a heavy reliance on cars and thus limits opportunities to walk, cycle or take public transit. Together, these factors make Peel a highly salient setting to examine relationships between area-level factors, healthy living and diabetes. In this chapter, the following topics – as they relate to diabetes – are explored:

- Individual behaviours such as eating healthy foods and being physically active are important for maintaining a healthy body weight. Being overweight or obese is related to higher risk of diabetes. However, a growing body of research shows that the neighbourhood in which people live also has an important influence on their health.
- The spatial arrangement of neighbourhood streets, sidewalks, stores, services and workplaces influences people's opportunities to access healthy foods and be physically active on a daily basis. These two things play important roles in the risk of obesity and diabetes. Residents who live in areas far from shops and services, workplaces, schools or parks must rely on cars to get around. This discourages daily physical activity, such as walking for errands, and thus promotes obesity and diabetes.
- In this chapter and throughout this atlas, census tracts are used as proxies of neighbourhoods. Census tracts are neighbourhood-like communities that are small enough to be homogenous in terms of socioeconomic characteristics and living conditions, but large enough to examine unique local environments and access to local resources. Census tracts are referred to interchangeably as "census tracts" and "neighbourhoods" throughout this report.
- Spatial techniques provide the tools to create maps, measure distances and visualize the nature of spatial relationships between rates of diabetes and various other factors. These techniques are used extensively throughout this atlas.

Key Findings

- Peel region is comprised of three municipalities: the cities of Brampton and Mississauga, and the town of Caledon. In 2006, Peel was divided into 205 census tracts, each ranging in total population from 1,700 to 20,500 people, with an average of 5,700 people.
- Peel has a younger population, fewer people living alone, more people who self-identify as belonging to a visible minority and much higher levels of immigration compared with the Greater Toronto Area and Ontario.
- Between 2001 and 2006, Peel experienced the largest population growth (170,457 new residents) within the Greater Toronto Area. The majority of new residents settled in newly-developed outlying areas of Brampton and Mississauga.

Implications

- Peel has a growing rate of diabetes which is already higher than in the province as a whole.
- Sprawling low-density neighbourhoods that have become a growing trend in Peel during recent decades make residents dependent on cars and thus limit opportunities to incorporate physical activity (e.g., walking or cycling) into daily routines.
- Large parcels of previously undeveloped land in Peel are currently being developed at a rapid rate. This presents a prime opportunity to design neighbourhoods that better support healthy eating and daily physical activity. There is also a need to redevelop existing neighbourhoods in order to influence and mitigate some of the environmental determinants of diabetes.

INTRODUCTION

Around the world, an estimated 371 million people are living with diabetes.[1] Due to an aging population and increasing rates of obesity, the number of people with diabetes is expected to reach 439 million within the next 20 years.[2] According to the World Health Organization, obesity and physical inactivity, which are key risk factors for diabetes, are among the greatest health challenges in the 21st century.[3]

In 2013, an estimated 3.1 million Canadians (8.6%) are living with diagnosed diabetes.[4] In Ontario over the past two decades, the number of people living with diabetes has increased dramatically. Among adults, diabetes prevalence rose by 69% (from 5.2% to 8.8%) between 1994/95 and 2004/05.[5] In 2010, nearly 1.2 million people in Ontario (8.3% of the population) had been diagnosed with diabetes.[6] This was higher than the estimated national prevalence of 7.3% in the same year. Furthermore, the prevalence of diabetes increases with age. By age 65, about one in five individuals will be diagnosed with this condition. Projections indicate that by 2020, 4.2 million Canadians (10.8%) will be living with diagnosed diabetes[5] (for more information on diabetes prevalence and risk factors, see Chapter 2).

What is diabetes?

Diabetes is a chronic disease that affects the body's ability to produce or properly use insulin, a hormone that regulates the amount of glucose (sugar) in the blood. There are three basic forms of diabetes: type 1, type 2 and gestational.

- Type 1 diabetes, which is often diagnosed in children and young adults, occurs when the body does not produce enough insulin. This disease cannot be prevented and requires treatment with insulin.
- Type 2 diabetes, which accounts for 90%–95% of all cases of diagnosed diabetes, occurs when the body cannot effectively use the insulin it produces. Although increasingly seen in children and young adults, type 2 diabetes is most common in people aged 40 and older. It is also strongly linked to excess body weight, unhealthy diet and lack of physical activity.[3]
- Gestational diabetes occurs during pregnancy. Although it usually resolves after delivery, it is a strong risk factor for developing type 2 diabetes later in life.

Complications and Costs

Diabetes is a leading cause of blindness, kidney disease and heart and circulatory problems. In Ontario, people with diabetes account for one-third of all heart attacks and strokes, one-half of all people starting kidney dialysis and two-thirds of all non-traumatic amputations.[7-10] These complications place a very heavy burden on Canada's health care system, as well as on individuals and their families.[11] The direct and indirect cost of diabetes in Ontario in 2010 was estimated at $4.9 billion, but this cost could soar to $7 billion by 2020.[6]

RISK FACTORS

Obesity

The obesity epidemic is one of the major causes of the rising rates of diabetes. The likelihood of developing diabetes is more than seven times higher among individuals classified as obese than among those with normal body weight.[12]

Among people classified as overweight, the likelihood of diabetes is three times higher (for more details about how body weight and fat distribution are measured, see Chapter 2). Almost one in four Canadian adults is now obese and more than one in three is overweight.[13, 14] In 2007/2008, a similar proportion of Peel residents aged 18 and older were classified as overweight (36%) and 15% were obese.[15] Levels of overweight and obesity among Peel's youth are similarly alarming, with 37% of male youths and 27% of female youths in grades 7 to 12 classified as overweight or obese in 2011.[15] Over the last 50 years, the typical North American (or "Western") lifestyle has increasingly included sedentary behaviour and a diet high in calories and processed foods.[16] Lifestyle changes that promote physical activity and weight loss can delay or prevent the onset of type 2 diabetes by nearly 60% in people who are at high risk for developing this disease.[17, 18]

Socioeconomic Factors

Risk factors for diabetes are not distributed evenly across society.[16] Socioeconomic status has a well-established connection with health and with behaviours that promote healthy lifestyles.[19] Levels of income and education shape overall living conditions and influence health-related behaviours such as quality of diet (including eating the recommended amount of fruits and vegetables), levels of physical activity, tobacco use and levels of obesity.[19, 20] In 1998/99, 21% of people with diabetes reported low income compared with only 13% of the general population.[19] Between 1994 and 2005, although diabetes prevalence increased in almost all income groups, the rise was greatest among low- and lower-middle income Canadians.[20] Two recently-published atlases report a significantly greater prevalence of diabetes among those living in lower income neighbourhoods compared with residents of more affluent areas[8, 22] (for more details about how socioeconomic status relates to diabetes, see Chapter 3).

Ethnicity

Diabetes is also more common among certain ethnocultural populations.[16] Visible minorities, such as those of African or Caribbean, Hispanic, or South and East Asian descent, all have a greater predisposition to diabetes than people of European descent.[21, 22] (For a definition of "visible minority," see Appendix 1.A). Every year, Canada receives thousands of newcomers from regions of the world that are home to people at high risk for diabetes. According to the 2006 Canadian census, the largest proportion of recent immigrants (58.3%) originated from Asia and the Middle East.[23] In 2005, recent immigrants to Ontario from South Asia, Latin America, the Caribbean and sub-Saharan Africa had significantly higher rates of diabetes compared with long-term Ontario residents.[24] In addition, Aboriginal groups have among the highest rates of diabetes in the world. In some Aboriginal communities, diabetes prevalence among adults is 30% to 50%[19] (for more information about ethnicity, immigration and diabetes, see Chapter 4).

Physical Inactivity

The amount of time spent in sedentary behaviours, such as watching television, sitting at work, driving, using the computer or playing video games, is associated with a higher risk of obesity and type 2 diabetes.[24, 25] The physical environment in which we live also influences our level of activity. A lack of convenient and accessible

places where a person can be physically active may discourage physical activity and promote obesity. Residents of communities with easy access to recreational facilities, such as trails, parks and fitness centres, were more physically active and had healthier body weights.[27, 28] While engaging in physical activity for recreation or exercise is important, utilitarian activity that is part of everyday life, such as walking or biking for errands, may play a stronger role at the population level in promoting healthier body weights. Modern suburban neighbourhoods are laid out in a way that makes daily opportunities to walk, cycle or take public transit inconvenient or even unsafe. These types of spread-out or "sprawling" communities are characterized by a large proportion of low-density housing, long distances between homes, stores and services, and a heavy dependence on cars.[29] There is growing evidence that adults and youth living in areas that are more compact or "walkable" (with convenient access by foot or bicycle to various local amenities and recreational facilities) are more physically active and have lower rates of obesity[30-33] (for more information about neighbourhood resources relating to physical activity and diabetes, see Chapters 5 and 6).

Unhealthy Diet

Major changes in food production, processing and distribution patterns in North America and around the world have resulted in an increased amount of cheap and readily-available, calorie-dense foods.[33-36] Not surprisingly, according to data from the most recent national survey of Canadians' eating habits, in 2004 the majority of Canadians (59%) were consuming a diet that required improvement, while fewer than 1% were consuming a diet classified as good quality.[37] Less healthy diets commonly include too many highly-processed and nutrient-poor "convenience" foods like salty snacks and sugar sweetened beverages. Canadians of all income levels are increasingly purchasing and consuming such foods away from home.[38] The growing number of neighbourhood stores selling sweets, pizza and fast food may play a role in shaping food choices.[39] People who live in neighbourhoods with better access to fast-food outlets and worse access to stores selling fresh foods, such as supermarkets and grocery stores, tend to have less healthy diets, heavier body weights and higher insulin resistance – all important risk factors for type 2 diabetes.[40-46] (for more information about access to healthy and unhealthy retail food outlets and diabetes, see Chapter 7).

To date, there has been little research on how neighbourhood environments and resources associated with diet, physical activity and access to health care relate to diabetes.[48] The spatial distribution of factors related to diabetes prevention and control in Peel region is presented in this atlas. These factors include: socioeconomic status, immigration, ethnic composition, population density, service density and dispersion, car ownership, opportunities for physical activity, access to healthy and unhealthy food, and access to health care.

WHY FOCUS ON PEEL?

Diabetes rates in Peel region are among the highest in the province and are expected to continue to rise. Between 1995/96 and 2004/05, diabetes prevalence in Peel increased by more than 50% from 5.9% to 9.2%.[48] Among both men and women living in Peel, the age-adjusted diabetes prevalence rate in 2004/05 was higher than that for Ontario as a whole (9.7% among Peel men vs. 8.8% among Ontario men, and 8.7% among Peel women vs. 7.9% among Ontario women).[48] At the same time, Peel received 213,000 new immigrants between 1996 and 2006, many from areas of the world that are home to people at high risk for diabetes, such as South Asia and the Caribbean.[49] Immigration is driving Peel's rapid and steady population growth. With over 1.1 million residents in 2006 and about 34,000 new residents every year, Peel is the second-largest regional municipality in Ontario and the second-fastest growing region in the Greater Toronto Area (GTA).[50, 51] By the year 2031, the population of Peel is expected to grow by 36% to more than 1.5 million people.[50] Currently, many Peel families make their home in low-density housing developments that lack convenient

access – by active means (e.g., walking or cycling) – to schools, workplaces and retail services. The combination of a high proportion of residents from populations at high risk of diabetes (e.g., recent immigrants and low-income groups) and a diverse urban landscape, make Peel a highly salient setting for exploring relationships between the environment and the health and well-being of local residents.

Diverse population

Peel provides an ideal setting to investigate complex interactions between ethnically and culturally diverse groups and their environment.

- In 2006, one half of Peel residents classified themselves as being part of a visible minority.[50] This is the highest percentage within the GTA and is more than double that of Ontario.
- South Asian, Black and Chinese were the most commonly reported visible minority groups in Peel.[50]
- More than one quarter of Peel residents (27%) spoke a language other than English or French at home, compared with 15% of Ontario residents.
- Peel also has a growing proportion of ethnically-diverse residents who are non-immigrants (residents born in Canada who classify themselves as being part of a visible minority) or long-term immigrants (residents who have been in the country for longer than 10 years).

Over the past two decades, Peel has experienced a very high population mobility rate fuelled primarily by immigration. In 2006, nearly half (49%) of Peel's population were immigrants, the second-highest percentage in the GTA. In this group, more than one in five were recent immigrants who arrived in Canada after 2001, and one in three arrived between 1991 and 2000.[50] More than half (51%) of immigrants were born in Asia and 27% were European-born.[49] Recent immigrants typically have healthier body weights and are generally in better health than long-term immigrants or non-immigrants. However, this effect generally fades over time as many immigrants adopt a Western energy-rich diet and sedentary lifestyle. Certain ethnic groups, such as those of South or Southeast Asian, African and Caribbean descent – groups that are well represented in Peel – are also particularly susceptible to diabetes and heart disease.[24, 51, 52] In addition, some new immigrants to Peel settle in areas of lower household income, another known risk factor for diabetes.[54]

Built environment

A small number of relatively walkable urban areas exist in Peel region. The majority of residents make their home in sprawling suburban developments that have become a growing trend in Peel over the past few decades. Such developments are characterized by high proportions of low-density housing that are often located far from schools, workplaces and stores and services. In these types of communities, driving a car tends to be the most convenient way of getting around because walking, cycling or taking public transit is generally perceived to be inconvenient, inefficient and sometimes unsafe. Indeed, Peel is ranked as one of three municipalities in Canada in which walking or bicycling to work is least common.[54] In 2006, only 6% of Peel households did not have a car compared with 16% of households in the GTA.[55]

Because of the considerable diversity of Peel region in terms of social and economic characteristics, it is particularly fitting to examine social determinants of health, such as immigration and low income, and how they may affect rates of diabetes in Peel's rapidly developing and largely suburban environment.

WHY FOCUS ON NEIGHBOURHOODS?

Neighbourhoods can be defined in various ways and the concept means different things to different people.[16] For the purpose of this atlas, Statistics Canada's census tracts have been used as proxies for neighbourhoods. These are small, relatively stable geographical areas located in metropolitan areas that usually have a population of 2,500 to 8,000 people.[56]

In Peel region in 2006, census tracts ranged in total population from 1,700 to 20,500 people, with an average of about 5,700 residents. Census tract boundaries were created to delineate neighbourhood-like communities that are as homogeneous as possible in terms of socioeconomic characteristics, such as similar economic status and social living conditions. They also follow natural and permanent physical boundaries, such as rivers and major roads.[56]

Census tracts are good proxies of "naturally" defined neighbourhoods when exploring the effect of neighbourhoods on health.[57] The resulting neighbourhoods are small enough to capture the rich heterogeneity of Peel, but large enough to provide meaningful geographic areas for analysis, reporting, and planning. This neighbourhood size is also appropriate for identifying local resources available to individuals near their homes which could contribute to their health and behaviour. Too large an area would provide an unrealistic view of what is available to people within a convenient and walkable distance.[16] Too small an area would fail to capture the richness of local resources that may be scattered within a community.

For some analyses in this atlas, the census tracts did not have sufficiently large populations to provide reliable values. In such cases, a different set of larger geographical areas, known as Peel Health Data Zones (PHDZs), was used. PHDZs were defined by the Region of Peel in collaboration with McMaster University (for an overview of how PHDZs were created, please see Appendix 1.B – Peel Health Data Zones). Each of the 15 PHDZs was created to be relatively homogeneous with respect to health, socioeconomic and sociodemographic factors. The boundaries of PHDZs follow census tract boundaries but may include more than one census tract. Like census tracts, PHDZs boundaries generally respect natural and man-made physical features.

WHY STUDY ENVIRONMENTAL FACTORS?

The control of diabetes requires continuous access to high-quality health care, preferably from a multi-disciplinary team.[16] It also requires a high degree of knowledge, as well as the ability to self-regulate one's diet, physical activity and medications, and monitor blood sugar levels on a regular basis. Eating a healthy, balanced diet and being physically active are key aspects of managing diabetes and are critical to the prevention of diabetes.[58] Although it may be tempting to blame individual behaviours, many environmental factors – those beyond individual control – have likely played a key role in the current epidemic of obesity and diabetes. Recently, researchers have been paying increasing attention to factors such as access to stores selling healthy foods and opportunities for physical activity – factors which are likely to be of fundamental importance in the control of the current obesity epidemic and its attendant consequences.[30, 32]

Incorporating physical activity into daily routines is a key strategy for improving fitness and maintaining a healthy body weight. However, this may be very difficult to accomplish in neighbourhoods without walkable destinations or with poor access to public transit. Living in sprawling low-density communities marked by a heavy reliance on cars and lack of walkable destinations is related to heavier body weights, lower levels of physical activity and increased risk of certain chronic conditions.[29, 59, 63] Excessive reliance on cars as the primary mode of transportation is common for a large portion of Peel's residents. In 2006, 84% of Peel residents aged 15 or older who were in the workforce used a motor vehicle (such as a car, truck or van) as their usual mode of transportation to work; only 16% walked or took public transit.[50] However, while owning a car may reduce the probability of leading a more active daily lifestyle, a lack of one in certain neighbourhoods can make it difficult for a person to access healthy resources, such as stores selling fresh fruit and vegetables – foods that are important in the prevention and management of diabetes.[16] Living in communities with convenient access to stores selling healthy foods (e.g., grocery stores and supermarkets) plays an important role in maintaining a healthy diet and body weight.[30, 36]

Many environmental factors can support or hinder active lifestyles and successful management of diabetes. Among these factors, neighbourhood safety may play an important role. Areas where crime is more prevalent are less desirable places for physical activities, such as walking or bicycling.[16] Access to health services is also a crucial factor in managing diabetes. In the case of another current epidemic, that of tobacco-related diseases, a combined approach involving clinical preventive strategies (e.g., counselling, patches, gums and cessation programs) together with environmental and other policy changes (e.g., smoking bans and high tobacco taxes) have been successful in reducing population tobacco use.[64] A mix of clinical, environmental and public policy interventions is also likely needed in the current fight against obesity and diabetes.[16]

WHY USE SPATIAL APPROACHES?

Spatial analytical and descriptive methods were initially created for use in geography and cartography.[16] However, in recent decades, these techniques have been increasingly used in epidemiology and public health. Spatial methods take into account the physical location of areas, boundaries, people and services, as well as types of land use and natural features. These techniques provide the ability to create maps, measure distances and travel times, and define the extent and nature of spatial relationships.[16]

To generate this atlas, spatial methods were used to examine relationships between the neighbourhood prevalence of diabetes and various factors that could influence the development and management of this disease. The following environmental factors were considered: car ownership, population density, and density and dispersion of commercial services. Resources for healthy living, which included access to healthy and unhealthy food, locations where people could take part in physical activity and access to diabetes-related health services, were also identified.

Spatial approaches empower health professionals, decision makers, community groups and individuals with a new set of informative tools.[16] However, caution must be used in order to avoid stigmatization of a neighbourhood or area. The benefits of using spatial approaches are outlined below:

- Front-line health providers can learn more about their patients/clients and the environments they live in.
- Local residents can learn to identify environmental contributors to their health conditions and where to look for appropriate care.
- Health service planners and policy makers can use spatial information to assess population health patterns and the effectiveness of existing levels of service provision within and across municipal boundaries. They can also use this information to design new programs to address unmet service needs in the most optimal way given available budgets and other constraints.

- Community groups and individuals can employ spatial knowledge in their advocacy, fundraising efforts and promotion of healthy living behaviours.

Spatial approaches are rapidly becoming an essential part of health research.[16] This atlas was produced using geographic information system (GIS) tools that allow spatial exploration and interpretation of findings. Such techniques provided an opportunity to develop a unique perspective about diabetes in Peel, which includes new data and observations about important social, environmental and behavioural factors.

LIMITATIONS OF SPATIAL APPROACHES

By themselves, spatial analyses do not provide information about the actual behaviour of populations and/or individuals, including the foods people eat, the amount of physical activity they undertake or how frequently they use health care services.[15] They also do not provide information about non-spatial barriers, such as the appropriateness or acceptability of services, hours of operation, languages spoken, ability to get time off work or to obtain child care, the cost of medications or devices, or the cost of buying healthy foods. Spatial approaches also involve a heavy reliance on secondary data sources, some of which may be outdated, inaccurate or incomplete.[16]

Despite these limitations, spatial approaches are an excellent starting point for understanding availability and accessibility of neighbourhood resources and environments.[16] For example, the appropriateness of activities at a community centre is secondary to whether a neighbourhood has access to a community centre at all. In this atlas, spatial methods have been used to address these kinds of fundamental issues as a starting point for further research. Additional research about appropriateness, acceptability, affordability and actual use will be essential to knowing whether and how neighbourhoods and the resources they contain can be modified to improve residents' health.

LIST OF EXHIBITS

Exhibit 1.1. Peel region, within the Greater Toronto Area (GTA), 2006

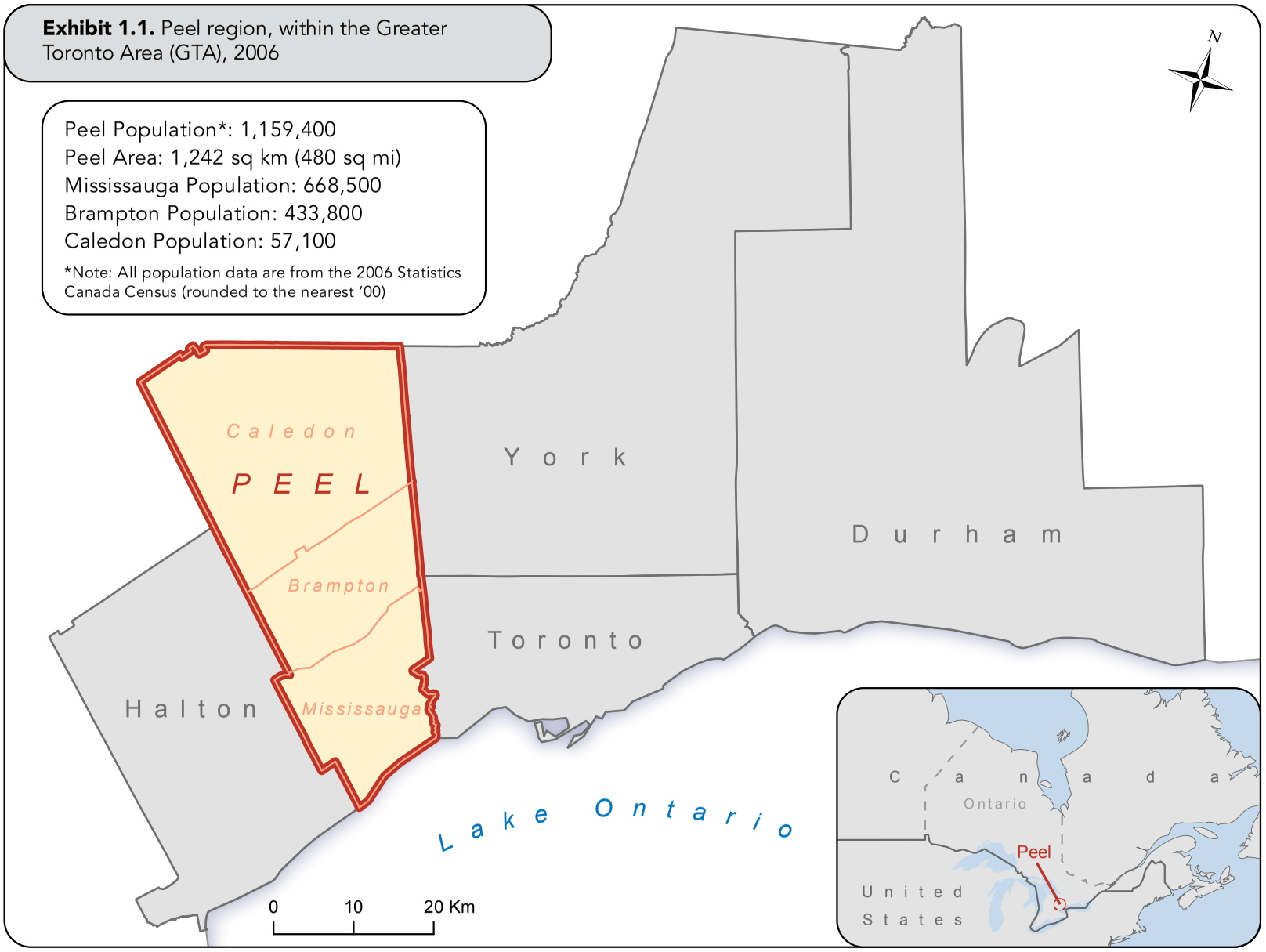


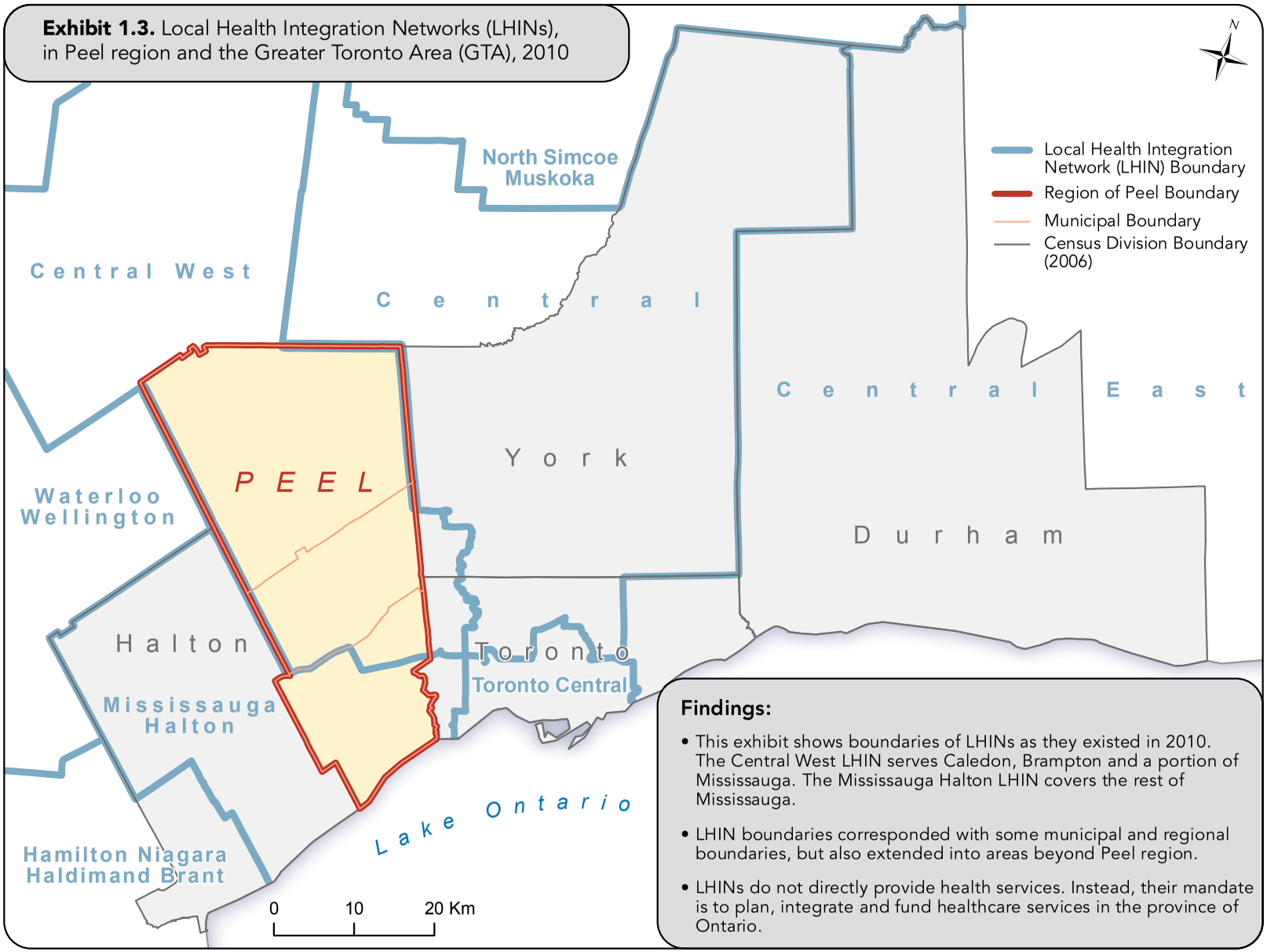
Exhibit 1.2. Demographic and social characteristics of Peel region, Greater Toronto Area (GTA) and Ontario, 2006

Sociodemographic composition	Peel	Mississauga	Brampton	Caledon	Greater Toronto Area (GTA)*	Ontario
Demographics (%)						
Total population	1,159,405	668,549	433,806	57,050	5,520,643	12,028,895
Age under 19 years	28.4	27.3	30.0	29.4	25.3	25.3
Age 65 years and older	9.0	9.8	7.8	9.0	12.0	12.9
Household Composition and Tenure						
Living alone, total population	4.6	5.3	3.6	3.6	8.1	9.2
Seniors (age 65 years and older) living alone	15.6	16.8	13.4	14.8	22.8	25.7
Lone parent families	15.3	16.1	15.2	10.6	16.8	15.8
One year population mobility**	14.3	13.6	16.3	7.6	14.0	13.4
Rented dwellings (%)	21.9	25.0	18.5	8.5	31.5	28.8
Immigration and Ethnocultural Characteristics (%)						
No knowledge of English/French	3.7	3.6	4.3	0.7	3.9	2.2
Recent immigrants (within 10 years)	18.5	20.2	17.9	1.9	15.0	8.7
Immigrants**	48.6	51.6	47.8	20.8	43.8	28.3
Visible minority**	50.0	49.0	57.0	7.2	40.5	22.8
Socioeconomic Status						
Median after-tax household ($) income a ***	62,181	61,083	62,470	73,857	57,807	52,177
Prevalence of low income after tax (% of individuals) a **	11.0	12.1	10.3	3.5	13.8	11.1
Unemployment rate (%)[a]	6.4	6.5	6.6	4.1	6.6	6.4
Not in labour force** (%)[a]	28.4	29.2	27.5	25.3	31.6	32.9
Less than high school education (%)[b]	12.3	10.2	15.7	10.7	11.6	13.6
With a university degree (%)[b]	28.6	33.8	21.4	21.2	32.8	26.0

* The Greater Toronto Area (GTA) consists of the regional municipalities of Durham, Halton, Peel and York, and the City of Toronto.
** For a definition of these terms, refer to Appendix 1.A of this chapter.
*** Exact median after-tax household income for the GTA is not available from Statistics Canada's Community Profiles feature. Therefore, this value is estimated. Values for all other areas are obtained directly from Statistics Canada's Community Profile feature for Peel region.

[a] Refers to population aged 15 years and older.
[b] Refers to population aged 25 to 64 years.

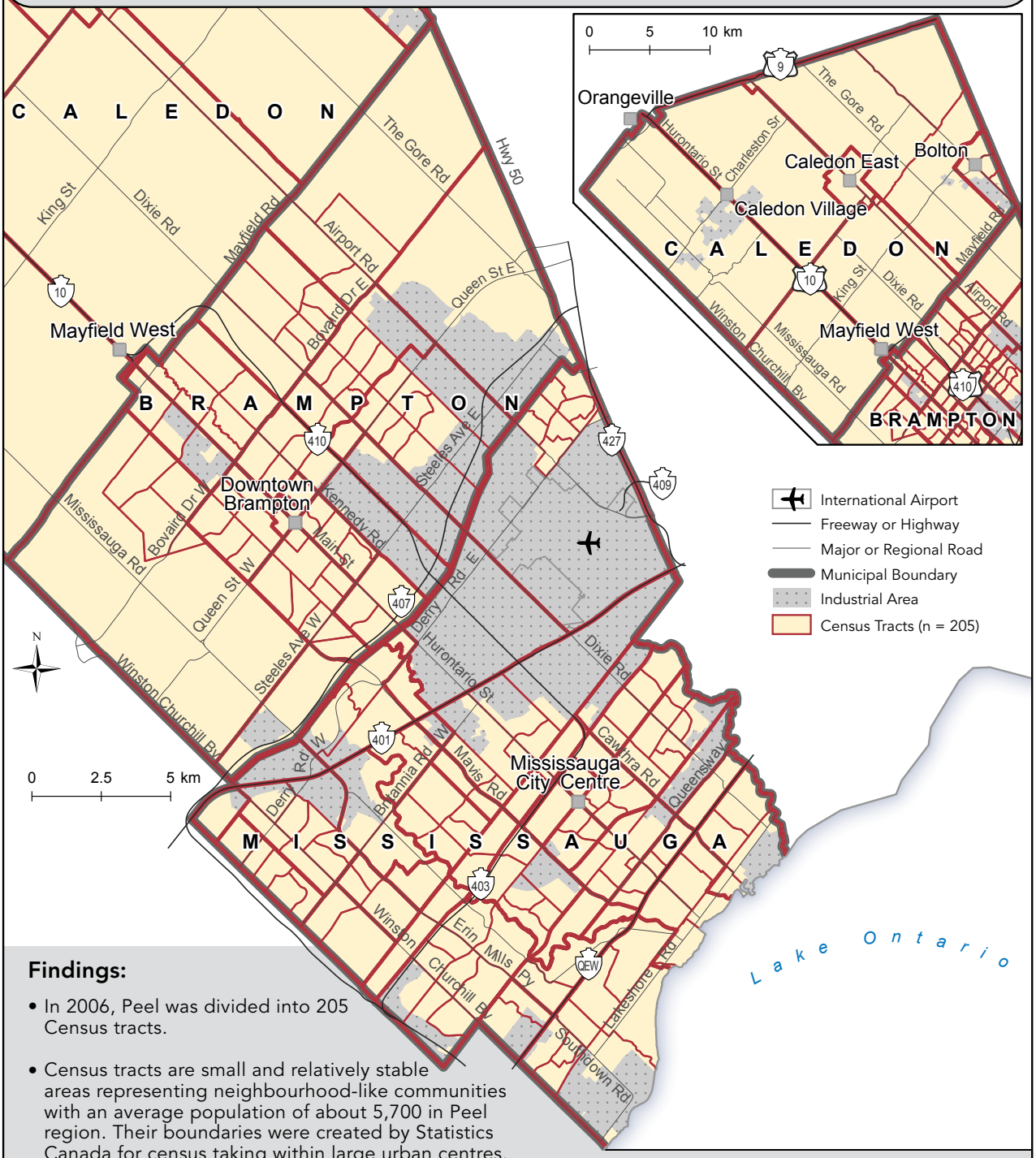
Exhibit 1.3. Local Health Integration Networks (LHINs), in Peel region and the Greater Toronto Area (GTA), 2010



Findings:

- This exhibit shows boundaries of LHINs as they existed in 2010. The Central West LHIN serves Caledon, Brampton and a portion of Mississauga. The Mississauga Halton LHIN covers the rest of Mississauga.
- LHIN boundaries corresponded with some municipal and regional boundaries, but also extended into areas beyond Peel region.
- LHINs do not directly provide health services. Instead, their mandate is to plan, integrate and fund healthcare services in the province of Ontario.

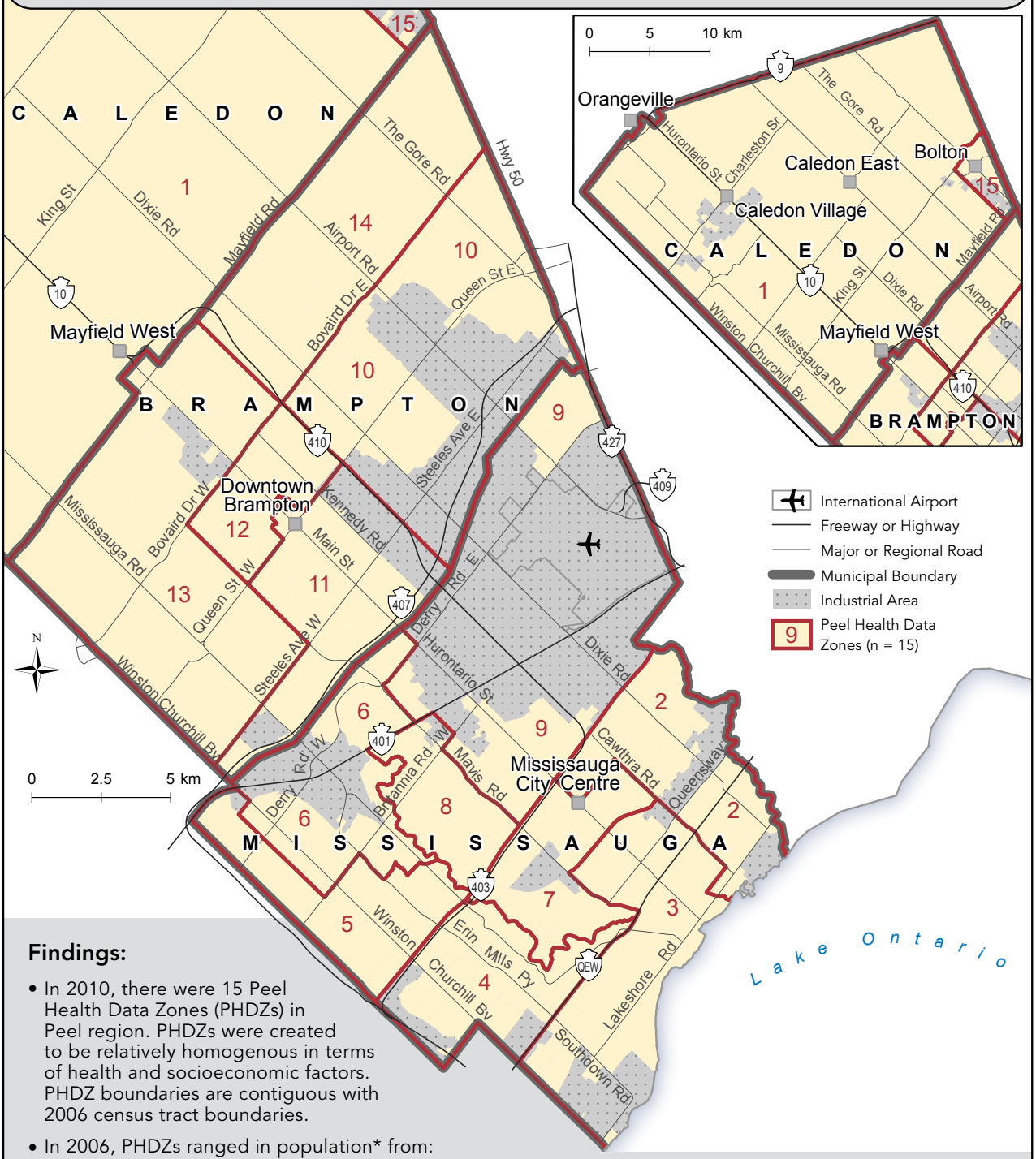
Exhibit 1.4. Major and regional roads, provincial highways and freeways [2010], and census tracts [2006], in Peel region



Findings:

- In 2006, Peel was divided into 205 Census tracts.
- Census tracts are small and relatively stable areas representing neighbourhood-like communities with an average population of about 5,700 in Peel region. Their boundaries were created by Statistics Canada for census taking within large urban centres.
- In 2010, seven provincial freeways and two major highways traversed Peel region.
- The Toronto Pearson International Airport and surrounding industrial lands occupied a large portion of east-central Peel. There were very few private dwellings in this area.

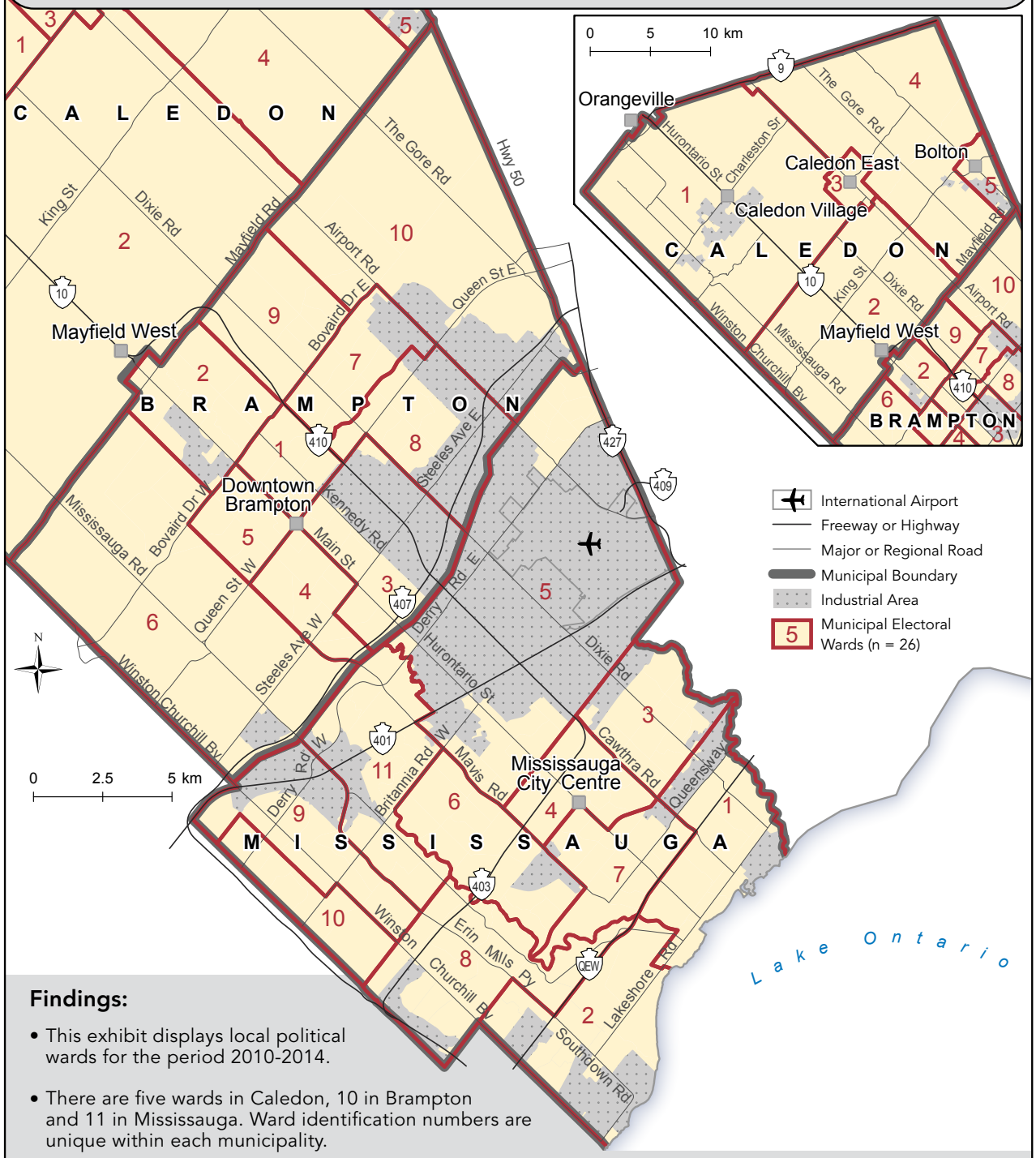
Exhibit 1.5. Peel Health Data Zones (PHDZs) [2010], in Peel region



Findings:

- In 2010, there were 15 Peel Health Data Zones (PHDZs) in Peel region. PHDZs were created to be relatively homogenous in terms of health and socioeconomic factors. PHDZ boundaries are contiguous with 2006 census tract boundaries.
- In 2006, PHDZs ranged in population* from:
  Mississauga (n=8): 62,900 – 104,100 (people per PHDZ)
  Brampton (n=5): 73,600 – 106,000
  Caledon (n=2): 22,700 – 34,300 (*Population numbers are rounded to the nearest '00)
- PHDZs are used in several chapters to display data that are not available at the census tract level.

Exhibit 1.6. Municipal electoral wards [2010], in Peel region



Findings:

- This exhibit displays local political wards for the period 2010-2014.
- There are five wards in Caledon, 10 in Brampton and 11 in Mississauga. Ward identification numbers are unique within each municipality.
- Ward and federal electoral district boundaries did not always align with each other, nor did they align with census tract, PHDZ or LHIN boundaries, adding to the challenges of inter-sectoral and municipal/regional/provincial/federal co-operative efforts.

Exhibit 1.7. Federal electoral districts [2006], in Peel region

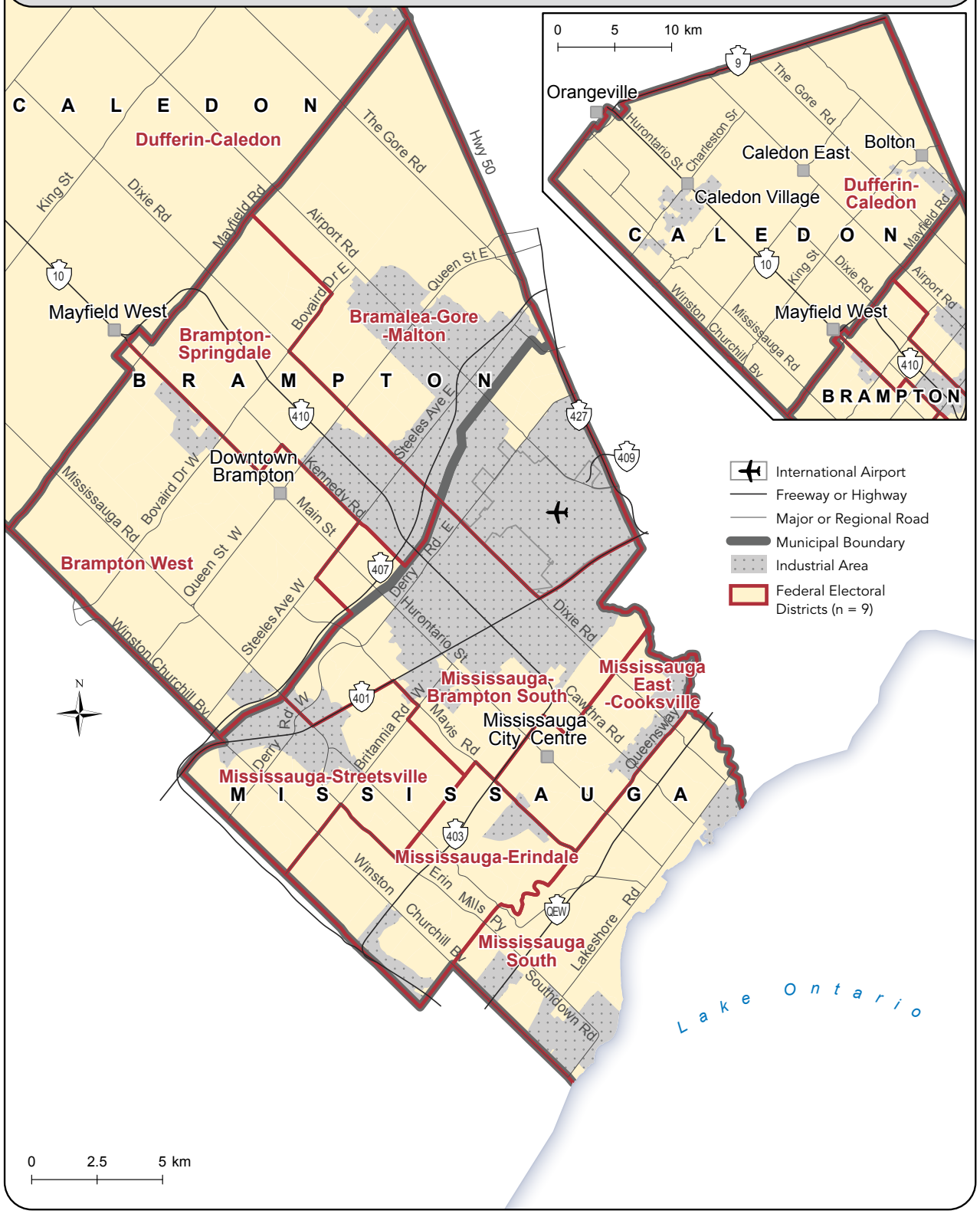
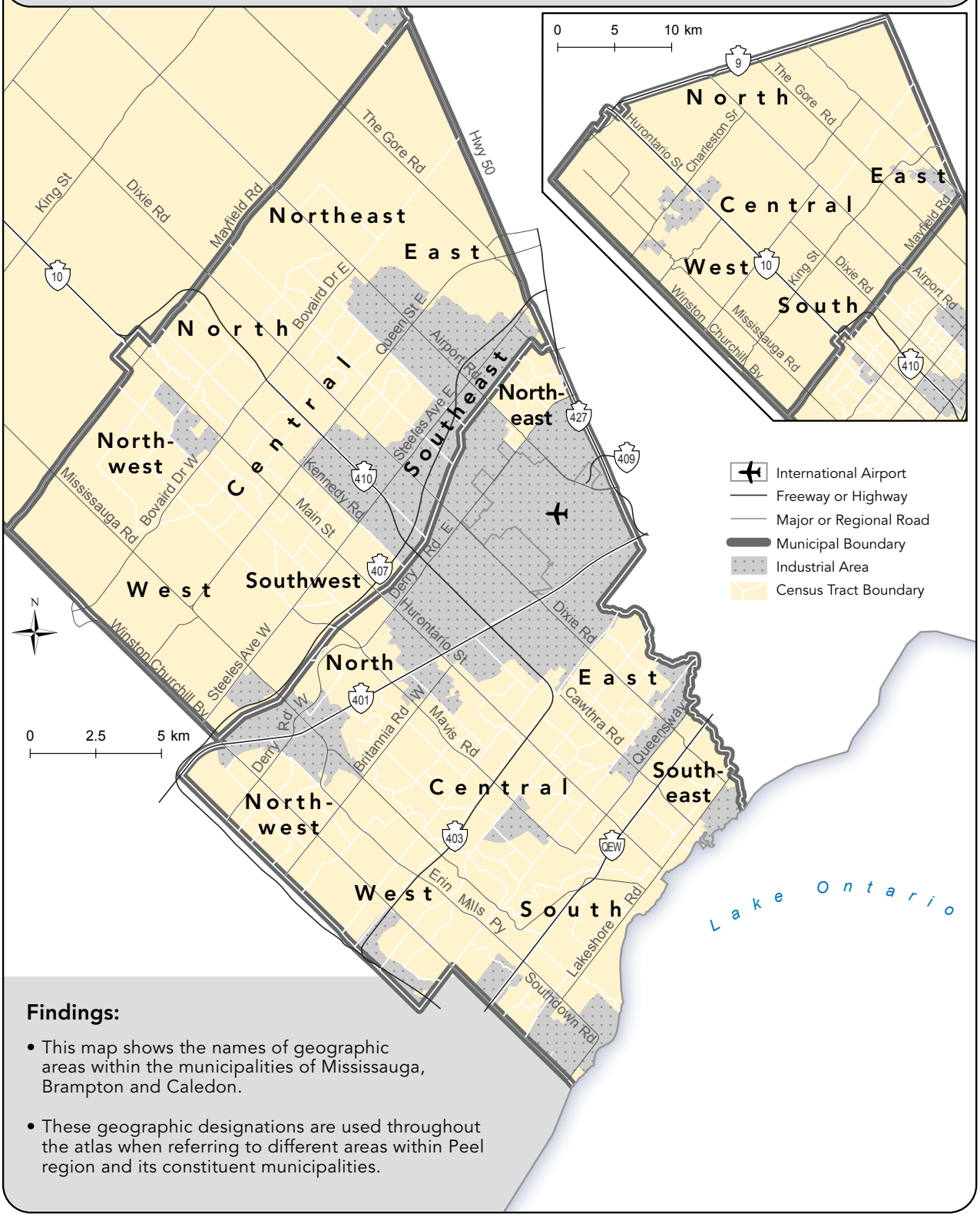


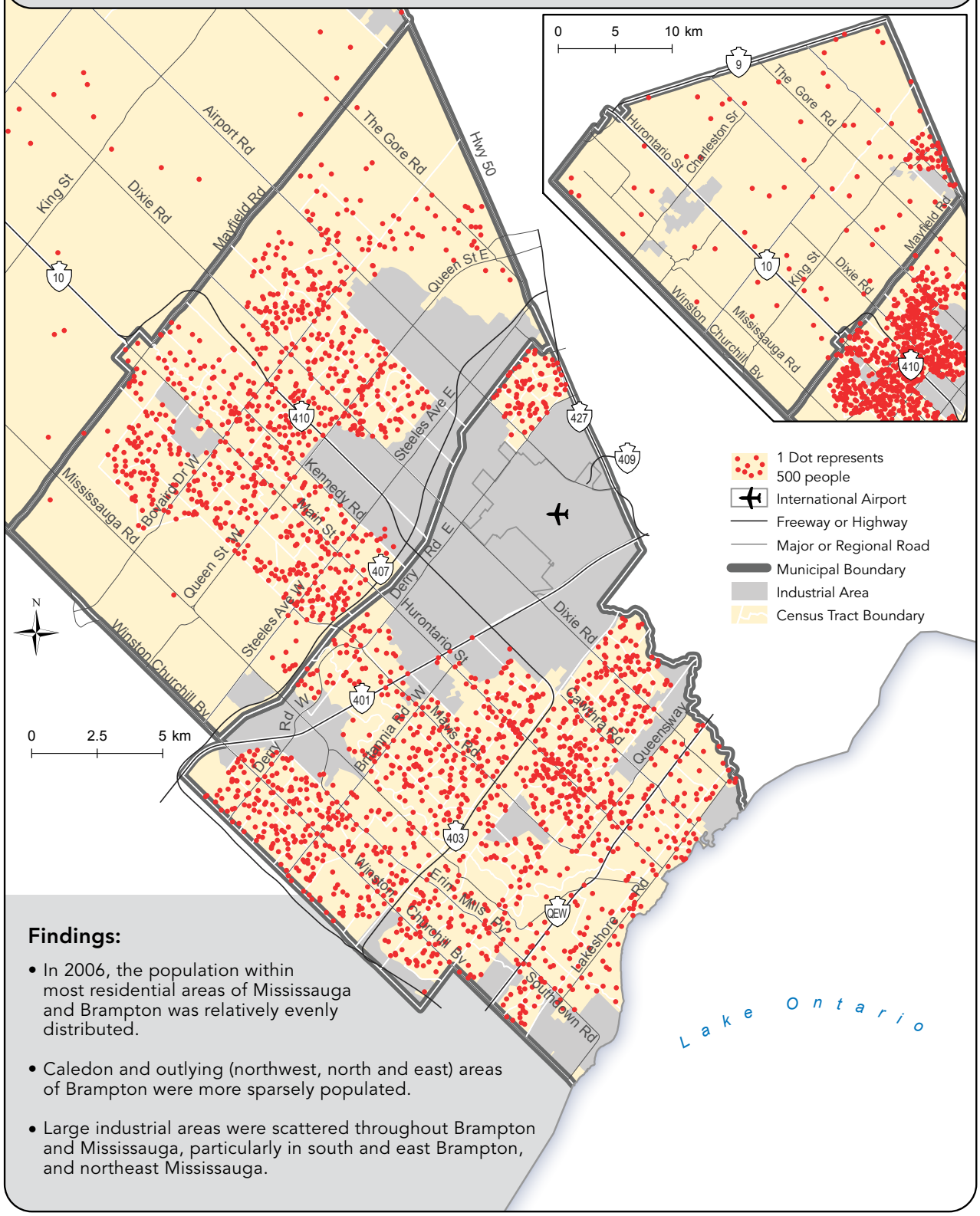
Exhibit 1.8. Designations of geographic areas within Mississauga, Brampton and Caledon [2011]



Findings:

- This map shows the names of geographic areas within the municipalities of Mississauga, Brampton and Caledon.
- These geographic designations are used throughout the atlas when referring to different areas within Peel region and its constituent municipalities.

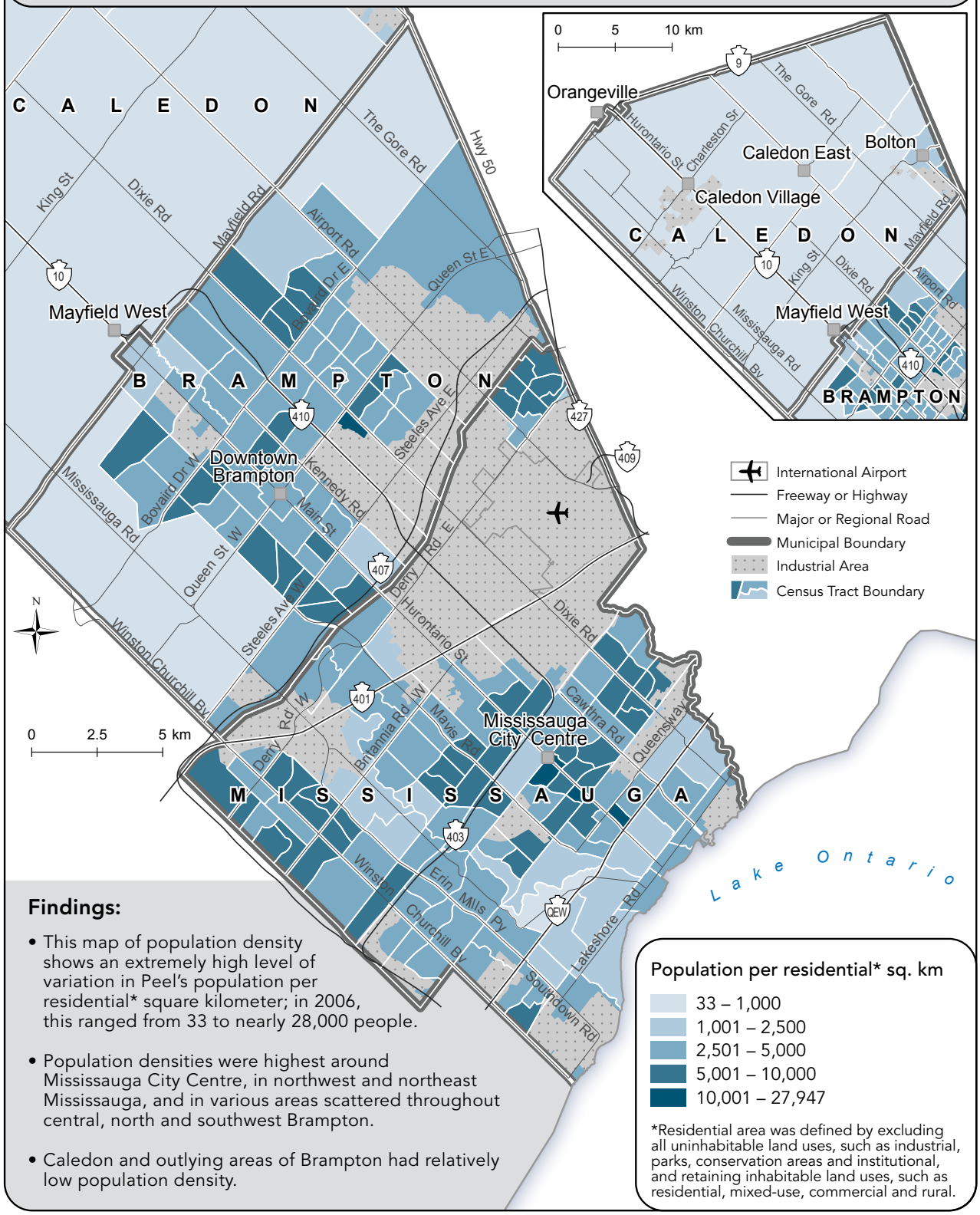
Exhibit 1.9. Distribution of the total population [2006], in Peel region



Findings:

- In 2006, the population within most residential areas of Mississauga and Brampton was relatively evenly distributed.
- Caledon and outlying (northwest, north and east) areas of Brampton were more sparsely populated.
- Large industrial areas were scattered throughout Brampton and Mississauga, particularly in south and east Brampton, and northeast Mississauga.

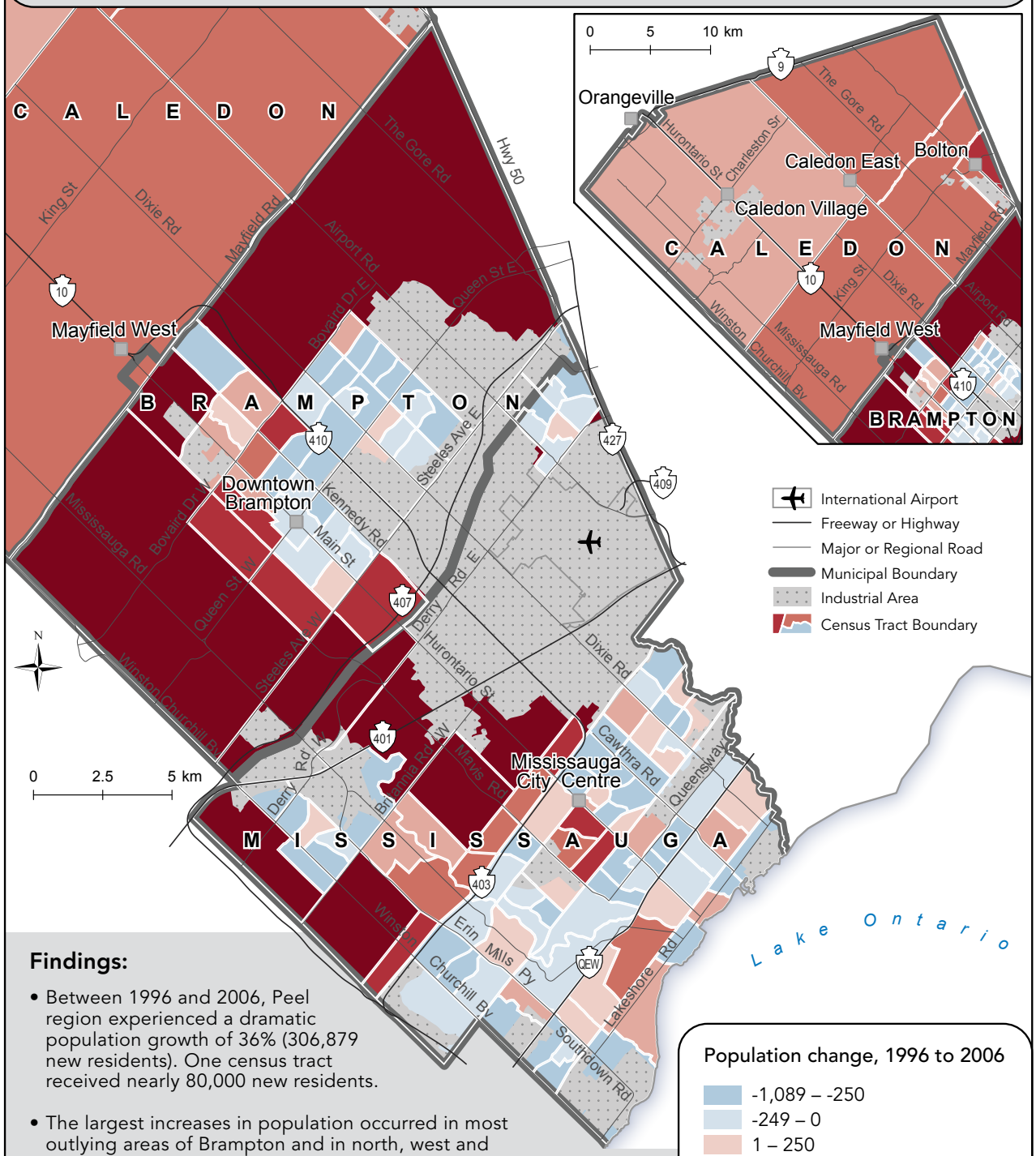
Exhibit 1.10. Total population per residential* area (persons per sq. km), by census tract [2006], in Peel region



Findings:

- This map of population density shows an extremely high level of variation in Peel's population per residential* square kilometer; in 2006, this ranged from 33 to nearly 28,000 people.
- Population densities were highest around Mississauga City Centre, in northwest and northeast Mississauga, and in various areas scattered throughout central, north and southwest Brampton.
- Caledon and outlying areas of Brampton had relatively low population density.

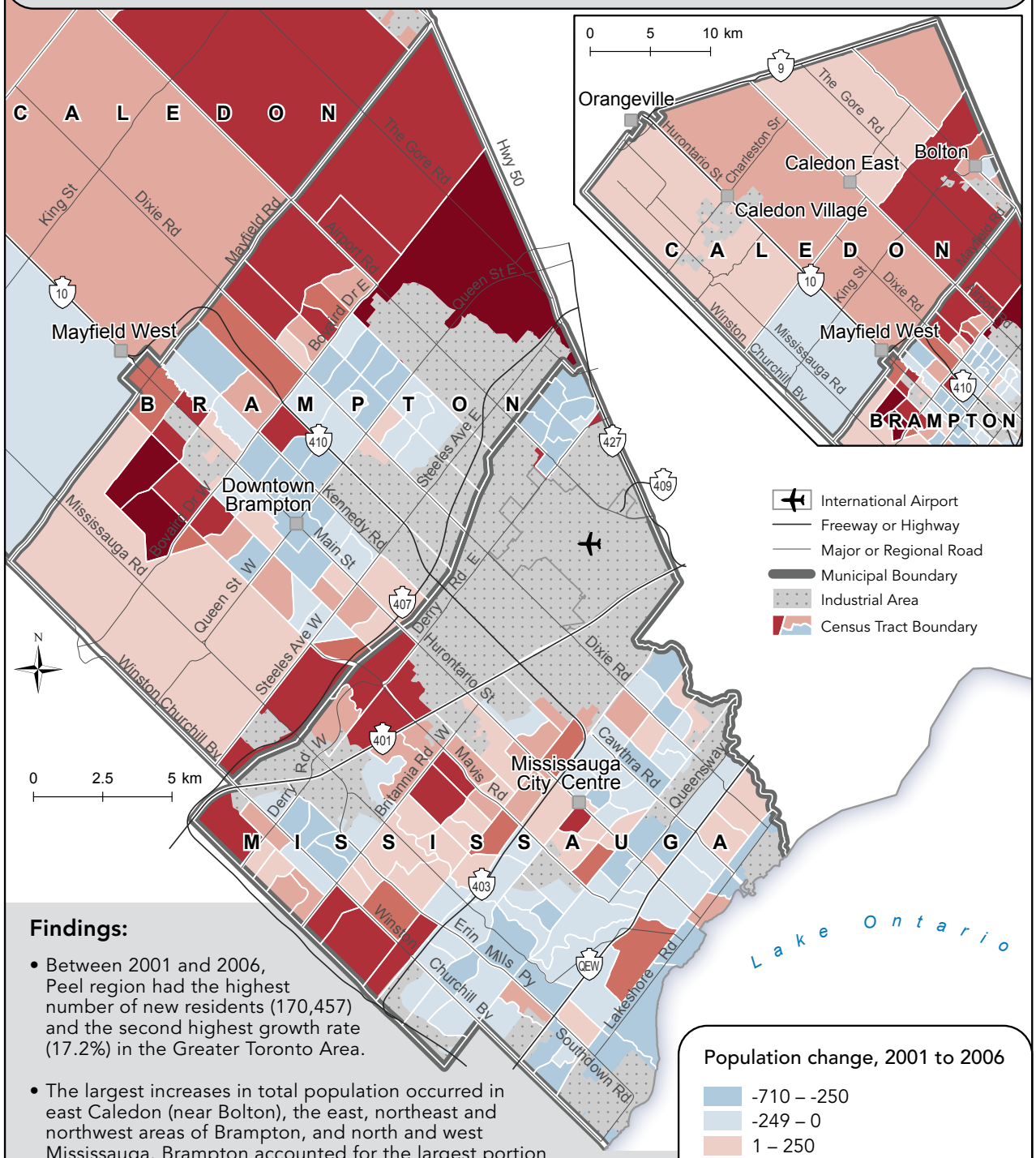
Exhibit 1.11. Change in the total population (number of persons) from 1996 to 2006, by census tract [1996], in Peel region



Findings:

- Between 1996 and 2006, Peel region experienced a dramatic population growth of 36% (306,879 new residents). One census tract received nearly 80,000 new residents.
- The largest increases in population occurred in most outlying areas of Brampton and in north, west and northwest Mississauga. Most parts of Caledon experienced a more moderate population growth.
- Core areas of Mississauga and Brampton experienced either no increase in population growth or a slight decrease.

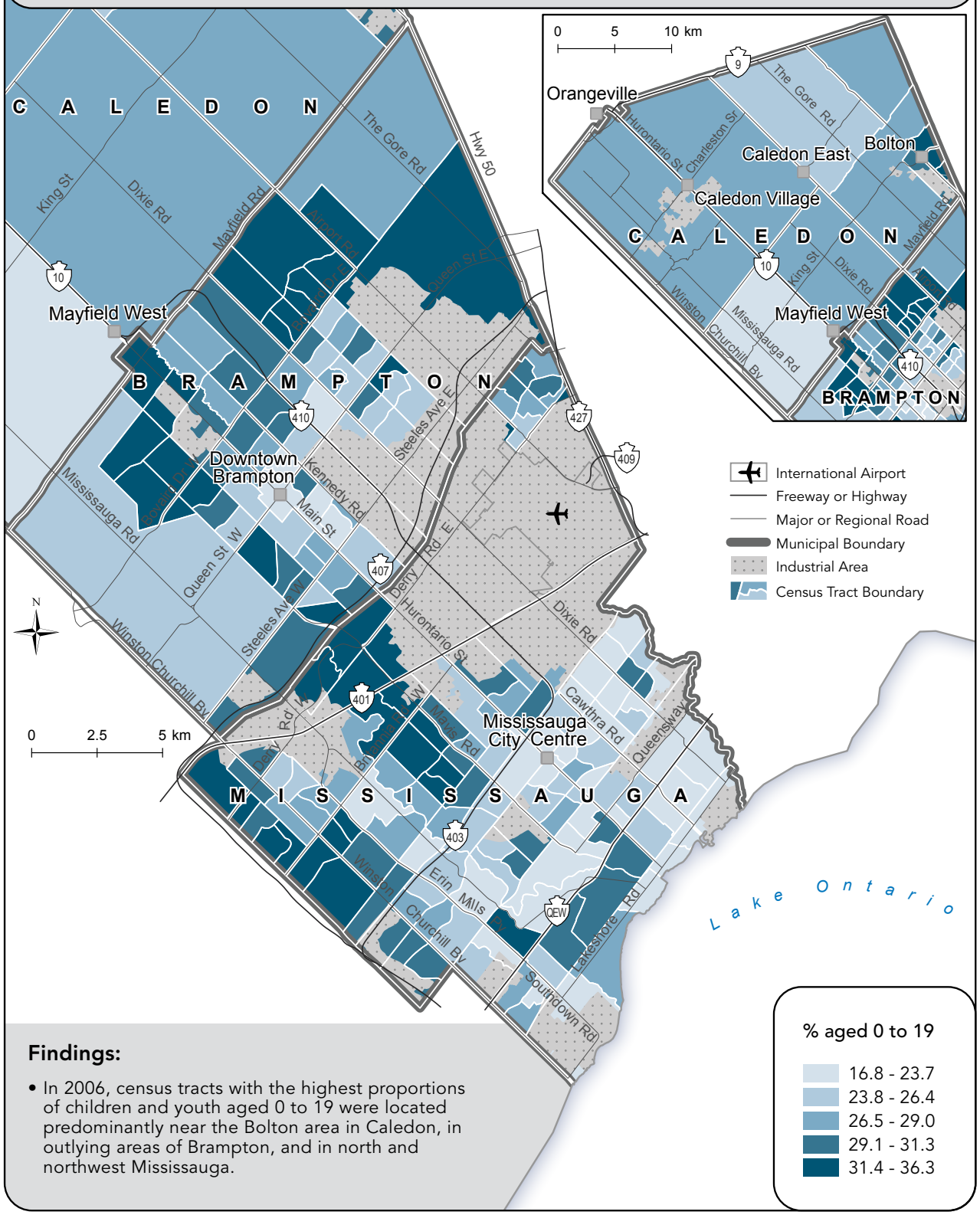
Exhibit 1.12. Change in the total population (number of persons) from 2001 to 2006, by census tract [2006], in Peel region



Findings:

- Between 2001 and 2006, Peel region had the highest number of new residents (170,457) and the second highest growth rate (17.2%) in the Greater Toronto Area.
- The largest increases in total population occurred in east Caledon (near Bolton), the east, northeast and northwest areas of Brampton, and north and west Mississauga. Brampton accounted for the largest portion (64%) of the total population growth in Peel in this time period.
- Many areas of Caledon and inner areas of Mississauga and Brampton experienced either no increase or a slight decrease in population.

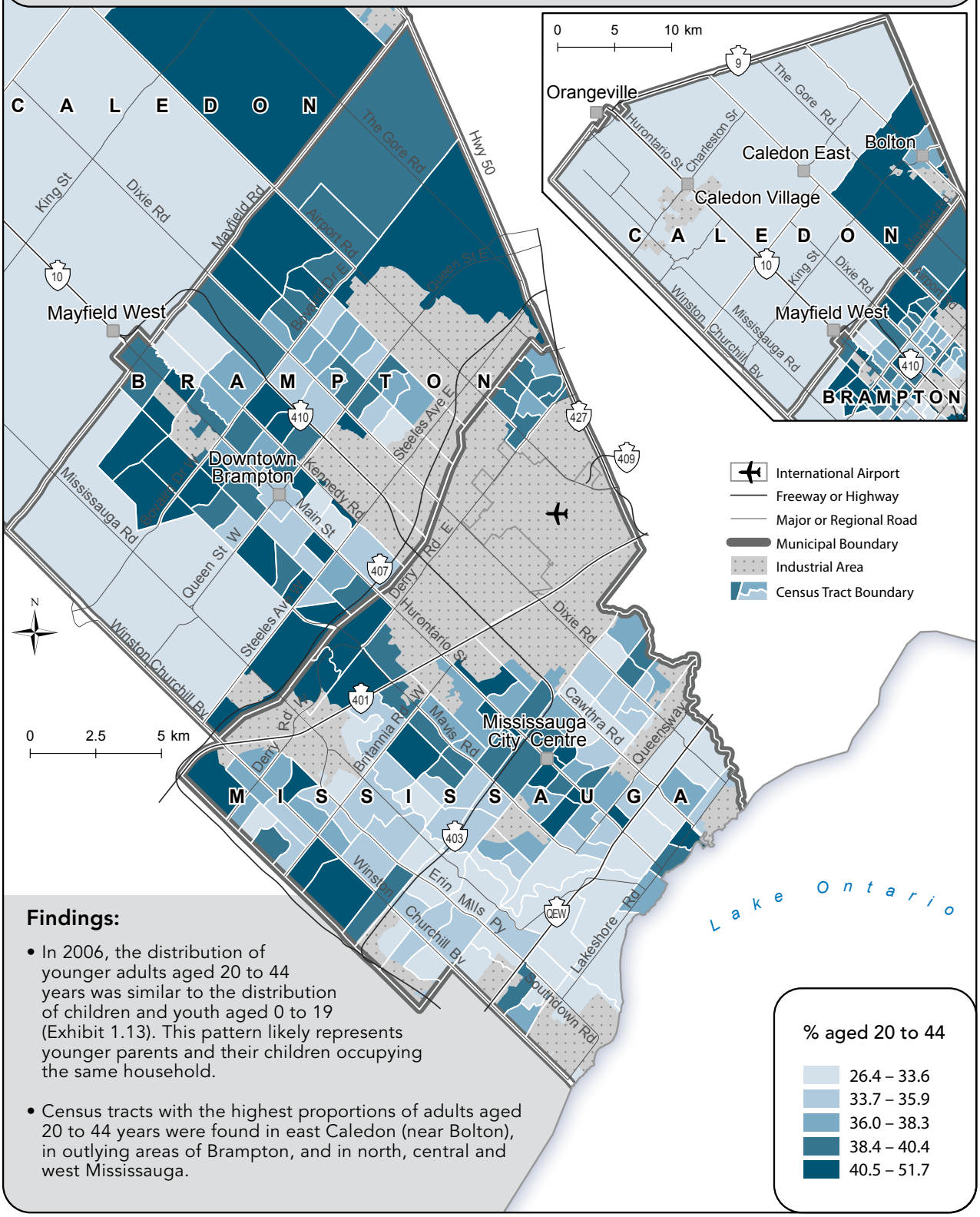
Exhibit 1.13. Population aged 0 to 19, as a per cent of the total population, by census tract [2006], in Peel region



Findings:

- In 2006, census tracts with the highest proportions of children and youth aged 0 to 19 were located predominantly near the Bolton area in Caledon, in outlying areas of Brampton, and in north and northwest Mississauga.

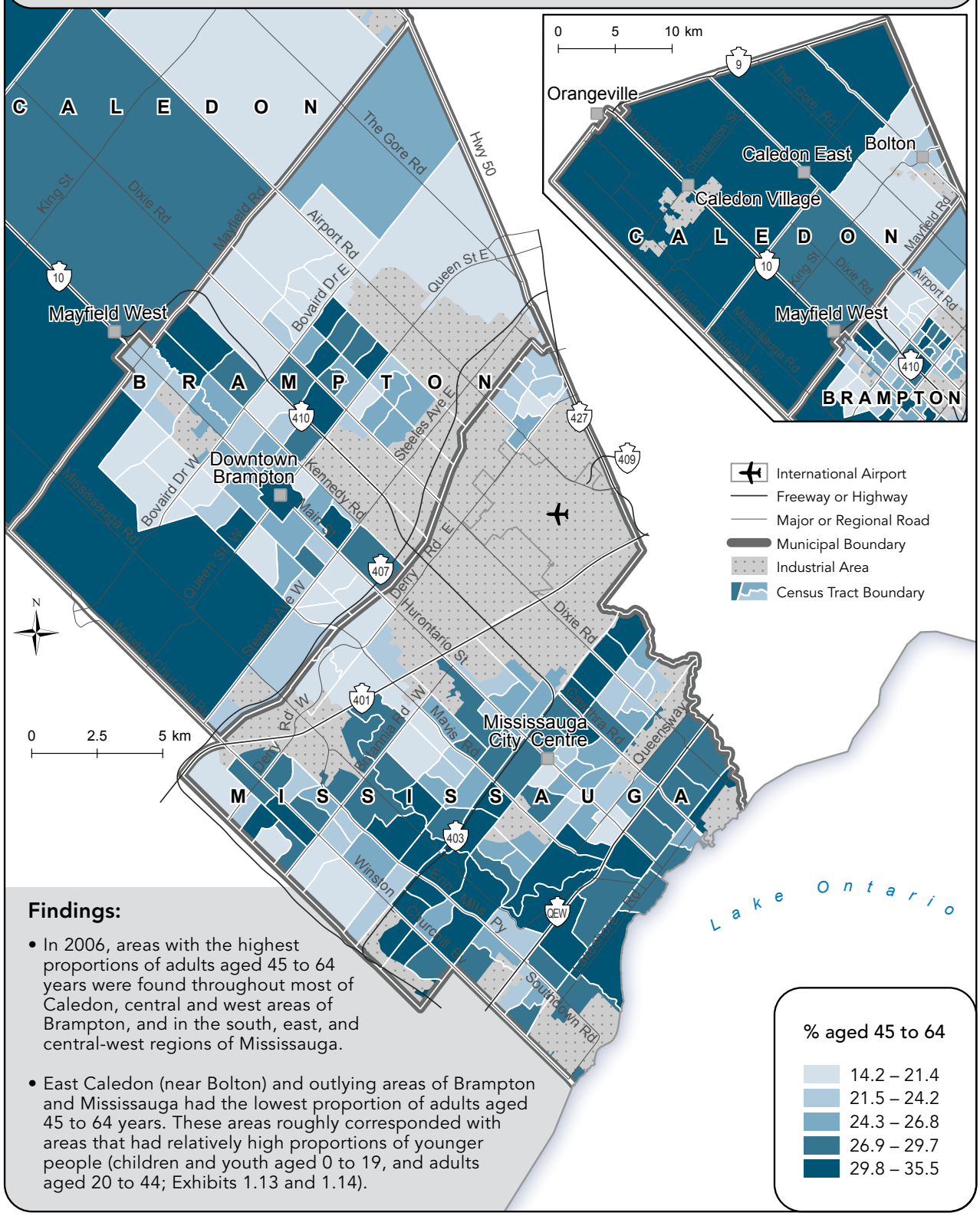
Exhibit 1.14. Population aged 20 to 44, as a per cent of the total population, by census tract [2006], in Peel region



Findings:

- In 2006, the distribution of younger adults aged 20 to 44 years was similar to the distribution of children and youth aged 0 to 19 (Exhibit 1.13). This pattern likely represents younger parents and their children occupying the same household.
- Census tracts with the highest proportions of adults aged 20 to 44 years were found in east Caledon (near Bolton), in outlying areas of Brampton, and in north, central and west Mississauga.

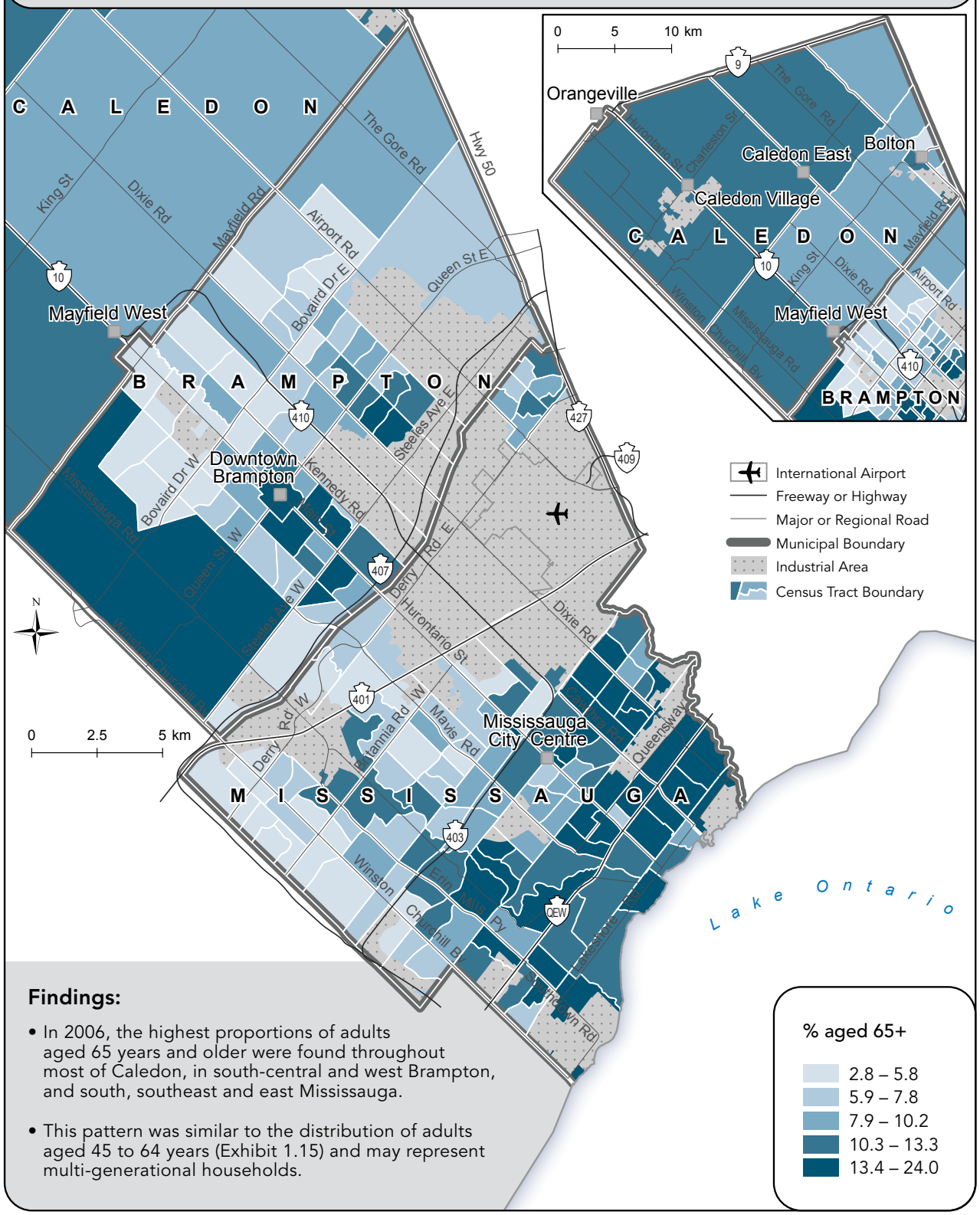
Exhibit 1.15. Population aged 45 to 64, as a per cent of the total population, by census tract [2006], in Peel region



Findings:

- In 2006, areas with the highest proportions of adults aged 45 to 64 years were found throughout most of Caledon, central and west areas of Brampton, and in the south, east, and central-west regions of Mississauga.
- East Caledon (near Bolton) and outlying areas of Brampton and Mississauga had the lowest proportion of adults aged 45 to 64 years. These areas roughly corresponded with areas that had relatively high proportions of younger people (children and youth aged 0 to 19, and adults aged 20 to 44; Exhibits 1.13 and 1.14).

Exhibit 1.16. Population aged 65 and older, as a per cent of the total population, by census tract [2006], in Peel region



Findings:

- In 2006, the highest proportions of adults aged 65 years and older were found throughout most of Caledon, in south-central and west Brampton, and south, southeast and east Mississauga.
- This pattern was similar to the distribution of adults aged 45 to 64 years (Exhibit 1.15) and may represent multi-generational households.

DISCUSSION

Between 1996 and 2006, Peel region experienced significant population growth driven primarily by immigration. Most of this rapid population increase occurred in the outlying and recently developed suburban areas of Brampton and Mississauga. During the same time period, many older and more centrally located neighbourhoods within these municipalities experienced a population decline. In areas where the total population decreased, the dominant demographic group was persons aged 45 and older – many of whom may be "empty-nesters" and seniors living as couples, alone or in multi-generational households. This trend may explain the declining population in these areas over time. Conversely, the dominant demographic groups in many rapidly expanding suburban areas of Brampton and Mississauga were adults aged 20 to 44 years and children and youth under 20 years of age. Many of the recently constructed suburban developments in these areas provide affordable housing options for young families, thus contributing to their rapid growth.

CONCLUSIONS AND IMPLICATIONS

Diabetes is a rapidly increasing health concern that disproportionately affects ethno-racial groups of non-European heritage, recent immigrants and low-income populations – groups that are well represented in Peel region. The growing rate of obesity is a major contributor to the recent rise in diabetes. Our society has become increasingly sedentary and has abundant access to calorie-dense, highly-processed foods.

There is growing evidence that neighbourhood environments and resources are important for providing access to both healthy and unhealthy foods, opportunities for physical activity, and community-based health services, all of which play a role in the risk of obesity and diabetes. The spatial arrangement of streets, sidewalks, stores, services and workplaces shapes peoples' opportunities to access healthy foods and to be physically active on a daily basis. Sprawling low-density communities that have become a growing trend in Peel during recent decades make residents dependent on cars and thus limit opportunities to incorporate physical activity (e.g., walking or cycling) into daily routines. The high rates of greenfield development in Peel, as well as the need to redevelop existing neighbourhoods to make them more supportive of healthy eating and daily physical activity, provide a prime opportunity to influence and mitigate some of the environmental determinants of diabetes.

This atlas makes extensive use of spatial methods for locating and visualizing neighbourhood environments, resources and rates of diabetes in relation to each other in space. Census tracts (2006) were used as proxies of neighbourhoods to examine these relationships within Peel, a region with a highly diverse and rapidly growing population, diverse resources and a largely suburban environment.

APPENDIX 1.A – RESEARCH METHODOLOGY

Data Sources

- Boundaries of 2006 Statistics Canada census divisions, census subdivisions (municipalities) and census tracts were obtained from Statistics Canada. Demographic, socioeconomic, language, immigration and visible minority data were obtained from the 2006 Canadian census using standard definitions created by Statistics Canada.
- Boundaries of Local Health Integration Networks (LHINs) were obtained from the Ministry of Health and Long-Term Care.
- Boundaries of local political wards and federal electoral districts were provided by the Region of Peel (Integrated Planning).
- Peel Health Data Zone (PHDZ) boundaries were provided by Region of Peel (Public Health).

- Data on highways and major roads within Peel region and surrounding areas, location of regional nodes, rural service centres and other settlement areas were provided by the Region of Peel (Integrated Planning).
- Municipal Property Assessment Corporation (MPAC) lot parcel data and other relevant generalized land use information were provided by the Region of Peel (Integrated Planning).

DEFINITIONS

The following definitions are derived directly from the Statistics Canada 2006 Census dictionary.[56]

- Private households refer to a person or a group of persons (other than foreign residents) who occupy a private dwelling and who do not have a usual place of residence elsewhere in Canada.
- An immigrant is defined as a person born outside of Canada who has been granted the right to live in Canada permanently by immigration authorities.
- Recent immigrants refers to persons who gained immigrant status in the preceding 10-year period (i.e., between 1996 and 2006).
- One year population mobility refers to the percentage of persons who, on Census Day (May 16, 2006), were living at a different address than the one in which they resided one year earlier.
- Not in labour force refers to persons who were neither employed nor unemployed on the day of the Census. This includes students, homemakers, retirees and persons who could not work because of a long-term illness or disability.
- Visible minorities are defined as "persons, other than Aboriginal persons, who are non-white in race or colour," in accordance with Canada's Employment Equity Act.
- Prevalence of low income after tax is defined as the percentage of economic families or persons not in economic families who spend 20% more of their after-tax income than average on food, shelter and clothing.

ANALYSIS

The distribution of the total population of Peel region was displayed as a dot density map with each dot representing 500 people (for a description of map types used in this atlas, refer to "How to Read the Maps" section, Page VIII). To maintain confidentiality, dots were placed at random locations within the residential portion of each census tract and not in the actual location of residential addresses. Population density per square kilometre was shown on choropleth (shaded) maps. This mapping technique was also used to depict the change in total population over time and to depict patterns of population composition by age. The residential area used to generate the dot density map was also used as the denominator to calculate population density per residential square kilometre. This residential area was defined using Municipal Property Assessment Corporation (MPAC) lot parcel data. All lots with uninhabitable land uses, such as industrial, conservation area, park, government, institutional and unclassified, were removed, leaving only potentially-inhabitable lots that that could be home to Peel region residents. Residential areas thus included both vacant and occupied residential, mixed-use, rural and commercial lots. Population density per residential square kilometre within each census tract was calculated as total population divided by the residential area.

APPENDIX 1.B – PEEL HEALTH DATA ZONES (PHDZ)

The Peel Health Data Zones (PHDZ) are contiguous zones that use census tracts as a building block and where plausible, respect natural and man-made boundaries such as rivers, highways and municipal boundaries (i.e., data zones are entirely within municipalities).

BACKGROUND

The need for health status data to be reported at areas of geography smaller than the municipality has surfaced numerous times over the past several years in Peel. Data at smaller areas of geography can be helpful in planning programs and services.

In 2009, Peel Public Health commissioned a project to develop a statistical method to delineate neighbourhood-based "Data Zones" within the region. The purpose of the project was to provide a standard set of data zone boundaries to allow for the geographic assessment of health status at a level that balances individual privacy and analysis for decision-making. The resulting data zones were intended to be used to describe selected health issues and outcomes across spatial areas and to identify relationships between inequalities in neighbourhoods and health disparities.

Specifically, PHDZ were developed to:

- Spatially describe selected health issues and outcomes
- Analyze and report differences in health outcomes between spatial areas
- Serve as a communications vehicle
- Assist with strategic planning
- Monitor relevant trends over time

The methods used to delineate PHDZ were developed by Adam Drackley, K. Bruce Newbold and Christian Taylor from McMaster University. The content of this appendix was adapted from their final report to the Region of Peel Health Services.

METHODOLOGY

Census tracts were used as the building blocks for the data zones given the ease of data availability at this scale. A broad set of census variables were considered in the analysis.

Principal component analysis (PCA) with a varimax orthogonal rotation was then used to summarize variables and build indices using SAS 9.2. The central idea of PCA is to reduce the dimensionality of a data set that consists of a large number of interrelated variables, while retaining the variations present in the data set.[65] In cases where two variables were highly correlated with each other (indicating that they are likely measuring the same outcome), one variable was removed from further consideration.

Overall, the first two factors explained approximately 65% of the variance, and appear to reflect comparatively undesirable conditions defined by the determinants of health literature. Two major factors emerged from the PCA. The first principal component, which explained 45% of the variance, is labelled as "recent immigrants" and includes the variables seemingly indicating a high recent immigrant population, such as no knowledge of either English or French, percent unemployed, no high school, and low income. The second component, which explained 20% of the variance, was labelled as "low socioeconomic status". Principle component analysis reduced the number of variables suspected to be likely indicators of health or socioeconomic status from 21 to 11 variables (see Table 1 for variables retained).

Following the selection of variables used to characterize and contextualize census tracts relative to health outcomes, GIS and spatial analysis techniques were used to map and construct data zones within the Region using the Getis-Ord (Gi) statistic (1992).[66] The Gi statistic identifies "hot-spots" or statistically significant clusters of similar census tracts, providing a statistically robust definition of neighbourhoods. The delineation of data zones was further facilitated by a structured decision-tree approach, "ground-truthing" with staff from Peel, and the overlay of road and other physical landforms to ensure appropriate representation.

For detailed discussion of the techniques used to delineate PHDZ, please refer to the report entitled, A Mixed-Methods Approach to Defining Socially-Based Spatial Boundaries in the Region of Peel.[67]

Table 1. Variables Retained in the Principal Component Analysis

Factor	Definition
Housing	% Renters % Owner households spending 30% or more of household income on major payments % Households in need of major repairs
Socioeconomic	% Aged 20+ with no High School % Unemployed (Prior to May 16, 2006) % Low Income (Before tax, 2005)*
Sociodemographic	% No Knowledge of English or French % Separated or Divorced % Widowed % Recent immigrants (Immigrated to Canada between 2001 and Census Day, May 16, 2006) (Census, 2006) % Lone Female Parent Family

* Although the measure of low income after tax could also be used and shows the re-distribution of income, before tax income is used in this analysis as it provides the opportunity to compare results with prior census periods. After tax income – was "new" with the 2006 Census. Sensitivity analysis – testing model fit with either before or after tax income did not alter results in a substantive manner.

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Chapter 2

Patterns of OVERWEIGHT/OBESITY and Diabetes Prevalence

INSIDE

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HIGHLIGHTS

Issue

- Diabetes is a growing public health problem with serious implications for health. Excess body weight is a major risk factor for developing diabetes.
- The purpose of this chapter is to examine patterns of prevalence of overweight/obesity and diabetes in Peel region.

Key Findings

- In 2003–08, rates of overweight and obesity in Peel were higher than in the Greater Toronto Area (GTA). Within Peel, rates were highest in Caledon (particularly near Bolton), followed by Brampton, and were lowest in Mississauga.
- Rates of diabetes in Peel were higher than in the GTA and the province as a whole. In 2007, one in 10 adults in Peel had diagnosed diabetes.
- The majority of neighbourhoods with very high rates of diabetes were located in Brampton and a smaller number was located in Mississauga.
- There was no clear correspondence between patterns of overweight/obesity and diabetes. This is likely due in large part to the distribution of ethnocultural groups across Peel, many of which develop diabetes at lower body weights.
- Higher levels of affluence and a higher proportion of the population of European descent in both Caledon and south Mississauga likely acted as protective factors against diabetes despite high rates of overweight/obesity in these areas.

Implications

- In the coming years, adequate resources will be needed to manage the rising numbers of people living with diabetes in Peel (and elsewhere) in an effort to reduce the burden of this disease and its complications.
- High-risk neighbourhoods (those with a greater prevalence of diabetes or overweight/obesity) are ideal targets for community-based interventions aimed at preventing and better managing diabetes. Such interventions should be carefully targeted to particular sub-populations belonging to the many ethno-culturally diverse groups in Peel, that are at higher risk for contracting diabetes.

INTRODUCTION

Increasing rates of overweight and obesity have played a central role in the rapid rise in diabetes and cardiovascular disease across North America.[1, 2] The World Health Organization (WHO) defines overweight and obesity as conditions of excess or abnormally high levels of body fat that may be harmful to health.[3]

Measurement of overweight/obesity

At the individual and population levels, overweight and obesity are most commonly measured using Body Mass Index (BMI). This is a simple index based on a person's height and weight that is an international standard for determining whether an individual's weight is in a healthy range based on his or her height.

Despite its widespread use, BMI serves as a rough guide because it does not reflect the distribution of fat within the body and may not correspond to the same proportion of body fat in different individuals. Other measures such as skin-fold thickness and waist circumference are correlated with BMI, but measure body fat more directly, including where it is concentrated in the body. Waist circumference is a particularly important measure because it measures levels of abdominal fat. Abdominal obesity, or excess fat around the body midsection, is an independent risk factor for serious health problems such as heart disease and type 2 diabetes.[4, 5]

The relationship between BMI, body fat and its distribution in the body differs by ethnic origin. For example, persons of East/Southeast Asian and South Asian descent tend to have lower BMI compared with individuals of European ancestry.[6] Despite their lower BMI, these groups are more likely to have higher levels of body fat and abdominal obesity.[7, 8] As a result, the WHO and the International Diabetes Federation recommend using lower cut-off points for BMI and waist circumference as markers of increased health risk among Asian populations.[9, 10] However, because waist circumference is challenging to measure in the general population, physicians and researchers use this measure less commonly than the BMI. Due to lack of available data, patterns of waist circumference are not presented in this atlas for Peel.

Prevalence patterns of overweight/obesity

More than one in three Canadian adults are overweight and nearly one in four are obese.[11, 12] In the past few decades, the waistlines of Canadian adults and youth have also grown significantly.[11, 13] Between 1981 and 2007–09, the prevalence of abdominal obesity among Canadian adults increased threefold (from 11.4% to 35.6%).[13] Adult women's waistlines grew on average by 10 centimetres or more compared with five centimetres or more in adult men.[11] In young adults aged 20 to 39, the prevalence of abdominal obesity has more than quadrupled; among youth aged 12 to 19, its prevalence increased sevenfold (from 1.8% to 12.8%).[13]

Prevalence patterns of diabetes

Diabetes has become one of the most common chronic conditions in our society, largely because of the rising prevalence of type 2 diabetes – the form that accounts for the majority of cases (90% to 95%).[14] Type 2 diabetes results from a complex interaction between genetic and environmental factors that lead to a state of insulin resistance. Insulin resistance refers to a condition in which the body's tissues are not able to respond normally to circulating levels of the hormone insulin. With age, the transition from insulin resistance to type 2 diabetes becomes more likely. Thus, a disproportionate number of people with diabetes are from older age groups.[15] Also, diabetes is diagnosed more commonly in men than in women.

In addition to an aging population, overweight and obesity are considered to be the main drivers of the rising rates of diabetes across North America. Other well-recognized risk factors at the individual level include having a family history of diabetes, lower socio-economic status, non-white ethnicity, low levels of physical activity and an unhealthy diet (see Chapter 1 for a more detailed overview of risk factors for diabetes).

Over the past two decades, the number of people with diabetes in Canada and Ontario has increased dramatically. The prevalence of diabetes in Ontario increased by 69% in the 10 years between 1994/95 and 2004/05 and has already surpassed predictions made for global prevalence for the year 2030 by the Word Health Organization.[16] In 2006/07, approximately two million Canadians were living with diabetes.[17] In 2013, an estimated 3.1 million Canadian (8.6%) are living with diagnosed diabetes.[18] Projections indicate that by 2020, diabetes prevalence will rise to 4.2 million (10.8%).[18]

Overweight/obesity and diabetes

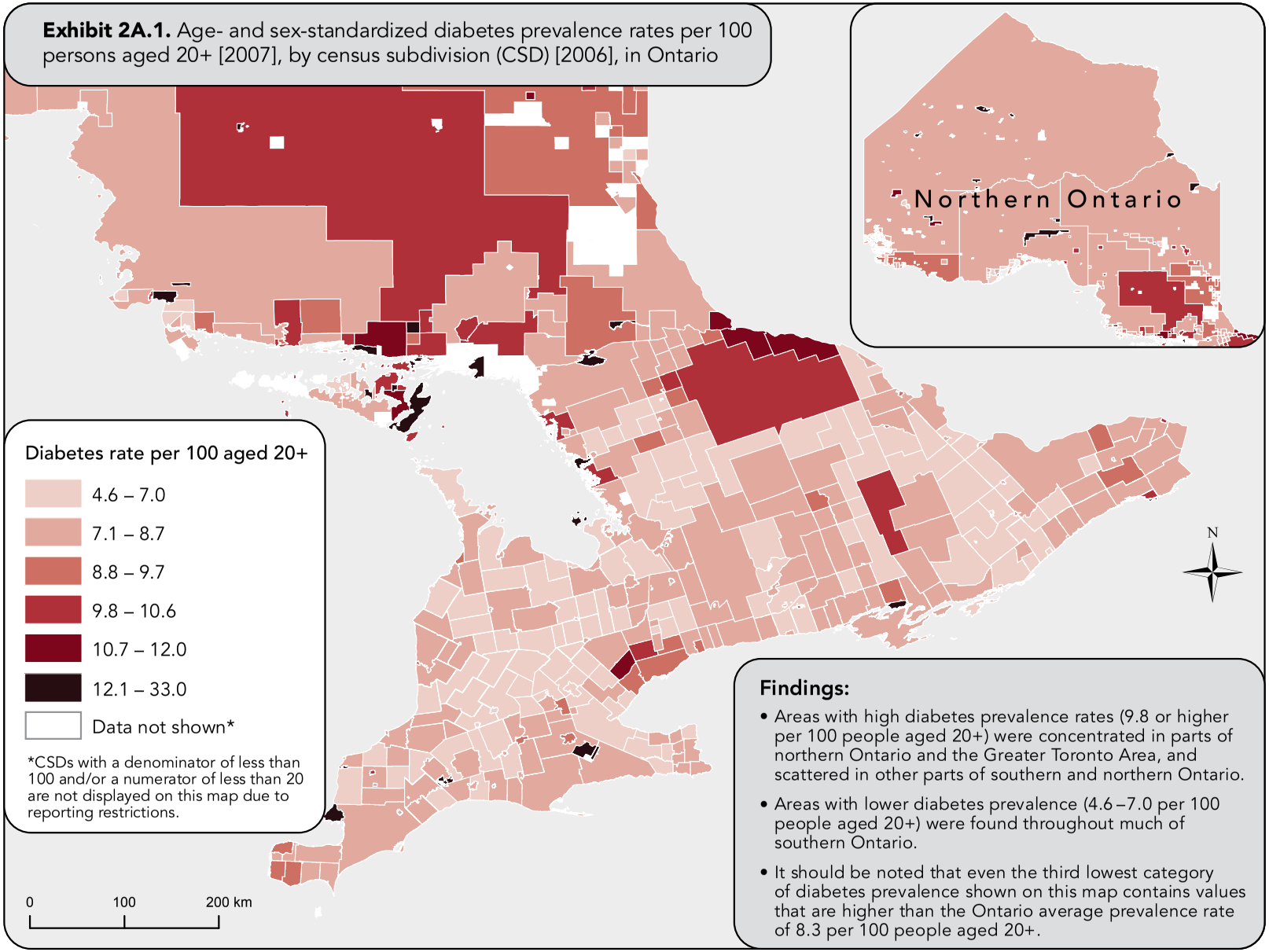
The likelihood of developing diabetes is more than seven times higher among individuals whose BMI is in the obese category (BMI ≥30) and three times as high among those whose BMI is classified as overweight (BMI of 25.0 to 29.9) compared with individuals whose BMI is in the normal range (BMI of 18.5 to 24.9).[19] This association, however, is not the same for all ethnic groups: South Asians, for example, have a genetic susceptibility to developing diabetes at a lower BMI and younger ages compared to White Caucasians.[7, 20]

With the rise in obesity and waistlines in all age groups, the onset of diabetes has now shifted toward younger ages. In Canada and the United States, the greatest relative increase in new diagnoses of diabetes has occurred among adults under 50 years of age.[1, 16, 21] In this age group, the number of people living with diabetes has approximately doubled over the past decade. Rising rates of obesity are also driving an increase in type 2 diabetes among Canadian children and youth.[22] Such trends have important implications for population health promotion because being diagnosed with diabetes earlier in life predisposes individuals to an earlier onset of serious conditions like cardiovascular disease.

The purpose of this chapter is to examine patterns of prevalence of diabetes and its main risk factors – overweight and obesity (measured using BMI) – in Peel region.

LIST OF EXHIBITS

Exhibit 2A.1. Age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census subdivision (CSD) [2006], in Ontario



Findings:

- Areas with high diabetes prevalence rates (9.8 or higher per 100 people aged 20+) were concentrated in parts of northern Ontario and the Greater Toronto Area, and scattered in other parts of southern and northern Ontario.
- Areas with lower diabetes prevalence (4.6 –7.0 per 100 people aged 20+) were found throughout much of southern Ontario.
- It should be noted that even the third lowest category of diabetes prevalence shown on this map contains values that are higher than the Ontario average prevalence rate of 8.3 per 100 people aged 20+.

Exhibit 2A.2. Age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in the Greater Toronto Area (GTA)

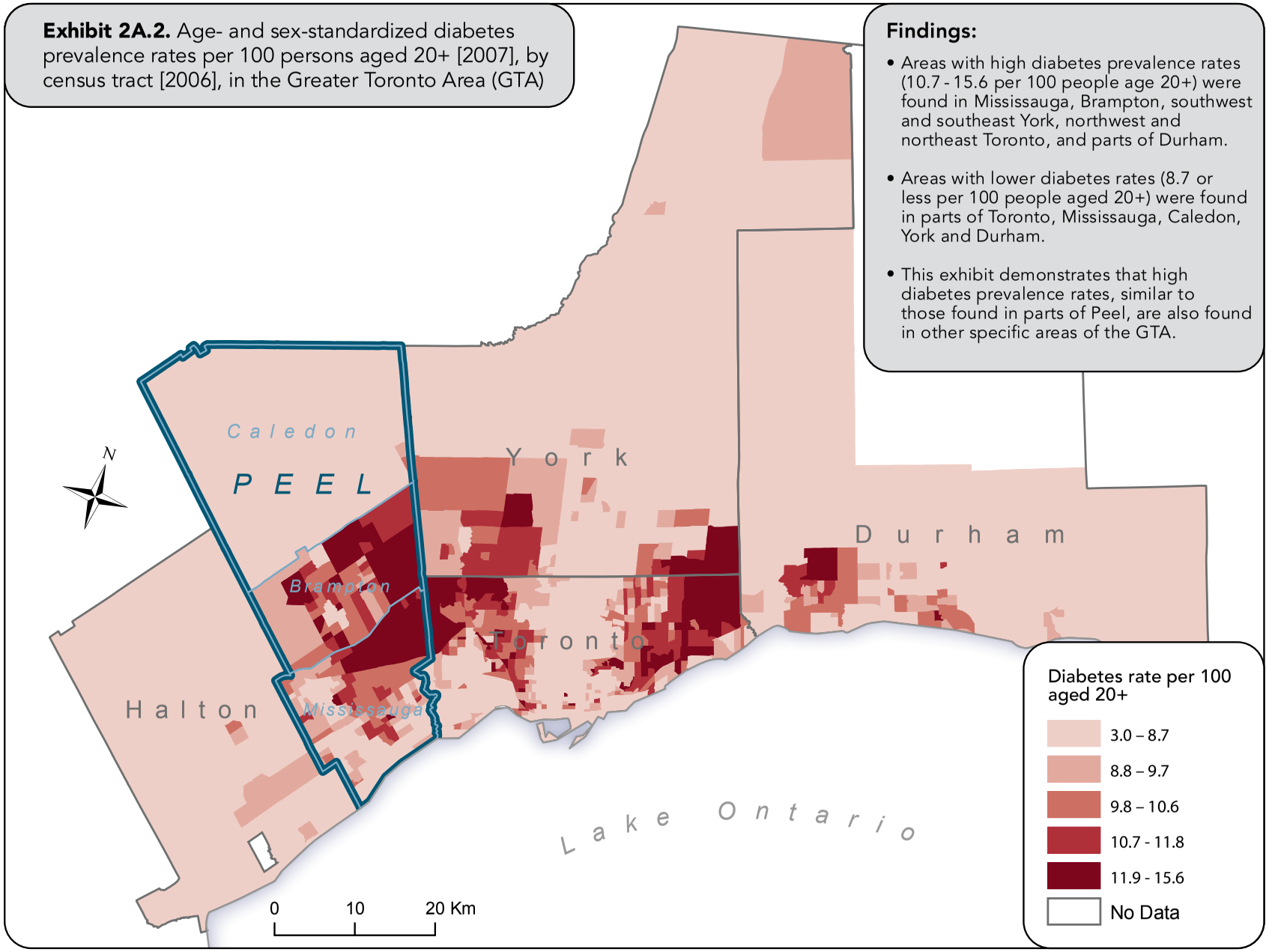


Exhibit 2.1 (a). Age- and sex-standardized overweight and obesity prevalence rates and associated 95% confidence intervals in persons aged 18 years or older [2003–08], in Peel region, the Greater Toronto Area (GTA) and Ontario

	Peel	Mississauga	Brampton	Caledon	Greater Toronto Area (GTA)[a]	Ontario
Prevalence of overweight or obese per 100 adults[b] (95% confidence interval)	**47.0 (45.3-48.7)**	45.1 (42.9-47.3)	**49.9 (47.0-52.8)**	**54.7 (46.6-62.8)**	44.4 (43.5-45.2)	48.6 (48.2-49.1)
Men						
All ages	54.2 (51.8-56.6)	51.8 (48.7-54.9)	**58.3 (54.5-62.2)**	61.5 (49.9-73.2)	52.4 (51.1-53.7)	56.9 (56.2-57.6)
Ages 18-39	48.0 (44.2-51.8)	44.1 (39.4-48.8)	**53.7 (47.2-60.3)**	63.4 (46.0-80.8)	45.0 (43.1-46.9)	49.1 (48.0-50.2)
Ages 40-64	62.1 (57.8-66.3)	61.0 (55.7-66.3)	64.5 (57.0-72.1)	61.1 (42.3-80.0)	60.6 (58.6-62.6)	65.9 (64.9-67.0)
Ages 65+	55.5 (48.8-62.2)	54.0 (45.7-62.4)	58.7 (46.1-71.2)	57.2* (31.2-83.2)	57.1 (54.1-60.1)	60.8 (59.3-62.2)
Women						
All ages	39.8 (37.5-42.1)	38.9 (35.8-42.0)	41.1 (37.2-45.0)	**47.8 (37.6-58.0)**	36.4 (35.3-37.5)	40.5 (39.8-41.1)
Ages 18-39	30.1 (26.8-33.5)	28.9 (24.7-33.1)	31.2 (25.4-37.0)	43.1* (18.9-67.4)	25.7 (24.1-27.3)	30.4 (29.5-31.4)
Ages 40-64	48.2 (44.2-52.2)	47.1 (42.0-52.2)	50.3 (43.6-57.0)	52.5 (36.4-68.7)	45.5 (43.5-47.4)	49.1 (48.1-50.2)
Ages 65+	50.8 (44.1-57.6)	49.7 (41.8-57.5)	53.2 (39.8-66.5)	51.2* (23.4-79.0)	49.3 (46.8-51.8)	52.1 (50.9-53.4)
Prevalence of obese per 100 adults[b] (95% confidence interval)	13.3 (12.1-14.6)	12.6 (11.1-14.1)	14.1 (12.1-16.1)	19.9 (13.5-26.3)	12.5 (11.9-13.0)	15.4 (15.1-15.7)
Men						
All ages	14.5 (12.8-16.3)	14.0 (11.9-16.2	14.6 (11.8-17.5)	21.6 (13.8-29.5)	13.4 (12.5-14.2)	16.4 (15.9-16.9)
Ages 18-39	13.0 (10.6-15.5)	11.8 (9.0-14.6)	13.7* (9.0-18.3)	28.6* (11.7-45.5)	11.2 (9.9-12.4)	13.9 (13.1-14.6)
Ages 40-64	15.6 (12.4-18.8)	16.5 (12.1-20.9)	14.3 (9.9-18.6)	† †	16.3 (14.7-18.0)	20.4 (19.5-21.3)
Ages 65+	16.8 (11.5-22.1)	15.1* (8.7-21.6)	19.4* (9.1-29.7)	† †	13.3 (11.5-15.2)	15.4 (14.4-16.3)
Women						
All ages	12.2 (10.6-13.8)	11.2 (9.2-13.2)	13.8 (11.0-16.5)	18.3 (9.1-27.4)	11.5 (10.8-12.2)	14.3 (13.9-14.7)
Ages 18-39	8.7 (6.7-10.7)	7.3* (4.9-9.7)	10.9* (7.3-14.5)	† †	7.7 (6.8-8.7)	11.1 (10.4-11.7)
Ages 40-64	16.4 (13.6-19.3)	15.2 (11.7-18.6)	18.6 (13.3-23.8)	† †	15.1 (13.7-16.4)	17.8 (17.1-18.6)
Ages 65+	13.5 (9.6-17.4)	14.1* (9.3-18.9)	11.5* (4.6-18.3)	† †	15.2 (13.3-17.14)	16.4 (15.5-17.3)

[a] Greater Toronto Area (GTA) consists of the regional municipalities of Durham, Halton, Peel and York, and the City of Toronto.
[b] The overall overweight and obesity rates represent age- and sex-standardized prevalence rates in persons aged 18 years or older.
Rates were standardized to the 1991 Canada Census population.
* Estimate based on small numbers (coefficient of variation = 16.6-33.3) and should be used with caution.
† Estimates of unacceptable quality for reporting (coefficient of variation > 33.3).

Bolded estimates represent rates in Peel region that are statistically different from the GTA rate in the same age/sex category.
Peel region rates are not compared to overall Ontario rates in this table.

General notes:
Overweight/obesity is defined as a Body Mass Index (BMI, weight in kg / height in m^2) of ≥25. Obesity is defined as BMI of ≥30.
Data Source: Canadian Community Health Survey combined cycles 2.1 (2003), 3.1 (2005) and 2007/08.

Exhibit 2.1 (b). Age- and sex-standardized overweight and obesity prevalence rates and associated 95% confidence intervals (CIs) in persons aged 18 years or older [2003–08], in Peel Health Data Zones (PHDZs)

PHDZ	Prevalence of overweight/obesity per 100 adults (95% CI)		Prevalence of obesity per 100 adults (95% CI)	
1	49.0	(37.7-60.4)	13.9	(7.3-20.6)
2	48.4	(43.8-53.0)	15.2	(10.6-19.7)
3	46.4	(41.3-51.6)	11.8	(8.2-15.4)
4	44.5	(37.2-51.9)	12.6	(8.6-16.7)
5	43.7	(35.9-51.6)	14.7	(8.9-20.5)
6	45.8	(39.8-51.8)	12.4	(8.6-16.2)
7	42.0	(35.6-48.5)	11.3	(8.3-14.2)
8	47.6	(36.5-58.6)	13.6	(6.1-21.2)
9	42.7	(37.9-47.5)	11.0	(7.8-14.2)
10	46.6	(40.9-52.3)	11.9	(8.6-15.2)
11	**53.8**	**(48.7-58.9)**	14.7	(11.2-18.2)
12	50.4	(43.6-57.2)	15.3	(10.7-20.0)
13	51.6	(42.9-60.2)	19.1	(11.6-26.6)
14	50.0	(41.4-58.6)	15.8	(10.0-21.6)
15	**63.5**	**(52.0-75.0)**	**26.6**	**(15.8-37.4)**

Bolded estimates represent PHDZ rates that are statistically different from the overall Greater Toronto Area (GTA) rate.
The overall GTA rate of overweight/obesity per 100 adults was 44.4 (95% CI: 43.5-45.2); the GTA obesity rate per 100 adults was 12.5 (95% CI: 11.9-13.0).
The GTA is comprised of the regional municipalities of Durham, Halton, Peel, York and the City of Toronto.
Rates were standardized to the 1991 Canada Census population.

General notes:
Overweight/obesity is defined as a Body Mass Index (BMI, weight in kg / height in m^2) of ≥25. Obesity is defined as BMI of ≥30.
Data Source: Canadian Community Health Survey combined cycles 2.1 (2003), 3.1 (2005) and 2007/08.

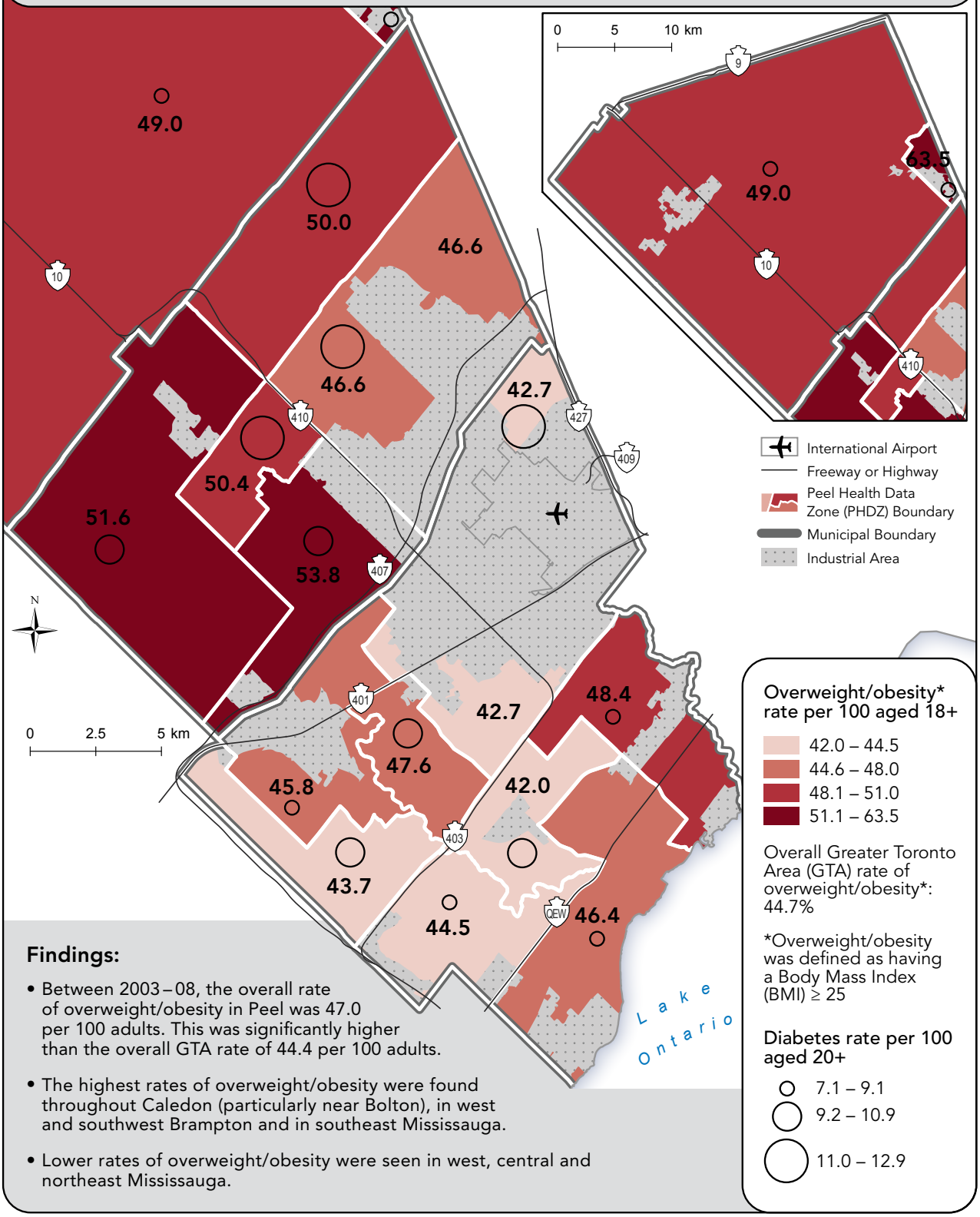
Exhibit 2.2. Age-standardized diabetes prevalence rates in persons aged 20 years and older [2007], in Peel region, the Greater Toronto Area and Ontario

	Peel	Mississauga	Brampton	Caledon	Greater Toronto Area (GTA)[a]	Ontario
Diabetes prevalence rate per 100 adults[b]	9.98	9.46	11.46	7.67	9.04	8.28
Men						
All ages	10.24	9.77	11.34	7.88	9.28	8.56
Ages 20-44	3.04	2.69	3.62	2.43	2.63	2.31
Ages 45-64	15.20	14.32	17.35	10.94	13.31	12.29
Ages 65+	31.55	31.37	32.82	25.43	30.12	28.27
Women						
All ages	9.68	9.12	10.96	7.33	8.79	7.98
Ages 20-44	3.11	2.80	3.61	2.86	2.68	2.45
Ages 45-64	12.06	11.15	14.22	8.09	10.74	9.75
Ages 65+	25.56	25.74	28.93	20.10	24.85	22.54

[a] Greater Toronto Area (GTA) consists of the regional municipalities of Durham, Halton, Peel and York and the City of Toronto.
[b] The overall diabetes prevalence rate represents age- and sex-standardized prevalence rates in persons aged 20 years or older.
Diabetes rates were standardized to the 1991 Canada Census population.

Data Source: Ontario Diabetes Database 2007.

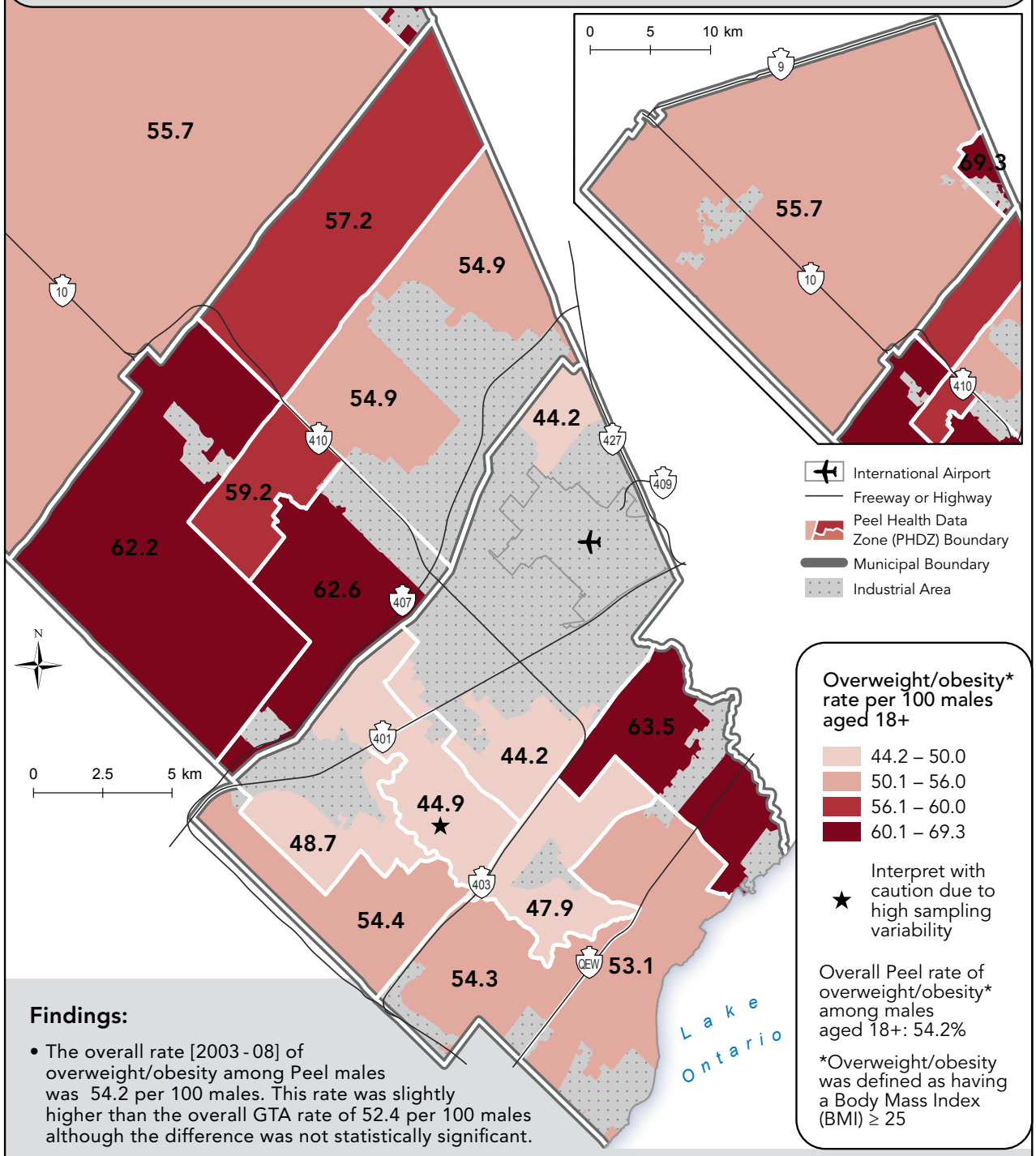
Exhibit 2.3. Age- and sex-standardized rate of overweight/obesity* per 100 persons aged 18+ [2003–08] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by Peel Health Data Zone (PHDZ) [2006], in Peel region



Findings:

- Between 2003–08, the overall rate of overweight/obesity in Peel was 47.0 per 100 adults. This was significantly higher than the overall GTA rate of 44.4 per 100 adults.
- The highest rates of overweight/obesity were found throughout Caledon (particularly near Bolton), in west and southwest Brampton and in southeast Mississauga.
- Lower rates of overweight/obesity were seen in west, central and northeast Mississauga.

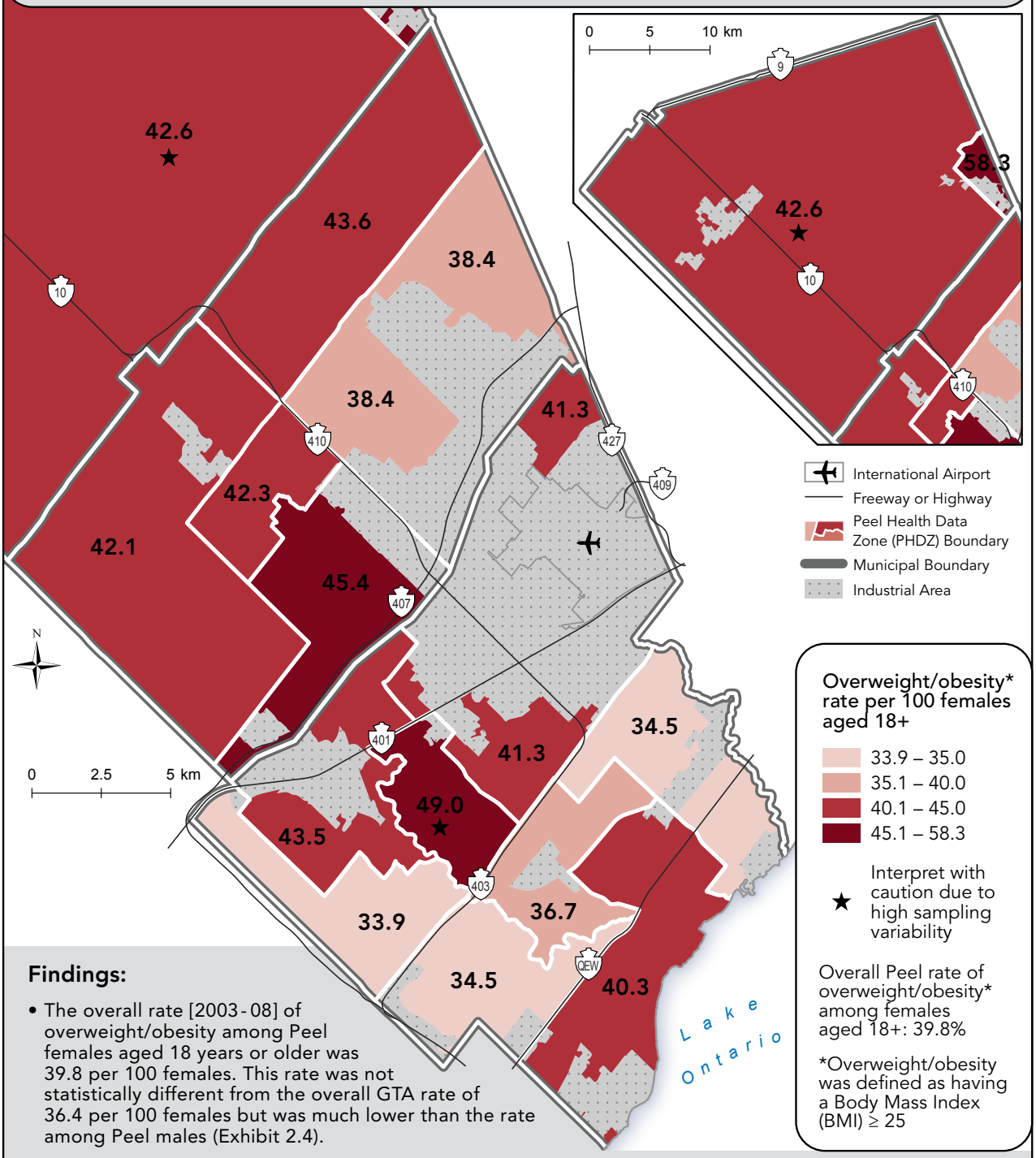
Exhibit 2.4. Age-standardized rate of overweight/obesity* per 100 males aged 18+ [2003–08], by Peel Health Data Zone (PHDZ) [2006], in Peel region



Findings:

- The overall rate [2003 - 08] of overweight/obesity among Peel males was 54.2 per 100 males. This rate was slightly higher than the overall GTA rate of 52.4 per 100 males although the difference was not statistically significant.
- In the majority of PHDZs, more than half of all adult males were overweight or obese. Only four PHDZs, all of which were in Mississauga, had rates of overweight/obesity below 50 per 100 males.
- Areas with very high rates of overweight/obesity (above 60 per 100 males) were found in east Caledon (near Bolton), west Brampton and southeast Mississauga.

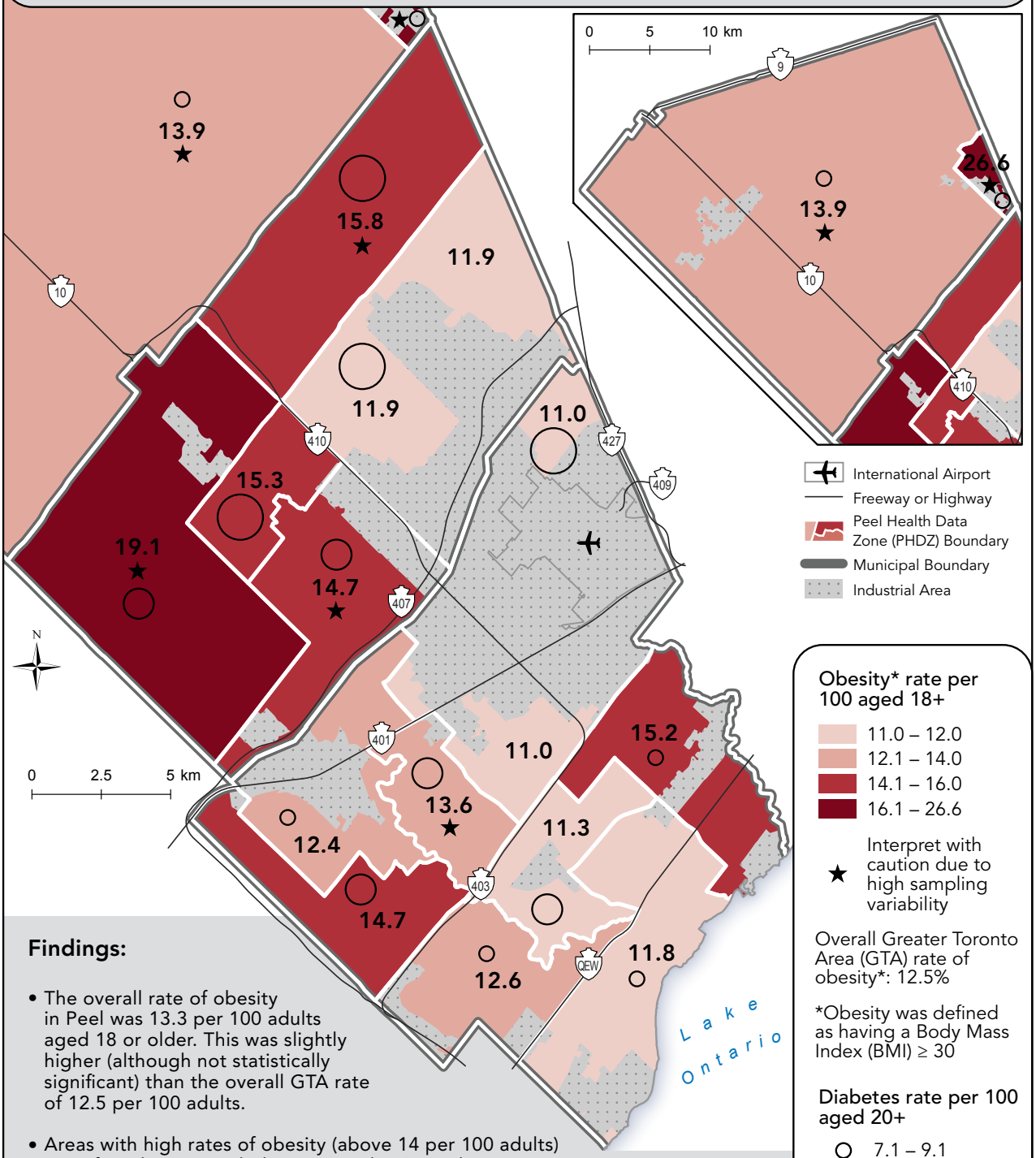
Exhibit 2.5. Age-standardized rate of overweight/obesity* per 100 females aged 18+ [2003–08], by Peel Health Data Zone (PHDZ) [2006], in Peel region.



Findings:

- The overall rate [2003-08] of overweight/obesity among Peel females aged 18 years or older was 39.8 per 100 females. This rate was not statistically different from the overall GTA rate of 36.4 per 100 females but was much lower than the rate among Peel males (Exhibit 2.4).
- Areas with high rates of overweight/obesity (above 40 per 100 females) were found throughout Caledon (particularly near Bolton), Brampton and in south, central, north and northeast Mississauga.
- Areas where rates of overweight/obesity were highest differed somewhat for males and females.

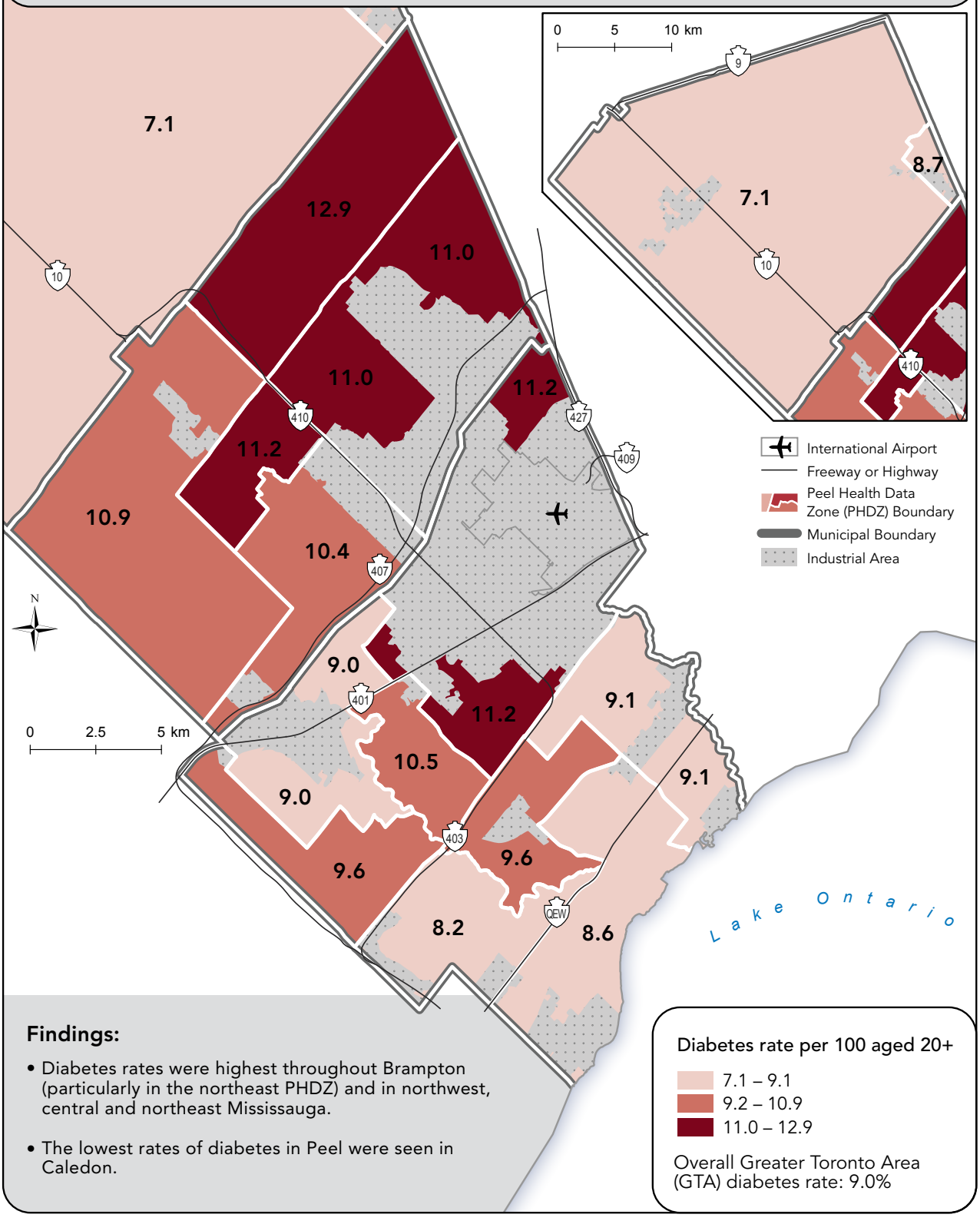
Exhibit 2.6. Age- and sex-standardized rate of obesity* per 100 persons aged 18+ [2003–08] and age- and sex-standardized diabetes prevalence rate per 100 persons aged 20+ [2007], by Peel Health Data Zone (PHDZ) [2006], in Peel region



Findings:

- The overall rate of obesity in Peel was 13.3 per 100 adults aged 18 or older. This was slightly higher (although not statistically significant) than the overall GTA rate of 12.5 per 100 adults.
- Areas with high rates of obesity (above 14 per 100 adults) were found in east Caledon (near Bolton), northeast, west and northwest Brampton, and in northwest and southeast Mississauga.
- Lower rates of obesity were seen in east Brampton and in south, central and northeast Mississauga.

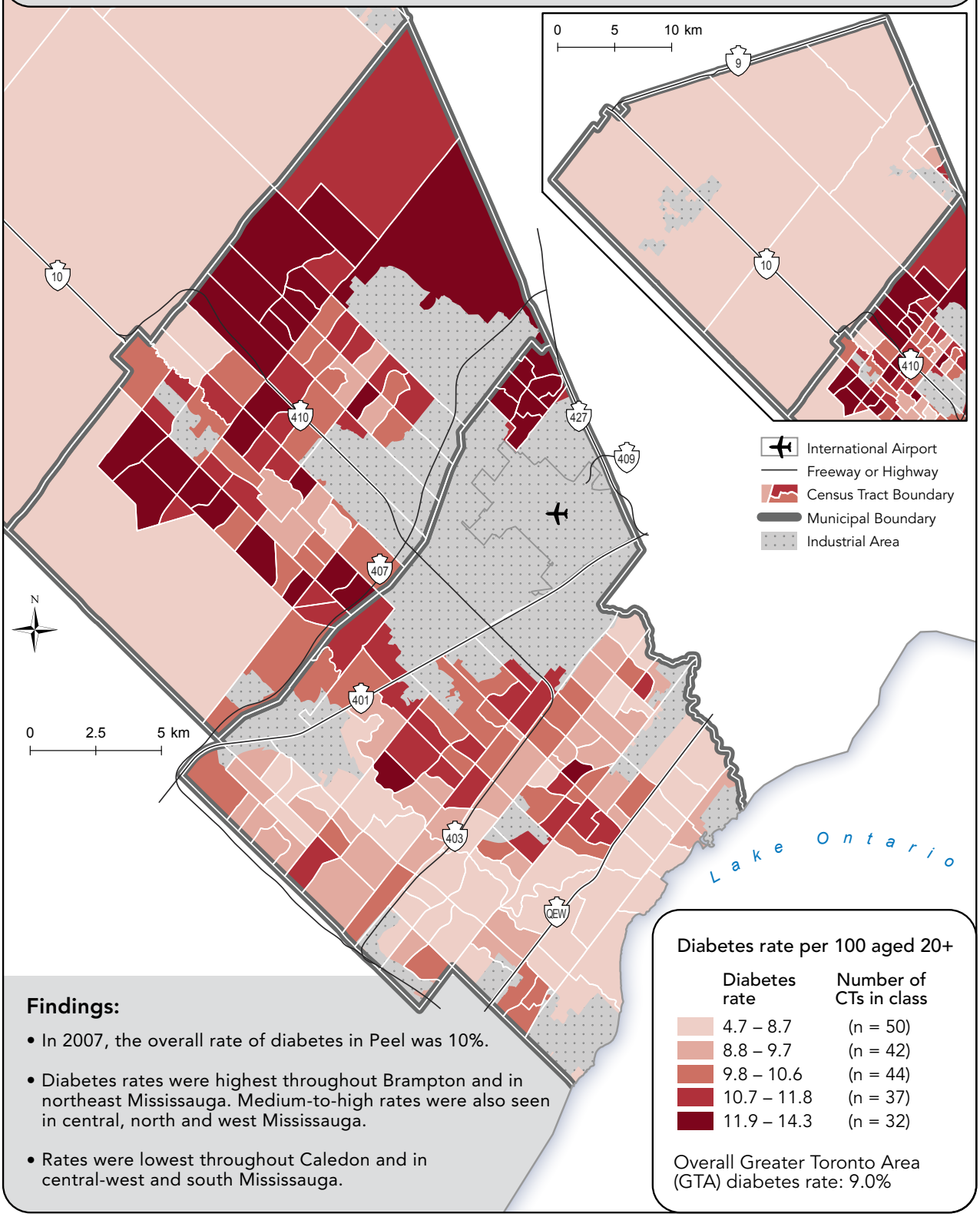
Exhibit 2.7. Age- and sex-standardized diabetes prevalence rate per 100 persons aged 20+ [2007], by Peel Health Data Zone (PHDZ) [2006], in Peel region



Findings:

- Diabetes rates were highest throughout Brampton (particularly in the northeast PHDZ) and in northwest, central and northeast Mississauga.
- The lowest rates of diabetes in Peel were seen in Caledon.

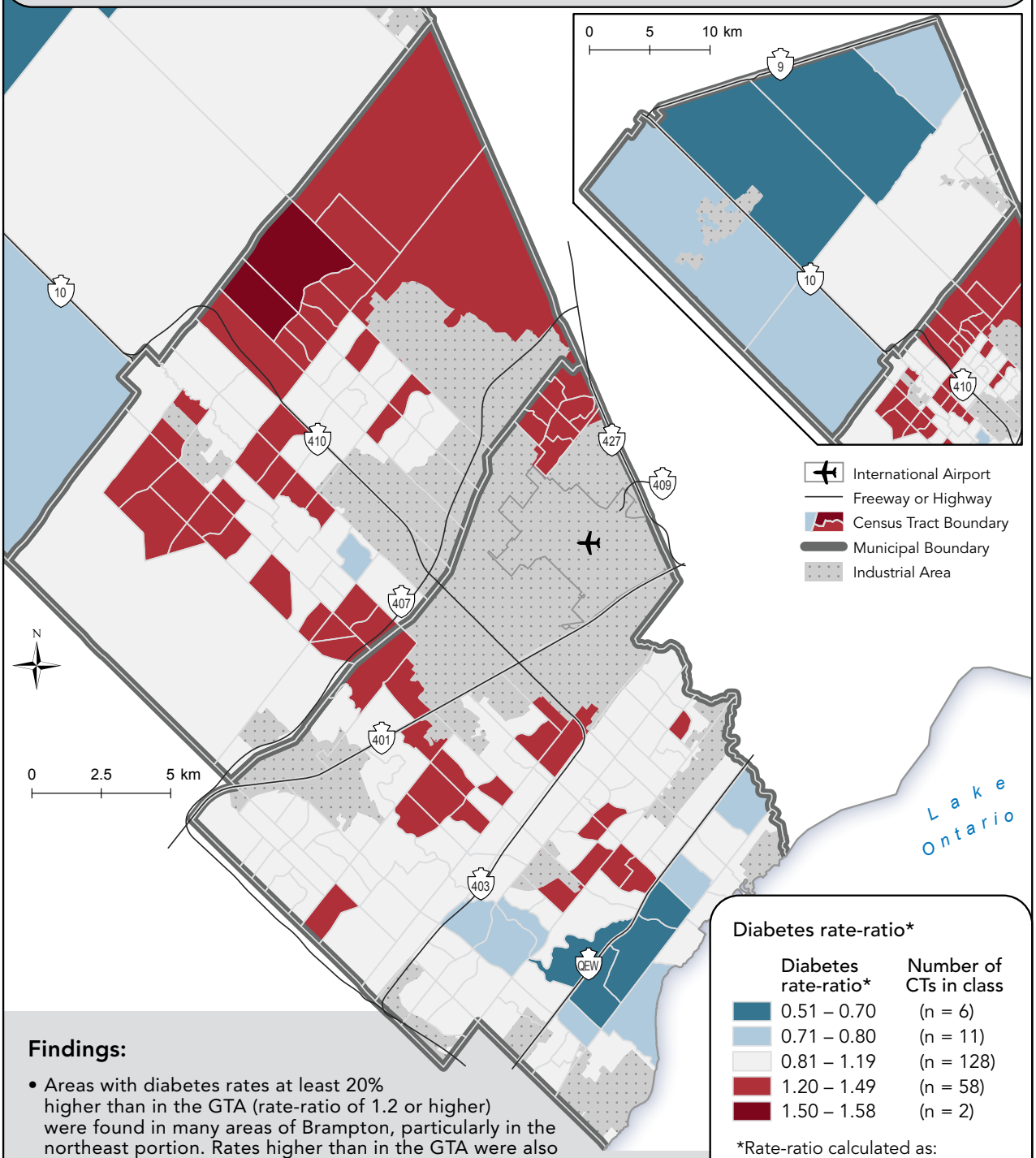
Exhibit 2.8. Age- and sex-standardized diabetes prevalence rate per 100 persons aged 20+ [2007], by census tract (CT) [2006], in Peel region



Findings:

- In 2007, the overall rate of diabetes in Peel was 10%.
- Diabetes rates were highest throughout Brampton and in northeast Mississauga. Medium-to-high rates were also seen in central, north and west Mississauga.
- Rates were lowest throughout Caledon and in central-west and south Mississauga.

Exhibit 2.9. Rate-ratio comparison of age- and sex-standardized diabetes prevalence rate per 100 persons aged 20+ [2007] in Peel region, to the overall Greater Toronto Area (GTA) age- and sex-standardized diabetes prevalence rate per 100 persons aged 20+ [2007], by census tract



Findings:

- Areas with diabetes rates at least 20% higher than in the GTA (rate-ratio of 1.2 or higher) were found in many areas of Brampton, particularly in the northeast portion. Rates higher than in the GTA were also seen in central and northeast Mississauga.
- Areas with diabetes rates substantially lower than in the GTA (rate-ratio of 0.80 or lower) were found in north and west Caledon and in south Mississauga.

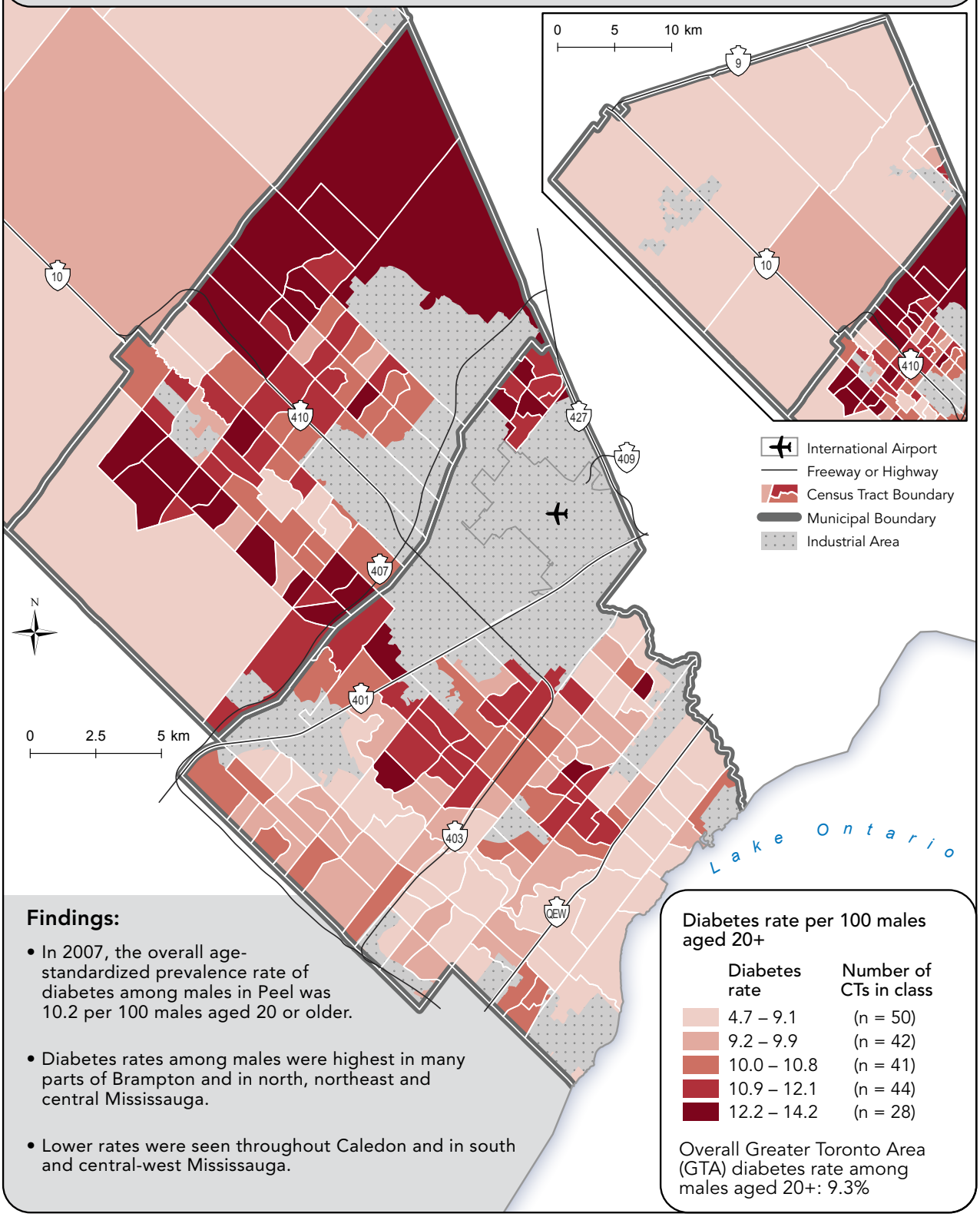
Diabetes rate-ratio*

Diabetes rate-ratio*	Number of CTs in class
0.51 – 0.70	(n = 6)
0.71 – 0.80	(n = 11)
0.81 – 1.19	(n = 128)
1.20 – 1.49	(n = 58)
1.50 – 1.58	(n = 2)

*Rate-ratio calculated as:
census tract rate for pop. aged 20+
GTA rate for pop. aged 20+

Overall Greater Toronto Area (GTA) diabetes rate: 9.0%

Exhibit 2.10. Age-standardized diabetes prevalence rate per 100 males aged 20+ [2007], by census tract [2006], in Peel region



Findings:

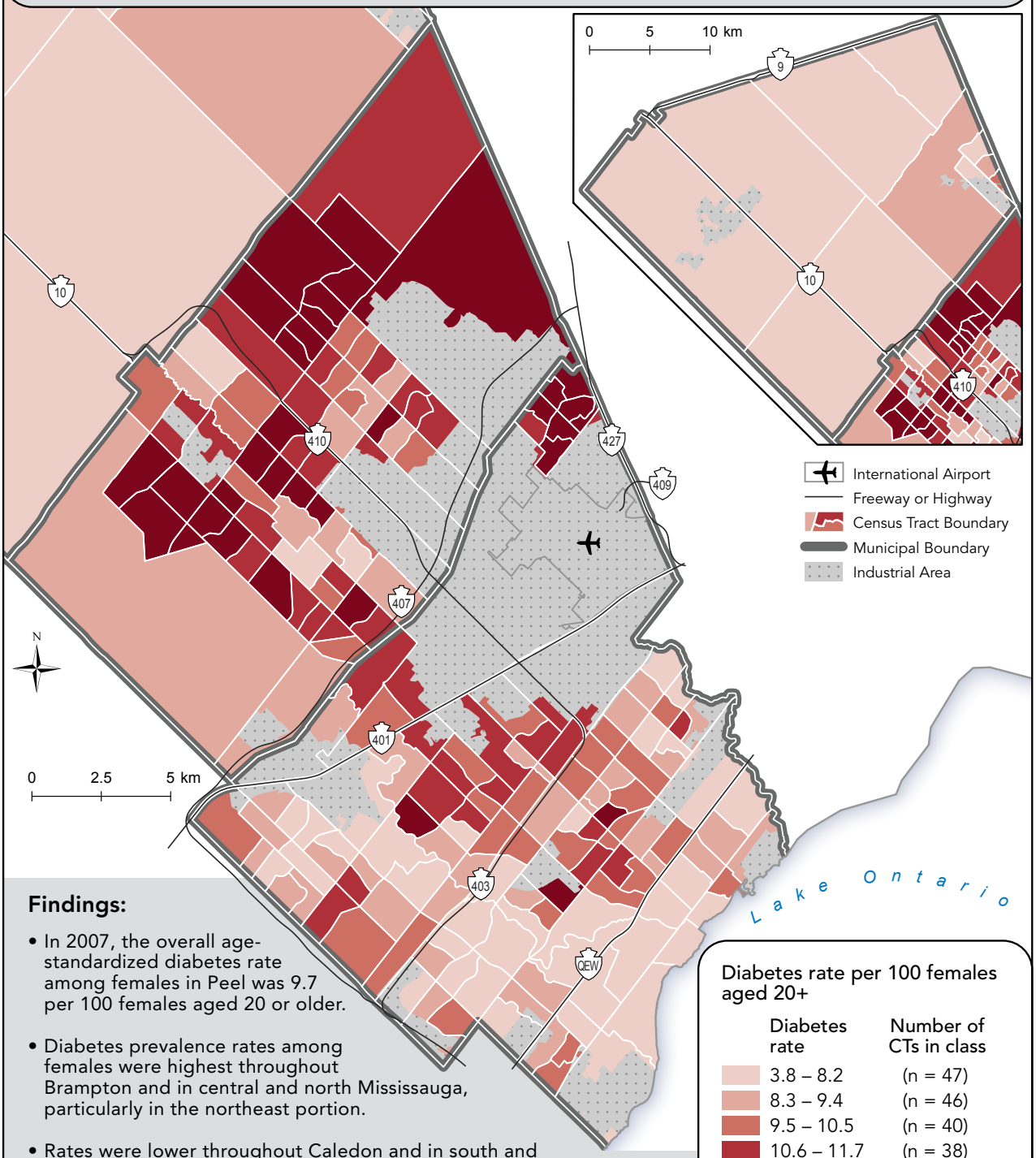
- In 2007, the overall age-standardized prevalence rate of diabetes among males in Peel was 10.2 per 100 males aged 20 or older.
- Diabetes rates among males were highest in many parts of Brampton and in north, northeast and central Mississauga.
- Lower rates were seen throughout Caledon and in south and central-west Mississauga.

Diabetes rate per 100 males aged 20+

Diabetes rate	Number of CTs in class
4.7 – 9.1	(n = 50)
9.2 – 9.9	(n = 42)
10.0 – 10.8	(n = 41)
10.9 – 12.1	(n = 44)
12.2 – 14.2	(n = 28)

Overall Greater Toronto Area (GTA) diabetes rate among males aged 20+: 9.3%

Exhibit 2.11. Age-standardized diabetes prevalence rate per 100 females aged 20+ [2007], by census tract [2006], in Peel region



Findings:

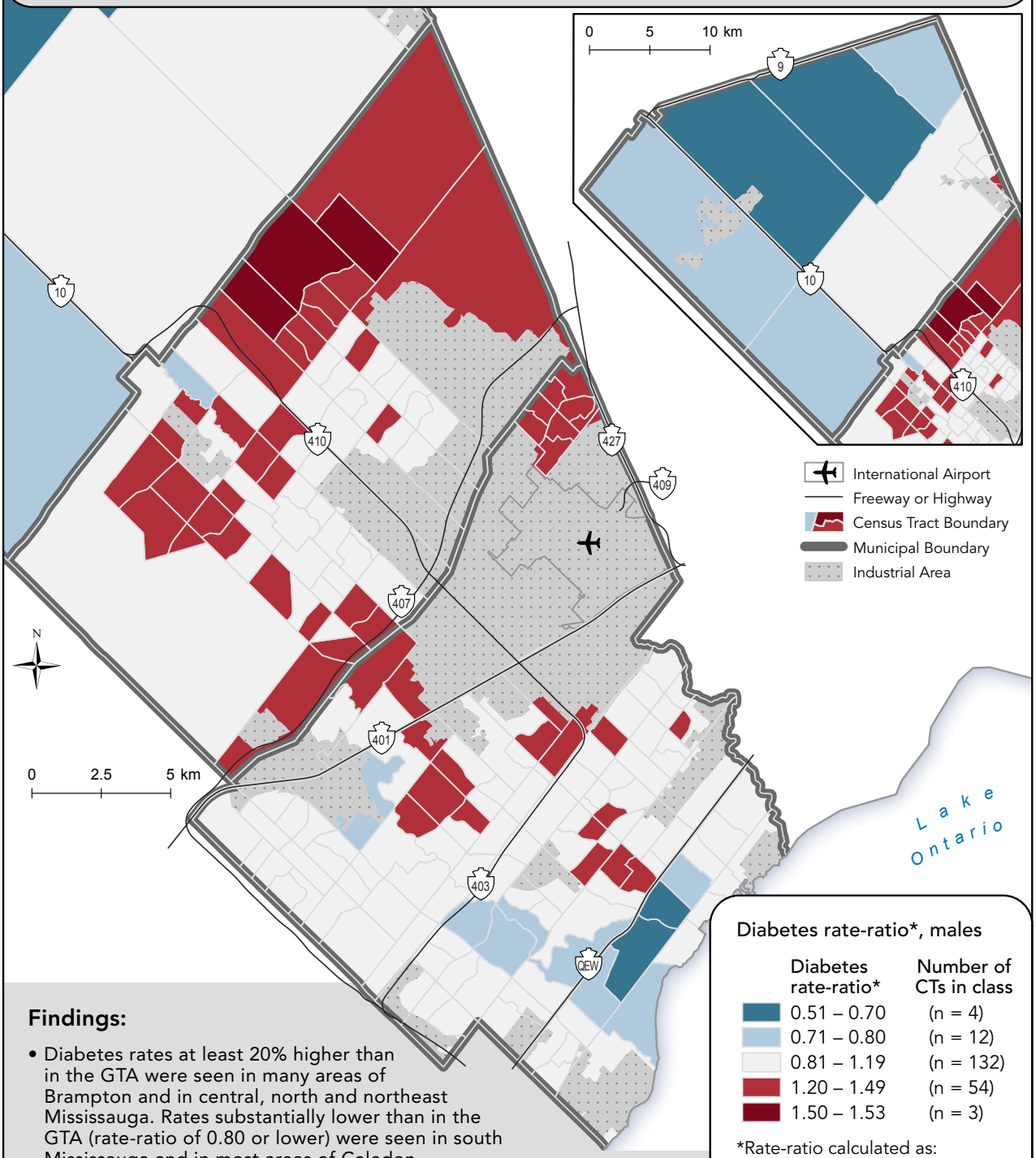
- In 2007, the overall age-standardized diabetes rate among females in Peel was 9.7 per 100 females aged 20 or older.
- Diabetes prevalence rates among females were highest throughout Brampton and in central and north Mississauga, particularly in the northeast portion.
- Rates were lower throughout Caledon and in south and central-west Mississauga.
- Areas that were home to a higher percentage of female residents diagnosed with diabetes generally coincided with the location of higher diabetes areas among males (Exhibit 2.10).

Diabetes rate per 100 females aged 20+

Diabetes rate	Number of CTs in class
3.8 – 8.2	(n = 47)
8.3 – 9.4	(n = 46)
9.5 – 10.5	(n = 40)
10.6 – 11.7	(n = 38)
11.8 – 14.5	(n = 34)

Overall Greater Toronto Area (GTA) diabetes rate among females aged 20+: 8.8%

Exhibit 2.12. Rate-ratio comparison of age-standardized diabetes prevalence rate per 100 males aged 20+ [2007] in Peel region, to the overall Greater Toronto Area (GTA) age-standardized diabetes prevalence rate per 100 males aged 20+ [2007], by census tract



Findings:

- Diabetes rates at least 20% higher than in the GTA were seen in many areas of Brampton and in central, north and northeast Mississauga. Rates substantially lower than in the GTA (rate-ratio of 0.80 or lower) were seen in south Mississauga and in most areas of Caledon.
- Compared to females (Exhibit 2.13), there were slightly fewer areas in Brampton and Mississauga where diabetes prevalence among males was substantially higher than in the GTA.

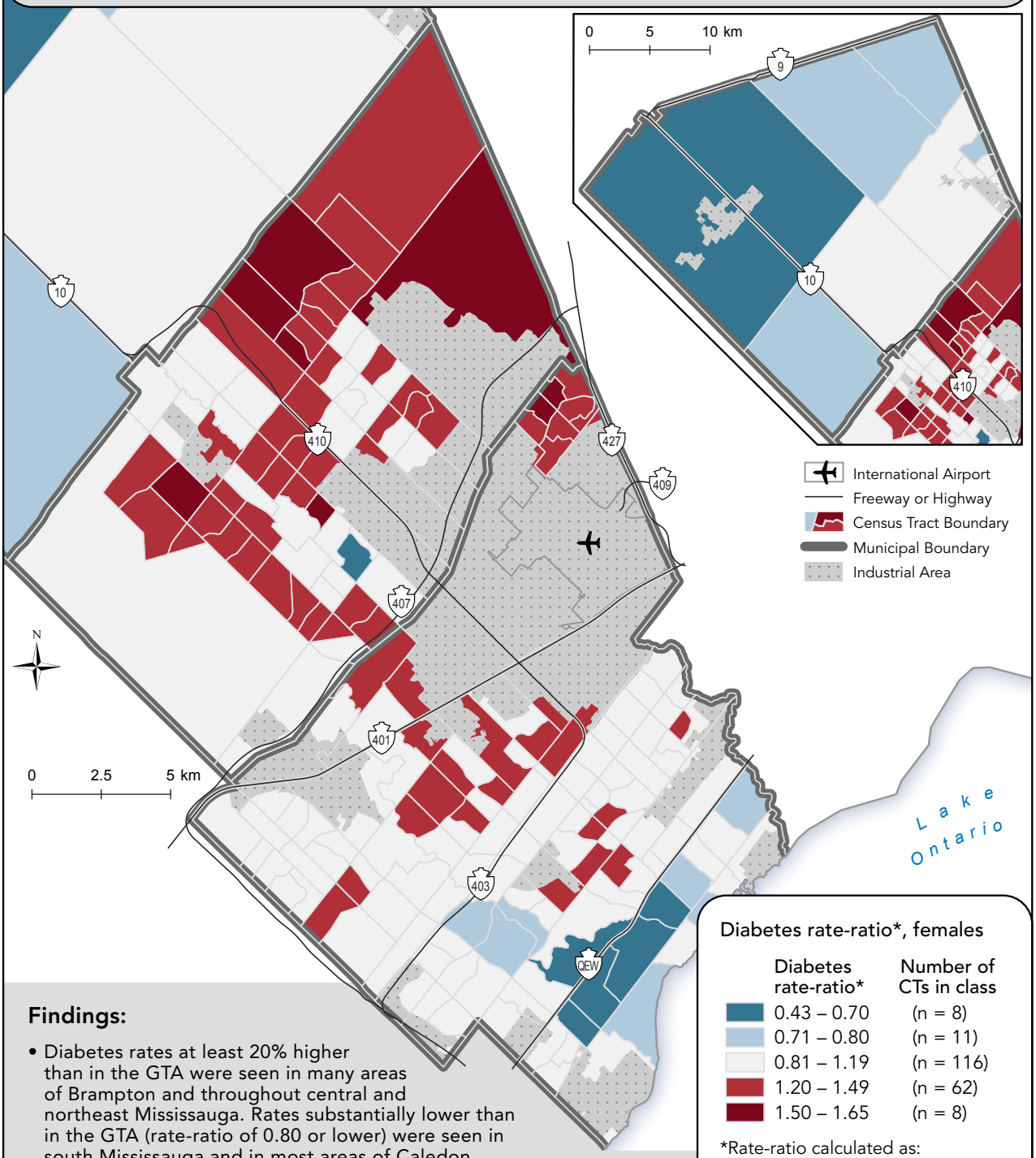
Diabetes rate-ratio*, males

Diabetes rate-ratio*	Number of CTs in class
0.51 – 0.70	(n = 4)
0.71 – 0.80	(n = 12)
0.81 – 1.19	(n = 132)
1.20 – 1.49	(n = 54)
1.50 – 1.53	(n = 3)

*Rate-ratio calculated as:
census tract rate for males aged 20+ / GTA rate for males aged 20+

Overall Greater Toronto Area (GTA) diabetes rate among males aged 20+: 9.3%

Exhibit 2.13. Rate-ratio comparison of age-standardized diabetes prevalence rate per 100 females aged 20+ [2007] in Peel region, to the overall Greater Toronto Area (GTA) age-standardized diabetes prevalence rate per 100 females aged 20+ [2007], by census tract



Findings:

- Diabetes rates at least 20% higher than in the GTA were seen in many areas of Brampton and throughout central and northeast Mississauga. Rates substantially lower than in the GTA (rate-ratio of 0.80 or lower) were seen in south Mississauga and in most areas of Caledon.
- Compared to males (Exhibit 2.12), there were slightly more areas in Brampton and Mississauga where diabetes prevalence among females was higher than in the GTA.

DISCUSSION

Between 2003–08, the rates of overweight and obesity among Peel adults were high – nearly half of Peel residents reported being either overweight or obese according to standard BMI classification. The overall rate of overweight/obesity in Peel was significantly higher than in the Greater Toronto Area (GTA) overall (47.0% in Peel vs. 44.4% in the GTA). The proportion of residents who were overweight or obese was highest in Caledon (especially near Bolton), followed by Brampton; these rates were higher than in the GTA, but similar to the province as a whole. There were also high rates of overweight/obesity among younger adult (under age 40) men and women living in Caledon and among younger adult men in Brampton. This is concerning because being overweight or obese at a younger age is a risk factor for developing diabetes earlier in life.

In 2007, one in 10 adult residents of Peel had diagnosed diabetes. This represented a higher prevalence than in the GTA and the province as a whole. Rates were highest in Brampton (11.5%), followed by Mississauga (9.5%); the lowest rates were observed in Caledon (7.7%). These patterns were consistent for both men and women. There was a particularly high prevalence of diabetes among younger adult men and women in Brampton compared with the rest of Peel, the GTA and Ontario. This is cause for concern because younger adults have longer to live with the disease and thus have a greater opportunity to develop serious complications such as heart attack, stroke and kidney disease.[16]

Although epidemiologic studies consistently show a high BMI to be among the leading risk factors for developing diabetes, there was no strong spatial concordance observed between rates of overweight/obesity and diabetes in Peel. An important factor in this lack of association is likely the distribution of immigrant and ethnocultural groups across Peel (for a more detailed discussion of immigration, ethnicity and diabetes, see Chapter 4). Some ethnic groups, such as individuals of East Asian and South Asian heritage, have a higher risk of developing diabetes at lower body weight and/or at younger ages than other ethnic groups.[20, 23] Thus, using the standard BMI cut-off points to determine overweight or obesity does not appropriately identify high-risk individuals belonging to these and other ethnoracial groups.

In 2007 in Peel, virtually all neighbourhoods with high rates of diabetes were also home to a large proportion of residents belonging to visible minority groups such as South Asians, who are known to have a higher risk of developing diabetes at lower body weights. This pattern of spatial distribution of ethnic groups across Peel is likely to be an important reason for the lack of a strong spatial association between rates of overweight/obesity and diabetes. Additionally, abdominal obesity is a more important risk factor for diabetes than BMI, particularly in Asian populations.[14] Unfortunately, measures such as waist circumference were not available for this study.

In Peel, rates of diabetes were lowest throughout Caledon and in south Mississauga. These areas tended to be wealthier, with fewer visible minority residents and recent immigrants (see Chapters 3 and 4 for patterns of socio-economic status and immigrant/ethnicity in relation to diabetes in Peel).

Despite the substantial variation in rates of diabetes across Peel, it is important to note that rates were higher than the provincial average throughout most of the region. In fact, because of the way that neighbourhoods were divided into categories (see Appendix 2.A for details), some neighbourhoods with rates of diabetes higher than the provincial average were included in the "lowest" category of diabetes prevalence (for example, in Exhibit 2.8 the lowest category of diabetes prevalence ranged from 4.7% to 8.7%, which included census tracts with rates above the Ontario average of 8.0%).

An important limitation of these analyses is that BMI was calculated based on self-reported height and weight measurements of Peel residents who responded to the Canadian Community Health Survey (CCHS). Because survey respondents tend

to overestimate height and underestimate weight, self-reported BMI leads to an underestimation of overweight and obesity. For example, in Canada in 2005, the prevalence of obesity was 15.2% by self-report compared with 22.6% by measurement.[24] This suggests that the rates of overweight/obesity shown in these analyses are likely underestimated.

CONCLUSIONS AND IMPLICATIONS

Diabetes is a significant public health problem. Excess body weight is a major risk factor for developing diabetes. The prevalence of diabetes in Ontario has already surpassed the World Health Organization's predictions for global prevalence for the year 2030.[16] In 2007 in Peel, rates of diabetes among both men and women exceeded those of the GTA and Ontario. The majority of neighbourhoods where rates of diabetes were very high were located in Brampton, with a smaller number located in Mississauga.

In Peel, there was no clear correspondence between patterns of diabetes and overweight/obesity. This is likely due to the distribution of ethnocultural groups across Peel, many of which develop diabetes at lower body weights. There were high rates of diabetes among younger adults, particularly in Brampton. This is concerning because younger adults have longer to live with the disease and thus have a greater opportunity to develop serious complications.

Neighbourhoods with high rates of overweight/obesity or diabetes are ideal settings for community-based program planning and intervention.[14] This could include local strategies to prevent the development of diabetes among residents, as well as the provision of health care programs and services to help manage this condition. The relationships between diabetes and both neighbourhood design/infrastructure and the availability of resources related to diabetes prevention and control are discussed in upcoming sections of this atlas.

APPENDIX 2.A – RESEARCH METHODOLOGY

Data Sources

Overweight/Obesity Rates

Data from Statistics Canada's 2003 (Cycle 2.1), 2005 (Cycle 3.1) and 2007/2008 Canadian Community Health Surveys (CCHS) were combined to examine the percentage of adult residents within Peel Health Data Zones (PHDZs) who reported being either overweight/obese (BMI ≥ 25) or obese (BMI ≥ 30). The larger PHDZs were used as the geographical unit of analysis because there were too few CCHS respondents at the census tract level to ensure Statistics Canada's data quality and reporting standards.

All data on height and weight used to calculate the BMI were self-reported by respondents to the CCHS. These data were collected on all respondents excluding pregnant women and people less than 0.91 metres (3 feet) or greater than 2.11 metres (6 feet, 11 inches) tall. This analysis was restricted to persons aged 18 and over. Due to some incidents of extreme data outliers (e.g., extremely high or low values of BMI) which may have been due to reporting errors, the analyses were restricted to individuals whose BMIs fell between 15 and 60. These values were selected to represent the normal range of possible BMIs in the population. Statistical methods were used to standardize the rates in order to remove any age and sex differences across the region and to ensure that different age or sex distributions in census tracts and PHDZs did not account for the differences seen between areas.

Some prevalence rates of overweight/obesity in some sub-groups of Peel's population (particularly in Caledon) were not presented or were identified as estimates that should be interpreted with caution. This occurred because Statistics Canada imposes specific guidelines for reporting estimates based on CCHS data – guidelines that were followed for the current analyses. First, the number of sampled respondents contributing to the calculation of an estimate had to be greater than or equal to 30. If an estimate met this requirement, the coefficient of variation (CV) was calculated using the same weighted bootstrapping techniques that were used to produce the point estimate (i.e., prevalence rate) and 95% confidence intervals. As per Statistics Canada guidelines, estimates with a CV greater than 33.3% were suppressed (not shown) due to extreme sampling variability. Estimates with a CV between 16.6 and 33.3% were accompanied by a caution that the estimate is subject to high variability.

Diabetes Rates

Provincial administrative health databases were used to examine patterns of diabetes in Peel neighbourhoods. People aged 20 and older who had been diagnosed with diabetes on or before March 31, 2007 were identified from the Ontario Diabetes Database (ODD). The ODD is a population-based and validated disease registry created from hospital records and physician services claims. This database is held at the Institute for Clinical Evaluative Sciences (ICES). An individual is said to have physician-diagnosed diabetes (excluding gestational diabetes) if at least one of the following criteria is met within a two-year period: (i) two primary care visits for diabetes or (ii) one admission to hospital with a new or pre-existing diagnosis of diabetes. This selection criteria has a sensitivity of 86% and a specificity of 97% in identifying patients with confirmed diabetes (i.e., this algorithm correctly identifies 86% of people who have diabetes and correctly omits 97% of people who do not have diabetes).[25] Once it has been registered in the ODD, an individual's record remains there until death.

The ODD does not differentiate type 1 from type 2 diabetes. However, type 1 diabetes represents a very small proportion (5 -10%) of all diabetes cases. Administrative data may also underestimate the true prevalence of diabetes because up to 30% of diabetes cases in the Ontario population may be undiagnosed by a physician.[26]

The Registered Persons Database (RPDB) was used to derive population denominators. The RPDB is an electronic registry of all individuals who are eligible for coverage under the Ontario Health Insurance Plan (OHIP) in a given year. Since numerators for diabetes rates are linked to addresses in the RPDB, for consistency, the RPDB was used to create the population denominators for this study. Patients' addresses are normally updated either at the time of hospitalization or when patients renew their provincial health card every five years.

If a person does not renew his/her health card or moves residences without notifying the Ministry of Health and Long-Term Care about the change of address, his/her address in the OHIP system can be out-of-date. This represents a limitation of the data.

The RPDB may include people who left Ontario, but did not inform the Ministry of Health and Long-Term Care. The RPDB may also include a few people who died, but whose records have not yet been updated. In an attempt to exclude individuals who have died, seniors who did not have a single health claim in the previous three-year period were excluded from the analyses. Despite potential inaccuracies, the RPDB is still a more appropriate denominator for OHIP-based numerators than census counts because physician claims from OHIP are derived from the RPDB population. Using census counts in the denominator is likely to inflate rates and create bias in estimates.

Age- and sex-standardized diabetes prevalence rates were calculated per 100 population for each census tract in Peel. The diabetes prevalence categories displayed on the maps in this chapter were derived by ordering the census tracts from lowest to highest prevalence and then dividing them into five groups with equal populations (i.e., population-weighted quintiles). Diabetes rates for the larger Peel Health Data Zones (PHDZs) were also calculated. This was done to provide a common geographical unit of analysis with overweight/obesity analyses and all other analyses using data from the CCHS in subsequent chapters. The diabetes prevalence categories displayed on PHDZ maps were generated by ordering the PHDZs from lowest to highest prevalence and then dividing them into three groups with equal populations (i.e., populations-weighted tertiles). In order to remove any influence due to differences in the population's age and sex distribution across census tracts or PHDZs, the diabetes rates were standardized to the 1991 Canada Census population. Similar steps were used to calculate separate, age-standardized rates by census tract for men and women.

The categories of diabetes prevalence rates displayed on the Greater Toronto Area (GTA) map of diabetes prevalence (Exhibit 2A.2) were calculated based on population-weighted quintiles of diabetes prevalence for Peel. This was done to make categories on this map comparable to Exhibit 2.8, which displays diabetes prevalence rates in Peel. The same category cut-offs used for Exhibit 2.8 were used on the GTA map, except the maximum and minimum values for the highest and lowest categories, respectively, were extended due to the greater range of diabetes prevalence rates found within the GTA.

The categories of diabetes prevalence rates displayed on the Ontario map of diabetes prevalence (Exhibit 2A.2) were calculated based on natural breaks. Categories were determined through examination of the distribution of rates to find natural "breakpoints" in the data. Due to the wide range of population denominators in census subdivisions, use of other methods such as population-based quintiles was not appropriate. Where possible, however, category breaks were made similar to other diabetes prevalence rate maps in this atlas to facilitate comparison. All census subdivisions with denominators less than 100 and numerators less than 20 were excluded prior to classification and are marked accordingly on the map.

Definitions

- Body Mass Index (BMI) is a ratio of weight to height and can be calculated according to the equation: BMI = weight (kilograms) / height (metres) squared. In adults aged 18 or

older, overweight is defined by having a BMI between 25.0 and 29.9. Obesity is defined by a BMI of 30.0 or higher.

- Statistics Canada defines visible minorities as "persons, other than Aboriginal persons, who are non-White in race or colour," in accordance with Canada's Employment Equity Act.

Analysis

This analysis involved two types of maps. The first type shows area rates of overweight/obesity or diabetes rate variables depicted using shaded (choropleth) maps. A second type of map was created in order to highlight areas of Peel where diabetes rates were substantially higher or lower than the overall prevalence rate in the Greater Toronto Area (GTA) of 9.0%. Because these analyses use population-based data, even small differences in rates could easily reach statistical significance. Thus, in order to identify areas of Peel where rates of diabetes were meaningfully different from the GTA rate, a difference of at least 20% was chosen because a difference of this magnitude is likely to have public health significance. For each Peel census tract, the diabetes rate was divided by the overall GTA rate in order to calculate a rate-ratio. Census tracts with diabetes rates at least 20 per cent higher than the GTA rate (rate-ratio of ≥1.2) were depicted in shades of red, while tracts with rates at least 20% below the GTA rate (rate-ratio of ≤ 0.80) were depicted in shades of blue. All census tracts where rates did not differ substantially from the GTA rate (rate-ratio between 0.81 and 1.19) were depicted using a single grey colour.

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Chapter 3

Socioeconomic STATUS & DIABETES

INSIDE

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HIGHLIGHTS

Issue

- Education and income are the most commonly used measures of socioeconomic status (SES) and important social determinants of health.
- Low SES is often associated with worse health outcomes. This relationship has also been found for diabetes. However, it is unclear how strong these relationships are at the neighbourhood level in a largely suburbanized area.
- In this chapter, area-level median household income and per cent of the population who fell below Statistics Canada's low income cut-off (LICO) are used to measure income. Per cent of the population that did not complete their high school education is used as a measure of education.
- This chapter presents the spatial distribution of these socioeconomic characteristics, along with associated prevalence rates of diabetes, across Peel region.

Key Findings

- In Peel, there was a fairly consistent spatial relationship between rates of diabetes and socioeconomic variables. Higher rates of diabetes were generally found in areas with lower SES.
- Somewhat different patterns for income and education (components of SES) were seen across the three Peel municipalities. In Brampton, the majority of areas with high rates of diabetes were in the middle income category and had lower levels of educational attainment. In northeast Mississauga, there was a cluster of neighbourhoods, surrounded by industrial land, that had high rates of diabetes, lower income and a higher percentage of residents who did not complete high school. Relatively-high SES profiles and low diabetes rates were seen across Caledon and in south Mississauga.

Implications

- Both education and income appear to be strongly related to patterns of diabetes prevalence in Peel.
- Diabetes is often the outcome of poor quality diets and lack of physical activity – both of which need to be addressed in the general population. The consequences of developing diabetes, including the high cost of managing this condition and the risk of developing other serious health complications, are especially burdensome for people with low SES.
- The needs of people living in low-SES areas should be specifically kept in mind when policy makers and health planners design programs to prevent diabetes and help those living with the disease manage their condition.
- Low-SES populations may also live in areas with poor access to healthy resources, low walkability and inadequate public transit. Planners may need to especially attend to these aspects of the built environment in low-SES areas.

INTRODUCTION

Socioeconomic status (SES) refers to the position an individual or group holds in a society's socioeconomic hierarchy.[1] There is a well established connection between SES and the risk of developing chronic diseases including diabetes and cardiovascular disease.[2, 3] For these and many other diseases, individuals with low SES tend to have worse health outcomes. As well, individuals living in more socioeconomically disadvantaged areas have higher rates of illness and mortality resulting from chronic disease.[4, 5]

There is no single "best" way to measure SES. Rather, different measures emphasize different aspects of the socioeconomic hierarchy. Education and income are the most commonly-used measures of SES; they are also important social determinants of health. From this point in the atlas, income and education will be used to describe SES.

Low income and low levels of education have both been associated with higher rates of diabetes prevalence. Canadian men and women in the lowest income and education groups share a disproportionately high burden of diabetes. For example, in 2005 in Ontario, 8% of women and 10% of men in the low income group reported having diabetes compared with 3% of women and 5% of men in the highest income group.[6] Between 1994 and 2009, diabetes incidence – the onset of new diabetes cases – was highest among Canadian men and women with the lowest levels of household income or education.[7]

Individuals living in lower income areas are also known to be at higher risk of diabetes. Two recently published atlases both show a significantly higher prevalence of diabetes among residents of lower income neighbourhoods than among those living in more affluent neighbourhoods.[8, 9] In Ontario, individuals residing in the lowest income neighbourhoods have diabetes rates that are at least 50% higher than those living in the wealthiest neighbourhoods.[8]

While the underlying causes are not well understood, many factors may contribute to the different rates of diabetes seen among individuals

of varying levels of SES. Levels of income and education shape overall living conditions and health-related behaviours such as diet, physical activity and tobacco use. Diets low in fruits and vegetables, low levels of physical activity and higher rates of obesity are often seen among people in lower SES groups.[6, 10, 11] However, it is important to point out that these factors do not fully account for the higher rates of diabetes experienced by persons in low-SES groups. Other effects of low-SES conditions, such as the stress of living with economic hardship and in low-quality housing – throughout a person's life-course – are likely to be very important in shaping the relationship between SES and health.[12, 13] Researchers are just beginning to understand how such factors relate to diabetes.

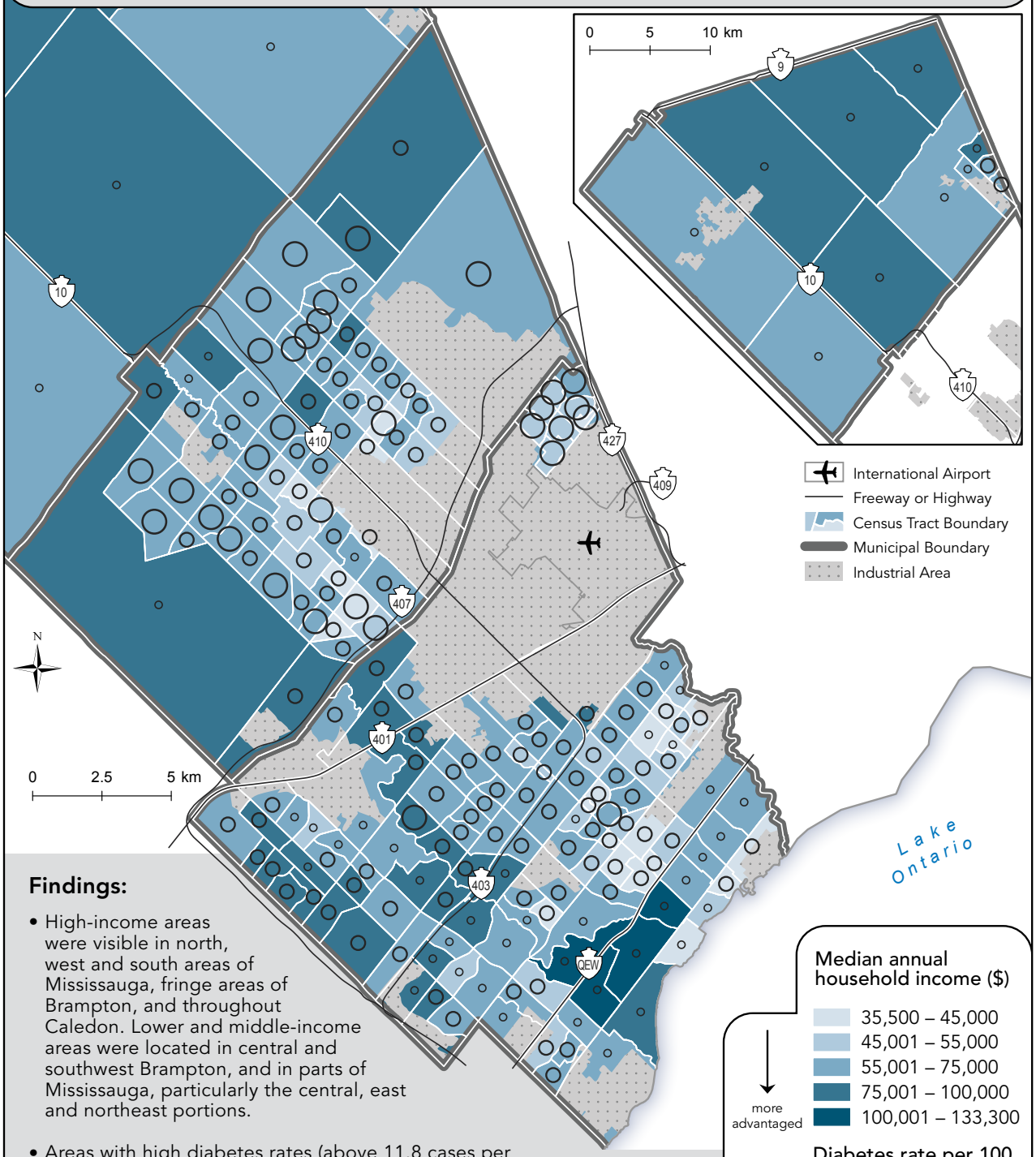
The purpose of this chapter is to present the spatial distribution of socioeconomic characteristics across Peel and their association with rates of diabetes. The specific socioeconomic factors presented in this chapter are median household income, per cent of the population who fell below

Statistics Canada's low-income cut-off (LICO) and those who did not complete their high school education. Median income and per cent of people below the LICO are both common measures of income in Canada. The LICO is a commonly used indicator to identify those who are substantially economically worse off than the average. Measuring the per cent of population without a high school diploma is important because individuals in the least educated groups typically experience the poorest health.

LIST OF EXHIBITS

EXHIBITS AND FINDINGS

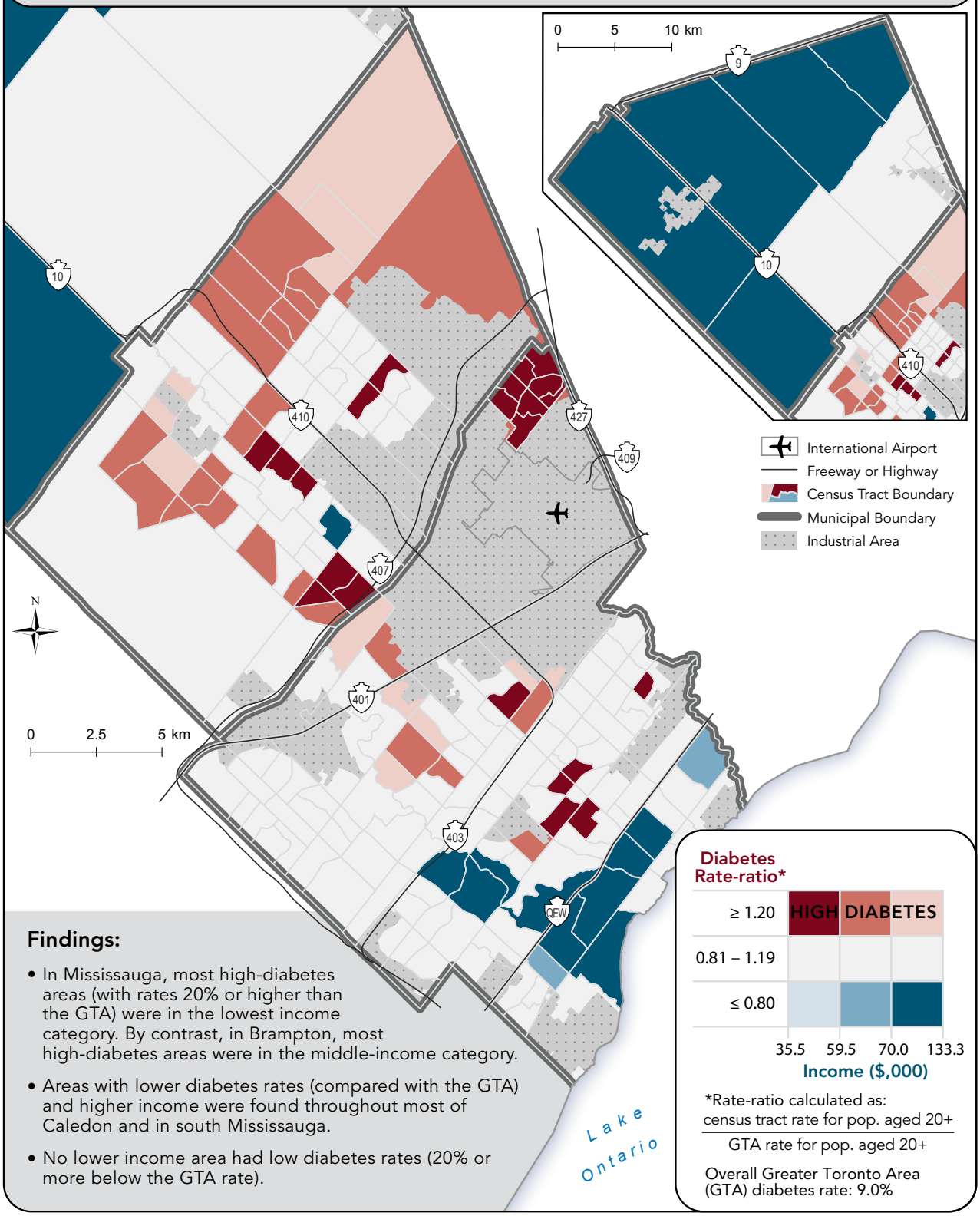
Exhibit 3.1. Median annual household income (in dollars, after-tax) [2005] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- High-income areas were visible in north, west and south areas of Mississauga, fringe areas of Brampton, and throughout Caledon. Lower and middle-income areas were located in central and southwest Brampton, and in parts of Mississauga, particularly the central, east and northeast portions.
- Areas with high diabetes rates (above 11.8 cases per 100 people) were found in many middle- and lower-middle income neighbourhoods throughout Brampton and northeast Mississauga.
- Lower diabetes rates (below 8.8 cases per 100 people) were visible in many middle- to high-income areas of Mississauga and Caledon.

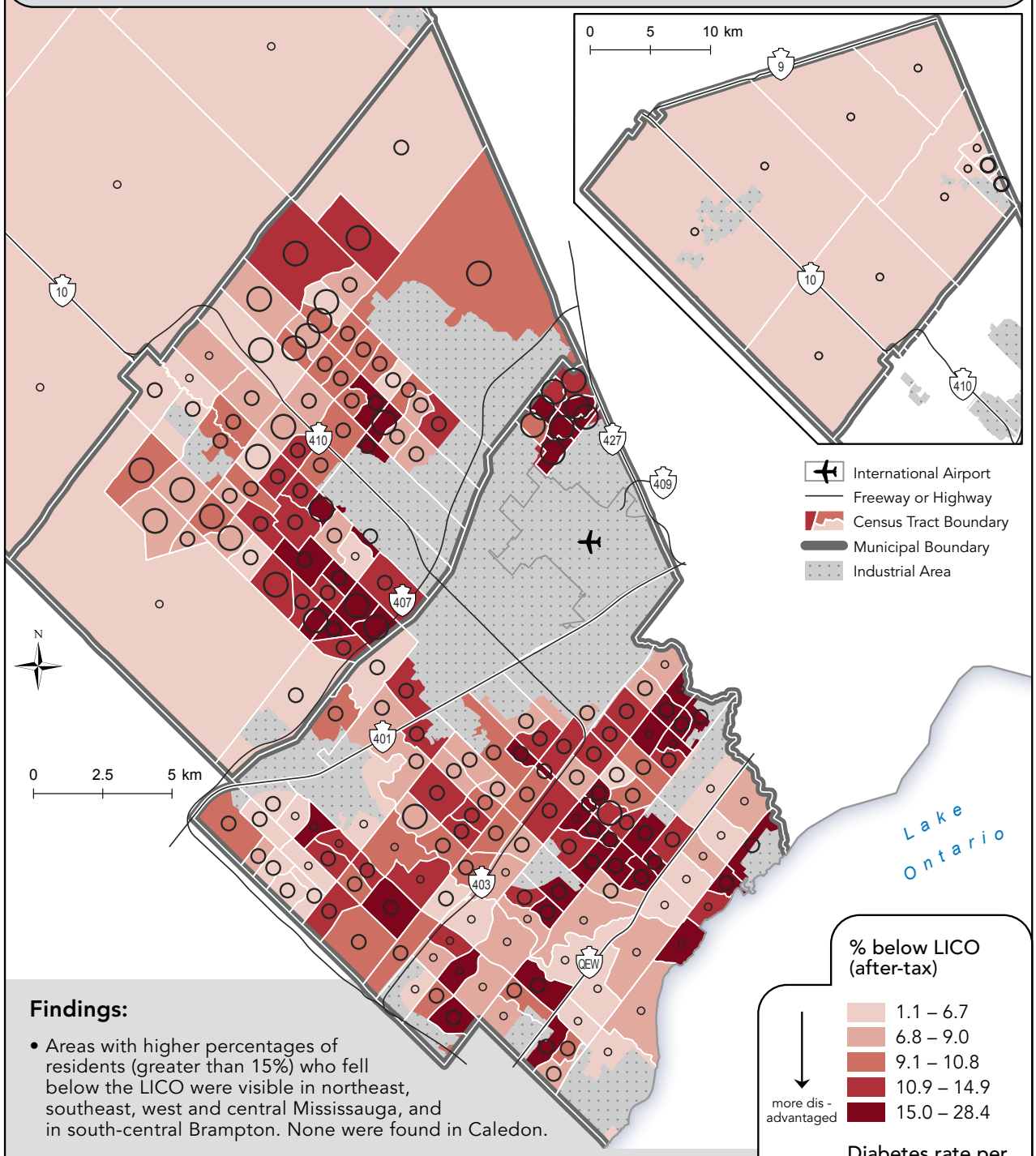
Exhibit 3.2. Spatial relationship between median annual household income (in dollars, after-tax) [2005] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

- In Mississauga, most high-diabetes areas (with rates 20% or higher than the GTA) were in the lowest income category. By contrast, in Brampton, most high-diabetes areas were in the middle-income category.
- Areas with lower diabetes rates (compared with the GTA) and higher income were found throughout most of Caledon and in south Mississauga.
- No lower income area had low diabetes rates (20% or more below the GTA rate).

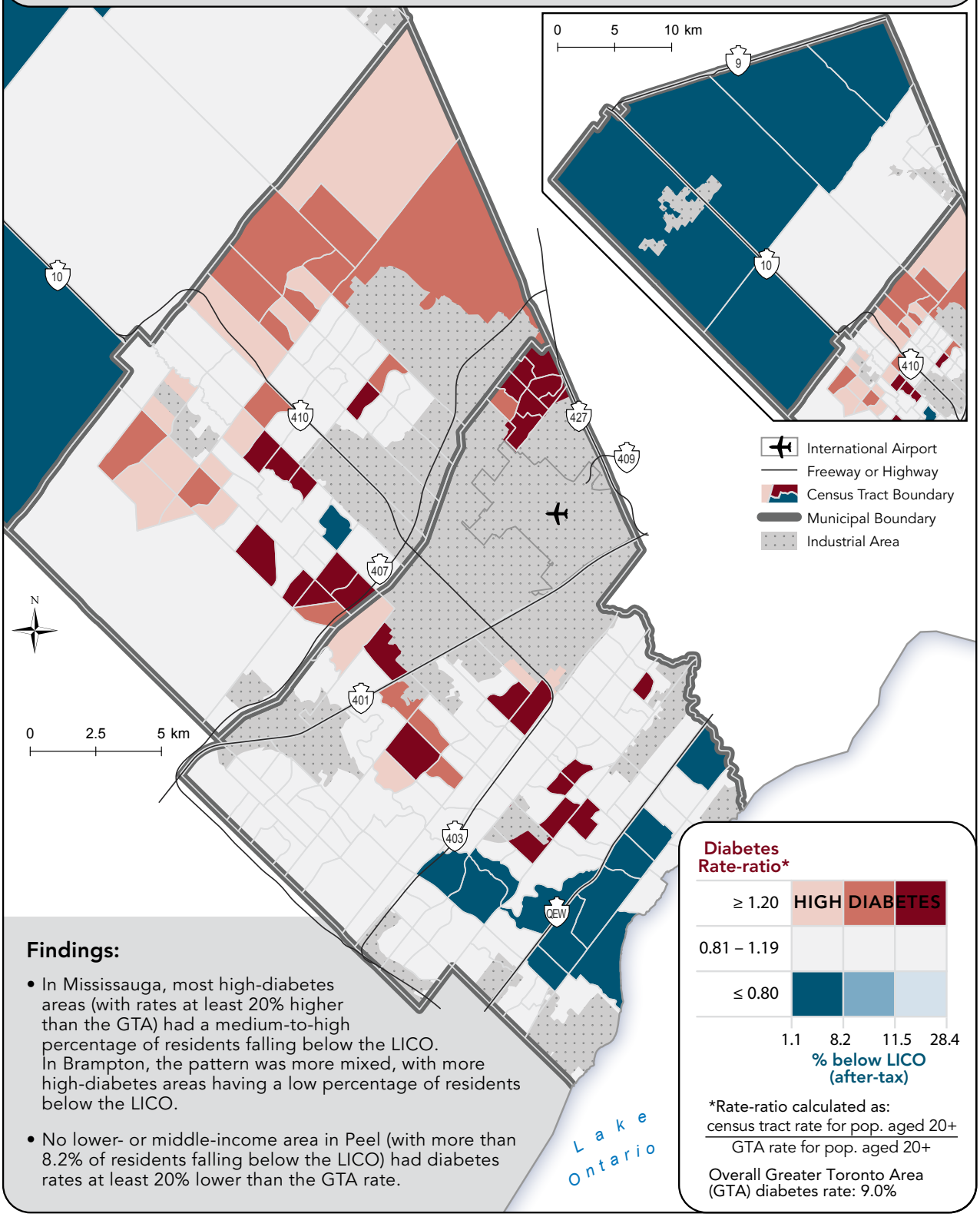
Exhibit 3.3. Per cent of the population who fell below Statistics Canada's low income cut-off (LICO; after-tax) [2005] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- Areas with higher percentages of residents (greater than 15%) who fell below the LICO were visible in northeast, southeast, west and central Mississauga, and in south-central Brampton. None were found in Caledon.
- High-diabetes areas in northeast Mississauga and in parts of Brampton had medium-to-high percentages of residents falling below the LICO.
- However, half of all high-diabetes neighbourhoods in Brampton had a relatively low percentage of residents below the LICO.

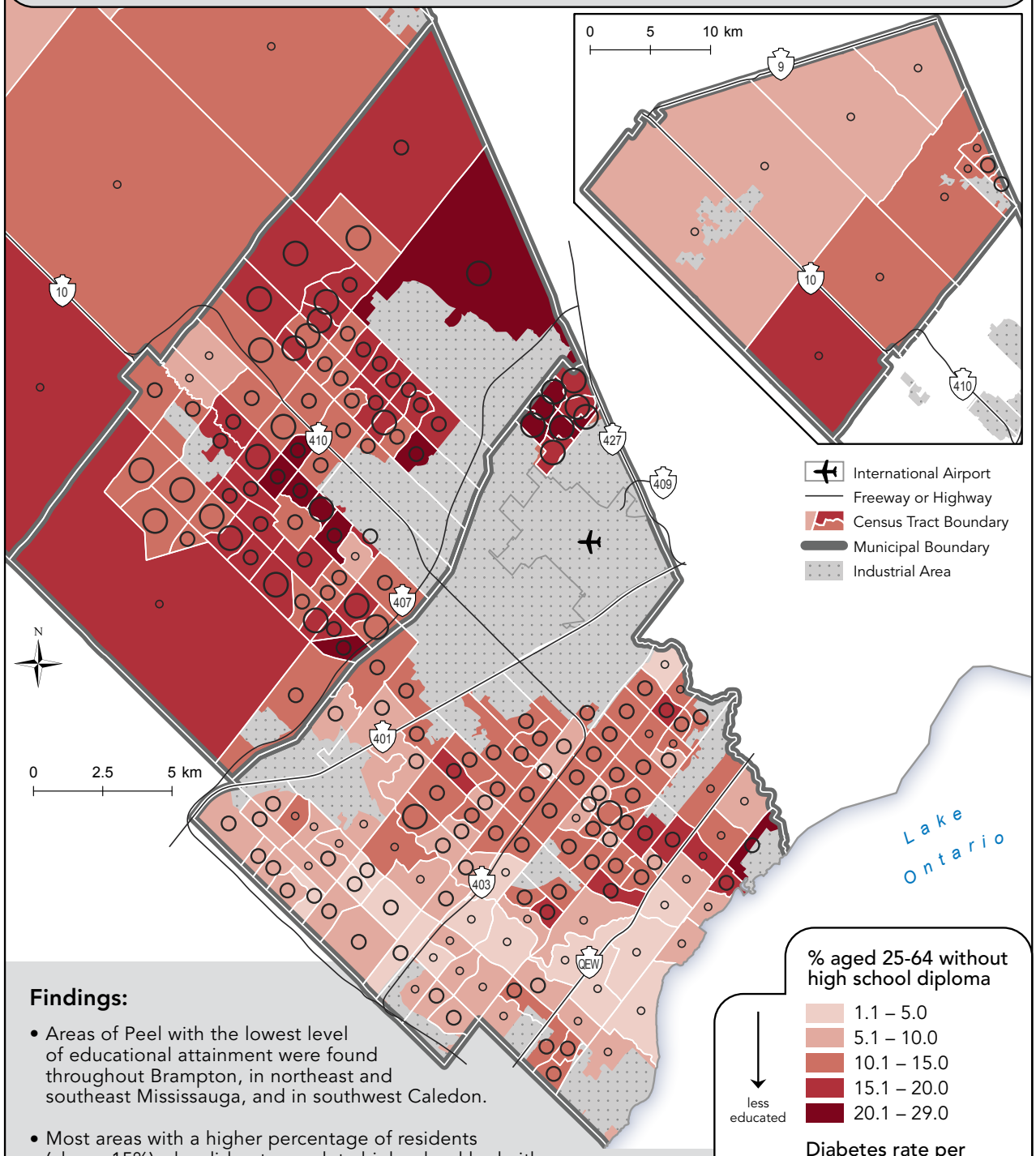
Exhibit 3.4. Spatial relationship between per cent of the population below Statistics Canada's low income cut-off (LICO; after-tax) [2005] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

- In Mississauga, most high-diabetes areas (with rates at least 20% higher than the GTA) had a medium-to-high percentage of residents falling below the LICO. In Brampton, the pattern was more mixed, with more high-diabetes areas having a low percentage of residents below the LICO.
- No lower- or middle-income area in Peel (with more than 8.2% of residents falling below the LICO) had diabetes rates at least 20% lower than the GTA rate.

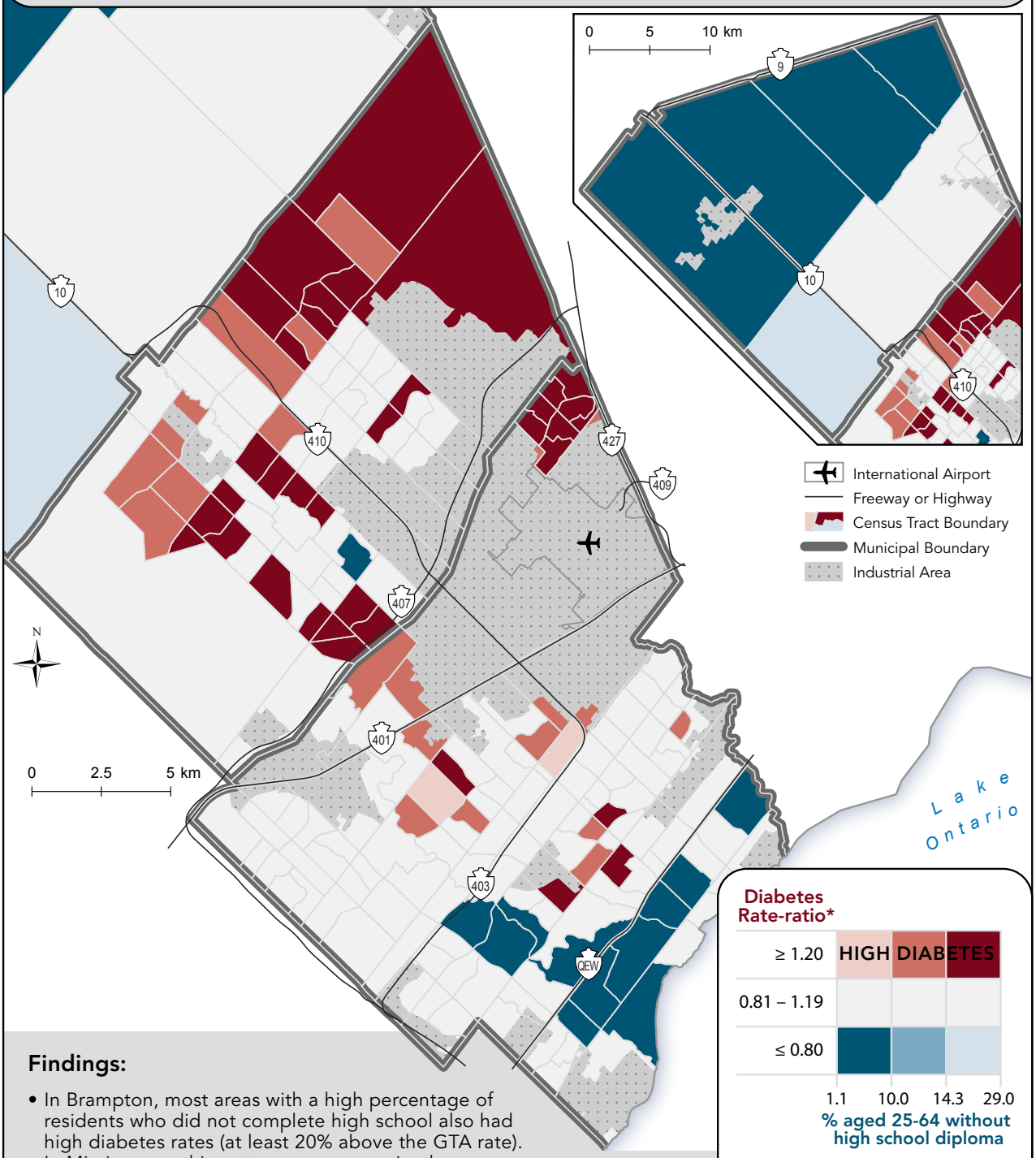
Exhibit 3.5. Per cent of the population aged 25-64 who did not complete their high school education [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- Areas of Peel with the lowest level of educational attainment were found throughout Brampton, in northeast and southeast Mississauga, and in southwest Caledon.
- Most areas with a higher percentage of residents (above 15%) who did not complete high school had either medium or high diabetes rates.
- High-diabetes areas had consistently lower levels of educational attainment.

Exhibit 3.6. Spatial relationship between per cent of the population aged 25-64 who did not complete their high school education [2006] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

- In Brampton, most areas with a high percentage of residents who did not complete high school also had high diabetes rates (at least 20% above the GTA rate). In Mississauga, this pattern was more mixed.
- With few exceptions, areas with higher levels of educational attainment in south Mississauga and north Caledon had lower rates of diabetes (at least 20% below the GTA).

*Rate-ratio calculated as:

$$\frac{\text{census tract rate for pop. aged 20+}}{\text{GTA rate for pop. aged 20+}}$$

Overall Greater Toronto Area (GTA) diabetes rate: 9.0%

DISCUSSION

In Peel, there was generally a consistent relationship between lower socioeconomic status (SES) and higher rates of diabetes prevalence. However, different patterns for the components used to define SES for this atlas (income and education) were visible across the three Peel municipalities.

Throughout Caledon and in south and west Mississauga, higher income areas had consistently lower rates of diabetes. The association of diabetes rates with level of educational attainment (secondary school) appeared to be more mixed. In Caledon, diabetes rates were in the lowest range regardless of education level. In contrast, in Mississauga, which on average has the highest education levels in Peel, areas with higher levels of educational attainment generally had lower rates of diabetes. In northeast Mississauga, a cluster of lower income and lower education areas surrounded by industrial land had a disproportionately high burden of diabetes.

The associations between household income and education with rates of diabetes were somewhat different in Brampton, the municipality with the largest number of high-diabetes areas. Here, most areas with high rates of diabetes were in the middle-income category. Many of these areas also had lower levels of educational attainment.

Although strongly linked to one another, a person's income and education may have independent effects on health and various behaviours that relate to health.[1, 14] For example, education may influence a person's choice of foods through greater knowledge of nutrition and make people more receptive to health education messages. It may also make it easier for people to communicate with and access appropriate health services. In turn, a higher income makes it easier to access better quality resources and services such as housing, nutritious food and leisure-time exercise activities, all of which have important implications for health.

There are many potential explanations for the association between SES and diabetes prevalence. Risk factors for diabetes such as obesity, less healthy eating patterns and sedentary lifestyles appear to be more common among population groups with lower SES.[6,11,15] These and other health-related behaviours are strongly shaped by levels of income, education and overall living conditions throughout a person's life-course.

Also, Peel is home to one of the largest immigrant communities in the Greater Toronto Area (GTA) which further complicates the link between SES and diabetes. New immigrants often experience a prolonged period of low income as a result of the resettlement process. The high rates of immigration also bring with them a diverse mix of ethnic origins which are known to impact health through diet, health-related behaviours and genetic make-up. Many recent immigrants who settle in Peel are from ethnic groups that have an inherently increased risk of developing diabetes, particularly those of South Asian, African, Latin American and Caribbean ancestry.[16, 17] Peel is also home to many established immigrants and persons born in Canada who identify themselves as being part of these ethnocultural groups. In 2006, Brampton was home to the largest South Asian community in Peel.[18] Black and Chinese were the second most commonly reported visible minority groups in Peel. Immigrants belonging to high-risk ethnocultural groups who are more established in Canada and have higher SES may have a higher residual risk of diabetes due to genetic susceptibility.[17] This could partly account for the high rates of diabetes throughout many higher and middle-income areas of Brampton and Mississauga shown in these analyses (for more details about patterns of ethnicity and immigration in Peel and about how these factors relate to diabetes, see Chapter 4).

It is important to note that the cross-sectional nature of this research cannot prove a causal link between lower SES and diabetes because lower SES may occur after the development of diabetes (i.e., cause and effect cannot be determined). Persons with diabetes often have higher rates of unemployment due to disability associated with the disease.[19, 20] Thus, a person's social status may deteriorate as a direct consequence of developing diabetes. Furthermore, the analyses presented in this chapter use aggregate data to show rates of

diabetes and SES across neighbourhoods. That is, there was no information on, for example, whether a particular individual had diabetes and also had a low level of education. This is a common issue in this type of research and must be kept in mind as one interprets the results of these analyses.

The findings of this chapter have a number of implications. Canadians diagnosed with diabetes who were in the highest household income group ($60,000 and over) were twice as likely to receive the recommended care to prevent complications than those in the lowest income group (less than $20,000).[21] Persons in lower SES groups also experience a higher rate of cardiovascular disease and are more likely to be hospitalized for an acute complication of diabetes.[5, 22, 23] This means that the consequences of developing diabetes may be more severe for those with low income.[24] In addition, diabetes is a costly condition to manage, requiring the use of multiple medications and supplies to regularly monitor levels of blood glucose.[9] This places an even greater burden on persons in lower income groups who have fewer resources to purchase these medications and supplies. Among some individuals with lower levels of educational attainment, low levels of health literacy – the ability to access, understand and act on medical information – may be an additional obstacle to managing this complex condition.[25]

The cost of maintaining a healthy lifestyle can pose an additional barrier to persons with lower incomes.[9] Regular exercise can help prevent weight gain, a major risk factor for the development of diabetes. Research from randomized trials shows that physical activity, along with changes in diet, plays an essential role in reducing the occurrence of diabetes in high-risk populations (i.e., in individuals with prediabetes).[26, 27] The costs associated with sports and other leisure activities could give wealthier individuals a health advantage over those in lower income groups who simply cannot afford to engage in certain sporting activities or join fitness clubs.[9] The higher cost of healthy foods (e.g., fruits and vegetables, lean meats, fish) relative to energy-dense convenience foods is also likely to contribute to obesity and diabetes among people with low incomes.[28, 29]

The association between SES and diabetes may be also driven by differences in access to healthy resources (e.g., stores selling fresh fruits and vegetables) and opportunities to engage in physical activities (e.g., nearby parks or recreation centres).[9] In some cities in Canada and the United States, lower income neighbourhoods have worse access to such resources as a result of unequal distribution of these amenities.[30-32] Low-SES populations may also live in areas that are less pleasant for walking, have fewer walkable destinations and poor access to public transit than higher SES areas.[32, 33] Thus, urban planners may need to especially attend to these aspects of the built environment in low-SES areas. Because this research is cross-sectional, it is also possible that the apparent clustering of individuals with diabetes and low SES in particular neighbourhoods may be due to some other factor or group of factors. For example, individuals with low SES and diabetes may be more likely to settle in particular areas because of more affordable housing.

Public health interventions focused on reducing the risk of diabetes in low-education and low-income groups may be more challenging to implement than public health measures in other high-risk populations.[9] Such measures will require approaches that are multi-faceted and tailored to the unique needs of the local community.

CONCLUSIONS AND IMPLICATIONS

In Peel, there was a fairly consistent spatial relationship between rates of diabetes prevalence and income and education, the components used to define socioeconomic status (SES) for this atlas. Higher rates of diabetes were generally found in lower SES areas. However, somewhat different patterns for the components of SES (income and education) were visible across the three Peel municipalities. In Brampton, the majority of areas with high rates of diabetes were in the middle-income category and had lower levels of educational attainment. In northeast Mississauga, a cluster of neighbourhoods – surrounded by industrial land – with high rates of diabetes, lower income and a higher percentage of residents who did not complete high school was identified. Relatively high SES profiles and low diabetes rates were seen across Caledon and in south Mississauga. Many factors may explain the relationship between neighbourhood SES and diabetes prevalence, including the distribution of ethnocultural groups across municipalities, as well as local access to healthy foods and opportunities for physical activity. The relationship between these factors and diabetes across neighbourhoods of varying SES will be explored in later chapters of this atlas.

APPENDIX 3.A – RESEARCH METHODOLOGY

Data sources

- The socioeconomic factors examined in this chapter and population estimates for Peel region were gathered from the 2006 Canadian census for each census tract.
- The total population included Canadian citizens, landed immigrants, refugees, students, people with work permits and people with Minister's permits whose usual place of residence is in Canada.
- The median household income represented the median after-tax income reported by households within a given census tract in the year 2005.
- The percentage of individuals living below Statistics Canada's low income cut-off (LICO, after-tax) was derived for economic families and persons aged 15 years or older in private households who were not in economic families. The LICO refers to income levels at which individuals spent 20% or more of their total income than the average family on food, shelter and clothing.
- The proportion of residents with less than high school education was based on the percentage of the non-institutionalized population aged 25 to 64 years who did not receive their secondary school graduation certificate or equivalent. The standard approach to measuring educational attainment in a population is to restrict the measure to adults aged 25 to 64 years. This approach is endorsed by the Organisation for Economic Co-operation and Development (OECD) and by Statistics Canada. Only adults aged 25 to 64 years are included because individuals younger than 25 may not have yet completed their schooling. Levels of education among adults aged 65 and older reflect educational attainment many decades ago, a time when general levels of education were lower than today.

- Age- and sex-adjusted diabetes rates per 100 adults aged 20 years or older were calculated using the Ontario Diabetes Database and other administrative data sources held at the Institute for Clinical Evaluative Sciences (ICES) (for a detailed description of the data sources of diabetes rates, please refer to Appendix 2.A in Chapter 2).

Analysis

Bivariate maps were created to display the spatial relationship between socioeconomic variables and rates of diabetes. Choropleth (shaded) maps were produced for each socioeconomic variable.

The classifications ranges for median household income and proportion of residents with less than high school education were determined using natural breaks in the distribution of the data, which is a common classification method for choropleth mapping. The classifications ranges for per cent of the population below LICO (after-tax) were generated based on population-weighted quintiles for Exhibit 3.3 and population-weighted tertiles for Exhibit 3.4.

Diabetes rates were depicted in three categories using proportional circles. The ranges for these categories were determined by first ordering the population-weighted diabetes rates of all Peel census tracts from lowest to highest, and then selecting the four points that divide the rates into five equal population-weighted groups (quintiles). Three different proportional circle sizes were used to correspond to the magnitude of diabetes rates (i.e., larger circles correspond to progressively higher ranges of diabetes rates). The lowest category of diabetes rates consisted of the first (lowest) quintile and the highest category consisted of the last (highest) quintile. The middle category of diabetes rates was made up of the middle three quintiles grouped together. These circles were then overlaid on top of the choropleth maps of socioeconomic variables. This was done so that the reader could observe whether there is a spatial correspondence between, for example, areas with higher diabetes rates and lower household income.

A second type of map for each socioeconomic variable was created in order to highlight areas of Peel where diabetes rates were substantially higher or lower than the overall prevalence rate in the Greater Toronto Area (GTA) of 9.0%. Because these analyses use population-based data, even small differences in rates could easily reach statistical significance. Thus, in order to identify areas of Peel with rates of diabetes that were meaningfully different from the GTA rate, a difference of at least 20% was chosen for examination because a difference of this magnitude is likely to have public health significance. For each Peel census tract, the diabetes rate was divided by the overall GTA rate in order to calculate a rate-ratio. Census tracts with diabetes rates at least 20% higher than the GTA rate (rate-ratio of ≥ 1.20) were depicted in shades of red according to the ranges of values of each socioeconomic variable. Census tracts with rates at least 20% below the GTA rate (rate-ratio of ≤ 0.80) were depicted in shades of blue. All census tracts whose rates did not differ substantially from the GTA rate (rate-ratio between 0.81 and 1.19) were depicted using a single grey colour. The classification ranges for median household income and proportion of residents with less than high school education were determined using natural breaks in the distribution of the data, which is a common classification method for chloropeth mapping. The classification ranges for percent of the population below LICO (after-tax) were generated based on population-weighted quintiles for Exhibits 3.3 and population-weighted tertiles for Exhibit 3.4 (for more information on maps see the section, How to Read the Maps).

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Chapter 4

ETHNICITY, IMMIGRATION & Diabetes

INSIDE

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HIGHLIGHTS

Issue

- Type 2 diabetes occurs more commonly in non-European ethnoracial groups. This is due, in part, to differing genetic susceptibility to diabetes across various ethnic groups.
- Nearly 50% of the Peel population is comprised of immigrants to Canada. A large proportion of this population belongs to ethnic groups that experience a higher risk of developing diabetes compared with other ethnic groups.
- This chapter presents the spatial distribution of ethnoracial and immigration characteristics of Peel residents, and the association of these characteristics with rates of diabetes.

Key Findings

- Although settlement patterns differed by ethnic group, census tracts with higher proportions of South Asian and Black visible minorities, as well as those with higher proportions of recent immigrants, also had higher rates of diabetes.
- Areas with a large proportion of the population not speaking English also tended to have high diabetes rates, particularly in Brampton.

Implications

- Strategies to reduce the risk of diabetes in high-risk communities need to consider the underlying ethnicity and culture of the target population.
- Diabetes programs need to be culturally appropriate and accessible to groups for whom English is not their first language.

INTRODUCTION

Type 2 diabetes occurs more commonly in non-European ethnoracial groups, largely due to ethnic differences in genetic susceptibility. The highest rates of diabetes worldwide have been reported in Aboriginal populations, including those in Canada. In these populations, the prevalence of diabetes may be as high as 20% to 50%.[1-3] Other groups with a higher prevalence of diabetes, both in indigenous and immigrant populations, include people of South Asian, African and Hispanic ethnic background.[4-6]

In the United States, the prevalence of diabetes in African- and Hispanic-Americans, and South Asians, is twice that of non-Hispanic Whites.[5,7-9] In England, people from Black Caribbean, Indian, Pakistani and Bangladeshi ethnic groups have three to six times higher prevalence than the general population.[10] In Canada, people of South Asian descent are three to five times more likely to have diabetes than the White population.[4,11] In Ontario, South Asians and West Asians comprise 12% of the population with diabetes despite representing less than 4% of the overall population.[12] Although not as high as in those born in South Asian countries, Ontario residents born in Africa, the Caribbean and the Middle East have higher rates of diabetes compared with the general population and immigrants from western European countries.[4]

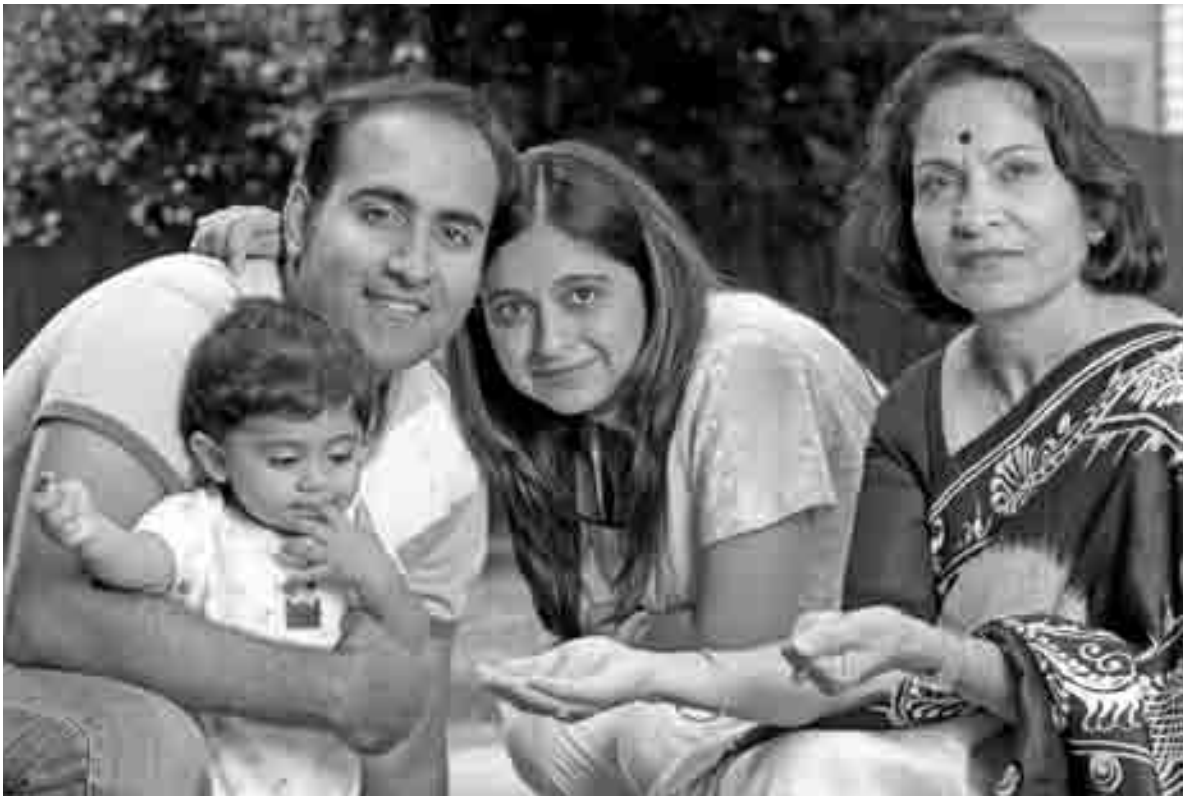
Ethnicity alters the risk of diabetes through genetic factors that are not completely understood. Obesity is known to be one of the most important risk factors for the development of diabetes. Genetics can influence a person's propensity to gain weight, where the weight is gained in the body, the likelihood that increased body fat will result in insulin resistance and the age at which diabetes develops.[13] Studies looking at people of Western European, African and South Asian ancestry have found that obesity is significantly more common in people of European and African ancestry, while rates of diabetes are higher among South Asians.[14] Although obesity levels were found to be similar in the population of European and African ancestry, diabetes rates were higher in African ethnic populations.[14] In addition, diabetes risk is significantly higher at lower body weights and lower waist circumferences for South Asians, as compared with people of European or African ancestry[15,16] (for more information on patterns of overweight/obesity and diabetes prevalence, see Chapter 2). These results suggest that the relationship between obesity and diabetes may differ across ethnoracial groups.

Programs aimed at preventing diabetes need to consider that standard body weight guidelines may not be appropriate in an ethnically-diverse population. The propensity for weight gain and subsequent development of pre-diabetes or diabetes are also impacted by social and environmental factors.

Immigration largely affects the epidemiology of diabetes in the overall population through changing the ethnic composition of the community. Risk seems to increase as immigrants become more affluent and move to urban centres. This phenomenon has been observed in migrants from rural to urban areas within the same country, and in migrants moving from less industrialized and urbanized countries to those that are more so.[6,17] Migration may influence the risk of diabetes through nutrition transition (i.e., a move from a diet rich in fruits and vegetables to a Western diet rich in fats, meat, processed foods and salt), changes in physical activity levels and stress.[17] The relationship between migration and socioeconomic status is further complicated by the fact that although migrants may move from less affluent to more affluent countries, recent immigrants themselves often experience a drop in socioeconomic position relative to the native-born population in the first years after migration.

Differences in socioeconomic status may compound the higher risk of diabetes among certain ethnoracial and immigration groups.[18] Recent immigrants and visible minorities in Canada tend to have lower incomes than Canadian-born individuals of European descent and this may exacerbate health disparities.[19, 20] There is also evidence that recent immigrants and visible minorities have poorer access to health services, which may negatively impact the quality of diabetes care they receive .[21-25]

Peel is a highly culturally and ethnically diverse region. In 2006, one-half (50%) of Peel residents overall identified themselves as being from a visible minority (57% in Brampton, 49% in Mississauga and 7% in Caledon; see Chapter 1).[26] In addition, immigrants comprise 28% of the total Ontario population, but nearly half of the Peel population (48.6%).[26] The majority of recent immigrants to Canada (and Peel) originate from non-European countries.[27] Thus, many of these groups are genetically more susceptible to

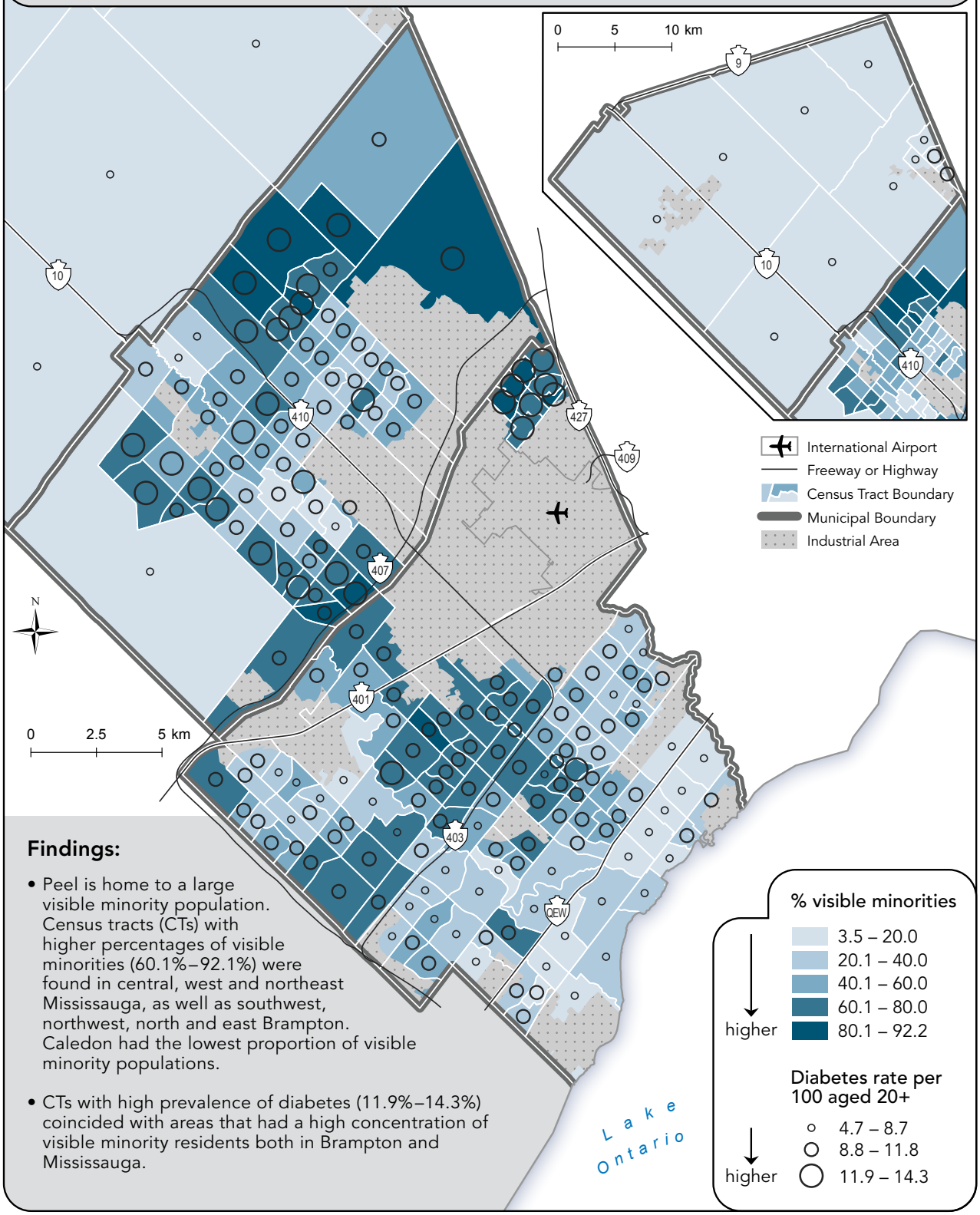


developing diabetes. The purpose of this chapter is to examine the relationship between the prevalence of diabetes and recent immigration and ethnicity in Peel. The ethnic composition of Peel is extremely heterogeneous. Therefore, for the purpose of the analyses in this chapter, the top five self-identified, visible minority ethnic groups (South Asian, Black, Chinese, Filipino and Latin American) and the top three self-identified, non-visible minority ethnic groups (Italian, Portuguese, Polish) from the 2006 census were identified (see Appendix 4A).

LIST OF EXHIBITS

EXHIBITS AND FINDINGS

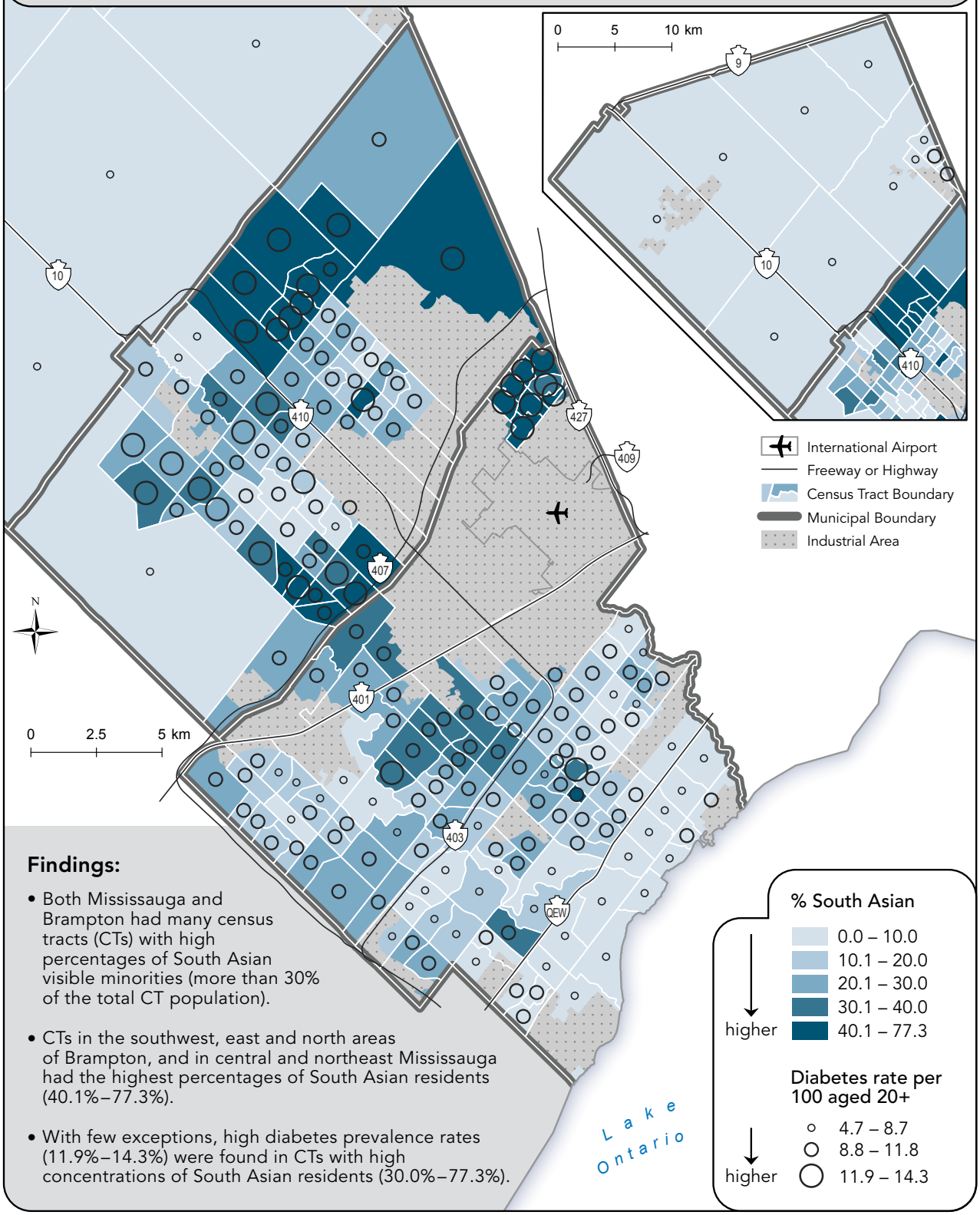
Exhibit 4.1. Visible minorities (self-identified) as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- Peel is home to a large visible minority population. Census tracts (CTs) with higher percentages of visible minorities (60.1%–92.1%) were found in central, west and northeast Mississauga, as well as southwest, northwest, north and east Brampton. Caledon had the lowest proportion of visible minority populations.
- CTs with high prevalence of diabetes (11.9%–14.3%) coincided with areas that had a high concentration of visible minority residents both in Brampton and Mississauga.

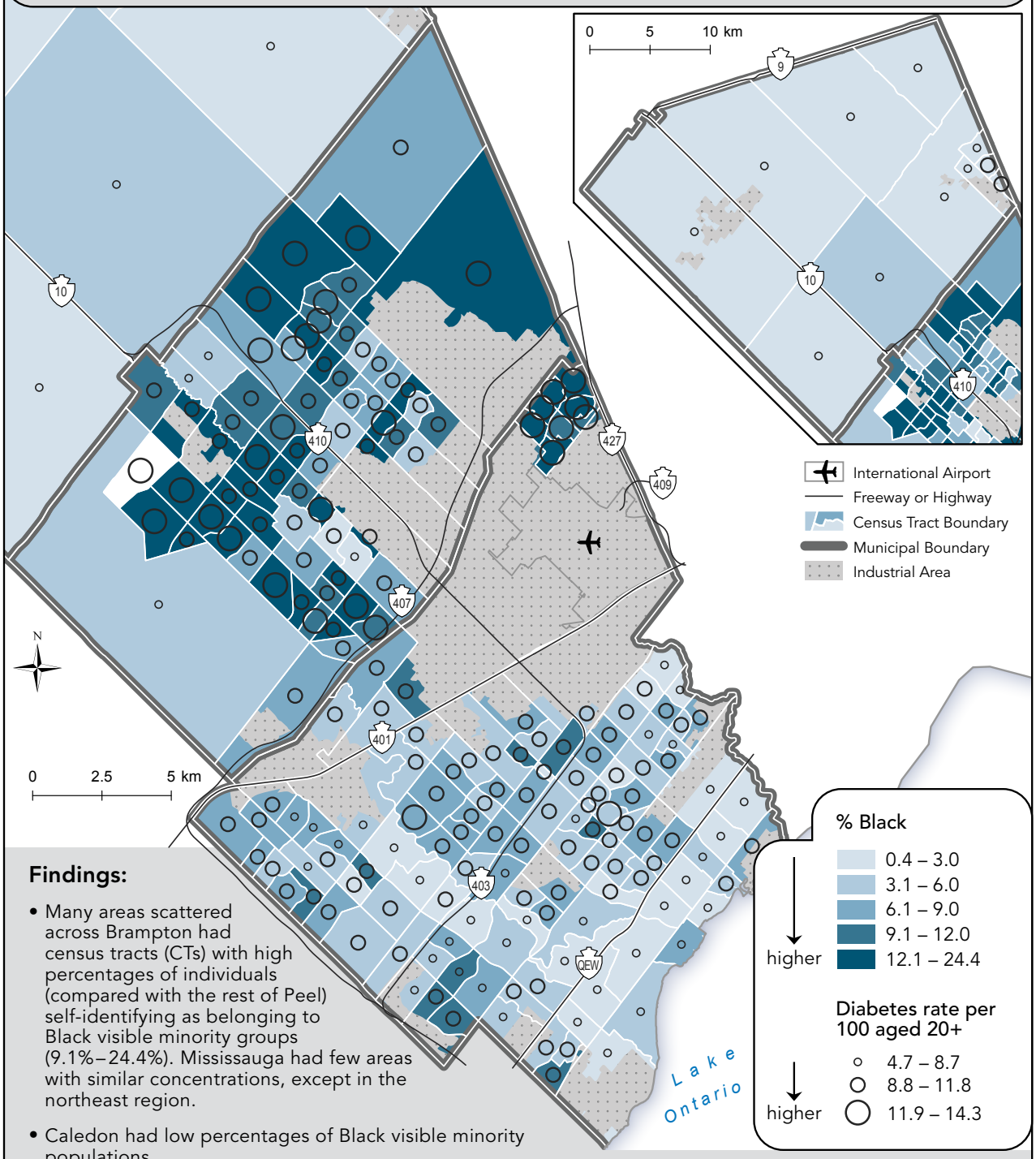
Exhibit 4.2. South Asian visible minorities (self-identified) as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- Both Mississauga and Brampton had many census tracts (CTs) with high percentages of South Asian visible minorities (more than 30% of the total CT population).
- CTs in the southwest, east and north areas of Brampton, and in central and northeast Mississauga had the highest percentages of South Asian residents (40.1%–77.3%).
- With few exceptions, high diabetes prevalence rates (11.9%–14.3%) were found in CTs with high concentrations of South Asian residents (30.0%–77.3%).

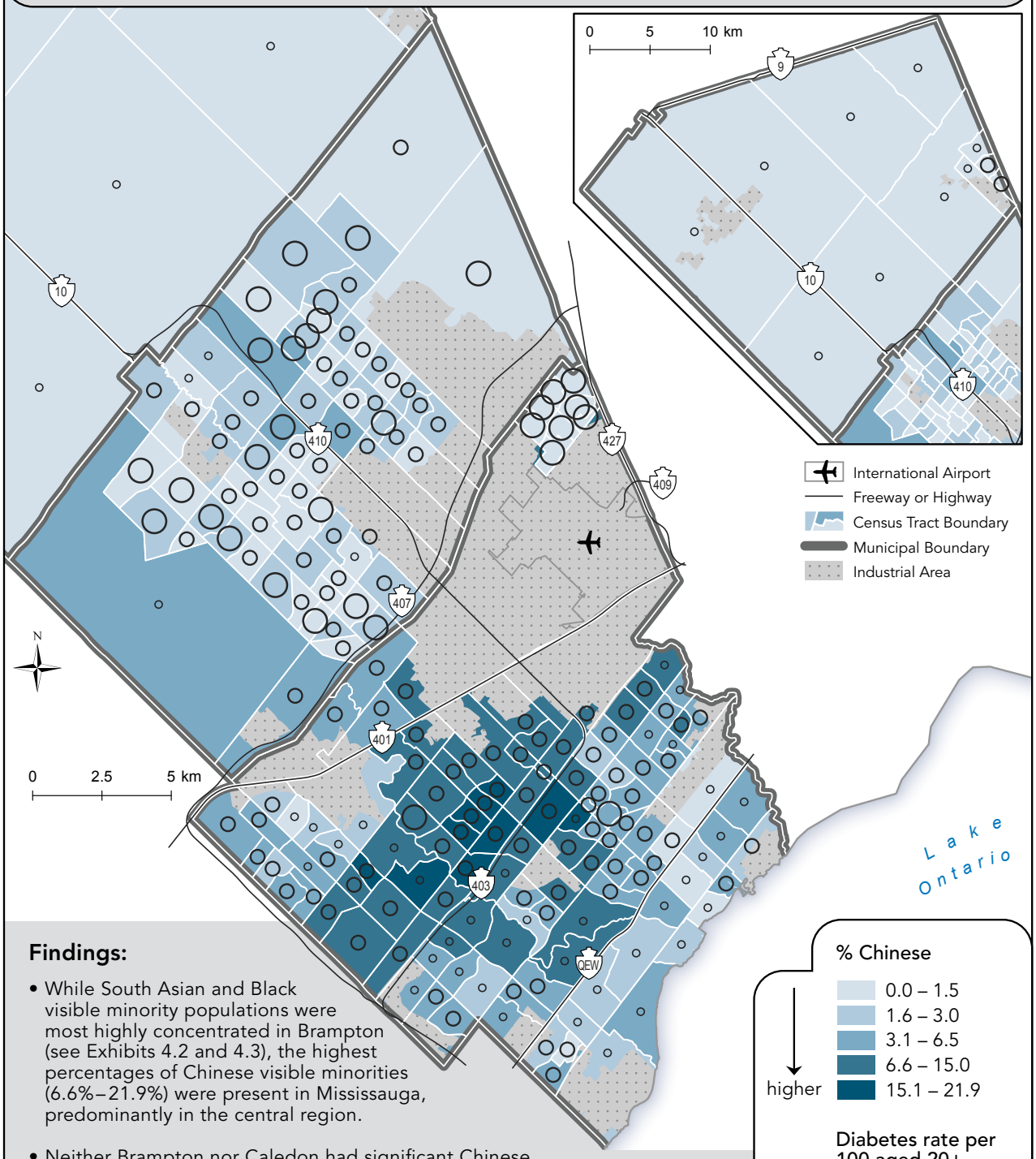
Exhibit 4.3. Black visible minorities (self-identified) as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- Many areas scattered across Brampton had census tracts (CTs) with high percentages of individuals (compared with the rest of Peel) self-identifying as belonging to Black visible minority groups (9.1%–24.4%). Mississauga had few areas with similar concentrations, except in the northeast region.
- Caledon had low percentages of Black visible minority populations.
- Many CTs in Brampton with the highest percentages of Black visible minorities (12.1%–24.4%) also had high rates of diabetes, particularly in the north, east, southwest and parts of central Brampton. Less of a pattern was observed in Mississauga, except in the northeast. Many of these areas were also found to have high percentages of South Asian populations [Exhibit 4.2].

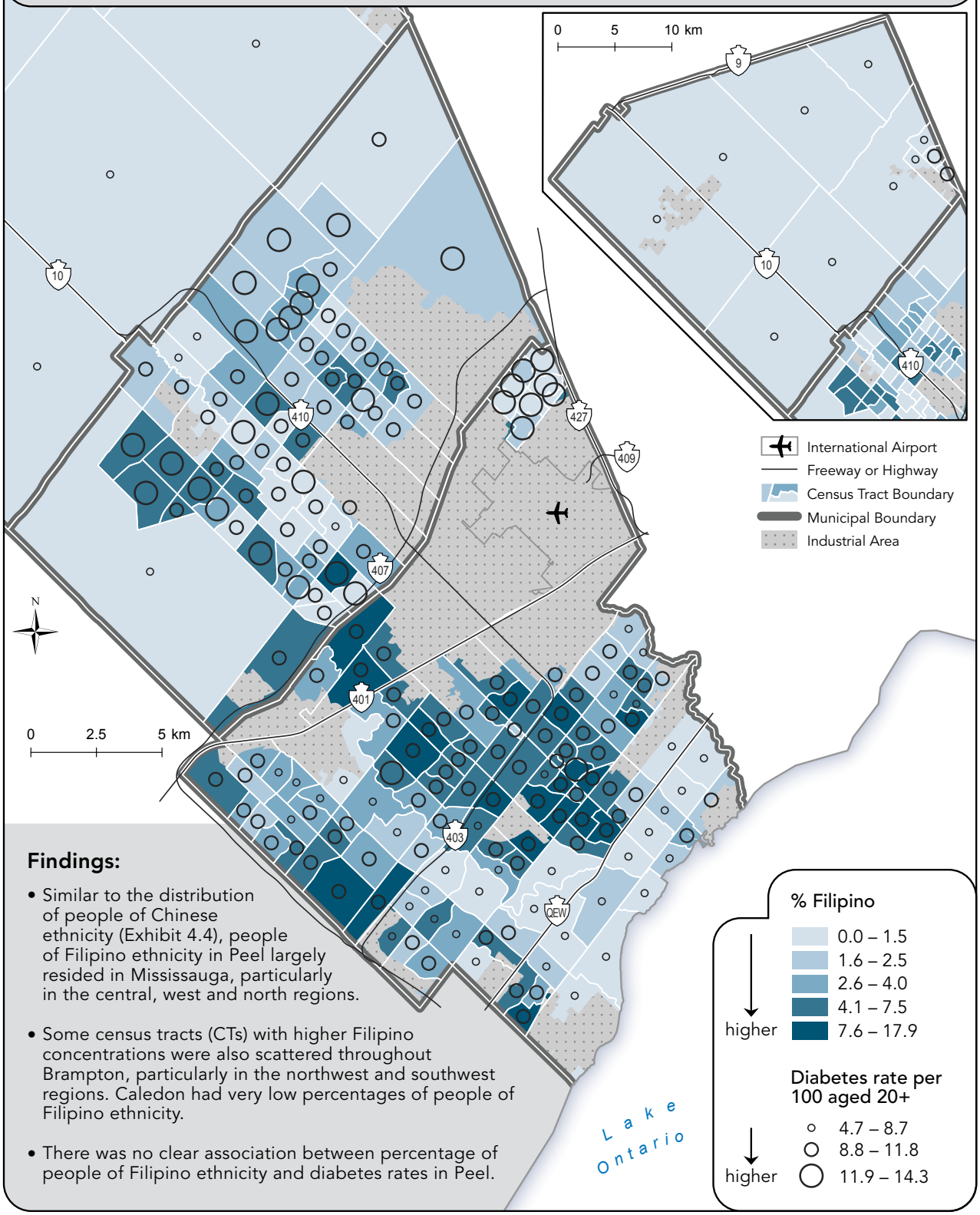
Exhibit 4.4. Chinese visible minorities (self-identified) as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- While South Asian and Black visible minority populations were most highly concentrated in Brampton (see Exhibits 4.2 and 4.3), the highest percentages of Chinese visible minorities (6.6%–21.9%) were present in Mississauga, predominantly in the central region.
- Neither Brampton nor Caledon had significant Chinese visible minority populations.
- There was no clear correspondence between percentage of people of Chinese ethnicity and rates of diabetes prevalence in Peel.

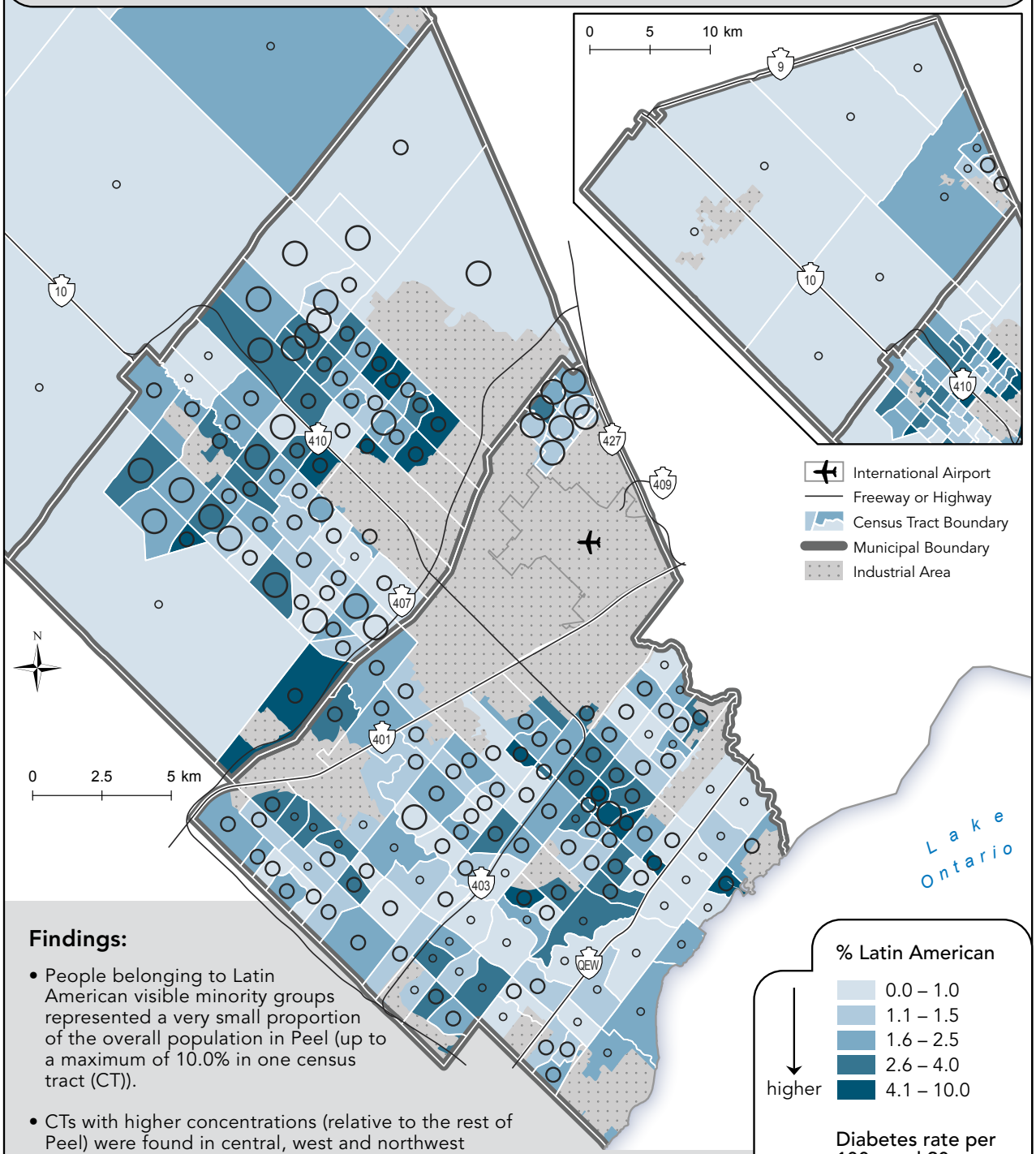
Exhibit 4.5. Filipino visible minorities (self-identified) as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- Similar to the distribution of people of Chinese ethnicity (Exhibit 4.4), people of Filipino ethnicity in Peel largely resided in Mississauga, particularly in the central, west and north regions.
- Some census tracts (CTs) with higher Filipino concentrations were also scattered throughout Brampton, particularly in the northwest and southwest regions. Caledon had very low percentages of people of Filipino ethnicity.
- There was no clear association between percentage of people of Filipino ethnicity and diabetes rates in Peel.

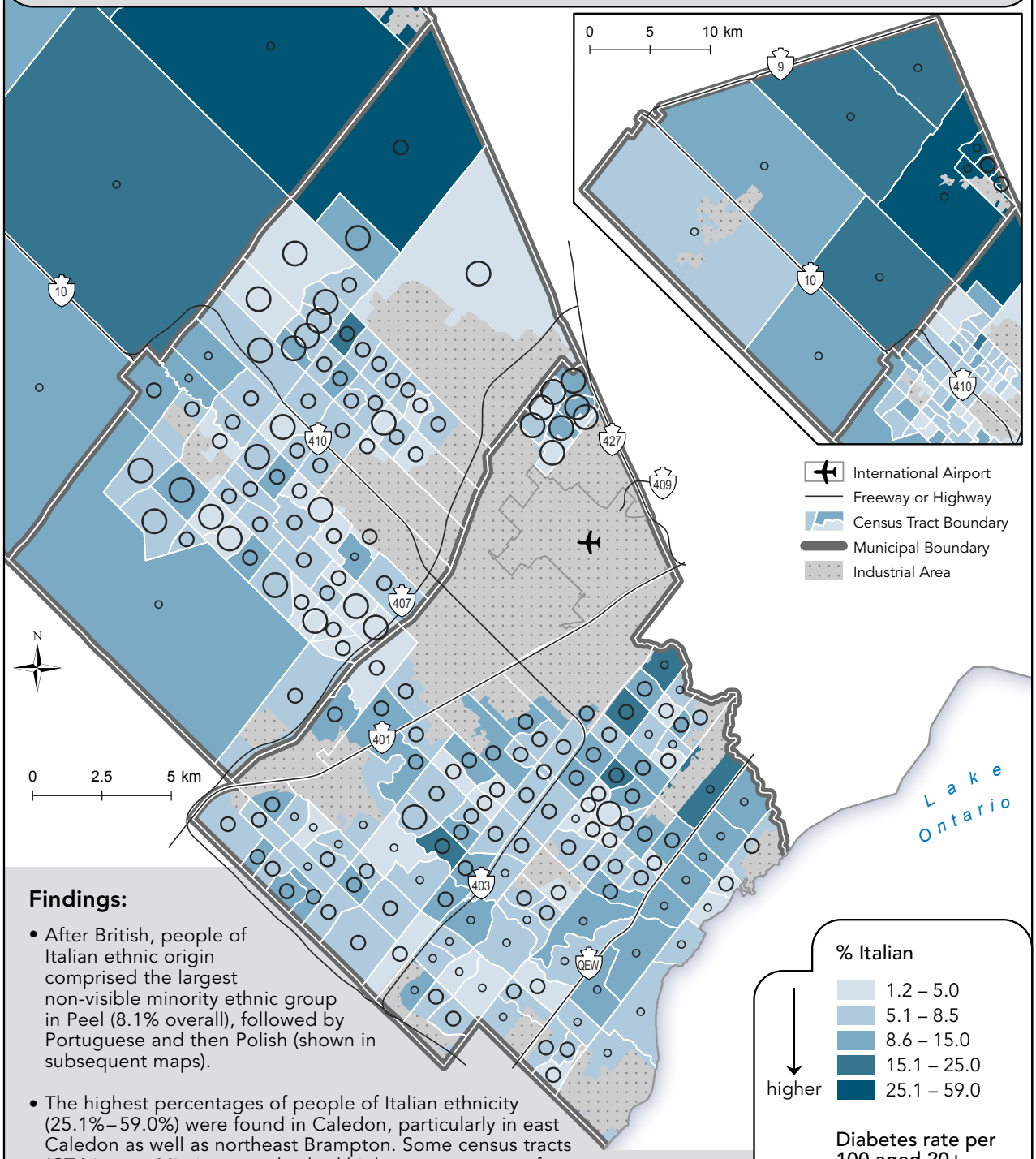
Exhibit 4.6. Latin American visible minorities (self-identified) as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- People belonging to Latin American visible minority groups represented a very small proportion of the overall population in Peel (up to a maximum of 10.0% in one census tract (CT)).
- CTs with higher concentrations (relative to the rest of Peel) were found in central, west and northwest Mississauga, and southwest, northwest and central Brampton (2.6%–10.0%).
- There was no apparent pattern in the distribution of Latin American minorities and diabetes prevalence rates in Peel.

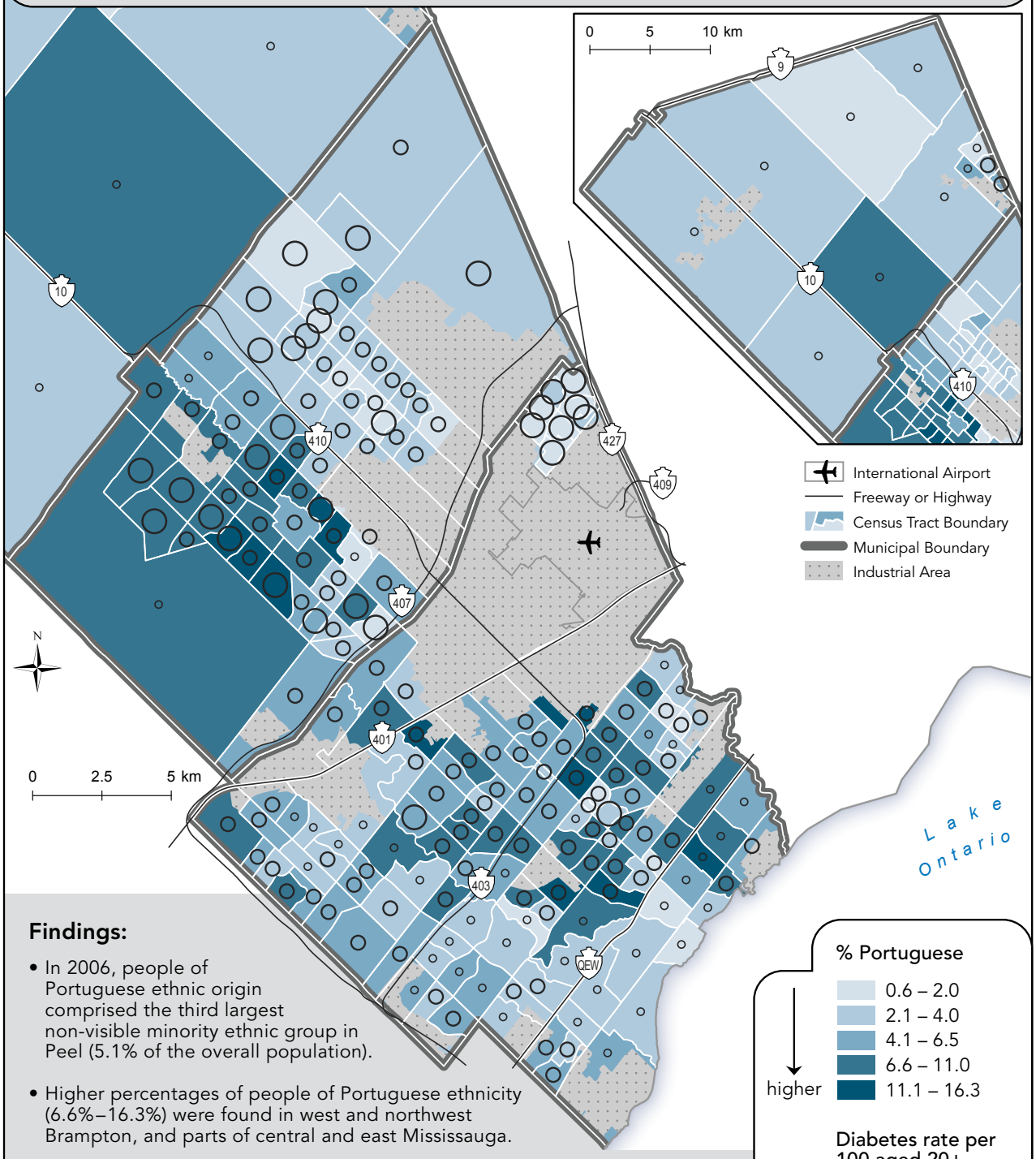
Exhibit 4.7. People of Italian ethnic origin (self-identified) as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- After British, people of Italian ethnic origin comprised the largest non-visible minority ethnic group in Peel (8.1% overall), followed by Portuguese and then Polish (shown in subsequent maps).
- The highest percentages of people of Italian ethnicity (25.1%–59.0%) were found in Caledon, particularly in east Caledon as well as northeast Brampton. Some census tracts (CTs) in east Mississauga also had higher percentages of people of Italian ethnic background (15.1%–25.0%).
- In general, CTs with the highest percentages of people of Italian ethnicity had lower diabetes prevalence as compared to other Peel CTs.

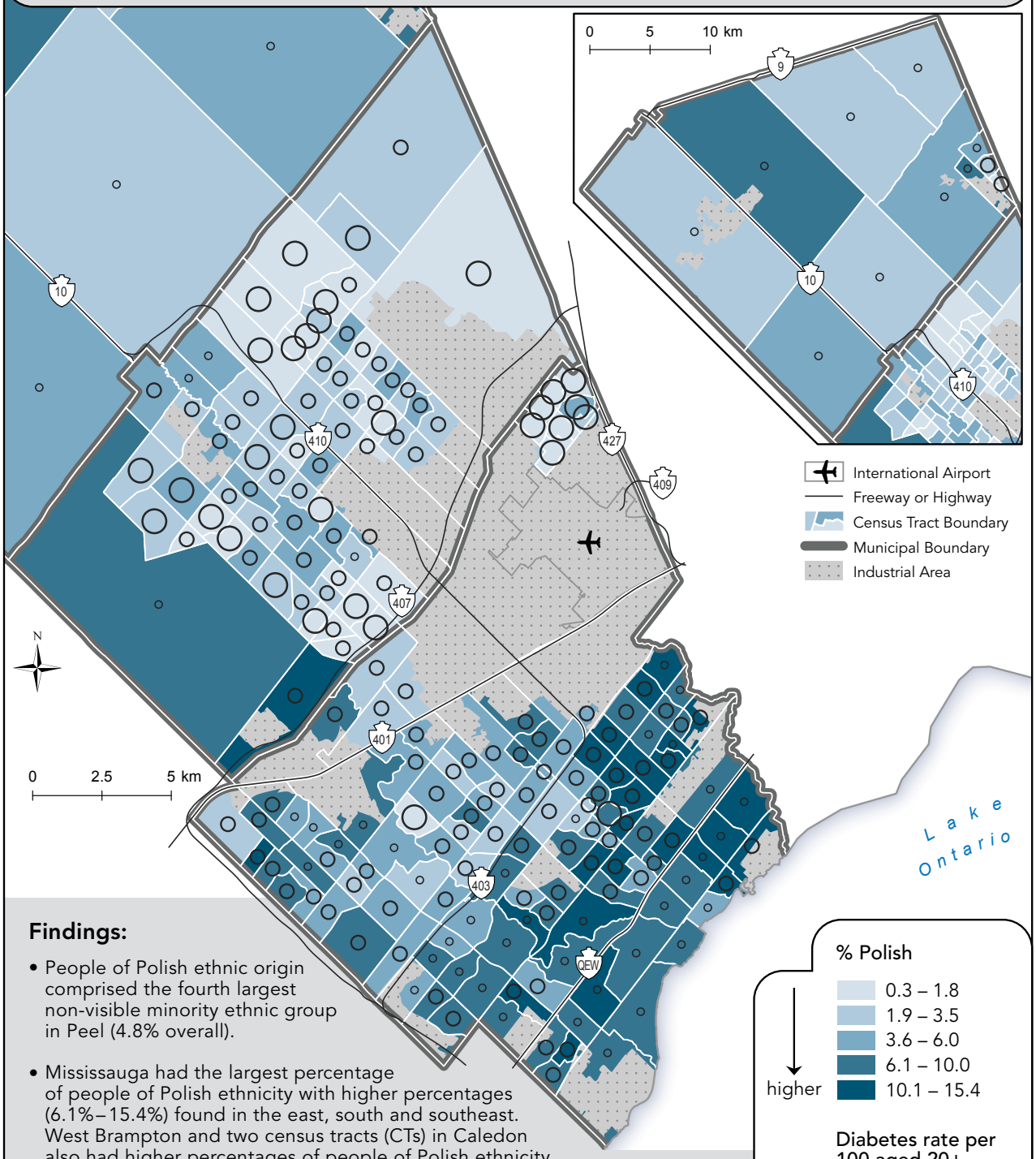
Exhibit 4.8. People of Portuguese ethnic origin (self-identified) as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- In 2006, people of Portuguese ethnic origin comprised the third largest non-visible minority ethnic group in Peel (5.1% of the overall population).
- Higher percentages of people of Portuguese ethnicity (6.6%–16.3%) were found in west and northwest Brampton, and parts of central and east Mississauga.
- In Mississauga and Caledon, census tracts (CTs) with higher percentages of people of Portuguese ethnicity had lower diabetes prevalence compared to the rest of Peel; however, in Brampton, areas with higher percentages of Portuguese populations had higher rates of diabetes.

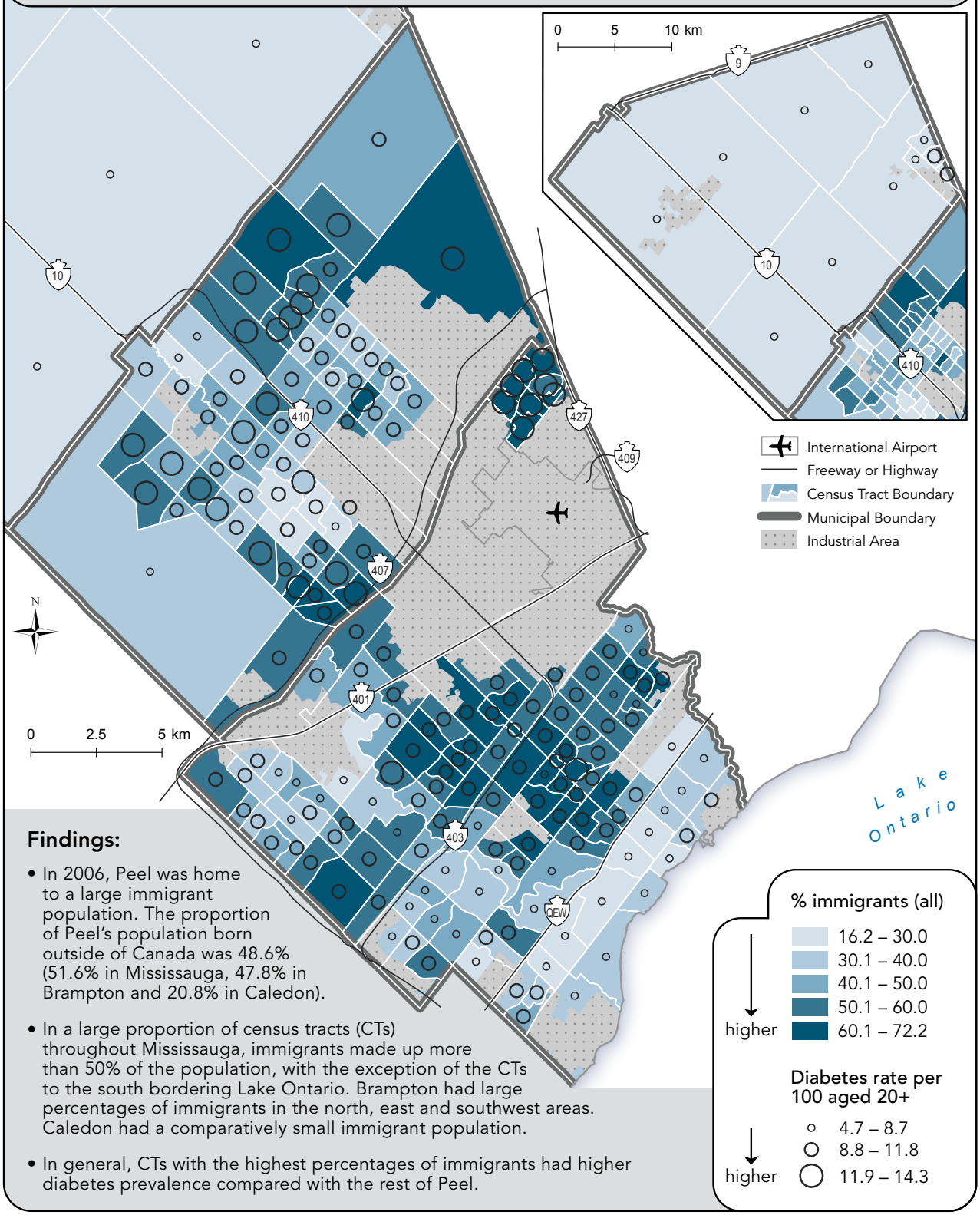
Exhibit 4.9. People of Polish ethnic origin (self-identified) as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- People of Polish ethnic origin comprised the fourth largest non-visible minority ethnic group in Peel (4.8% overall).
- Mississauga had the largest percentage of people of Polish ethnicity with higher percentages (6.1%–15.4%) found in the east, south and southeast. West Brampton and two census tracts (CTs) in Caledon also had higher percentages of people of Polish ethnicity.
- In general, CTs with higher percentages of people of Polish ethnicity had lower or mid-range diabetes prevalence rates (compared with the rest of Peel).

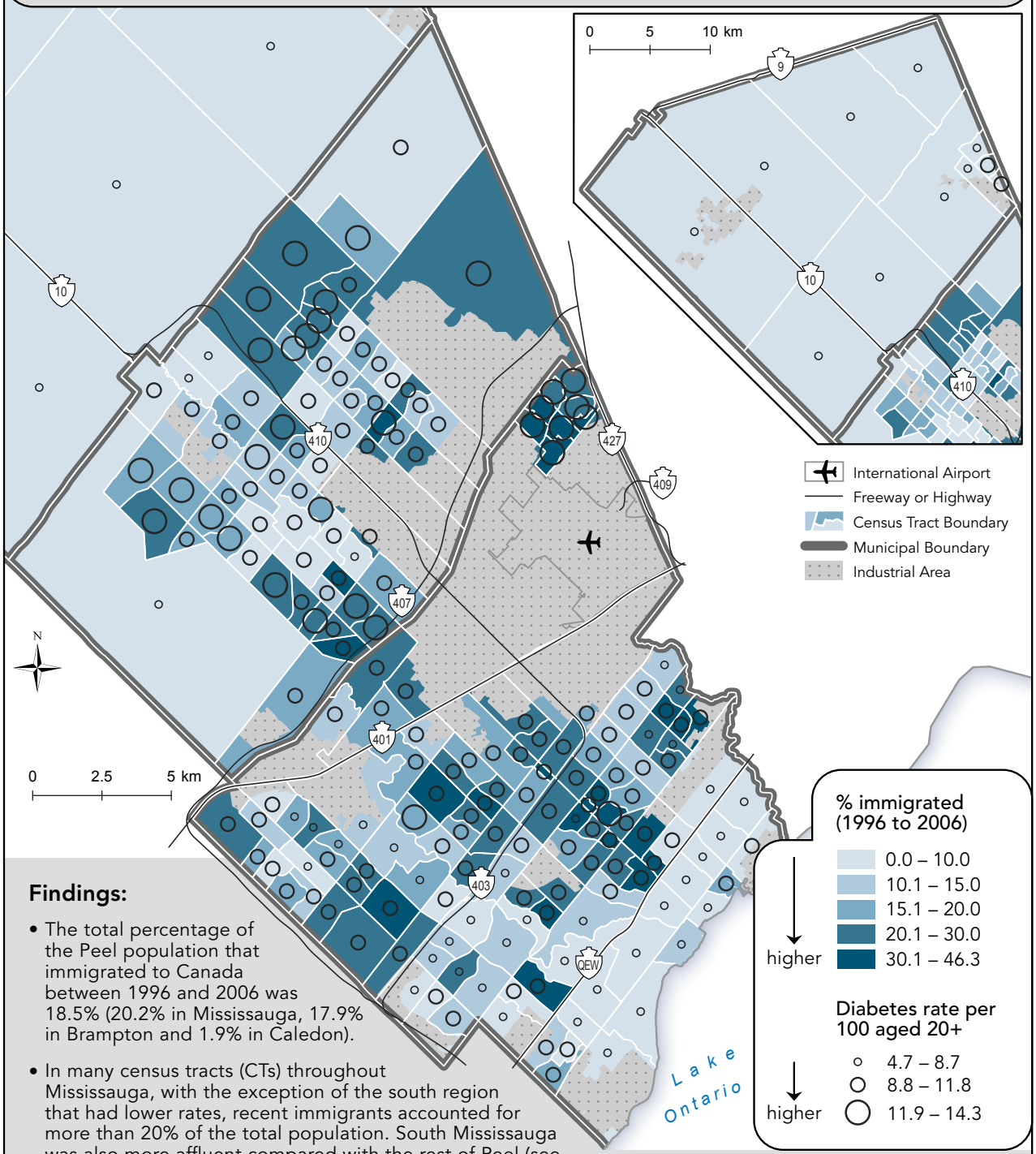
Exhibit 4.10. People who immigrated to Canada as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- In 2006, Peel was home to a large immigrant population. The proportion of Peel's population born outside of Canada was 48.6% (51.6% in Mississauga, 47.8% in Brampton and 20.8% in Caledon).
- In a large proportion of census tracts (CTs) throughout Mississauga, immigrants made up more than 50% of the population, with the exception of the CTs to the south bordering Lake Ontario. Brampton had large percentages of immigrants in the north, east and southwest areas. Caledon had a comparatively small immigrant population.
- In general, CTs with the highest percentages of immigrants had higher diabetes prevalence compared with the rest of Peel.

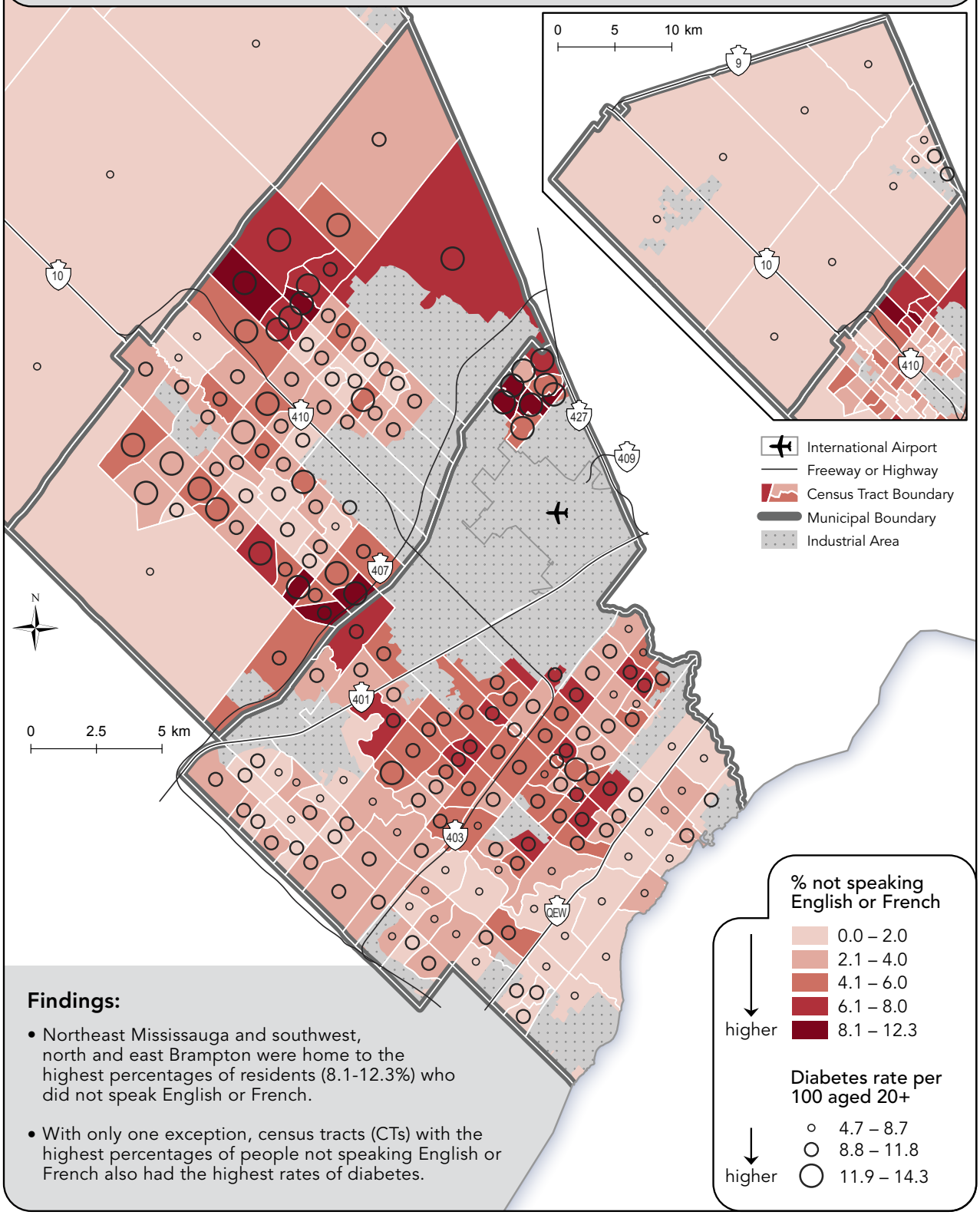
Exhibit 4.11. People who immigrated to Canada between 1996 and 2006 as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- The total percentage of the Peel population that immigrated to Canada between 1996 and 2006 was 18.5% (20.2% in Mississauga, 17.9% in Brampton and 1.9% in Caledon).
- In many census tracts (CTs) throughout Mississauga, with the exception of the south region that had lower rates, recent immigrants accounted for more than 20% of the total population. South Mississauga was also more affluent compared with the rest of Peel (see Chapter 3). In Brampton, CTs in the north, east, and southwest areas had the highest concentrations of recent immigrants. Caledon had very low levels of recent immigration.
- In general, Peel CTs with high percentages of recent immigrants had higher diabetes prevalence as compared to the rest of Peel.

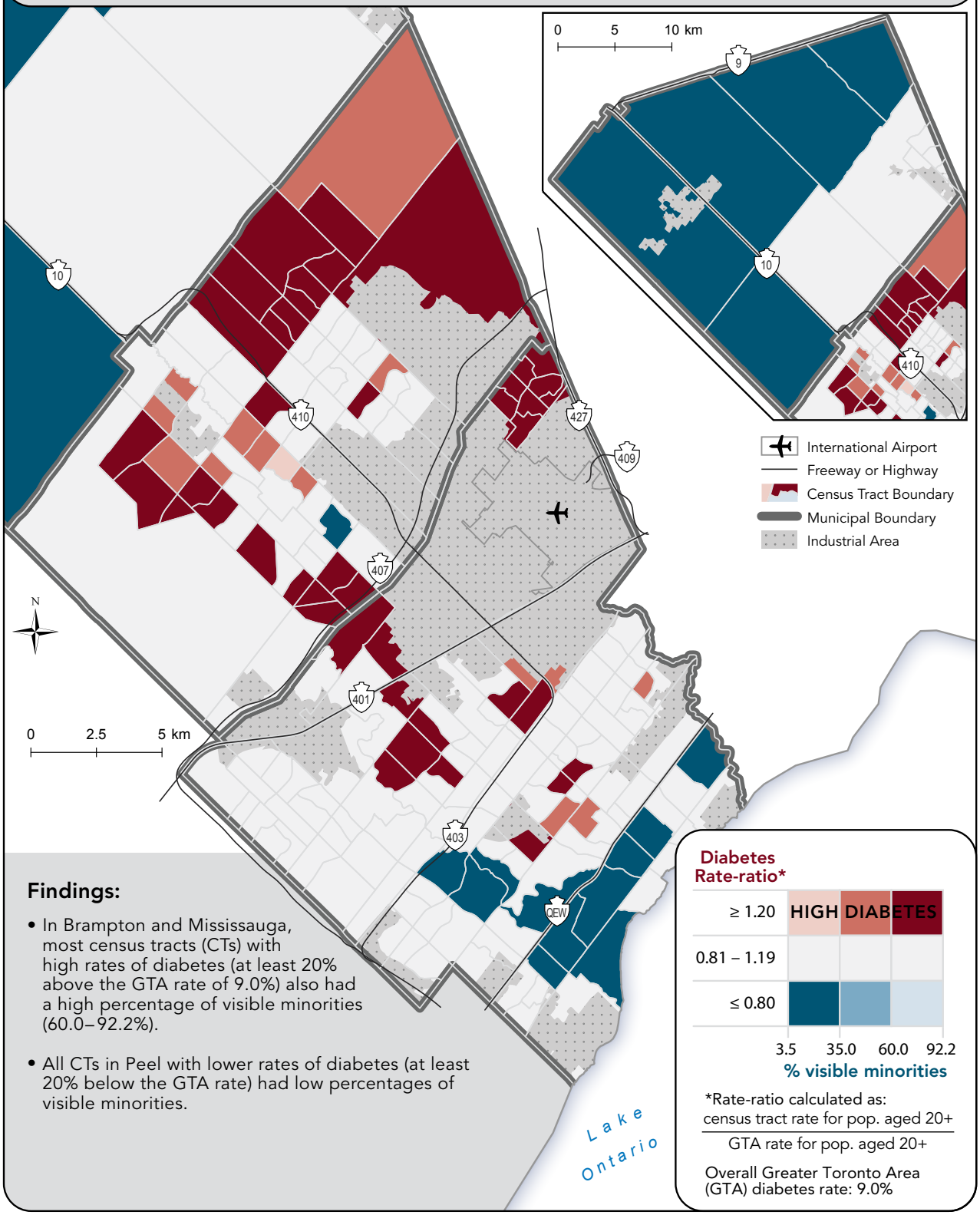
Exhibit 4.12. People not speaking English or French as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census tract [2006], in Peel region



Findings:

- Northeast Mississauga and southwest, north and east Brampton were home to the highest percentages of residents (8.1-12.3%) who did not speak English or French.
- With only one exception, census tracts (CTs) with the highest percentages of people not speaking English or French also had the highest rates of diabetes.

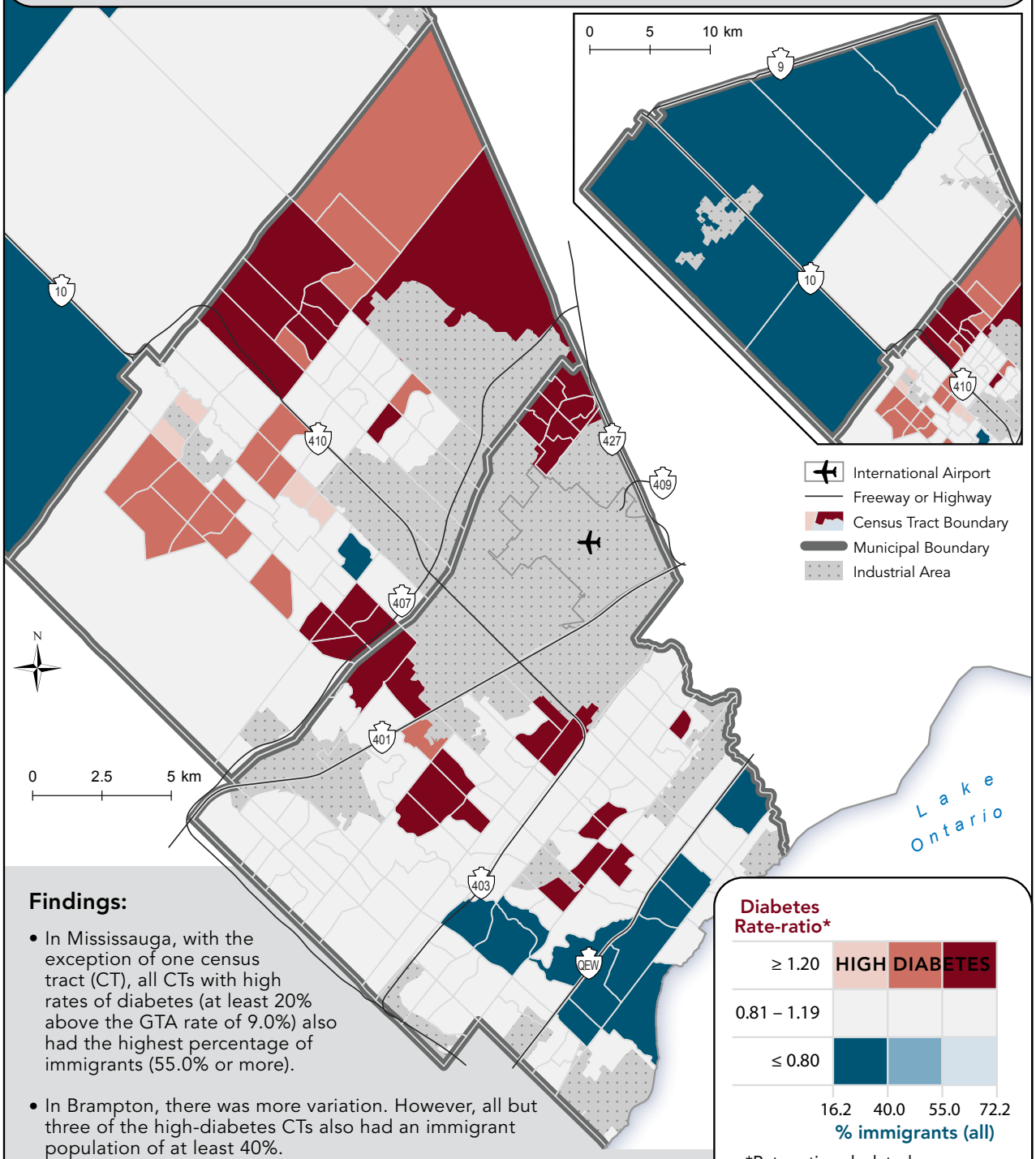
Exhibit 4.13. Spatial relationship between visible minorities (self-identified) as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

- In Brampton and Mississauga, most census tracts (CTs) with high rates of diabetes (at least 20% above the GTA rate of 9.0%) also had a high percentage of visible minorities (60.0–92.2%).
- All CTs in Peel with lower rates of diabetes (at least 20% below the GTA rate) had low percentages of visible minorities.

Exhibit 4.14. Spatial relationship between immigrants to Canada, as a per cent of the total population [2006] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

- In Mississauga, with the exception of one census tract (CT), all CTs with high rates of diabetes (at least 20% above the GTA rate of 9.0%) also had the highest percentage of immigrants (55.0% or more).
- In Brampton, there was more variation. However, all but three of the high-diabetes CTs also had an immigrant population of at least 40%.
- Few CTs in Mississauga or Brampton had low rates of diabetes (at least 20% lower than the GTA rate); however, all low-diabetes areas also had the lowest percentages of immigrants relative to other areas of Peel.

*Rate-ratio calculated as:
census tract rate for pop. aged 20+
GTA rate for pop. aged 20+

Overall Greater Toronto Area (GTA) diabetes rate: 9.0%

DISCUSSION

The analyses in this atlas showed a strong concordance between the ethnic composition of Peel census tracts and diabetes prevalence. In Peel, South Asians comprised the most prominent visible minority group, followed by Blacks. Brampton had many census tracts with high rates of diabetes (11.9% to 14.3% as compared with the GTA average of 9.0%), as well as a higher percentage of the population belonging to a non-White ethnoracial group, particularly South Asian and Black. Similar to Brampton, Mississauga had a large South Asian population, but was also home to a significant percentage of people of Chinese and Filipino ethnicity. Areas in both Brampton and Mississauga that had large percentages of visible minorities also had high percentages of immigrants, particularly recent immigrants (i.e., people who immigrated between 1996 and 2006). Caledon had low rates of diabetes in conjunction with a low percentage of visible minorities and a low percentage of immigrants. Caledon had a relatively high proportion of people of Italian, and to a lesser extent, Portuguese and Polish ethnicity.

Ethnicity, immigration and diabetes

The concordance observed between the proportion of visible minorities or immigrants and diabetes prevalence is largely driven by patterns of increased immigration from non-European countries over the last 20 years. In 2009, 69% of all immigrants to Canada came from Asia, Africa or the Middle East.[27] As discussed in the introduction, people of South Asian, African and Caribbean origin have a higher risk for diabetes. South Asians, in particular, have very high rates of diabetes regardless of whether they reside within their birth country or are external migrants from the region.[4, 6, 17, 28] For South Asians, this increased risk of developing diabetes begins at an earlier age, at a lower body mass index and with a smaller waist circumference.[15, 16] Developing diabetes at an earlier age further increases the burden of disease in this group by increasing the lifelong risk of complications related to diabetes (for more information, see Chapters 1 and 2). In 2006, South Asians comprised 24% of the total Peel population.

Although many chronic conditions occur less frequently in recent immigrants (a phenomenon described as the "healthy immigrant effect"), the prevalence of diabetes is higher in specific immigrant groups including people of South Asian, African and Caribbean origins.[4] It should be noted, however, that diabetes rates vary considerably across immigrant groups and immigrants from Western and Eastern Europe, and East and Central Asia have relatively low rates of diabetes compared with both other immigrant groups and the general Ontario population. Not only are certain groups at increased risk, but the health of recent immigrants also tends to decline over time.[29] Studies show that the body weight of many immigrants increases after only 10 years of residence in the new host country.[29, 30] As immigrants adopt a typical North American or Western diet high in saturated fats, red meats and "junk food", this may accelerate the development of insulin resistance and diabetes in these groups. The psychological stress of settlement can lead to unhealthy eating habits[31] and may even directly increase the risk for developing diabetes.[32, 33]

Thus, diabetes programs should be geared towards newcomers taking into consideration ethnicity, period of immigration and factors related to the immigration experience.

Language barriers, socioeconomic status and diabetes

In Peel, a number of areas that had high percentages of recent immigrants and visible minorities at high risk of developing diabetes (particularly in Brampton and north Mississauga) also had higher rates of people with no knowledge of Canada's official languages and lower socioeconomic status (SES) (for more information, see Chapter 3). Education and income are important factors that influence the health of high-risk populations and their ability to access appropriate health care services. The SES of many recent immigrants is complex as they tend to have high educational attainment, but low income, when first arriving in Canada. New immigrants may be less able to navigate the health care system or advocate for their health needs, which may result in poorer access to diabetes prevention and management programs.[24, 34] Language may serve as an additional barrier to accessing medical care and local resources.[35]

The clustering of low SES and high rates of recent immigration in some of the same areas makes it difficult to separate the effects of these two factors in those neighbourhoods. Ethnic enclaves may be advantageous because they give individuals more access to culturally-appropriate and familiar foods, and provide other pertinent cultural resources; however, neighbourhoods that are home predominantly to low-income or marginalized groups, including recent immigrants, can discourage healthy lifestyle choices through a lack of attractive and safe environments for physical activity and ready access to unhealthy foods.[36, 37] These environmental factors may compound the risk for diabetes in genetically susceptible individuals.

Not only are certain ethnic and socioeconomic groups more likely to develop diabetes (see also Chapter 3), but the consequences of developing diabetes may be particularly difficult for socially disadvantaged groups. Effective management of diabetes requires good access to primary care, regular specialist visits and, often, adherence to a complex medication schedule. Poorly controlled diabetes often leads to adverse health outcomes including cardiovascular disease, amputations and death.[38, 39] There are known racial differences in diabetes management and risk of health problems related to diabetes in the U.S.[23, 40-44] In Canada, the relationship between ethnicity, language and diabetes management is less clear. One study found that there was no significant difference between use of primary or specialist care by South Asians and Blacks as compared with the general population; however, these ethnic minorities were less likely to receive eye exams.[19] Gucciardi and colleagues (2007) found that non-English speaking patients were more likely to follow a diabetes self-management programs than English speaking Canadians when culturally- and language-appropriate resources were available.[45] Unfortunately, health information and services that are sensitive to a range of cultures, faiths and languages are often not available, which promotes inequities in access to health services and quality of medical care for a number of groups. Therefore, not only are diabetes prevention strategies important in high-risk populations, but investment in diabetes management programs for these same groups and neighbourhoods is also essential to improve individual outcomes.

Study limitations

Important limitations of these analyses deserve mention. Firstly, the analysis used health claims data to identify individuals who had been already diagnosed with diabetes by a physician. Thus, the rate of diabetes among new immigrant groups may be underestimated because individuals who experience barriers to accessing medical care, including those who may not yet be eligible for provincial health insurance, may not have had the opportunity to be diagnosed. Additionally, this analysis focused only on people with existing diabetes (i.e., prevalence) and did not attempt to identify new diagnoses of diabetes (i.e., incidence). Therefore, cause-and-effect or the exact time sequence of events (i.e., whether individuals had diabetes before they moved to an area or whether they developed it afterwards) cannot be inferred. Finally, this study only used area-level information about immigration and ethnicity. So although it can be observed, for example, that areas with high percentages of recent immigrants also had high rates of diabetes, the immigration status or ethnoracial background of the people with diabetes in census tracts cannot be inferred.

It should also be noted that the diabetes age- and sex-adjusted prevalence ranges found on the maps span a large spectrum of risk and it could be argued that even the lowest risk category contains a moderate diabetes burden. For example, the lowest diabetes prevalence group (4.7%– 8.7%) overlaps the overall Ontario prevalence of 8.3%. Similarly, the middle prevalence group (8.8 %–11.8%) spans both the overall GTA and Peel rates of 9.0% and 10.0%, respectively. What can be said, however, is that the highest prevalence group (11.9%–14.3%) truly does represent a high burden of diabetes where as many as one-in-seven people in these areas have been diagnosed with diabetes by a physician.

CONCLUSIONS AND IMPLICATIONS

Peel is home to a large visible minority population, particularly individuals of South Asian heritage. There was a strong relationship between diabetes, immigration (especially recent immigration) and visible minority status, particularly for South Asian and Black populations in Peel census tracts. This relationship was most evident in the high-diabetes areas in west, central and northeast Mississauga, as well as east, central-west, north and northeast Brampton, areas that are home to high concentrations of visible minorities and recent immigrants. One issue of concern was the high proportion of residents who did not speak English in areas with high rates of diabetes. Language-specific services and information should be provided in these areas.

The findings in this chapter suggest that local policymakers and planners need to take genetic, cultural and language issues into account when devising community-based interventions, prevention programs and health services aimed at reducing the burden of obesity and diabetes. There is evidence that maintaining a more traditional pattern of diet and increasing physical activity can reduce the development of obesity and diabetes in high-risk ethnoracial migrant groups.[45] It is important to take into account the genetic susceptibility of certain ethnic groups to

developing diabetes even at lower body weights and younger ages, suggesting that "one-size-fits-all" prevention programs may not be appropriate. Interventions to improve diabetes control in low income and ethnoracial minority groups also need to be tailored to individual, family and community needs.[46] Future research in this area could help to guide interventions that support health equity.

APPENDIX 4.A – RESEARCH METHODOLOGY

Data Sources

- Immigration, knowledge of official language and visible minority status of Peel residents were abstracted at the census tract level from the 2006 Census of Canadian Census using standard definitions created by Statistics Canada.
- For this analysis, ethnic groups were defined based on the visible minority populations to which people self-identified. The proportion of the population that belonged to the top three non-visible minority ethnic groups (after United Kingdom countries) was derived from the ethnicity question on the Census asking what were the ethnic or cultural origins of respondents' ancestors.
- Age- and sex-adjusted diabetes rates per 100 adults aged 20 years or older were calculated using the Ontario Diabetes Database and other administrative data sources held at the Institute for Clinical Evaluative Sciences (ICES) (for a detailed description of the data sources of diabetes rates, please refer to Appendix 2.A in Chapter 2).

Definitions

- An immigrant is defined by Statistics Canada as a person born outside of Canada who has been granted the right to live in Canada permanently by immigration authorities. Recent immigration refers to those who gained immigrant status in the preceding 10 years (i.e., between 1996 and 2006).
- Statistics Canada defines visible minorities as "persons, other than Aboriginal persons, who are non-White in race or colour," in accordance with Canada's Employment Equity Act.

Analysis

Bivariate maps were created to display the spatial relationship between immigration, language and ethnicity variables and rates of diabetes. Choropleth (shaded) maps were produced for each immigration, language and ethnicity variable. The classification ranges for each of the variables shown on these maps were determined using natural breaks in the distribution of the data, a common classification method for choropleth mapping. Diabetes rates were depicted in three categories using proportional circles. The ranges for these categories were determined by first ordering the population-weighted diabetes rates of all Peel census tracts from lowest to highest and then selecting the four points that divide the rates into five equal groups (quintiles). Each category of diabetes rates was depicted using proportional circles. Three different circle sizes were used to correspond to the magnitude of diabetes rates (i.e., larger circles correspond to progressively higher ranges of diabetes rates). The lowest category of diabetes rates consisted of the first (lowest) quintile and the highest category consisted of the last (highest) quintile. The middle category of diabetes rates was made up of the middle three quintiles grouped together. These circles were overlaid on top of the choropleth maps of immigration, language and ethnicity variables. This was done so that the reader could observe whether there is a spatial correspondence between, for example, areas with higher diabetes rates and higher percentages of recent immigrants. For the visible minority maps, 2006 Census data were examined for Peel and the top five visible minority groups that represented the largest proportion of residents in Peel were presented. The same method was used to identify the top three non-visible minority ethnic groups (excluding those of 'British' ethnic ancestry).

A second type of map for the immigration and visible minority (all) variable was created in order to highlight areas of Peel where diabetes rates were substantially higher or lower than the overall prevalence rate in the Greater Toronto Area (GTA). The overall GTA diabetes rate was 9% (nine cases per 100 adults aged 20 years or older). For each Peel census tract, the diabetes rate was divided by the GTA rate in order to calculate a rate-ratio. Census tracts with diabetes rates at least 20% higher than the GTA rate (rate-ratio of ≥1.2) and census tracts with rates at least 20% lower than the GTA rate (rate-ratio of ≤ 0.8) were shaded in different colors according to ranges of values of the immigration or visible minority (all) variable. All census tracts whose rates did not differ substantially from the GTA rate (rate-ratio between 0.81 and 1.19) were depicted using a single grey colour.

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Chapter 5

The BUILT ENVIRONMENT
Walkable Destinations and Diabetes

INSIDE

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HIGHLIGHTS

Issue

- Physical activity plays an essential role in the prevention and/or control of type 2 diabetes. The way a community is designed can either promote or discourage local residents from walking or using a bicycle for transportation, or from participating in other types of physical activities.
- Areas where it is difficult to walk make residents dependent on a car to perform daily activities and may contribute to low levels of physical activity, which may lead to obesity and obesity-related chronic diseases such as diabetes. Conversely, areas with dense, well-connected street networks and good access to transit may stimulate daily walking/bicycling and thereby lead to better health. Suburban areas developed in the post-World War II era are predominantly automobile oriented and tend to lack these activity-stimulating design features.
- This chapter explores the relationship between built environment factors linked to physical activity and diabetes within Peel region, with a focus on walking or bicycling for recreation or transportation purposes. "Built environment" commonly refers to the man-made or modified physical context in which people live, work and play, and includes features like roads, sidewalks, buildings, parks, recreational and retail facilities.

Key Findings

- The built environment throughout Peel is overwhelmingly automobile oriented. While short travel distances to a variety of common services and destinations were identified in some areas, many other physical and aesthetic barriers to walking and bicycling were identified. These include:
  - The extensive network of high-speed expressways and major highways in Peel limits connectivity of pedestrian and bicycling routes, and pathways. Fast traffic speeds may also affect residents' perceptions of safety when using these routes.
  - Few dedicated on-road bicycle lanes exist in Peel; all but one are located in Mississauga, and these are generally short and disconnected from each other.
- Rates of daily walking/bicycling trips were consistently very low and rates of daily car trips were consistently high throughout Peel.
- Generally inconsistent relationships between characteristics of the built environment and rates of diabetes prevalence were found in Peel. Both higher and lower rates of diabetes were found in areas with similar design characteristics and levels of access to walkable destinations.
- The majority of dwellings in all but one census tract in Peel were constructed after 1946. Most areas across Mississauga and Brampton share similar modern automobile-oriented suburban

design characteristics. This lack of variation in community design made it difficult to evaluate the relationship between built environment factors and walking/bicycling or diabetes prevalence because there were few "walkable" areas for comparison.

Implications

- Many areas in Peel have suburban design features that may partially account for the low levels of walking/bicycling and public transit use, and high levels of car use observed in this chapter. These low levels of active transportation may contribute to increased prevalence of overweight/obesity and diabetes in the region.
- Some aspects of the built environment, such as the street network, are difficult to modify within existing developments. Planners, developers and policy makers should make an effort to include healthy, walkable urban design characteristics in rapidly developing areas of Brampton and Caledon before communities are built.
- In existing built-up (developed) areas, planners and policy makers should encourage intensification through the re-development of parking lots and brownfield (abandoned or underused industrial or commercial) sites, and permit increased densities and mixed-use development through rezoning. Consideration should also be given to the ways in which physical barriers (such as parking lots, major highways and noise walls) and uninviting pedestrian-level aesthetics may discourage walking and bicycling in many areas of Peel.
- The development of an interconnected system of dedicated bicycle lanes on key routes throughout the region may better support bicycling to work/school, for running errands or for recreation.
- Additional research is required to fully evaluate the relationship between built environment characteristics, walking/bicycling and diabetes prevalence in Peel. For example, Peel and neighbouring urban centres could undertake a more detailed study that includes built environment characteristics, such as street-level aesthetics, sidewalk presence and physical barriers to walking, which could not be assessed in this atlas. Such research should make sure to include a variety of walkable and non-walkable areas to allow for optimal comparisons.

INTRODUCTION

Lack of physical activity and a sedentary lifestyle are risk factors for obesity and many chronic diseases such as type 2 diabetes.[1, 2] Even moderate-intensity activities such as brisk walking can have significant health benefits, including lowering the risk of cardiovascular disease and overall mortality.[3-5] There is also evidence that type 2 diabetes can be prevented in people who are at high risk through intensive lifestyle changes that include both diet and physical activity programs.[6, 7]

Canadian Physical Activity Guidelines recommend that adults accumulate at least 150 minutes of moderate- to vigorous-intensity physical activity in a week in order to accrue health benefits.[8] However, only 15% of Canadians are active enough to meet these recommendations.[9] Only 32.6% to 56.7% of Peel residents aged 12 and older were moderately to highly physically active (equivalent to walking 30 to 60 minutes a day or more), depending on where they lived in the region (for more information, see Chapter 6). The amount of time North Americans spend in sedentary activities such as viewing television or sitting in a car is increasing, while levels of physical activity during work hours are decreasing.[10, 11] There is also increasing evidence that aspects of the built environment, urban design and transportation planning can create reliance on automobiles for transportation and make it difficult to integrate activities like bicycling and walking (by far the most common type of physical activity) into daily routines.[12, 13]

Built environment influences residents' levels of physical activity

There is increasing awareness among planners, policymakers and researchers that features of the built environment can serve as either facilitators

or barriers to active living. For example, in comparison to the rest of Canada, residents of major urban centres were more likely to find their neighbourhoods as convenient places in which to walk or bike for leisure, or to run errands. They were also more likely to walk, bike or take public transit as their primary means of getting to work and to be at a healthy body weight.[14] In addition, walkable features of the built environment, such as greater street connectivity, residential density, and increased proximity to retail and service destinations, characterize areas that are more amenable to walking and bicycling.[15-18] Individuals' perceptions of aesthetics and safety, such as the friendliness and attractiveness of the built environment for walking, have also been related to walking for exercise or recreation.[19, 20] Older areas – built prior to World War II – commonly have many of these walkable characteristics because they tend to have smaller block sizes, more street connections and sidewalks, and provide easier access to local amenities.[21-23]

Trends in community planning and urban design over the past 60 years have resulted in residential communities that are less conducive to walking and other physical activities. Modern suburbs often lack sidewalks, have fewer connections between streets and contain streets that often end in cul-de-sacs, thus increasing the distance residents must travel to access common services and destinations. Moreover, newer housing developments are typically zoned for solely residential purposes, and often only connect to employment and commercial areas via high-speed arterial roads and expressways. This further increases residents' dependence on cars to access local retail, employment and community services.

Land-use mix greatly influences the method people choose for traveling from one place to another.[24] For example, the coexistence of commercial and residential areas in the same area gives local residents easier access to services and amenities. American and Australian residents were more likely to walk to a store, restaurant or recreational facility if it could be reached within five to 10 minutes.[25-27] An inverse relationship between the degree of land-use mix in neigh-

bourhoods and the level of obesity has been found in the United States, and Americans who spent more minutes per day traveling in a car had a higher likelihood of being obese.[28]

Patterns of land use development in Peel

Peel region contains land uses that range from agricultural fields and natural green spaces to industrial parks and urbanized areas with relatively high densities (compared with the rest of Peel). Among residential areas alone, there are variations in urban design ranging from sparsely-developed suburbs and estate housing to more densely populated zones near city centres. However, most of the typically suburban areas in Peel – which were developed in the post-World War II period – feature larger residential lots in areas far removed from single-use commercial and employment districts.

In this chapter, several aspects of the built environment that may affect levels of walking/bicycling and use of different modes of transportation in Peel are described. The location, density and accessibility of walkable destinations – such as shops, restaurants and community centres – that may influence people's propensity to walk or bicycle for transportation purposes are also examined. Using the list of "diverse uses" from the Leadership in Energy & Environmental Design (LEED) for Neighbourhood Development Rating System, four major categories of walkable destinations have been identified: food retail, community-serving retail, services and civic and community facilities[29] (see Appendix 5.A for a detailed list of the types of businesses, services and facilities in each category of walkable destinations). Finally, patterns of spatial correspondence between rates of trips by various modes of transportation, density of walkable destinations and diabetes prevalence are shown. These and other features of the built environment may be important facilitators of and barriers to healthy, active living in Peel.

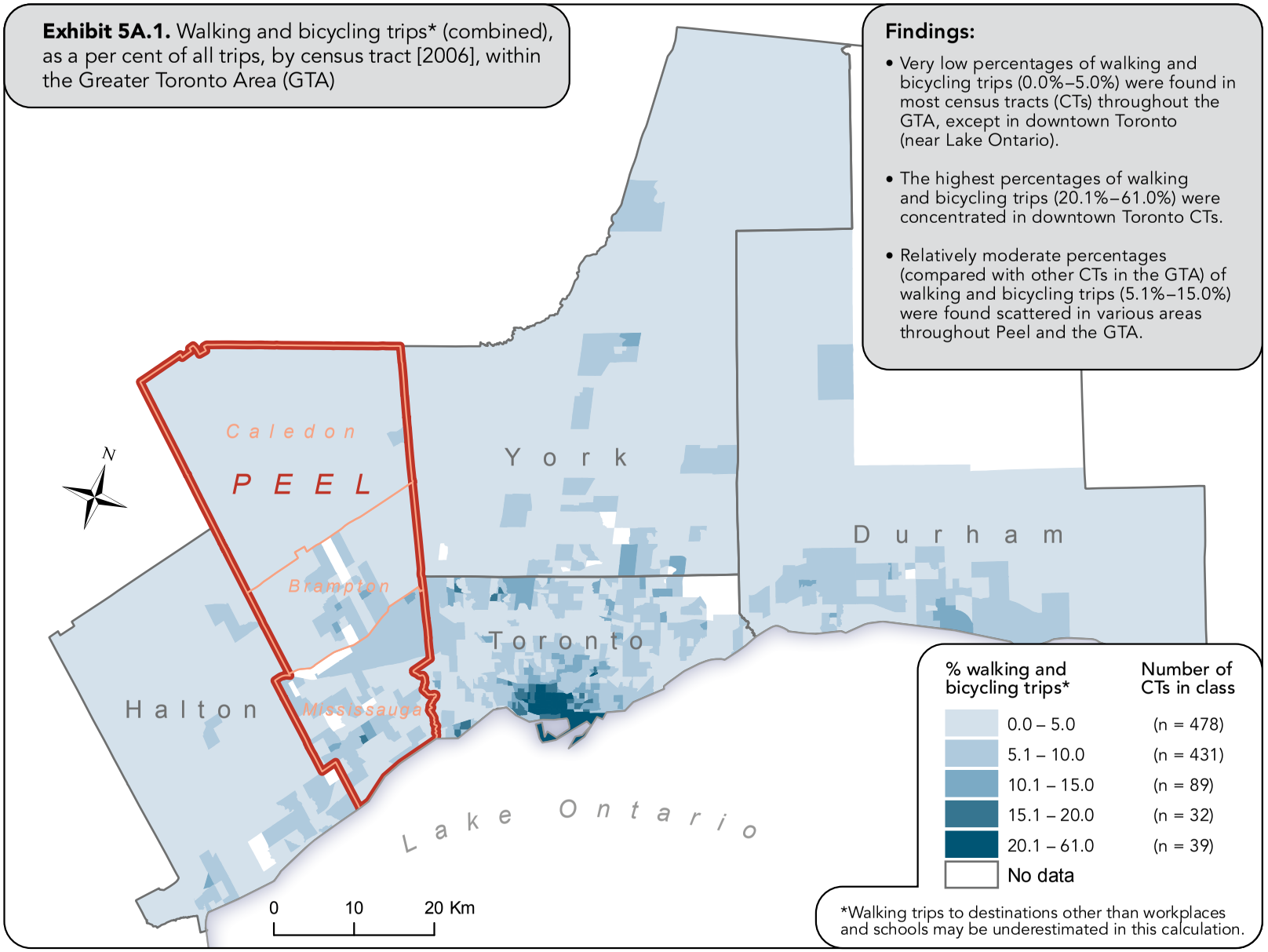
HISTORICAL NOTES

The built environment in Peel follows historical land use patterns. The first waves of European settlers came to this area in the early 1800s, establishing numerous small communities in the townships around the "Home District," an area that was divided into York and Peel counties in 1858. Because of its abundant agriculture, Peel was a bread basket in the province, growing ample amounts of wheat; beef and dairy production was also prominent. A few of the villages grew into significant towns, including Bolton, Brampton, Streetsville, Port Credit and Malton, largely because of their proximity to railways and the presence of other industries like manufacturing.

After World War II, small housing developments appeared around existing communities, a trend that shifted in the 1950s and 1960s with planned, unincorporated communities like Erin Mills and Bramalea. These were Peel's first typically suburban areas. Opened in 1939, Malton Airport (now Toronto Pearson International Airport) was the centre of the aviation industry in Canada, becoming a hub for industry in general as it added international routes in the 1960s. Other industrial areas were developed based on their proximity to the airport or the 400-series highways. In 1973, the Ontario government created Peel and a number of other regional municipalities from existing counties, primarily in urban areas. Responsibility for public health, formerly at the county level, was transferred to the new regions. By the late 1980s, there was little land left to develop between existing Peel communities and new housing pushed into the eastern and western fringes of the region, towards York and Halton regions. The largely rural Caledon is now one of the only significant remaining greenbelt areas in the Greater Toronto Area (GTA). Recently, there has been a move towards building "up" instead of "out", especially in downtown Brampton and Mississauga's City Centre district where there has been higher density development.

LIST OF EXHIBITS

Exhibit 5A.1. Walking and bicycling trips* (combined), as a per cent of all trips, by census tract [2006], within the Greater Toronto Area (GTA)



Findings:

- Very low percentages of walking and bicycling trips (0.0%–5.0%) were found in most census tracts (CTs) throughout the GTA, except in downtown Toronto (near Lake Ontario).
- The highest percentages of walking and bicycling trips (20.1%–61.0%) were concentrated in downtown Toronto CTs.
- Relatively moderate percentages (compared with other CTs in the GTA) of walking and bicycling trips (5.1%–15.0%) were found scattered in various areas throughout Peel and the GTA.

*Walking trips to destinations other than workplaces and schools may be underestimated in this calculation.

Exhibit 5A.2. Public transit trips*, as a per cent of all trips, by census tract [2006], within the Greater Toronto Area (GTA)

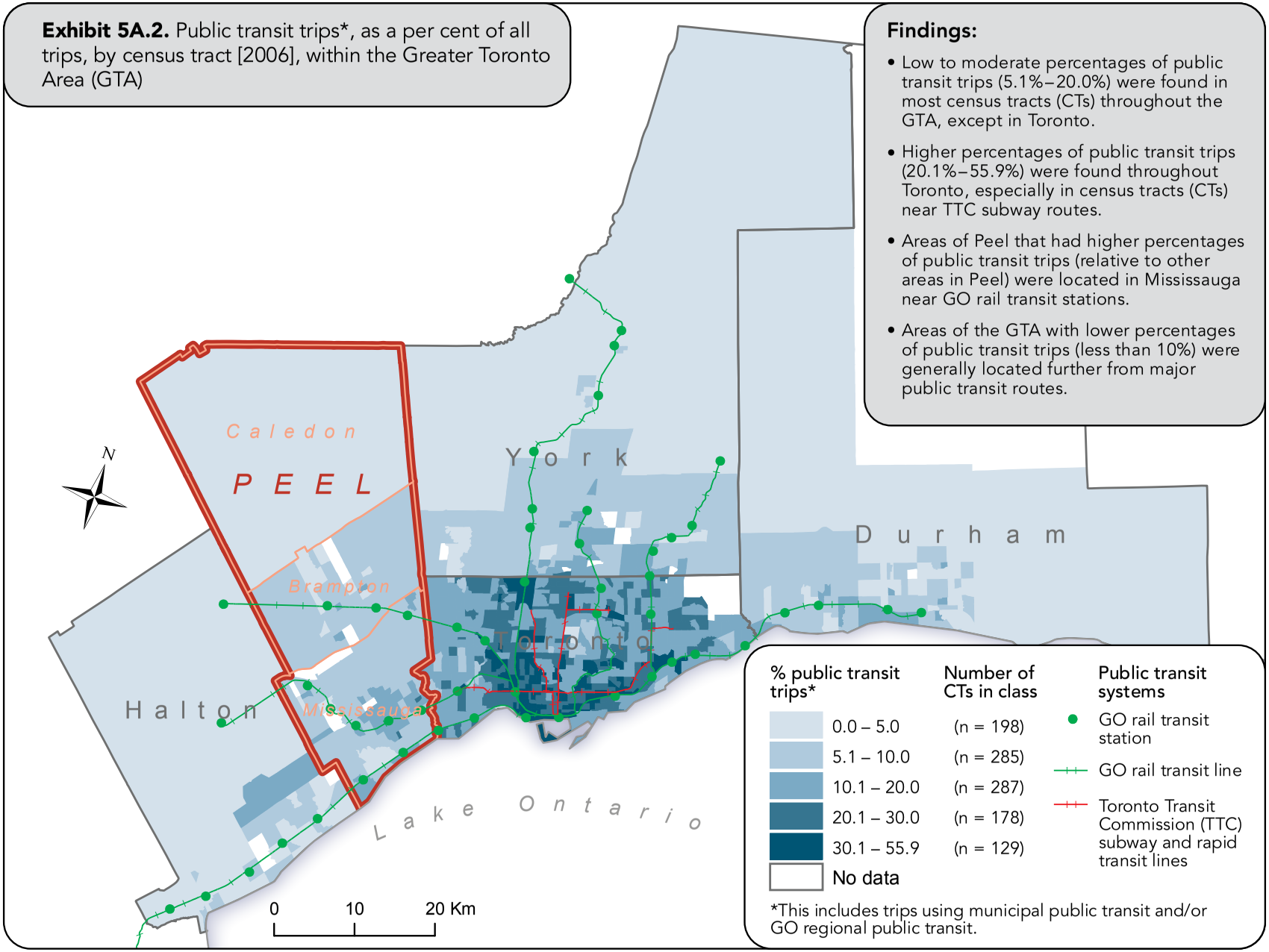


Exhibit 5A.3. Car trips, as a per cent of all trips, by census tract [2006], within the Greater Toronto Area (GTA)

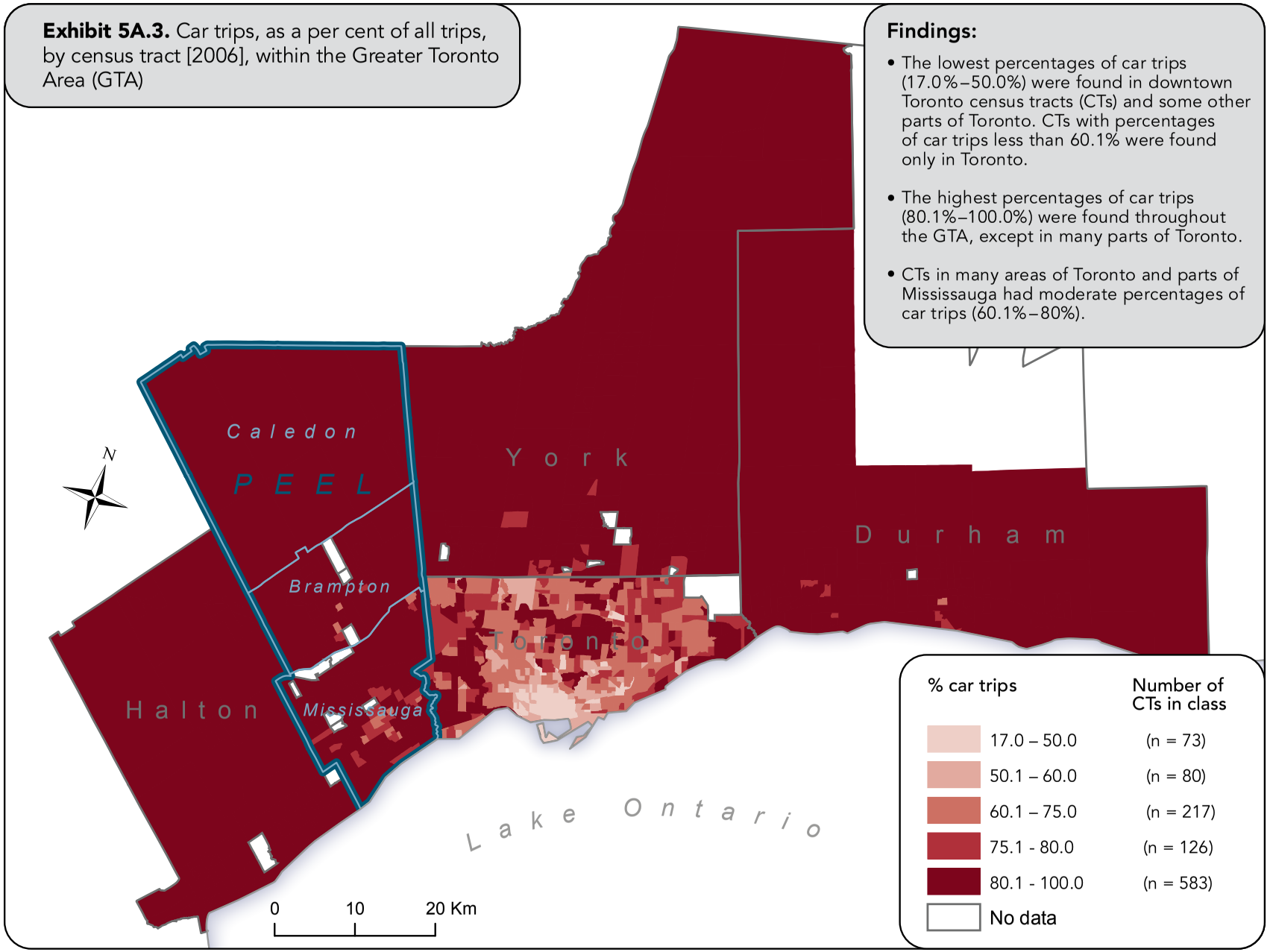
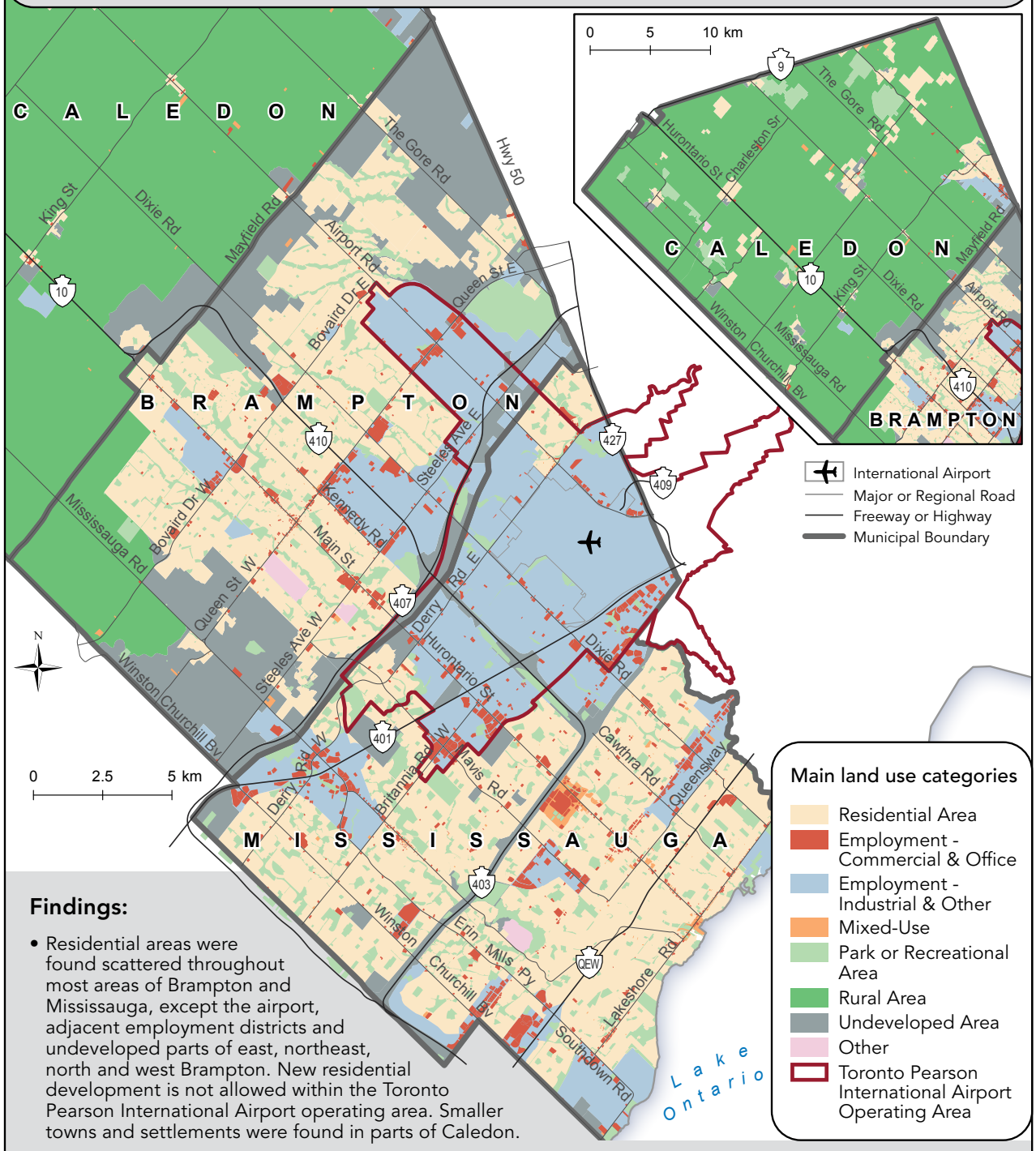


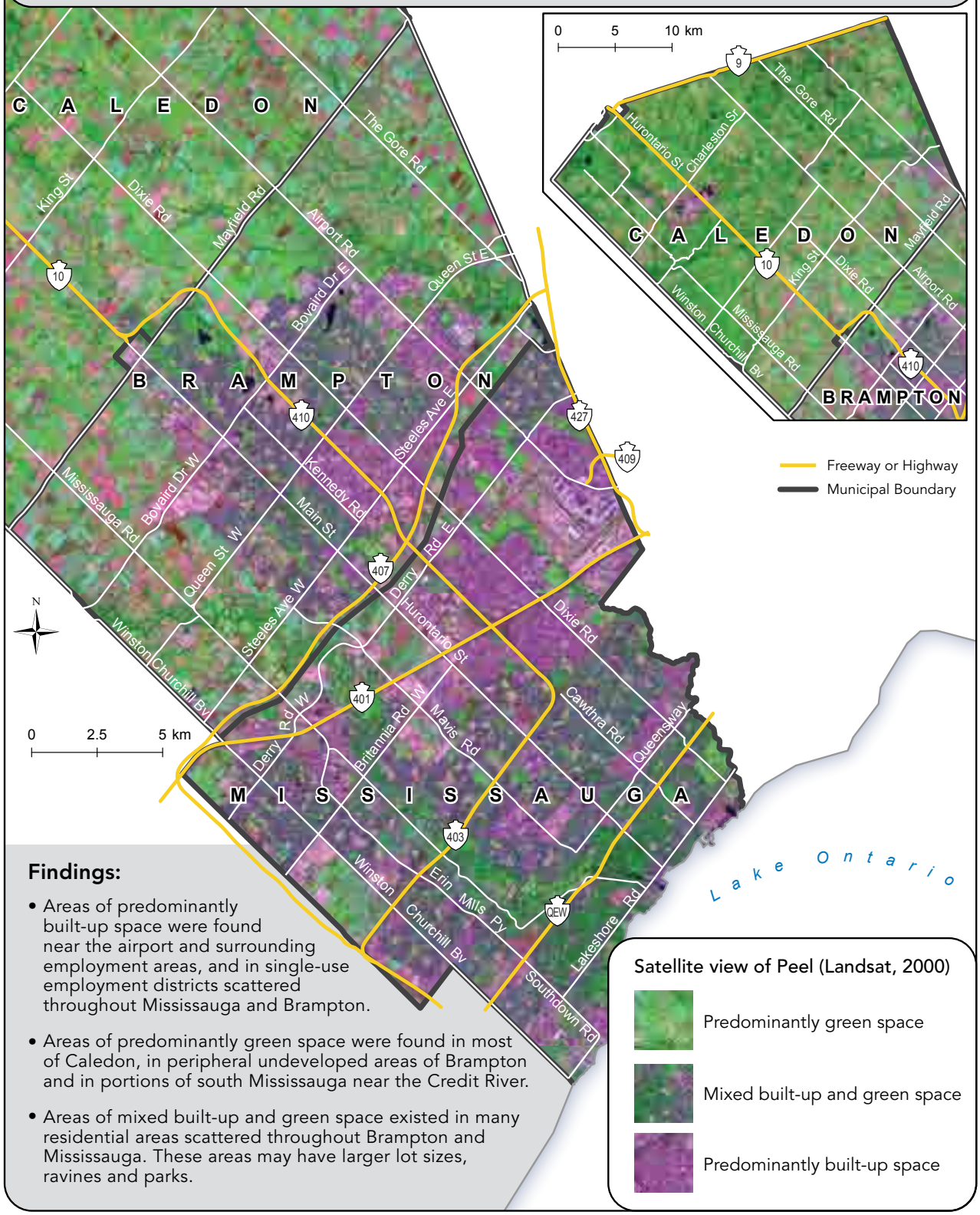
Exhibit 5.1. Main land use categories [2007–2010], in Peel region



Findings:

- Residential areas were found scattered throughout most areas of Brampton and Mississauga, except the airport, adjacent employment districts and undeveloped parts of east, northeast, north and west Brampton. New residential development is not allowed within the Toronto Pearson International Airport operating area. Smaller towns and settlements were found in parts of Caledon.
- Large single-use employment districts were scattered throughout Mississauga and southeast, central and northwest Brampton. Rural areas existed in most of Caledon.
- Parks were distributed fairly evenly in relation to residential areas in Brampton and Mississauga. Few mixed-use areas (e.g., retail, employment and residential together) existed outside of Mississauga City Centre, Port Credit and downtown Brampton.

Exhibit 5.2. Satellite view of Peel region [2000]



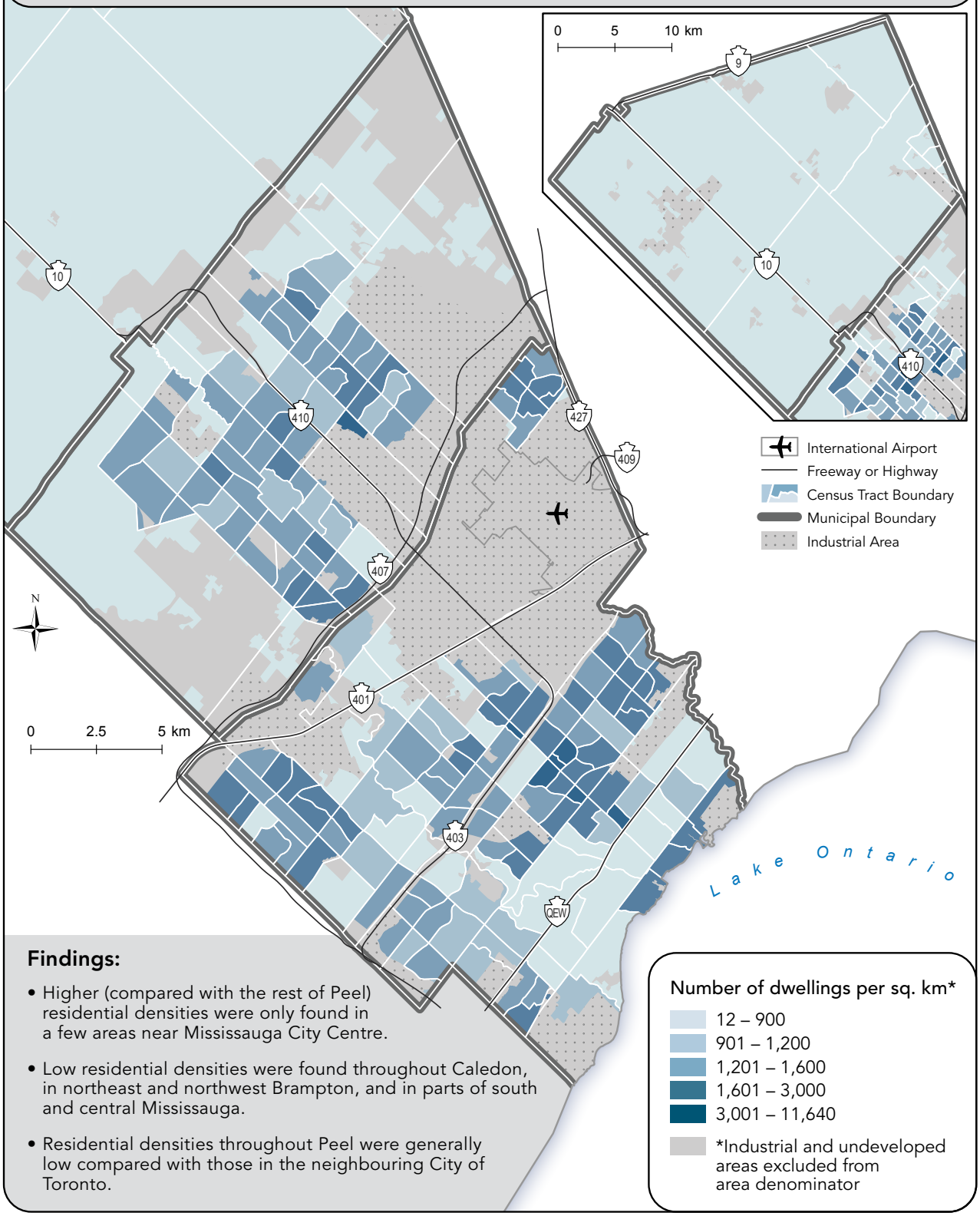
Findings:

- Areas of predominantly built-up space were found near the airport and surrounding employment areas, and in single-use employment districts scattered throughout Mississauga and Brampton.
- Areas of predominantly green space were found in most of Caledon, in peripheral undeveloped areas of Brampton and in portions of south Mississauga near the Credit River.
- Areas of mixed built-up and green space existed in many residential areas scattered throughout Brampton and Mississauga. These areas may have larger lot sizes, ravines and parks.

Satellite view of Peel (Landsat, 2000)

- Predominantly green space
- Mixed built-up and green space
- Predominantly built-up space

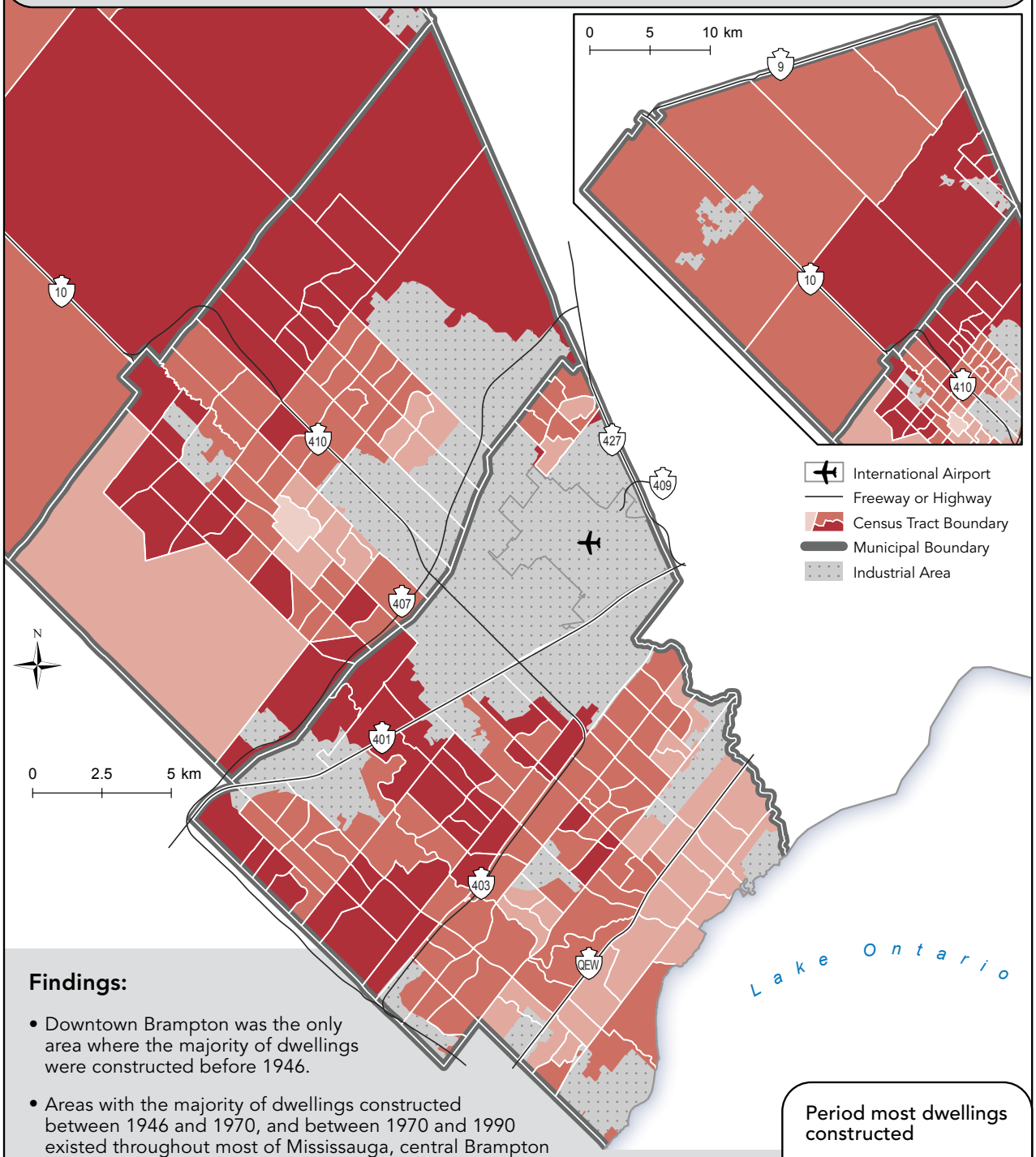
Exhibit 5.3. Number of dwellings per square kilometre*, by census tract [2006], in Peel region



Findings:

- Higher (compared with the rest of Peel) residential densities were only found in a few areas near Mississauga City Centre.
- Low residential densities were found throughout Caledon, in northeast and northwest Brampton, and in parts of south and central Mississauga.
- Residential densities throughout Peel were generally low compared with those in the neighbouring City of Toronto.

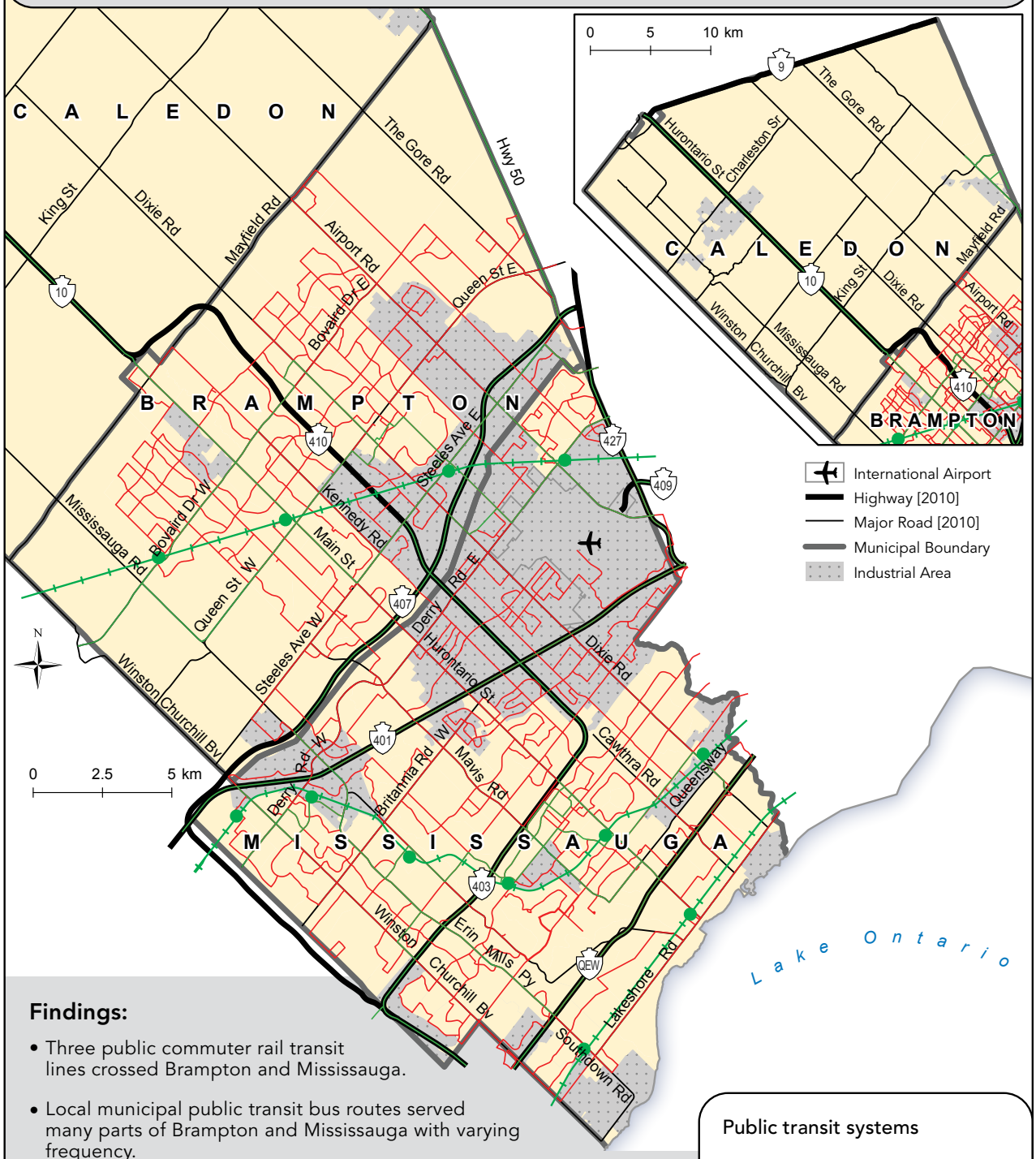
Exhibit 5.4. Period of construction of the majority of dwellings, by census tract [2006], in Peel region



Findings:

- Downtown Brampton was the only area where the majority of dwellings were constructed before 1946.
- Areas with the majority of dwellings constructed between 1946 and 1970, and between 1970 and 1990 existed throughout most of Mississauga, central Brampton and Caledon.
- Areas where the majority of dwellings were constructed between 1991 and 2006 were found in north, west and central Mississauga, northwest and northeast Brampton, and in south and east Caledon.

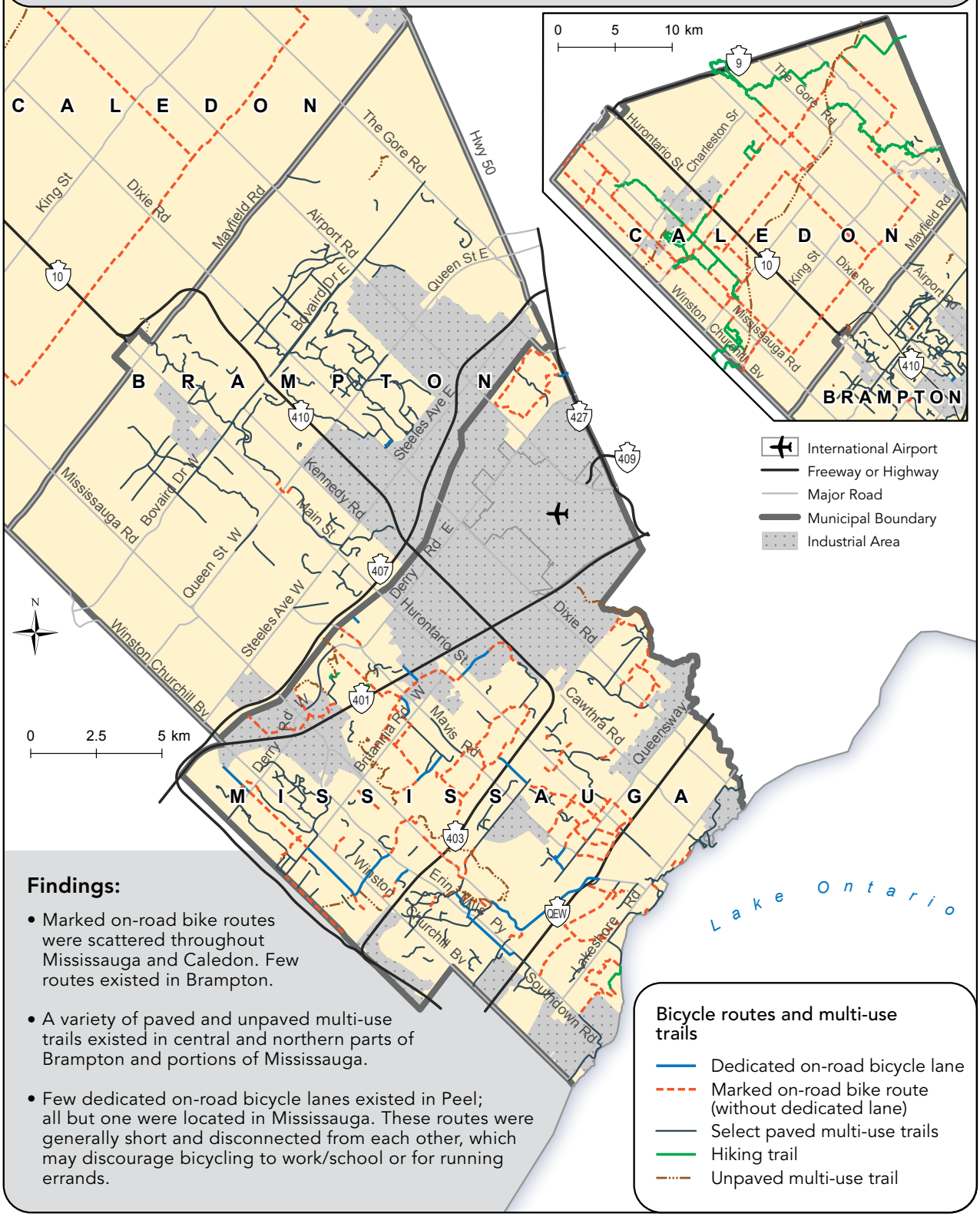
Exhibit 5.5. Highways [2010], roads [2010], municipal and regional public transit systems [2008/2010], in Peel region



Findings:

- Three public commuter rail transit lines crossed Brampton and Mississauga.
- Local municipal public transit bus routes served many parts of Brampton and Mississauga with varying frequency.
- Two regional commuter public transit bus routes existed in Caledon.
- The extensive network of major highways and high-speed arterial roads limits connectivity of local streets and pathways throughout Peel.

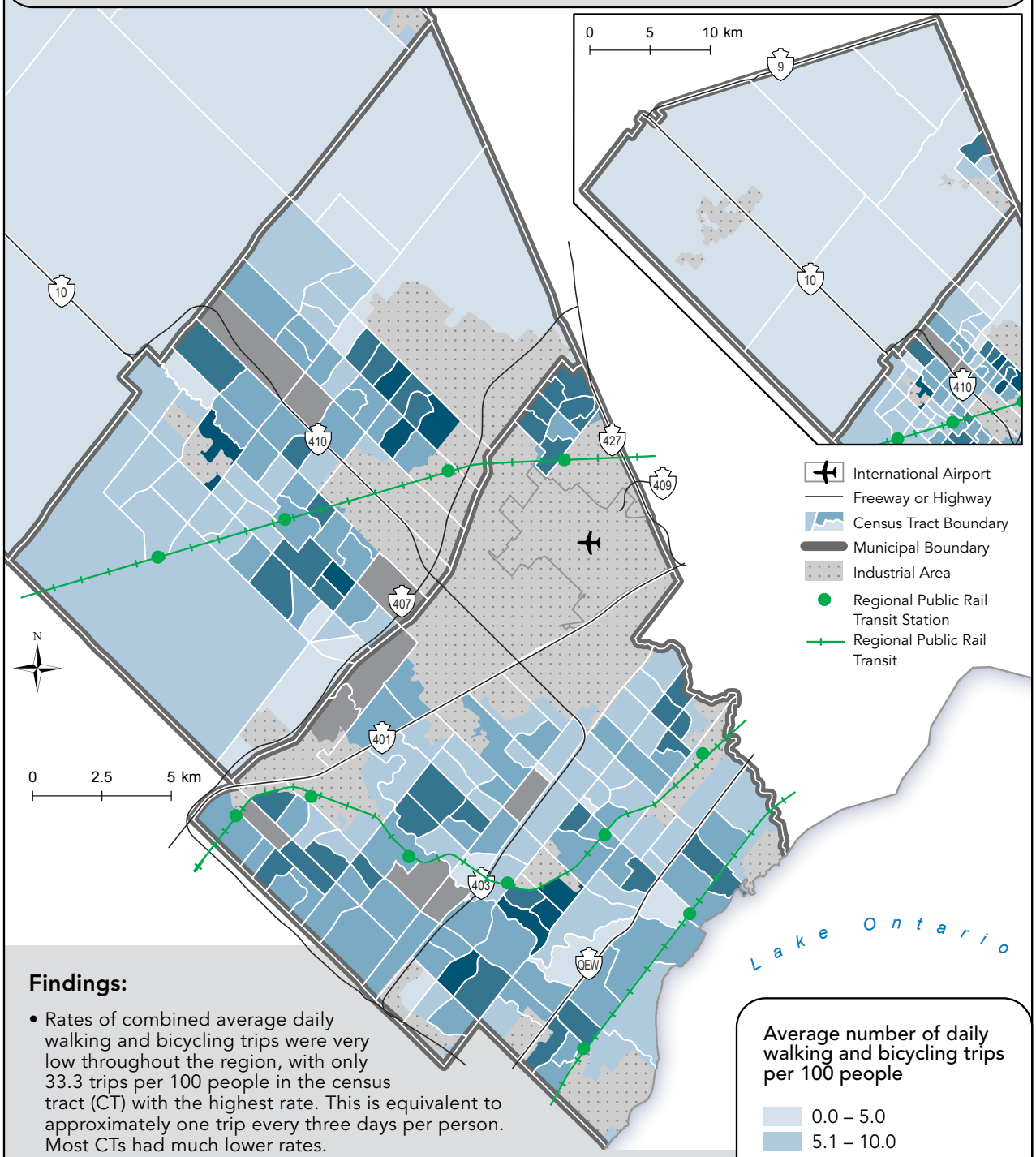
Exhibit 5.6. Bicycle routes and multi-use trails [2010], in Peel region



Findings:

- Marked on-road bike routes were scattered throughout Mississauga and Caledon. Few routes existed in Brampton.
- A variety of paved and unpaved multi-use trails existed in central and northern parts of Brampton and portions of Mississauga.
- Few dedicated on-road bicycle lanes existed in Peel; all but one were located in Mississauga. These routes were generally short and disconnected from each other, which may discourage bicycling to work/school or for running errands.

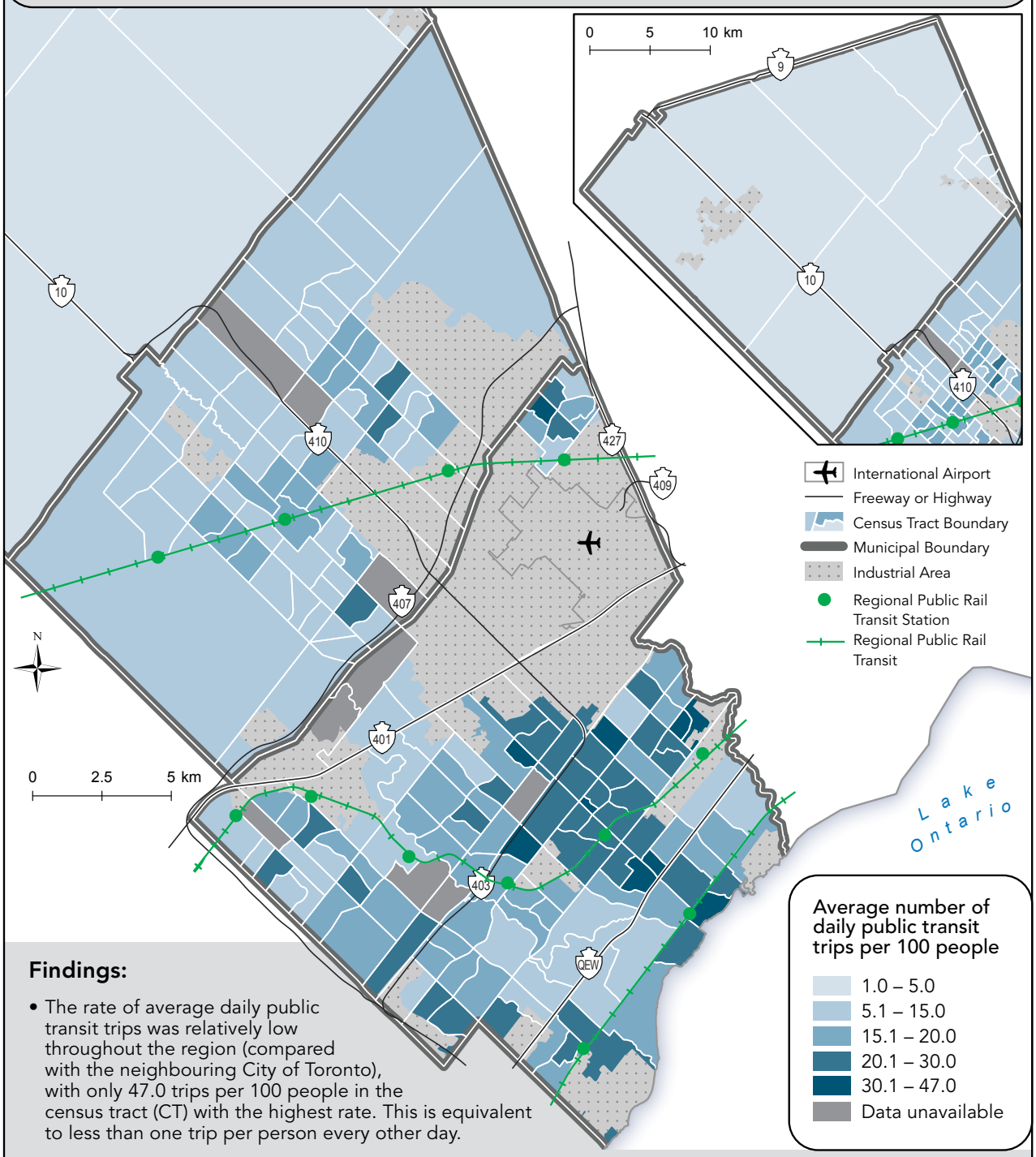
Exhibit 5.7. Average number of daily walking and bicycling trips per 100 people [2006], by census tract [2006], and locations of regional transit stations [2010], in Peel region



Findings:

- Rates of combined average daily walking and bicycling trips were very low throughout the region, with only 33.3 trips per 100 people in the census tract (CT) with the highest rate. This is equivalent to approximately one trip every three days per person. Most CTs had much lower rates.
- The lowest rates were reported in most of Caledon, east and southwest Brampton, and in south Mississauga. Areas with a relatively higher number of trips were scattered throughout Mississauga and central Brampton.

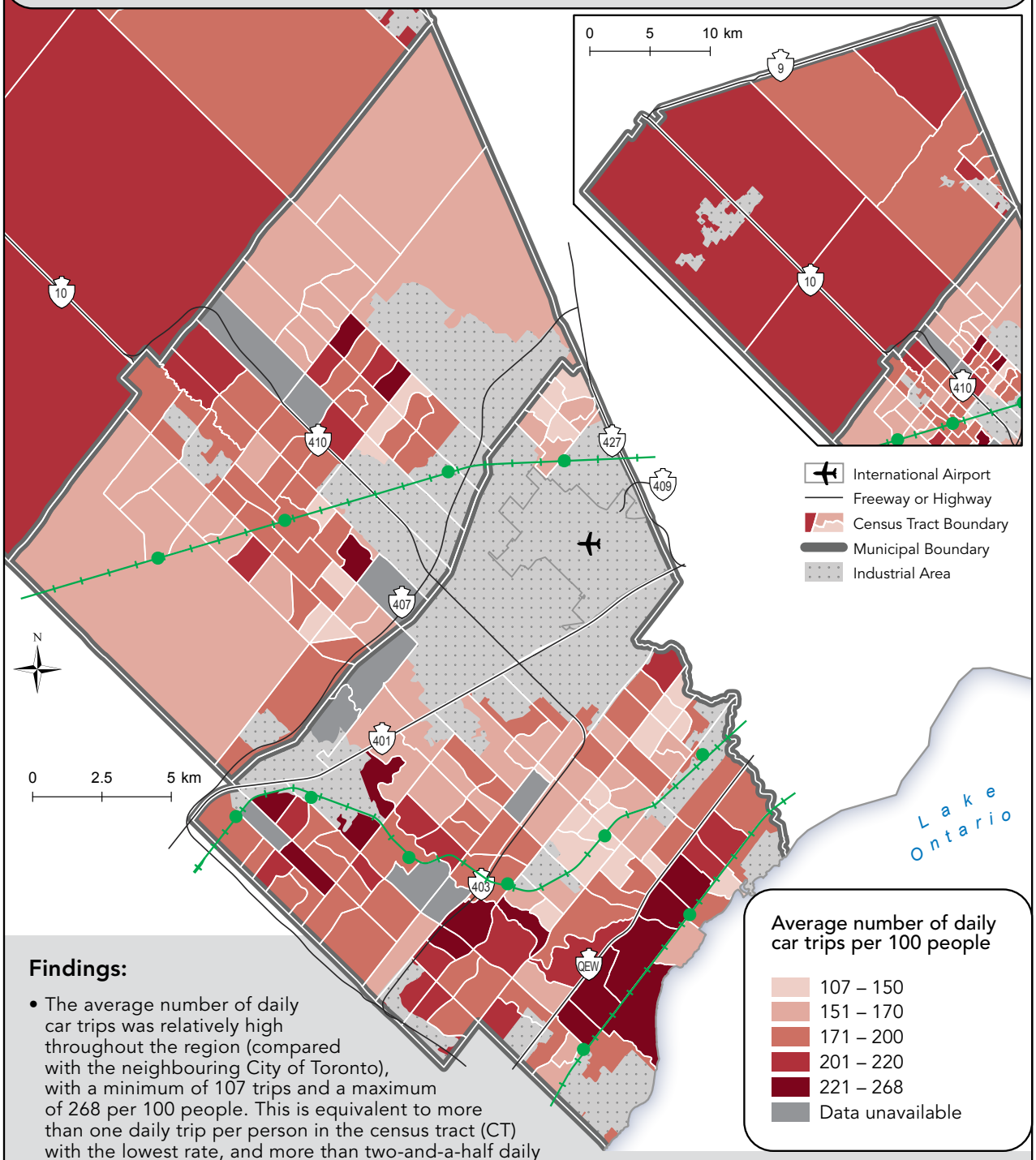
Exhibit 5.8. Average number of daily public transit trips per 100 people [2006], by census tract [2006], and locations of regional transit stations [2010] in Peel region



Findings:

- The rate of average daily public transit trips was relatively low throughout the region (compared with the neighbouring City of Toronto), with only 47.0 trips per 100 people in the census tract (CT) with the highest rate. This is equivalent to less than one trip per person every other day.
- Areas with a relatively higher number of trips (compared with the rest of Peel) were concentrated in central, south and northeast Mississauga, near and around Mississauga City Centre, and in central Brampton.
- Lower numbers of trips were reported throughout Caledon and in many peripheral and central portions of Brampton.

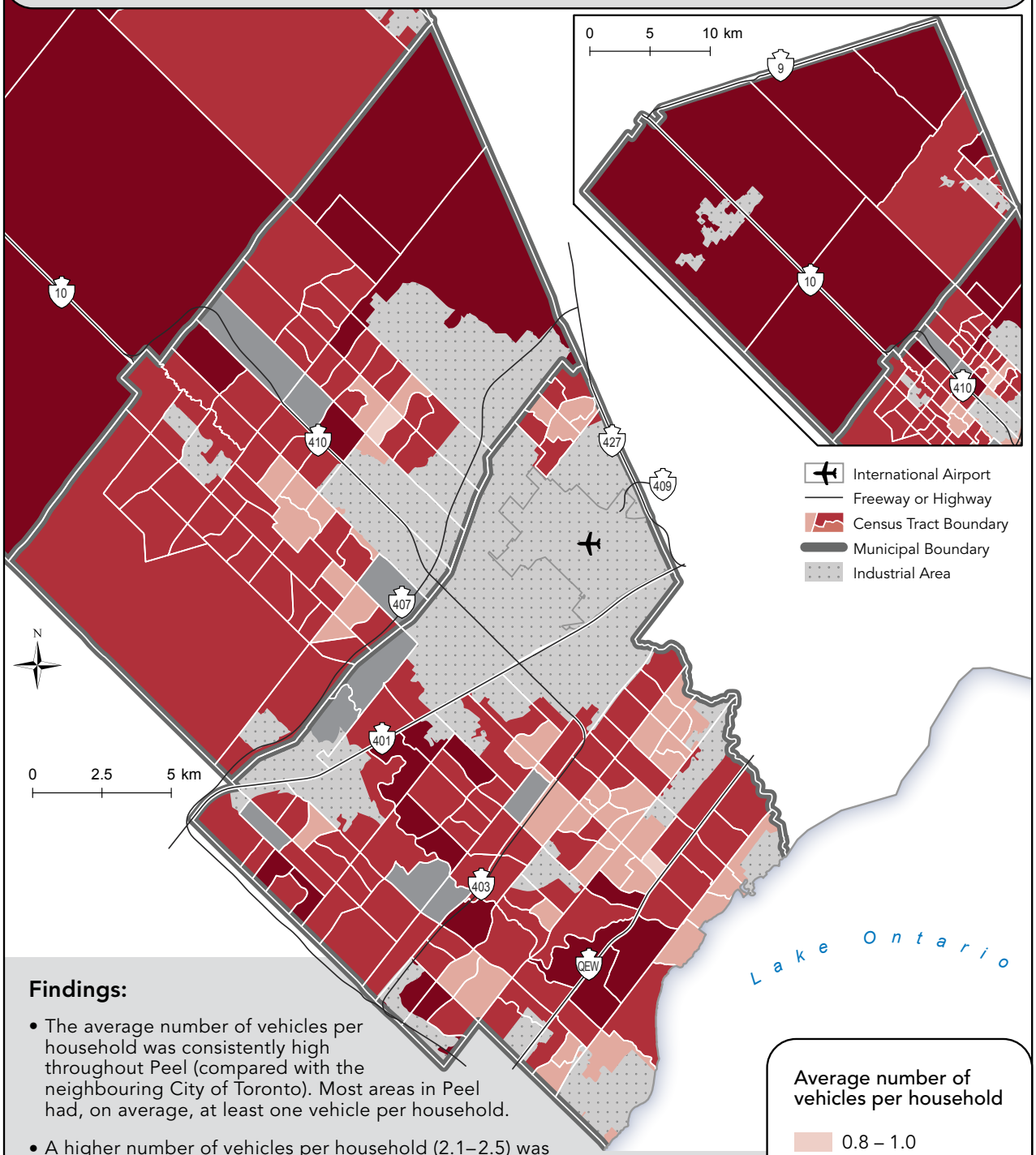
Exhibit 5.9. Average number of daily car trips per 100 people [2006], by census tract [2006], and locations of regional transit stations [2010], in Peel region



Findings:

- The average number of daily car trips was relatively high throughout the region (compared with the neighbouring City of Toronto), with a minimum of 107 trips and a maximum of 268 per 100 people. This is equivalent to more than one daily trip per person in the census tract (CT) with the lowest rate, and more than two-and-a-half daily trips per person in the CT with the highest rate.
- Areas with the highest number of trips were concentrated in south and west Mississauga, in parts of central Brampton, and in Caledon. A relatively lower number of trips (compared with the rest of Peel) was found near Mississauga City Centre, in northeast Mississauga, and in parts of central Brampton.

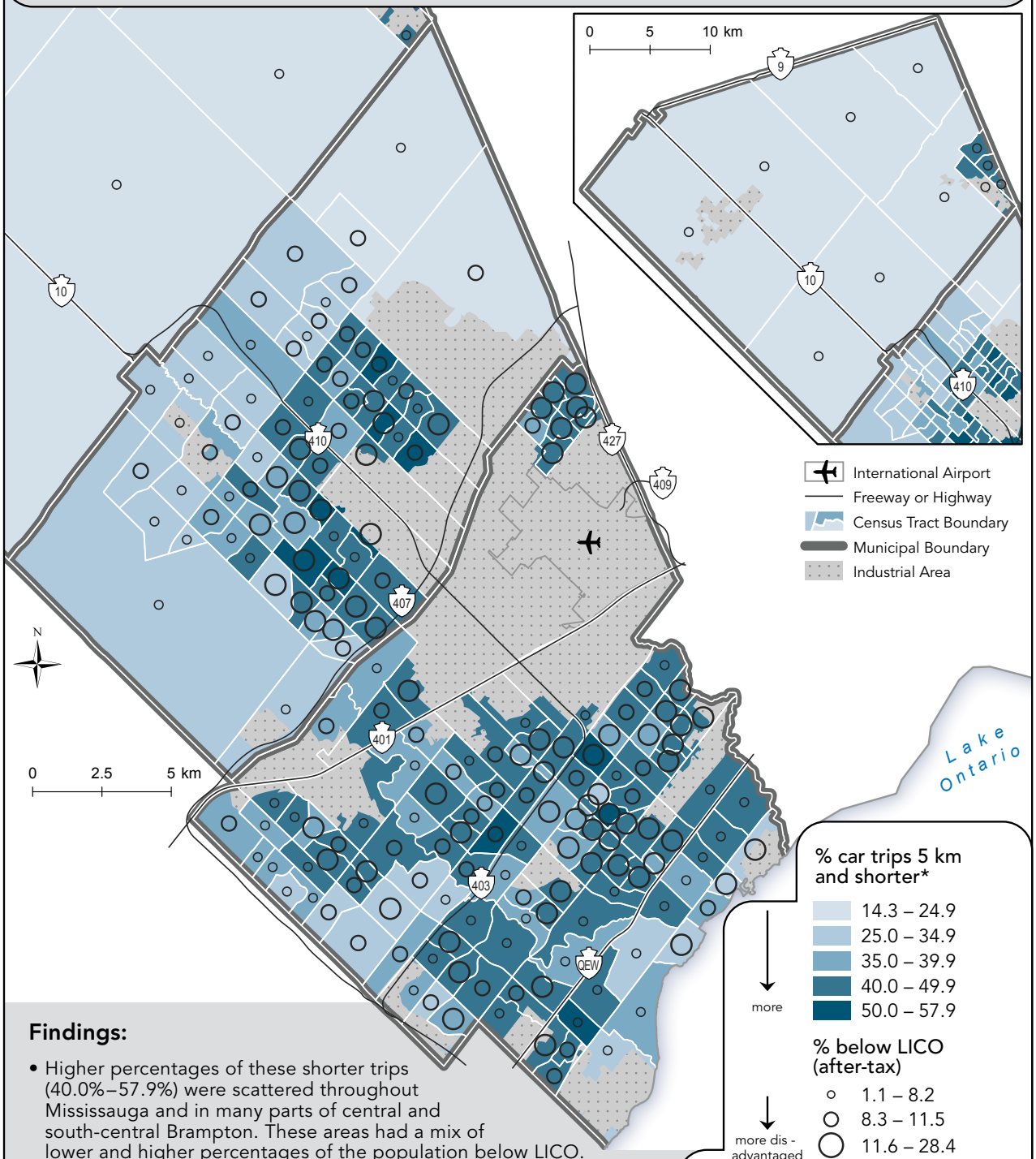
Exhibit 5.10. Average number of vehicles per household [2006], by census tract [2006], in Peel region



Findings:

- The average number of vehicles per household was consistently high throughout Peel (compared with the neighbouring City of Toronto). Most areas in Peel had, on average, at least one vehicle per household.
- A higher number of vehicles per household (2.1–2.5) was found in south and north-central Mississauga, northeast Brampton, and in most of Caledon.
- Fewer vehicles per household (0.8–1.0) were found in parts of central, south and northeast Mississauga, and in parts of central Brampton.

Exhibit 5.11. Car trips less than or equal to 5 kilometres in length (as a percentage of all daily car trips) [2006] and per cent of the population that fell below Statistics Canada's low income cut-off (LICO; after-tax) [2005], by census tract [2006], in Peel region

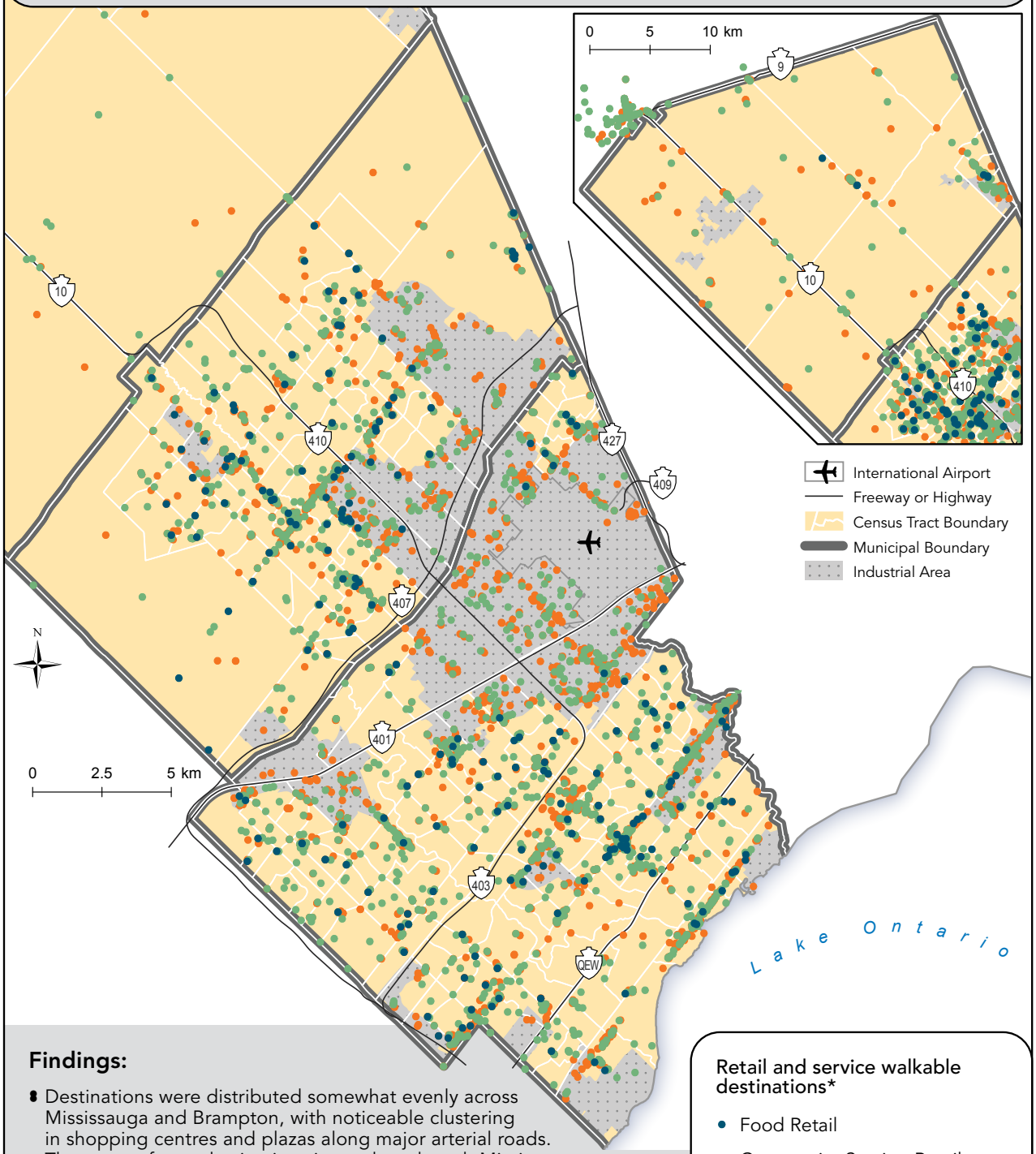


Findings:

- Higher percentages of these shorter trips (40.0%–57.9%) were scattered throughout Mississauga and in many parts of central and south-central Brampton. These areas had a mix of lower and higher percentages of the population below LICO.
- Lower percentages of shorter trips (14.3%–24.9%) were found in northeast Brampton and in all parts of Caledon except Bolton. These areas had a mix of lower and medium percentages of the population below LICO.

*Length was measured as "Manhattan distance," which is the right-angle distance between two points. This approximates distance as measured along a grid-type street network.

Exhibit 5.12. Locations of retail and service walkable destinations* [2009/2010], in Peel region



Findings:

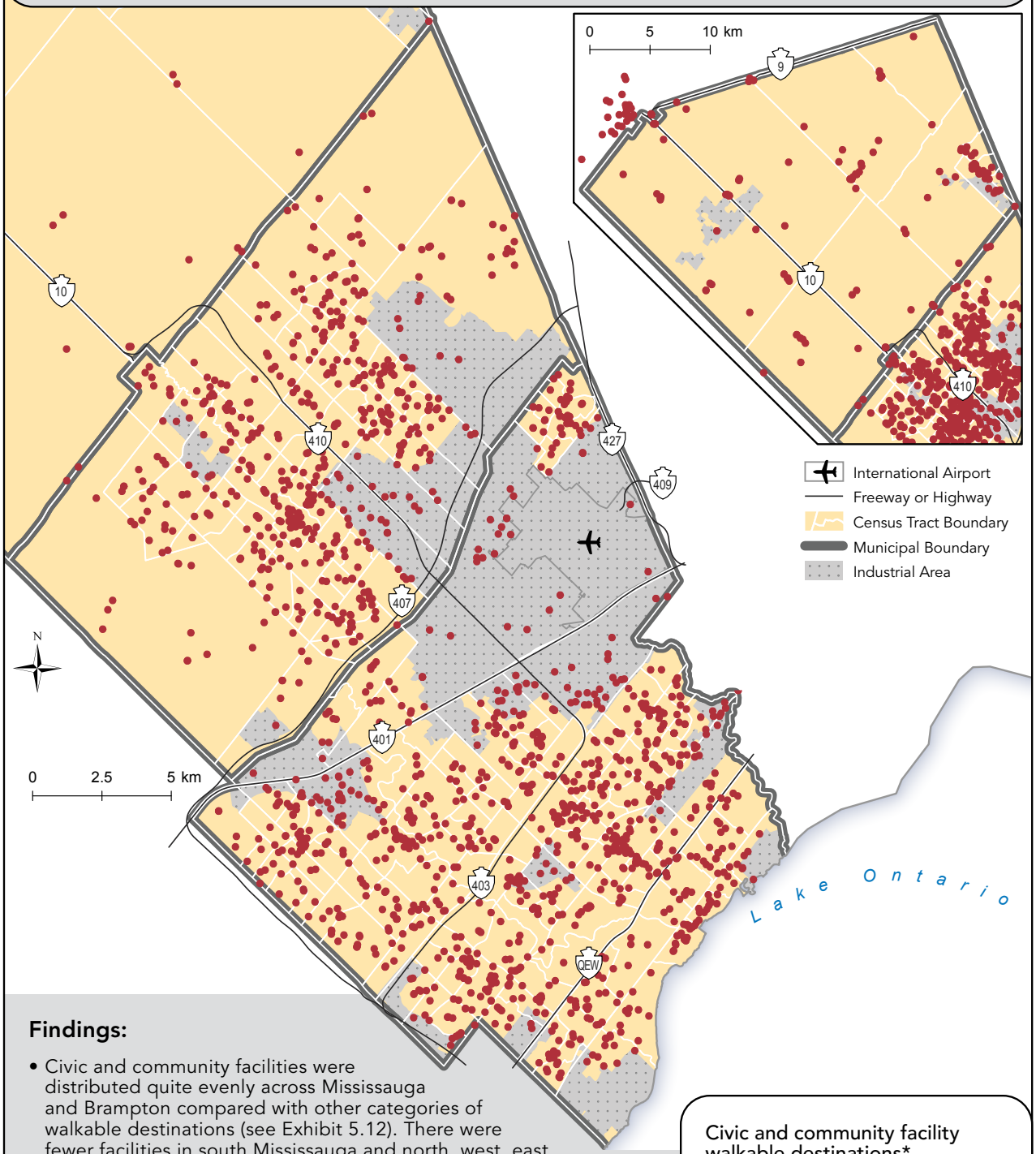
- Destinations were distributed somewhat evenly across Mississauga and Brampton, with noticeable clustering in shopping centres and plazas along major arterial roads. There were fewer destinations in south and north Mississauga and north, west, east and northeast areas of Brampton.
- Caledon had relatively few retail and service walkable destinations except in Bolton and Caledon East.

Retail and service walkable destinations*

- Food Retail
- Community-Serving Retail
- Services

*For more information on walkable destinations see Appendix 5.A

Exhibit 5.13. Locations of civic and community facility walkable destinations* [2009/2010], in Peel region



Findings:

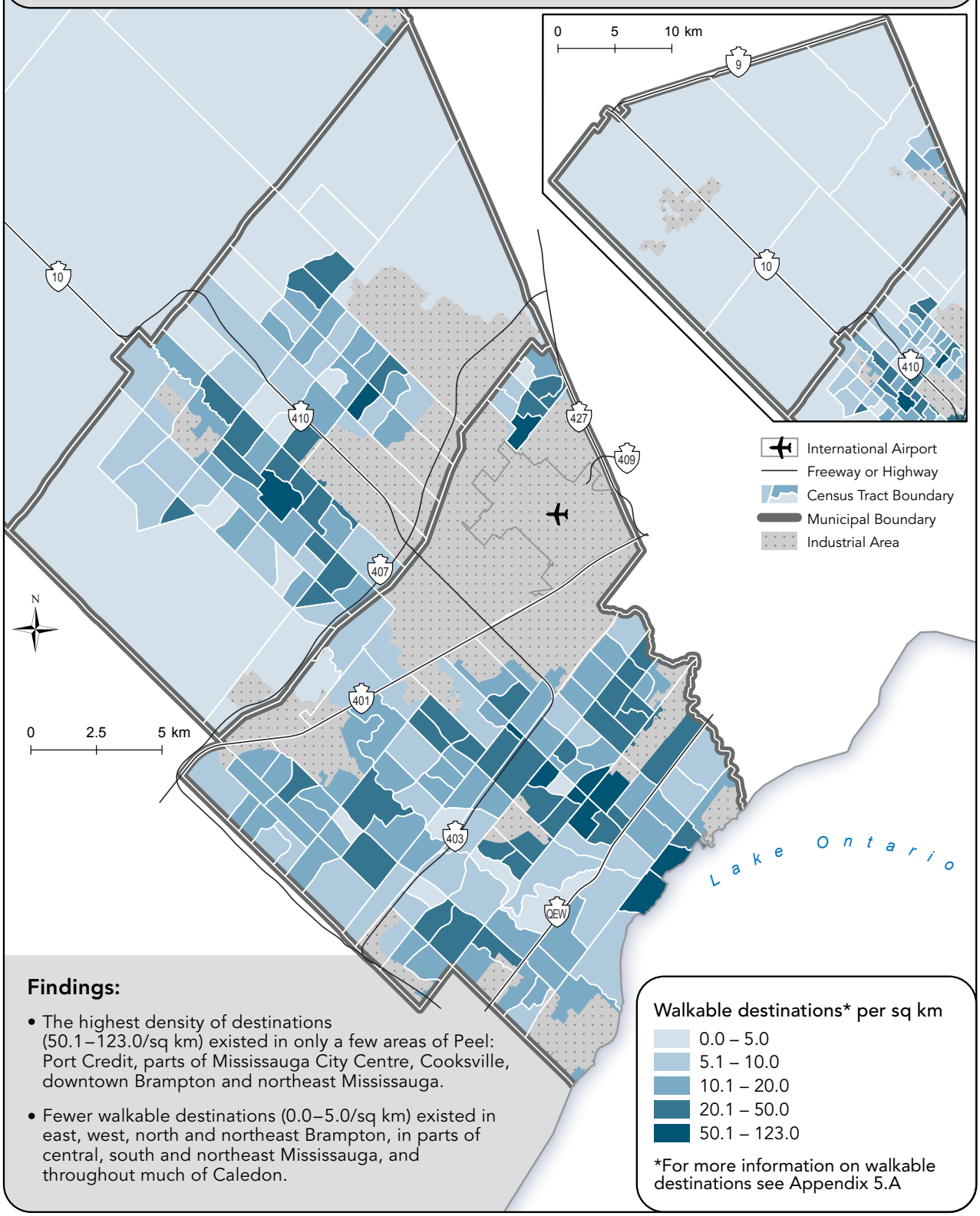
- Civic and community facilities were distributed quite evenly across Mississauga and Brampton compared with other categories of walkable destinations (see Exhibit 5.12). There were fewer facilities in south Mississauga and north, west, east and northeast areas of Brampton. These areas also had fewer retail and service walkable destinations.
- Caledon had relatively few civic and community facility walkable destinations except in Bolton and Caledon East.

Civic and community facility walkable destinations*

- Civic and Community Facilities

*For more information on walkable destinations see Appendix 5.A"

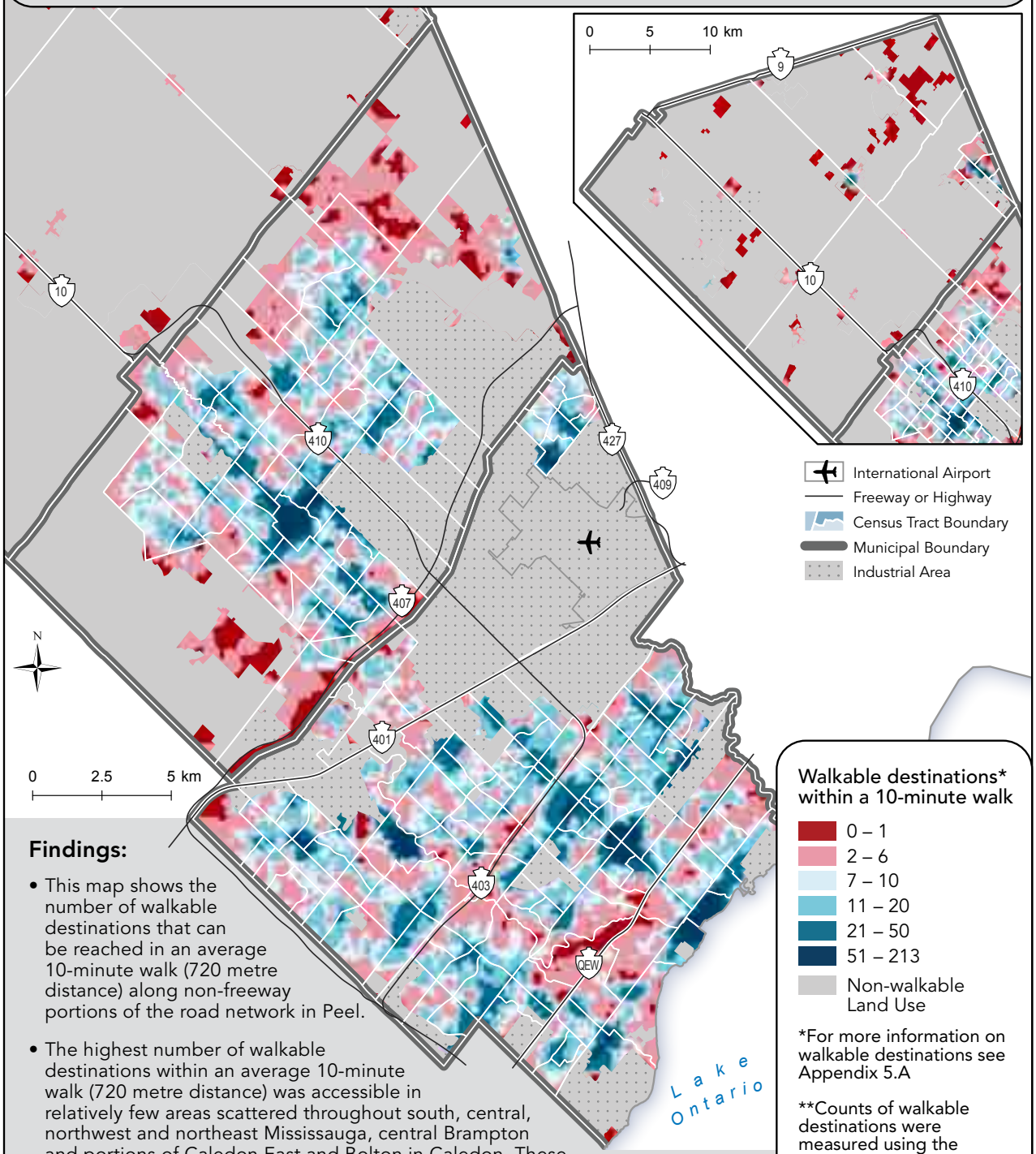
Exhibit 5.14. Number of walkable destinations* [2009/2010] per square kilometre, by census tract [2006], in Peel region



Findings:

- The highest density of destinations (50.1–123.0/sq km) existed in only a few areas of Peel: Port Credit, parts of Mississauga City Centre, Cooksville, downtown Brampton and northeast Mississauga.
- Fewer walkable destinations (0.0–5.0/sq km) existed in east, west, north and northeast Brampton, in parts of central, south and northeast Mississauga, and throughout much of Caledon.

Exhibit 5.15. Number of walkable destinations* [2009/2010] within a 10-minute walk of residential, mixed-use and other** areas [2009] along the road network [2009], interpolated grid across Peel region



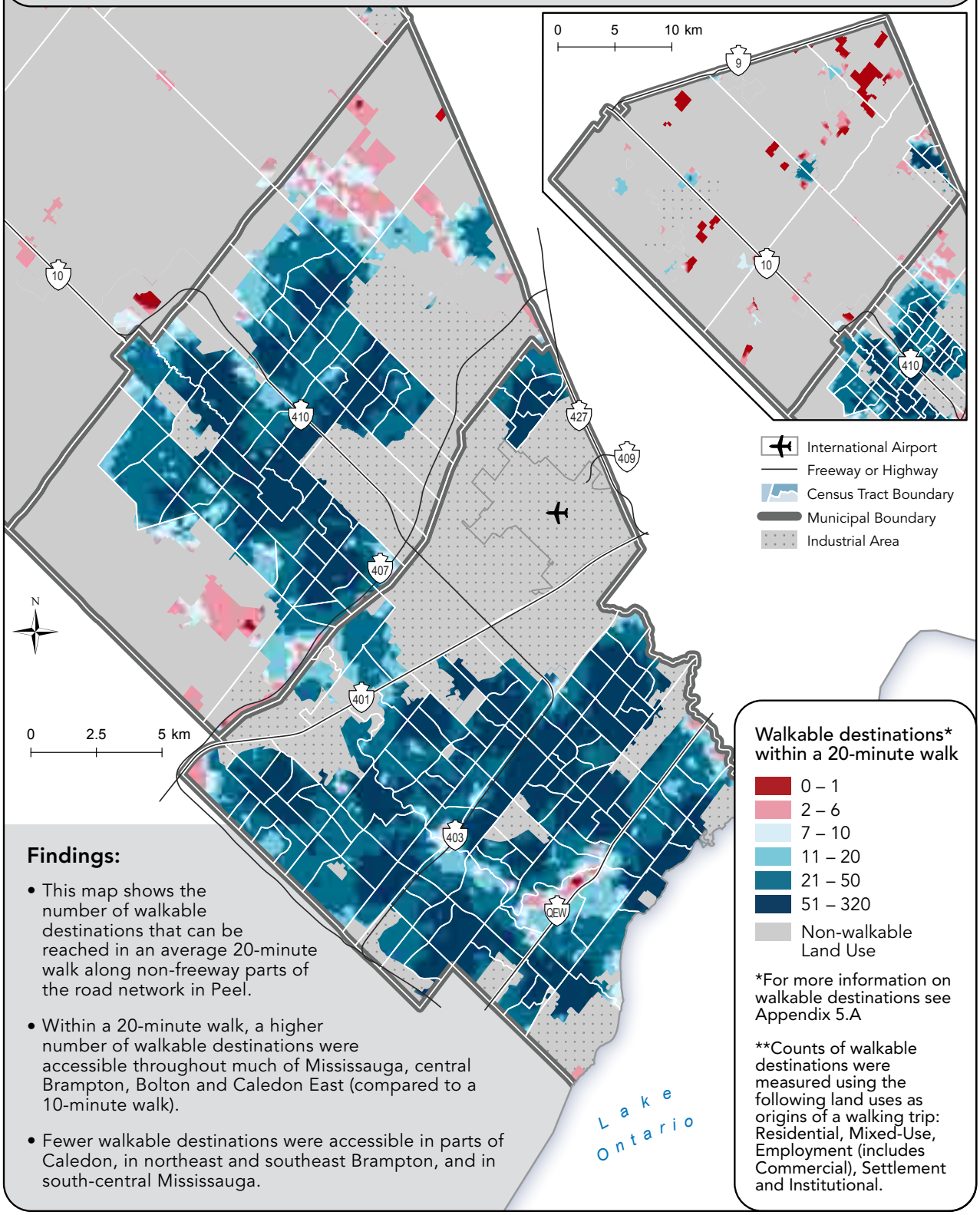
*For more information on walkable destinations see Appendix 5.A

**Counts of walkable destinations were measured using the following land uses as origins of a walking trip: Residential, Mixed-Use, Employment (includes Commercial), Settlement and Institutional.

Findings:

- This map shows the number of walkable destinations that can be reached in an average 10-minute walk (720 metre distance) along non-freeway portions of the road network in Peel.
- The highest number of walkable destinations within an average 10-minute walk (720 metre distance) was accessible in relatively few areas scattered throughout south, central, northwest and northeast Mississauga, central Brampton and portions of Caledon East and Bolton in Caledon. These areas were often, though not always, centred around single-use commercial districts such as shopping malls.
- Few walkable destinations (0–6) were accessible in a number of areas scattered throughout Mississauga and Brampton and in parts of Caledon.

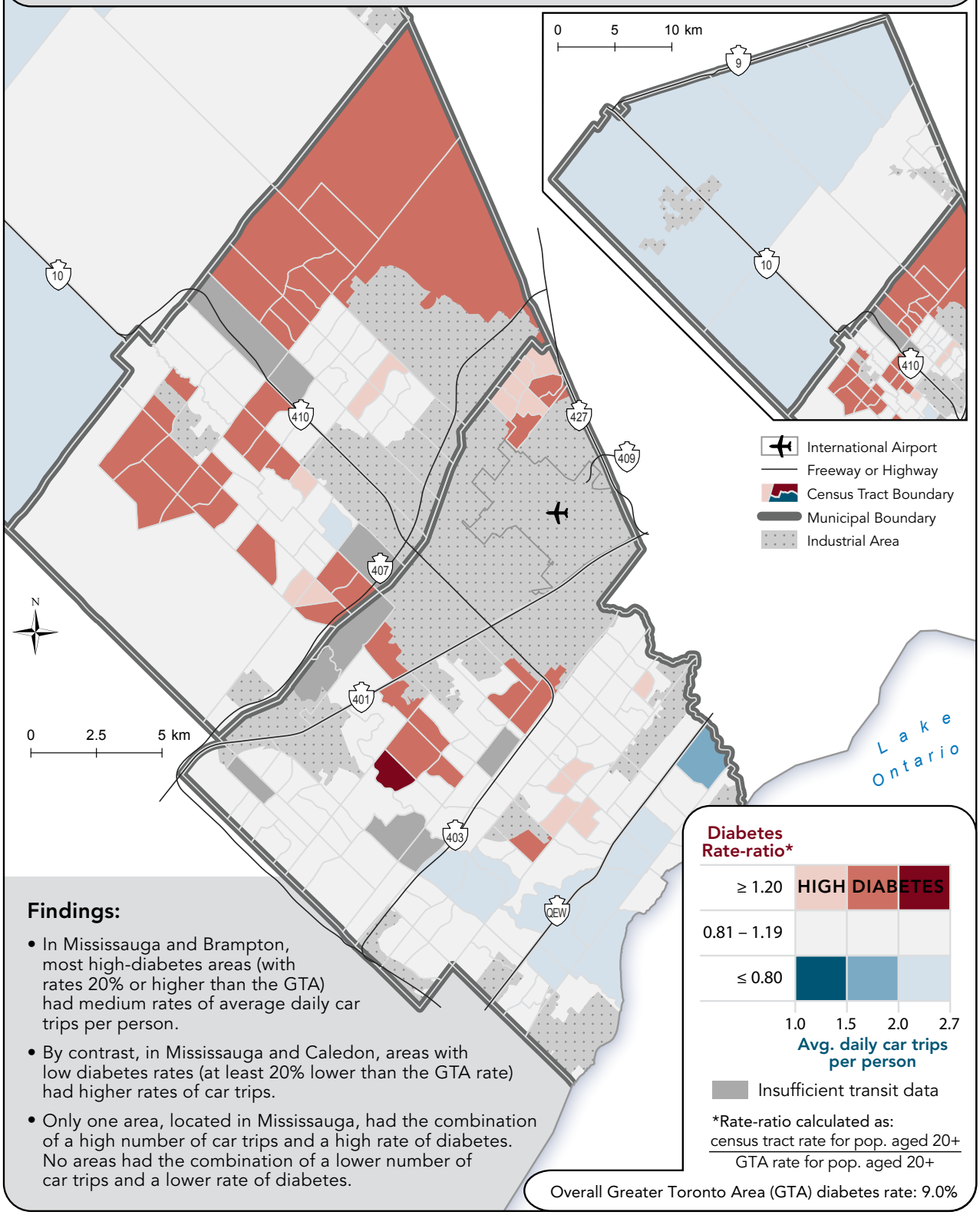
Exhibit 5.16. Number of walkable destinations* [2009/2010] within a 20-minute walk of residential, mixed-use and other** areas [2009] along the road network [2009], interpolated grid across Peel region



Findings:

- This map shows the number of walkable destinations that can be reached in an average 20-minute walk along non-freeway parts of the road network in Peel.
- Within a 20-minute walk, a higher number of walkable destinations were accessible throughout much of Mississauga, central Brampton, Bolton and Caledon East (compared to a 10-minute walk).
- Fewer walkable destinations were accessible in parts of Caledon, in northeast and southeast Brampton, and in south-central Mississauga.

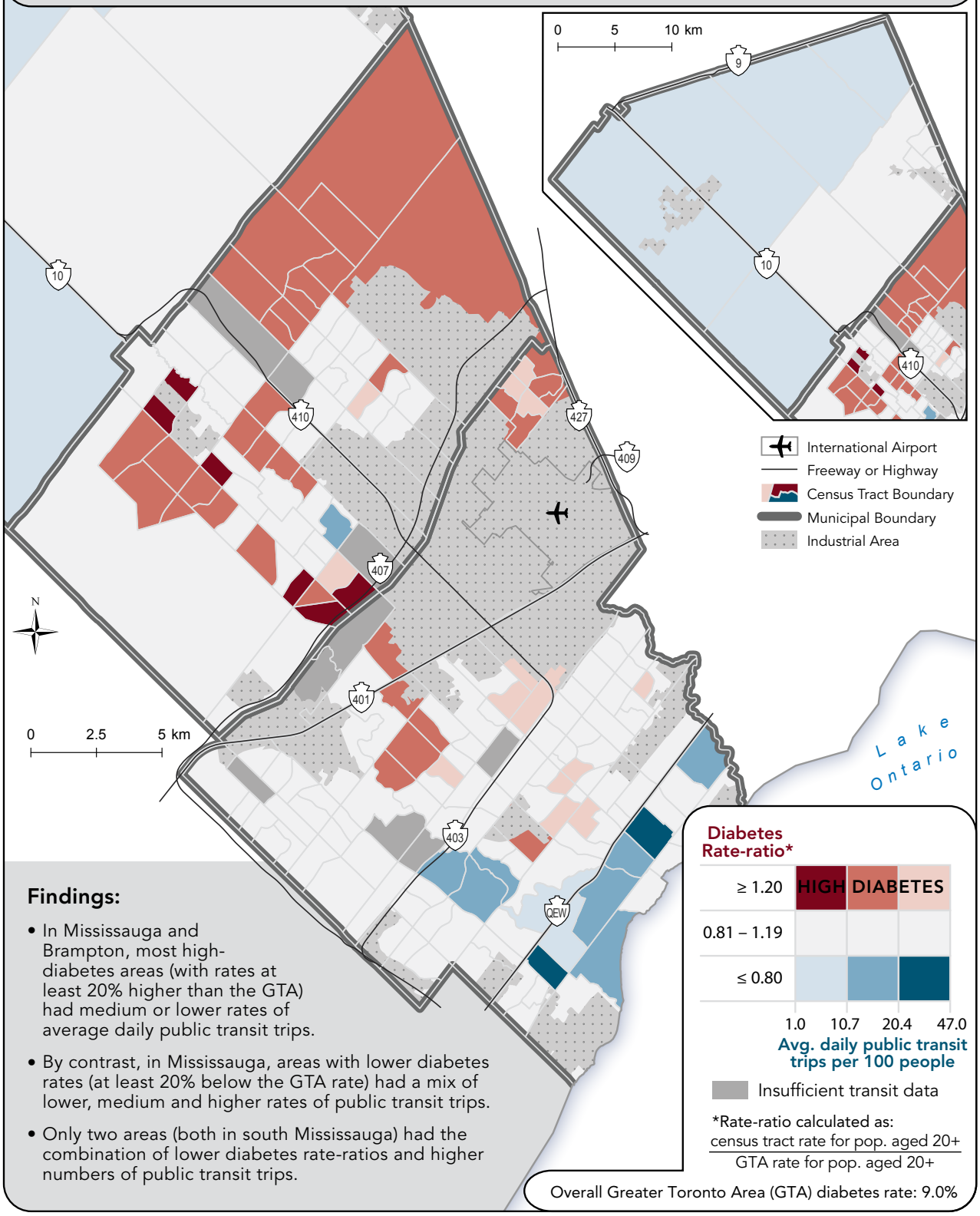
Exhibit 5.17. Spatial relationship between the average number of daily car trips per person [2006] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

- In Mississauga and Brampton, most high-diabetes areas (with rates 20% or higher than the GTA) had medium rates of average daily car trips per person.
- By contrast, in Mississauga and Caledon, areas with low diabetes rates (at least 20% lower than the GTA rate) had higher rates of car trips.
- Only one area, located in Mississauga, had the combination of a high number of car trips and a high rate of diabetes. No areas had the combination of a lower number of car trips and a lower rate of diabetes.

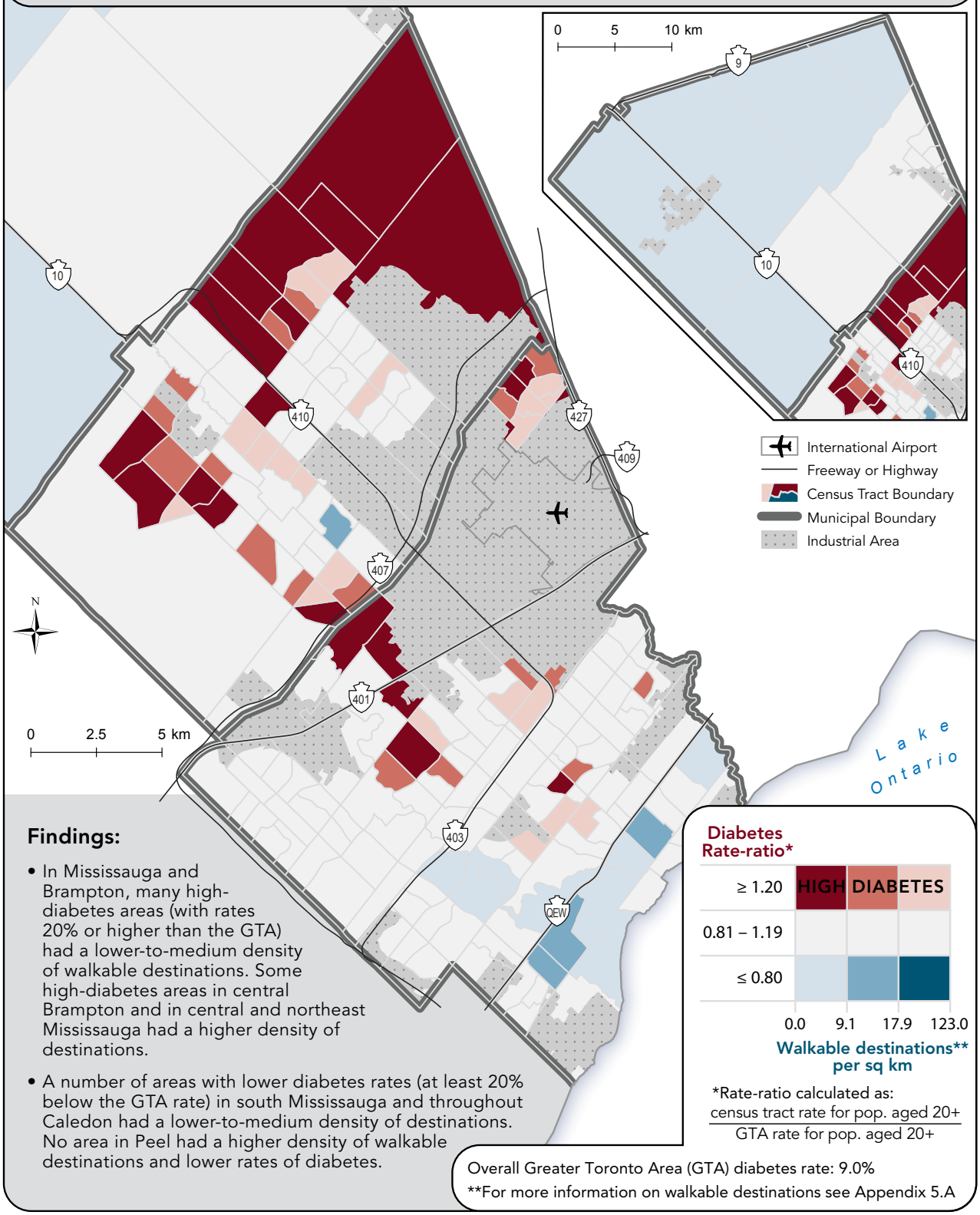
Exhibit 5.18. Spatial relationship between the average number of daily public transit trips per person [2006] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

- In Mississauga and Brampton, most high-diabetes areas (with rates at least 20% higher than the GTA) had medium or lower rates of average daily public transit trips.
- By contrast, in Mississauga, areas with lower diabetes rates (at least 20% below the GTA rate) had a mix of lower, medium and higher rates of public transit trips.
- Only two areas (both in south Mississauga) had the combination of lower diabetes rate-ratios and higher numbers of public transit trips.

Exhibit 5.19. Spatial relationship between the number of walkable destinations [2009/2010] per square kilometre and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

- In Mississauga and Brampton, many high-diabetes areas (with rates 20% or higher than the GTA) had a lower-to-medium density of walkable destinations. Some high-diabetes areas in central Brampton and in central and northeast Mississauga had a higher density of destinations.
- A number of areas with lower diabetes rates (at least 20% below the GTA rate) in south Mississauga and throughout Caledon had a lower-to-medium density of destinations. No area in Peel had a higher density of walkable destinations and lower rates of diabetes.

Overall Greater Toronto Area (GTA) diabetes rate: 9.0%

**For more information on walkable destinations see Appendix 5.A

DISCUSSION

The findings in this chapter are generally inconsistent with research that links the built environment characteristics of areas to individuals' propensity to walk or bicycle and the associated health risks of obesity and diabetes. Evidence indicates that built environment characteristics may increase these risks in areas where, for example, car travel is the only accessible method of transportation, or may reduce health risks if walking, bicycling or public transit trips are convenient and practical for daily activities. Living in a car-dependent area with few services within walking distance and other features that discourage walking, bicycling and use of public transit may be an important independent risk factor for developing obesity and diabetes. However, in the case of Peel, other factors such as socioeconomic status and a high concentration of ethnic groups that are at an increased risk of developing diabetes may have a stronger impact on the risk of diabetes than characteristics of the built environment.

The spatial patterns relating built environment characteristics to walking/bicycling rates and diabetes prevalence in Brampton and Mississauga were generally inconsistent. There were similar built environment characteristics, such as a lower density of walkable destinations and a higher numbers of daily car trips, in both high-diabetes and low-diabetes areas throughout Peel. Areas where the majority of dwellings were built between 1946 and 1970 generally had lower rates of diabetes than recently constructed areas. However, most of these areas still lacked walkable built environment characteristics such as higher residential densities and mixed-use communities with walkable destinations in close proximity.

Modes of transportation in Peel

The frequency with which Peel residents used various modes of transportation (i.e., public transit or car trips) was generally very similar across different areas of Peel. Because of this lack of variability, it was difficult to assess the relationship between various modes of transportation and characteristics such as period of dwelling construction and proximity of walkable destinations. Car trips were extremely common throughout the region, with a minimum of 107 daily trips per 100 people. This is equivalent to more than one daily car trip per person in the census tract with the lowest rate, and most census tracts had much higher rates.

A notable concentration of higher daily public transit rates (relative to other areas in Peel) was identified in a corridor around Mississauga City Centre and along Hurontario St. in Mississauga (see Exhibit 5.8). However, overall rates of public transit trips were relatively low throughout Peel, with a maximum of 47.0 trips per 100 people. The frequency and routing of public transit services in Peel may influence how often they are used. Due to data limitations, there was no way to evaluate relationships between transit frequency or route directness and number of public transit trips per person in this atlas.

Daily walking and bicycling rates were extremely low throughout Peel, with a maximum of only 33.3 trips (combined) per 100 people. This is equivalent to approximately one trip every three days per person in the census tract with the highest rate. Many census tracts had much lower rates. Interestingly, the proportion of daily car trips that were 5 km or less in length (see Exhibit 5.12) was 40% or higher in many middle-to-lower income areas of Brampton and Mississauga. These may be areas where improvements in cycling infrastructure could result in increased rates of bicycling – a highly cost-effective and active mode of transport – for these kinds of shorter trips. The current system of dedicated bicycle lanes exists almost exclusively in Mississauga where routes are generally short and disconnected from each other. This may discourage residents of Mississauga and Brampton from bicycling to work/school, for running errands or for recreation.

Walkable destinations and diabetes prevalence in Peel

20 minute walking distance

Most areas in Brampton and Mississauga have a moderate-to-high number of walkable destinations accessible within a 20-minute walk (see Exhibit 5.16). Northeast Brampton and south-central Mississauga were among the exceptions with less than six destinations accessible within this walking time. Patterns of diabetes prevalence in the moderate-to-high access areas were inconsistent, with lower rates in some areas and higher rates in others. A person's propensity to walk to local amenities may decrease when travel time exceeds five to ten minutes,[25-27] which may in part explain these findings.

10 minute walking distance

Within a 10-minute walking distance, there were a number of areas with a relatively high number of walkable destinations (compared with the rest of Peel; see Exhibit 5.15). However, many of these areas were located around single-use commercial districts contained in large shopping centres or strip malls which often have a variety of barriers to pedestrian access that could not be accounted for in these analyses. Large parking lots and building setbacks, uninviting pedestrian-level aesthetics, wider roads with higher speed limits and fewer sidewalks on route to such destinations in suburban areas can act as potential barriers to pedestrian access.[20,30-32]

Yet, even in Downtown Brampton and in Port Credit in Mississauga – areas with an older period of construction, relatively inviting streetscapes, buildings located closer to streets and sidewalks, and higher densities of walkable destinations at unique locations along the street – there was a weaker than expected relationship between built environment characteristics and both walking/bicycling rates and diabetes prevalence. These areas had medium levels of walking/bicycling rates (compared with the rest of Peel) and medium rates of diabetes prevalence (compared with the rest of Peel and the Greater Toronto Area average).

Period of dwelling construction in Peel and diabetes prevalence

Only one area in Peel – downtown Brampton – had the majority of its dwellings constructed prior to 1946. There are several areas in south Mississauga and central Brampton that were built between 1946 and 1970, but they still share many of the suburban design characteristics found in areas built since 1970 (the majority of residential areas in Brampton and Mississauga). These newer areas are often characterized by urban sprawl and planned separation of residential and non-residential lands. Toronto, which is home to

many areas with older styles of urban planning and design, has strong and consistent relationships between walkable built environment characteristics and increased rates of walking and physical activity, and lower rates of diabetes in older, pre-1946 areas of the downtown area.[22] With the exception of downtown Brampton, areas of similar period of construction do not exist in Peel.

This low level of variation in characteristics of the built environment throughout Brampton and Mississauga makes it difficult to assess the relationships between the built environment and physical activity or diabetes. Rates of diabetes in Peel also appear to have stronger and more consistent associations with factors such as socioeconomic status and ethnicity/immigration than with features of the built environment (for more information, see Chapters 3 and 4).

Limitations of this study

There are a number of limitations to these analyses. Ecological analyses such as this one, which examined area-level characteristics rather than individuals, cannot be used to prove causation. The same is true for cross-sectional analyses that examine data at one point in time (the type of analyses presented in this chapter). These analyses can suggest associations that can then be followed up with studies of individuals' levels of physical activity, their use of different modes of transportation, barriers to walking and other risk factors for diabetes.

The combined influence of multiple characteristics of the built environment on the utilization of different modes of transportation or risk factors for diabetes could not be examined. Having a combination of multiple pedestrian-friendly built environment characteristics may be more important for improving levels of physical activity than any one single characteristic on its own. For example, increased dwelling densities may be necessary to improve the walkability of an area, but may be insufficient without also having enough walkable destinations in close proximity and an attractive pedestrian-oriented streetscape in the same community.

The measures of walking and bicycling, public transit and automobile trips primarily included trips to/from work and/or school, and may have underestimated the number of trips for other purposes, such as errands and recreation. In certain analyses, it was not possible to account for any pedestrian- or bicycle-specific routes that do not follow the vehicular road network in Peel. Furthermore, the potential influence of physical barriers (such as parking lots) and street-level aesthetics on travel decisions could not be captured. Aesthetic features of the built environment are generally difficult to measure and have been rarely assessed in quantitative research. However, residents' perceptions of environmental attractiveness, pleasant scenery and friendliness are related to higher levels of physical activity.[19,20] Relationships between aesthetic factors (e.g., maintenance of sidewalks, road noise and noise walls, size and abundance of parking lots, and absence of trees along streets and pathways) and physical activity were not examined for Peel due to a lack of objective measures in GIS data. Examination of such relationships would be important to consider in future studies.

Lastly, it should be noted that most of the evidence linking built environment characteristics, walking/bicycling and obesity applies only to urban and suburban areas. Because Caledon consists of largely rural agricultural areas with only a few scattered towns and settlements, many of the analyses performed in this chapter are likely not relevant for this area.

CONCLUSIONS AND IMPLICATIONS

Mississauga and Brampton are generally characterized by newer (post-1946) patterns of suburban development, with characteristics such as longer blocks, cul-de-sacs with dead ends, lower residential densities and segregated land uses found in many areas. These patterns of development likely contribute to the very low rates of daily walking and bicycling trips, and high rates of daily car trips throughout the region. It is difficult to evaluate the relationship between

the built environment, walking/bicycling and diabetes prevalence because there are few older, walkable areas to compare with newer, less walkable areas. Although the generally suburban built environment characteristics in Peel may have a moderate influence on levels of walking/bicycling, this association may be masked by the stronger associations between diabetes and socioeconomic status, ethnic composition and patterns of immigration in the region (for more information, see Chapters 3 and 4).

Nonetheless, the relevance of the built environment to the low levels of walking/bicycling and increasing rates of obesity and diabetes in Peel should not be discounted based on these findings. Obesity and diabetes have multiple and complex causes that are a mix of genetic predisposition and a much broader array of environmental factors than those considered here. Future studies should compare more detailed aspects of the built environment (including measures of aesthetics and physical barriers to walking/cycling) with levels of physical activity, obesity and diabetes over a larger geographic area with a greater variability in walkable and non-walkable characteristics of the built environment. Traffic speed, road noise and noise walls, poor sidewalk maintenance, the presence of large parking lots and a lack of street trees – things that could not be measured in this atlas – could be researched to determine if they limit the appeal of walking and bicycling in many areas of Peel.

Some built environment characteristics are more modifiable than others. Street connectivity, for example, is modifiable only through major redevelopment projects in existing built-up areas. However, there are many undeveloped areas on the periphery of Brampton and in parts of Caledon. Northeast Brampton, in particular, is a rapidly developing area that had a large influx of new residents (including many recent immigrants) between 2001 and 2006 (see chapters 1 and 4), with more growth planned for the future. This area has limited access to walkable destinations, high rates of diabetes and extremely low rates of walking/bicycling trips (both compared with other areas in Peel and the GTA). Planners and policy makers should pay particular attention to the planning of new communities in this and other undeveloped areas of Peel to ensure that walkable, mixed-use community designs are implemented at an early stage in the planning process. Through introduction of the Growth Plan for the Greater Golden Horseshoe, 2006, (Growth Plan) and revisions to the Provincial Policy Statement, 2005, the Ontario provincial government has recognized the negative health, transportation and economic impacts of sprawling, low density development and taken policy action accordingly. While municipal conformance with the Growth Plan may not be sufficient to curb sprawl, these provincial goals and policies should be taken as a baseline upon which planners can improve in order to promote compact, sustainable development that accommodates growth and facilitates healthy lifestyles.

In areas that are mostly built-up, such as in most of Mississauga and central Brampton, planners and policy makers can still make changes to improve walkability. These modifications can include: increasing residential and commercial densities through development of brownfield (abandoned or underused industrial or com-

mercial) sites and parking lots; encouraging mixed-use development through re-zoning; and improving the safety and aesthetics of the streetscape to make walking more attractive to pedestrians. Policy changes designed to increase the number and accessibility of local services, enhance public transit and create a connected network of dedicated bicycle lanes could also reduce people's dependence on cars. Bylaw and regulation changes that reduce the number of required parking spaces in residential and commercial developments, as well as modifications to parking pricing, might further decrease car ownership and encourage local residents to walk and/or cycle.

The social and cultural environment in which people live also needs to be considered when governments and communities plan strategies to promote active living within a given area. For instance, inadequate street lighting may deter residents – particularly those living in areas perceived to be high in crime – from walking to their destinations. A multi-faceted approach that focuses on both social and environmental barriers to walking and bicycling is likely needed in order to create more opportunities for active, healthy living and widespread changes in lifestyle among Peel residents.

APPENDIX 5.A – RESEARCH METHODOLOGY

Data Sources

- The land use categories presented in this chapter were derived from two data sources received from the Region of Peel: generalized land uses (2007) and Municipal Property Assessment Corporation (MPAC) land parcels (2010).
- The satellite image of Peel is from Landsat (2000).
- The density of dwellings included all residential dwellings within a given census tract in the 2006 Canadian Census. The area denominator was defined using generalized land use data (2007) and MPAC land parcels (2010) to exclude all industrial, undeveloped residential and large parks or conservation areas from analysis.
- The period of construction of the majority of dwellings was defined using data from the 2006 Canadian Census. Each census tract was assigned the period in which the majority of its residential dwellings were built compared with the number of dwellings built in that census tract during each other period.
- Major highways and roads, bicycles routes and multi-use trails were obtained from the Region of Peel (2010). Municipal bus routes for Brampton (2008) and Mississauga (2008), and regional GO Transit (2010) bus and train stations and routes were also obtained from the Region of Peel.
- The rates of average daily walking/bicycling, public transit and car trips were obtained from the Transportation Tomorrow Survey (TTS; 2006). This data primarily captures trips to/from work and/or school, and may underestimate trips made for errands or recreational purposes. The average number of vehicles per household, per cent of daily car trips as a driver, and per cent of daily car trips less than or equal to five kilometres in length was also obtained from the TTS (2006). The TTS is a household phone survey conducted across the Greater Toronto Area (GTA), and asks respondents questions about the trips they made on the weekday prior to the day they are surveyed. Additional information on the TTS can be found on their website: www.transportationtomorrow.on.ca/
- Walkable Destinations were defined to closely match LEED (Leadership in Energy and Environmental Design) for Neighbourhood Development's list of "Diverse Uses."[29] This list is comprised of a large variety of retail services and community facilities (for a list of specific destination types, see Analysis section below). Therefore, a variety of data sources were used to capture all types of destinations:

  - Locations of food destinations were obtained from food inspection data ("Premise Points," 2010) provided by the Region of Peel.
  - Locations of civic and community facilities and services were obtained from "Peel Landmarks" (2009) provided by the Region of Peel.
  - Locations of various additional retail and community services were obtained from Dunn & Bradstreet Selectory Business Database (2009).
  - Locations of places of worship were obtained from Municipal Property Assessment Corporation lot parcel data provided by the Region of Peel (2010).
  - Locations of parks and conservation areas were provided by the Region of Peel (2009).
- Road Networks from Corporate Services, Integrated Planning Division, Information and Intelligence, Region of Peel were used to evaluate walking routes from places of origin spaced at 150m intervals across Peel to locations of walkable destinations. Places of placement of origin was limited to the following generalized land uses obtained from the Region of Peel: residential, mixed-use, employment (includes commercial), settlement and institutional.
- Age- and sex-adjusted diabetes rates per 100 adults aged 20 years or older were calculated using the Ontario Diabetes Database and other administrative data sources held at the Institute for Clinical Evaluative Sciences (ICES) (for a detailed description of the data sources of diabetes rates, refer to Appendix 2.A in Chapter 2).

Definitions

- The term "built environment" commonly refers to the man-made or modified physical context in which people live, eat, are educated, work and play, and includes features like roads, sidewalks, buildings, parks, recreational and retail facilities.

Analysis

Thematic maps were created to display categories of land use, majority period of dwelling construction, locations of roads, highways and public transit routes, locations of bicycle routes and multi-use trails and locations of walkable destinations. On each of these maps, different symbols and colours were used to represent different categories of built environment characteristics. Landsat satellite imagery was also used to provide an alternate representation of locations of built-up and green space in Peel.

Choropleth (shaded) maps were produced to depict the density of residential dwellings and walkable destinations within Peel census tracts. Choropleth maps were also generated to display average daily trip rates for various transportation modes and other transportation variables from the Transportation Tomorrow Survey (TTS). Ranges for each category of a given variable depicted on these maps were determined using natural breaks in the data. A bivariate map depicting the spatial correspondence between car trips less than or equal to 5 km in length and the percentage of the population below Statistics Canada's Low Income Cut-Off (LICO; after-tax) was also created. On this map, transit data was depicted as a choropleth layer and percentage of the population below the LICO was depicted in three categories (population-weighted tertiles) using proportional circles. This was done so that the reader could observe whether there is a spatial correspondence between, for example, areas with higher percentages of their population below the LICO and higher percentages of car trips less than or equal to 5 km in length.

A list of walkable destinations was defined based on LEED for Neighbourhood Development's (LEED-ND) definition of Diverse Uses, shown in the table below.[29] The data were cleaned to remove any duplicate records and to ensure that a business, service or other destination would be listed only once (i.e., in one category only). Where multiple destinations of the same type existed at the same address, only the first destination of each type for that address was included, except for "other retail" for which the first two were in-

cluded. This criterion is similar to the way Diverse Uses are applied in LEED-ND. Geographic Information Systems (GIS) and network analysis were used to measure the shortest travel time along the road network (excluding highways and other non-walkable routes) from a grid of origin points spaced 150m apart to each walkable destination across Peel. A walking time of 1.2m/s was utilized in analyses.[33] The placement of origin points was limited to areas designated as residential, mixed-use, employment (includes commercial), settlement and institutional land uses. The number of destinations accessed within a 10 and 20 minute walk of each origin point was calculated and attributed to the point. A continuous (raster) surface was then interpolated from these points to depict the number of walkable destinations accessible within various walking times at locations across Peel.

Another type of map was created for two Transportation Tomorrow Survey (TTS) variables (average daily public transit trip rates and average daily car trip rates) and density of walkable destinations. This map highlights spatial correspondence between these variables and areas of Peel where diabetes rates were substantially higher or lower than the overall prevalence rate in the Greater Toronto Area (GTA) of 9.0%. Census tracts with diabetes rates at least 20% higher than the GTA rate (rate-ratio of ≥1.2) were depicted in shades of red according to the ranges of values of each TTS or walkable destinations comparator variable. Census tracts with rates at least 20% lower than the GTA rate (rate-ratio of ≤ 0.8) were depicted in shades of blue. All census tracts whose rates did not differ substantially from the GTA rate (rate-ratio between 0.81 and 1.19) were depicted using a single grey colour (for a more detailed explanation of how this type of map was created, see the Appendix to Chapter 3).

Major and minor categories of walkable destinations, based on LEED-ND Diverse Uses

Food Retail

Supermarket

Other food store with produce

Community-Serving Retail

Clothing store or department store selling clothes

Convenience store

Farmer's market

Hardware store

Pharmacy

Other retail

Services

Bank

Gym, health club, exercise studio

Hair care

Laundry, dry cleaner

Restaurant, café, diner (excluding solely drive-thru establishments)

Civic and Community Facilities

Adult or senior care (licensed)

Child care (licensed)

Community or recreation centre

Cultural arts facility (museum, performing arts)

Educational facility (including adult education and vocational schools)

Family entertainment venue (theatre, sports)

Government office that serves the public on-site

Place of worship

Medical clinic or office that treats patients

Police or fire station

Post office

Public library

Public park

Social services centre

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Chapter 6

Opportunities for PHYSICAL ACTIVITY & Diabetes

INSIDE

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HIGHLIGHTS

Issue

- Regular physical activity is essential for the prevention and management of diabetes. Despite decades of public campaigns to promote physical activity, levels of activity in the Canadian population remain low.
- Researchers and planners recently began to direct attention to the role that neighbourhood opportunities, such as parks and recreation centres, play in fostering physical activity.
- The purpose of this chapter is to examine the distribution of and access to parks, schools and recreation facilities across Peel. This chapter also presents levels of leisure-time physical activity undertaken for recreation or exercise purposes, and associated prevalence rates of diabetes.

Key Findings

- Access to parks and schools was generally good and similar across residential areas in Peel. However, the density of park area varied significantly. In many areas of Mississauga and central Brampton, residents had relatively little park area per capita (compared with the rest of Peel) and were far from a larger park space. This may be due, in part, to a shift in design from smaller neighbourhood parks to fewer, larger "destination" park facilities.
- Public recreation facilities were much less evenly distributed. Because many facilities were clustered in certain locations, local residents had very good access to a number of different facilities, while many more residents of other areas were far from any recreation facility.
- There was no clear spatial correspondence between access to parks, schools and recreation facilities, and rates of diabetes or physical activity.
- About half of Peel residents were at least moderately physically active during their leisure time. Levels of physical activity were highest in parts of Mississauga and Caledon; they were lowest among residents of east Caledon, Brampton and central and northeast Mississauga.
- Levels of physical activity were related to rates of diabetes. Areas of lowest physical activity generally had the highest rates of diabetes and many areas with higher levels of physical activity had lower rates of diabetes.

Implications

- In Peel, levels of physical activity were generally unrelated to how close residents lived to physical activity resources. This implies that good spatial access to recreation resources may not be enough to encourage local residents to be more physically active.
- Creative initiatives to increase levels of physical activity will be very important given the relatively low levels of activity in the general population and a high proportion of residents at high risk of diabetes due to their ethnic background. Even small increases in daily levels of activity can play a large role in decreasing the risk of type 2 diabetes, particularly among high-risk individuals.

- Given the rapidly growing population in Peel and rising rates of diabetes, it is essential that various levels of government, urban planners and health officials work together to create ample opportunities to support and encourage higher levels of daily physical activity among Peel residents.
- The health needs and the ethnocultural preferences of local population subgroups, as well as the existing availability of appropriate resources, should be considered when policies and programs that support healthy living are created.

INTRODUCTION

Physical Activity and Health

Physical activity plays an essential role in preventing many chronic diseases, particularly cardiovascular disease, type 2 diabetes and some cancers.[1] As many as one in five diagnoses of type 2 diabetes in Canada may be due to inadequate levels of physical activity.[2]

Most people know that physical activity helps to maintain a healthy body weight. Maintaining a healthy body weight, in turn, helps to prevent the development of chronic diseases. It is also important to know that being physically active has an independent effect on health – for two people of the same body weight, the more physically active person will have a lower risk of disease than the person who is less physically active.[3, 4]

The term physical activity encompasses a variety of activities that people undertake either for utilitarian purposes (i.e., physical activity that occurs at home, at work or during travel, such as walking to get somewhere) or for recreation or exercise purposes during leisure time (e.g., playing basketball or jogging). For most people, the majority of their daily activities fall into the first category.

How physically active are Canadians?

New international and Canadian physical activity guidelines recommend that adults should accumulate at least 150 minutes of moderate- to vigorous-intensity physical activity a week, in bouts of 10 minutes or more, in order to achieve health benefits.[5] Most Canadians do not achieve sufficient levels of activity despite decades-long efforts to promote physical activity in the general population with mass educational campaigns like ParticipACTION. In 2007–09, only 15% of adults reached the recommended level of activity.[6] Men were consistently more active than women and levels of physical activity declined with advancing age and increasing body weight. Most indicators of fitness, including flexibility and muscle strength, declined between 1981 and 2007–09, particularly among young adults aged 20 to 39.[7]

For children and youth, regular physical activity is essential for healthy growth and development – the more active a young person, the greater the health benefits. Canadian guidelines recommend that children and youth (between five and 17 years of age) accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity every day.[5] In 2007–09, only 7% of children and youth attained these recommended levels of physical activity.[8] Boys were more active than girls, with 9% of boys and only 4% of girls achieving the recommended levels of activity.

Physical activity and diabetes

Inadequate levels of physical activity can cause decreased sensitivity to insulin and glucose intolerance – both of which are important factors in the development and control of diabetes.[9, 10] In individuals at high risk for type 2 diabetes (i.e., those with impaired glucose tolerance or prediabetes), even small increases in levels of physical activity have the potential to significantly slow down or prevent the progression to type 2 diabetes.[9, 11] Participation in regular physical activity and changes in diet play essential roles in reducing the occurrence of type 2 diabetes in high-risk groups by as much as 60%.[12]

For individuals living with diabetes, regular physical activity, diet and medication play key roles in optimally managing this condition and preventing complications. Regular physical activity helps to reduce the risk of cardiovascular disease, other complications and premature death

among those living with diabetes.[10, 13] As a result, Clinical Practice Guidelines published by the Canadian Diabetes Association recommend that adults with diabetes undertake regular aerobic activity (i.e., at least 150 minutes of moderate- to vigorous-intensity activity, such as brisk walking or jogging, a week), as well as resistance training exercises three times a week.[10]

The amount of time devoted to sedentary behaviours like sitting for long periods or watching television – independent of a person's levels of physical activity and diet – can directly increase the risk of obesity, type 2 diabetes and premature death.[4, 14, 15] These findings are of great concern given that in 2007–09, most Canadian adults and young people spent the majority of their waking hours in sedentary activities.[6, 8] To address these troubling trends, Canadian experts recently developed a separate set of guidelines specific to sedentary behaviour for children and youth.[16] These guidelines recommend that children and youth limit not only the amount of leisure time they spend in front of a screen to no more than two hours a day, but also the time they spend sitting in cars and indoors throughout the day (sedentary behaviour guidelines for Canadian adults are not currently available).

Physical Activity and the Environment

Levels of physical activity depend not only on an individual's propensity to be active, but also on the surrounding physical environment. For example, living in suburban communities has been associated with a greater reliance on cars, lower levels of walking and higher levels of overweight/obesity compared with living in compact cities.[17-19] (for a detailed discussion about features of neighbourhood design related to walking and bicycling for transportation, see Chapter 5). In addition to urban design features like the presence of sidewalks and nearby shops and services, good access to parks and recreation centres close to home also plays a role in determining the duration and frequency of physical activity.[20-22] For instance, adults who lived near more parks within one kilometre of their home in Waterloo, Ontario were more likely to meet physical activity recommendations by walking, bicycling or engaging in other types of physical activity in nearby parks or elsewhere in the neighbourhood.[23] Each additional hectare of parkland near home was also related to higher levels of moderate-to-strenuous physical activity undertaken within a nearby park.

Better access to neighbourhood opportunities for physical activity is often related to higher levels of activity among local residents, but these associations are not always consistent. Rather, activity patterns vary by type of neighbourhood amenity, how researchers measure access and by type of physical activity. Outdoor spaces, including trails, open spaces, golf courses and natural settings (e.g., beaches), are more strongly related to levels of various types of physical activity (i.e., leisure-time or utilitarian) among local residents than indoor settings such as recreation centres and exercise and sports facilities.[21] Proximity seems to play a more consistent role; living closer to parks and various recreation settings was associated with increased levels of various types of physical activity. Good access to parks and recreation settings is more commonly related to physical activity for exercise and utilitarian purposes – most commonly, walking – rather than for recreation.[22]

Neighbourhood amenities may also play a role in how active children and youth are. Children were more active if parents felt they had good access to recreation facilities and spaces within their neighbourhood.[24-26] For example, children living in Nova Scotia neighbourhoods with better access to playgrounds, parks and recreation facilities were more engaged in structured sports activities, had less television and video game time, and healthier body weights.[25] In London, Ontario, youth aged 11 to 13 living near more public recreation opportunities such as swimming pools, parks, recreation centres and bike paths were more physically active than youth whose neighbourhoods contained fewer of such amenities.[26]

Diabetes and the Environment

Investigation of links between the physical environment and diabetes is a relatively new area of study. In three different areas of the United States (U.S.), adults who lived in neighbourhoods with better access to opportunities for physical activity – such as parks and trails – were less likely to have insulin resistance than residents of areas less friendly to physical activity.[27] The fact that adults who lived in the more activity-friendly areas were more physically active accounted for some of this association. Adults who lived in neighbourhoods with better resources for physical activity and healthy eating were less likely to develop type 2 diabetes during a five-year period compared with those who lived in neighbourhoods with worse access to such resources.[28]

Neighbourhoods that make it easy for residents to be physically active on a daily basis are also important for people living with diabetes. Adults living with type 2 diabetes in Alberta who felt that their neighbourhoods were more "walkable" (e.g., with many shops and low-cost recreation facilities within a 10- to 15-minute walk from home) were more likely to achieve the recommended levels of physical activity by walking more frequently to get to and from places.[29]

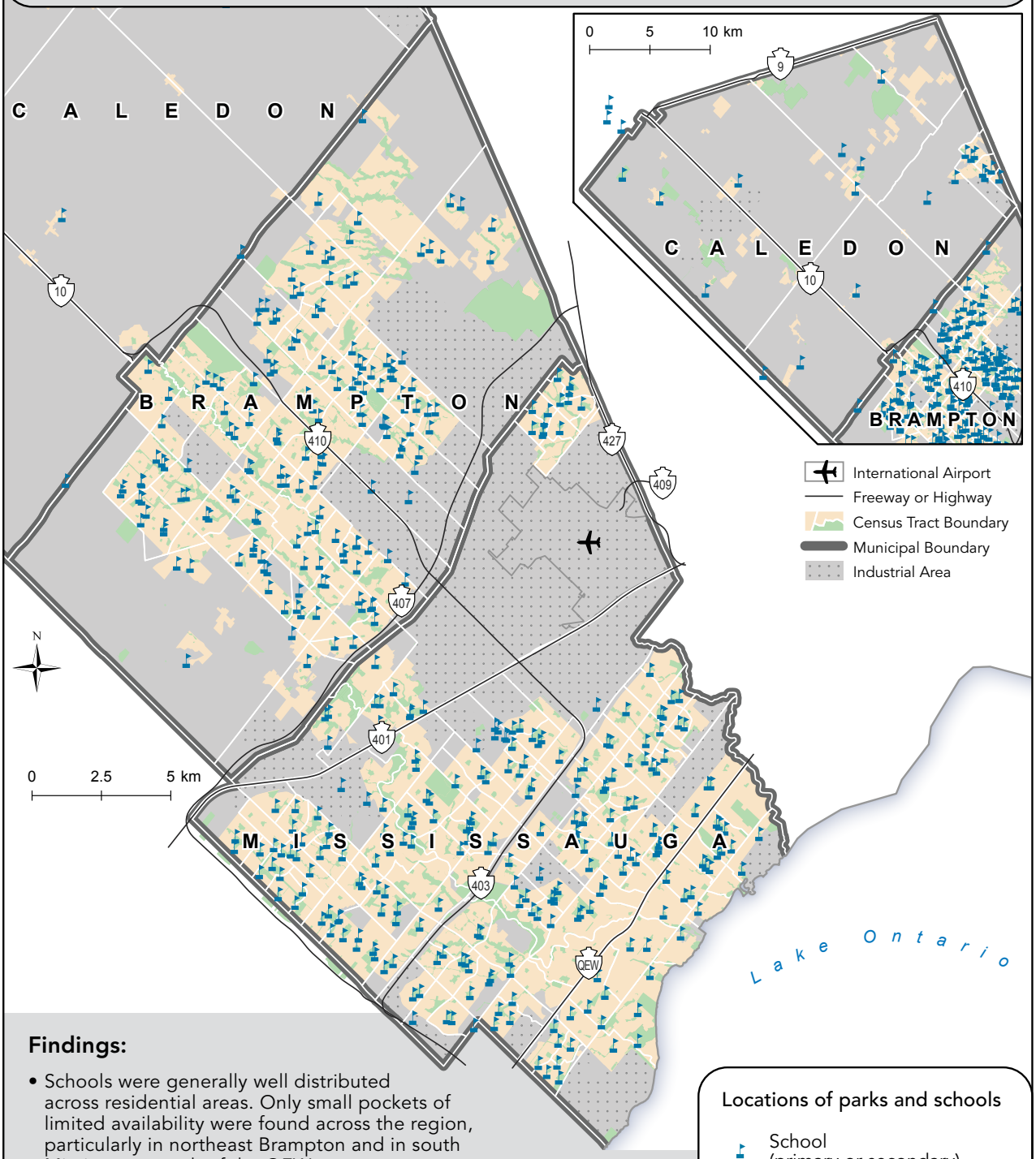
In this chapter, geographic access to several opportunities for physical activity across Peel is examined. Easy access to physical activity

or resources is important because it may encourage local residents to use these resources more frequently, as well as use active means of transportation (i.e., walking or bicycling) to reach these venues. Rates of physical activity undertaken for leisure (i.e., for recreation or exercise purposes, and not related to work) and the prevalence of diabetes are examined. In this chapter, a measure of physical activity derived from the Canadian Community Health Survey, which asked respondents about their participation in various leisure-time activities such as walking for exercise, gardening or yard work, bicycling, playing basketball, or jogging or running, was used. Because the survey question involved the respondents' own interpretation of what consitututes leisure time, some people's responses may have included some amount of active transportation, such as walking or bicycling to get to and from places. Unfortunately, in these analyses, a separate measure of levels of utilitarian physical activity (including active transportation) among Peel residents was not available (see Chapter 5 for average walking and bicycling trips in Peel, which are proxy measures of active transportation). Finally, the specific resources for physical activity under study in this chapter include schools, parks and public recreation facilities such as community recreation centres and sports arenas. While not every resource is suitable for all local residents, together they constitute an important source of indoor and outdoor opportunities for physical activity for communities.

LIST OF EXHIBITS

EXHIBITS AND FINDINGS

Exhibit 6.1. Locations of parks [2009] and schools [2009] in Peel region



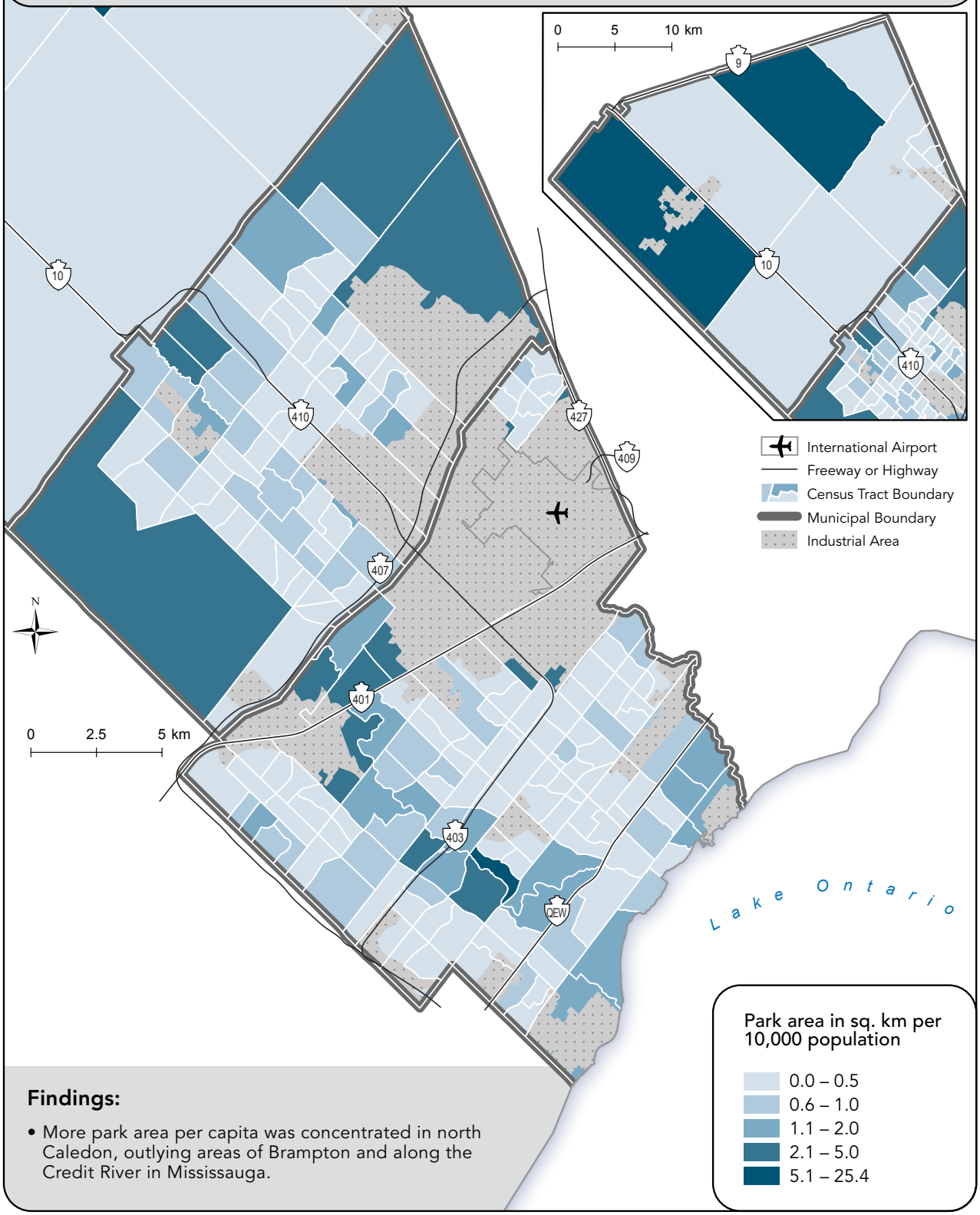
Findings:

- Schools were generally well distributed across residential areas. Only small pockets of limited availability were found across the region, particularly in northeast Brampton and in south Mississauga north of the QEW.
- Larger park areas were located in north Caledon, north and east Brampton, and central and west Mississauga (along the Credit River). Many smaller parks were scattered throughout the region.

Locations of parks and schools

- School (primary or secondary)
- Park or Recreational Area
- Residential Area
- Other Land Use

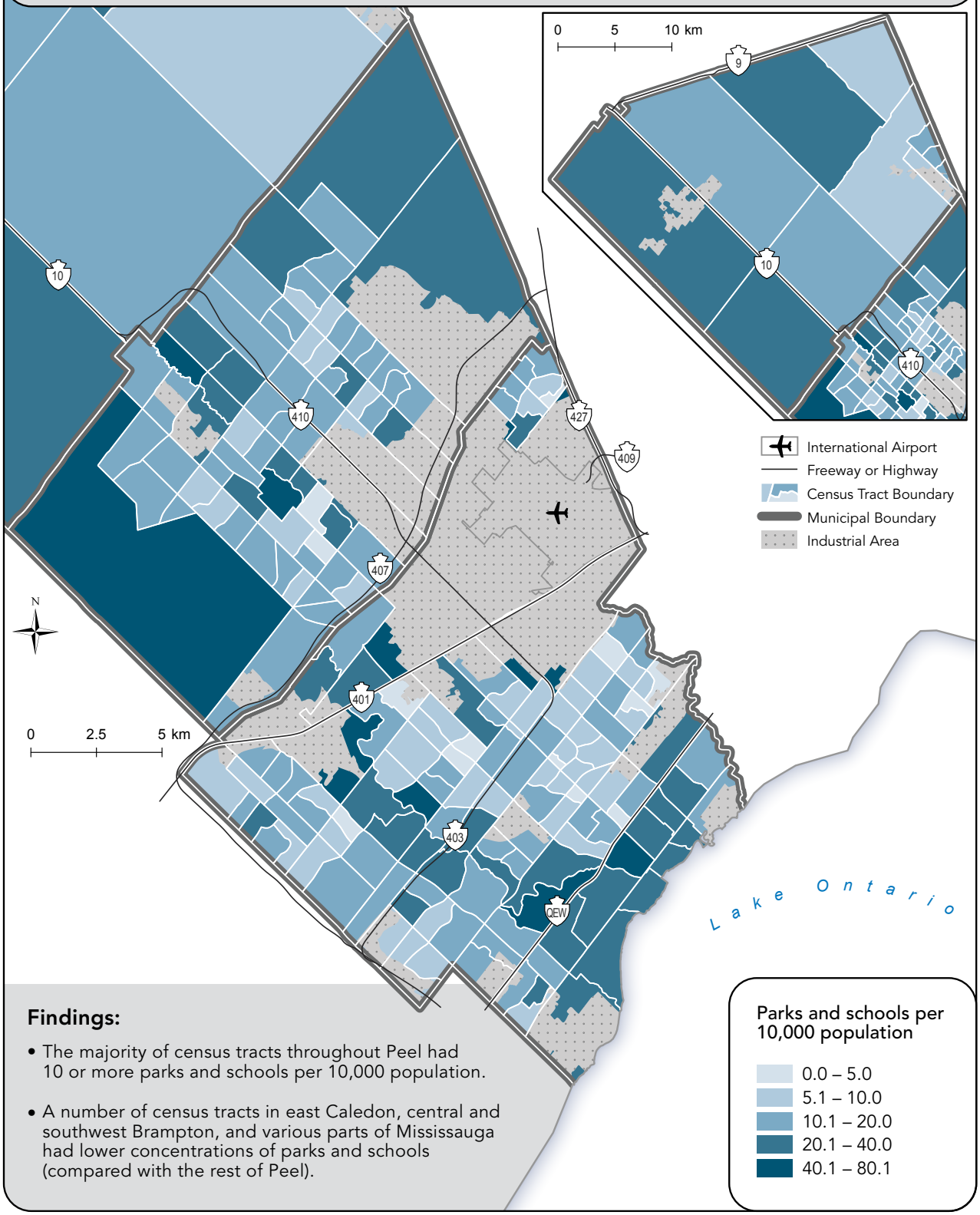
Exhibit 6.2. Park area in square kilometres (sq km) [2009] per 10,000 population [2006], by census tract [2006], in Peel region



Findings:

- More park area per capita was concentrated in north Caledon, outlying areas of Brampton and along the Credit River in Mississauga.

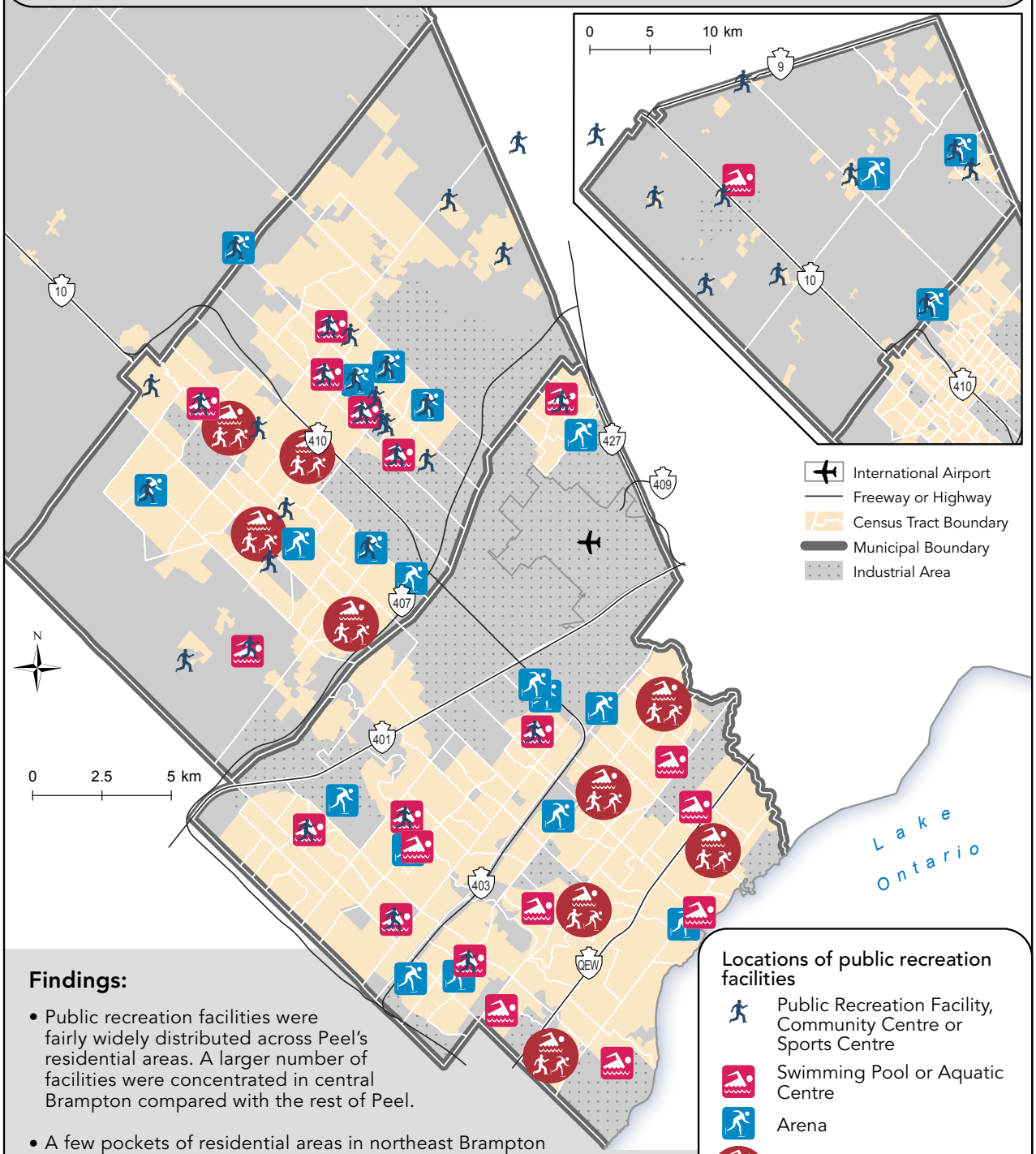
Exhibit 6.3. Parks [2009] and schools [2009] per 10,000 population [2006], by census tract [2006], in Peel region



Findings:

- The majority of census tracts throughout Peel had 10 or more parks and schools per 10,000 population.
- A number of census tracts in east Caledon, central and southwest Brampton, and various parts of Mississauga had lower concentrations of parks and schools (compared with the rest of Peel).

Exhibit 6.4. Locations of public recreation facilities [2010] in Peel region and adjacent areas*



Findings:

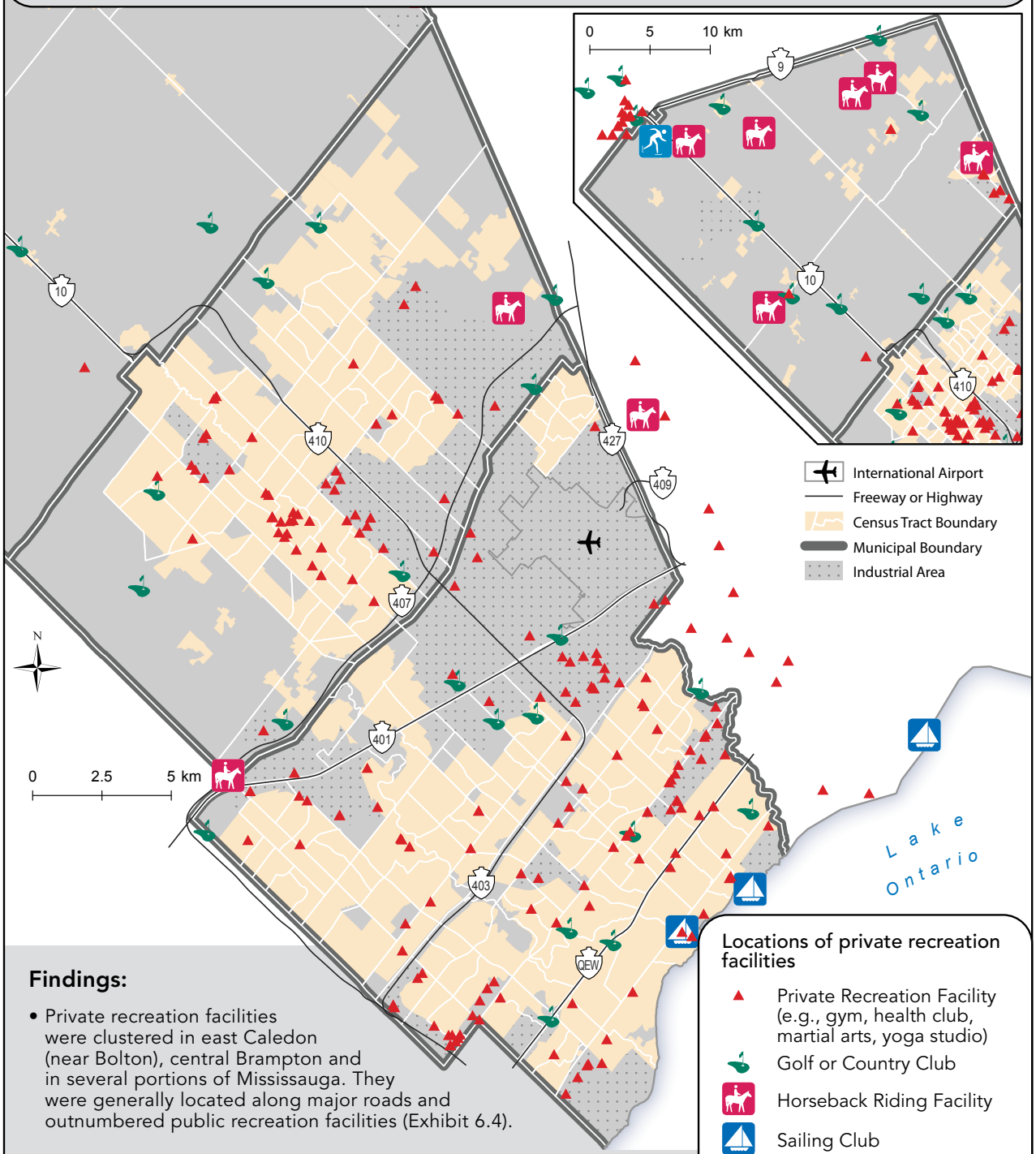
- Public recreation facilities were fairly widely distributed across Peel's residential areas. A larger number of facilities were concentrated in central Brampton compared with the rest of Peel.
- A few pockets of residential areas in northeast Brampton and in parts of Mississauga lacked a nearby public recreation facility.

* Some facilities in areas adjacent to Peel are not shown on this map to improve readability. These adjacent locations were included in the analyses shown in Exhibits 6.8 and 6.10.

Locations of public recreation facilities

- Public Recreation Facility, Community Centre or Sports Centre
- Swimming Pool or Aquatic Centre
- Arena
- Recreation/Community Centre, Pool and Arena
- Residential Area
- Other Land Use

Exhibit 6.5. Locations of private recreation facilities [2010] in Peel region and adjacent areas*

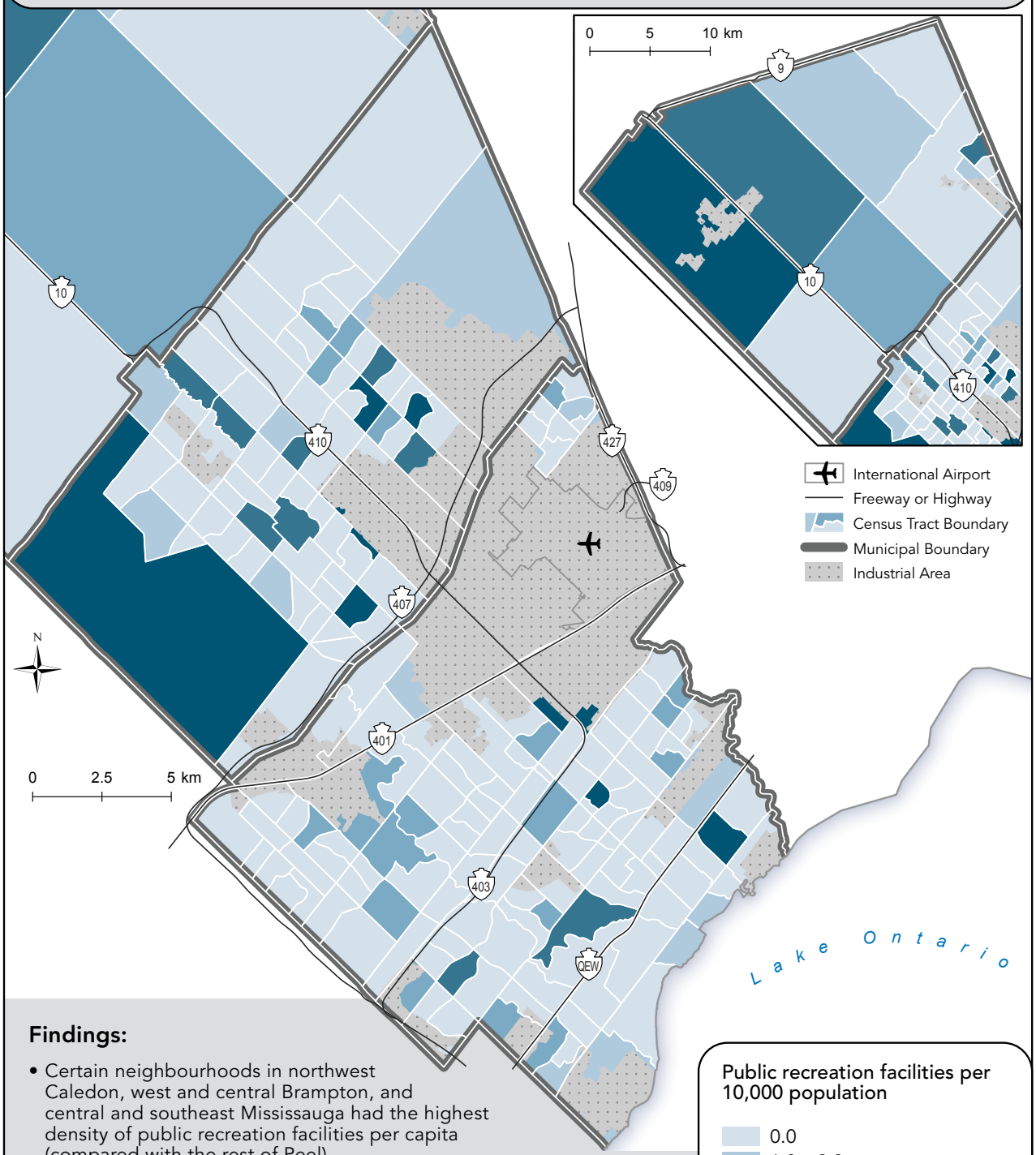


Findings:

- Private recreation facilities were clustered in east Caledon (near Bolton), central Brampton and in several portions of Mississauga. They were generally located along major roads and outnumbered public recreation facilities (Exhibit 6.4).
- In Brampton and Mississauga, many private recreation facilities were concentrated within or near industrial areas.

* Some facilities in areas adjacent to Peel are not shown on this map to improve readability.

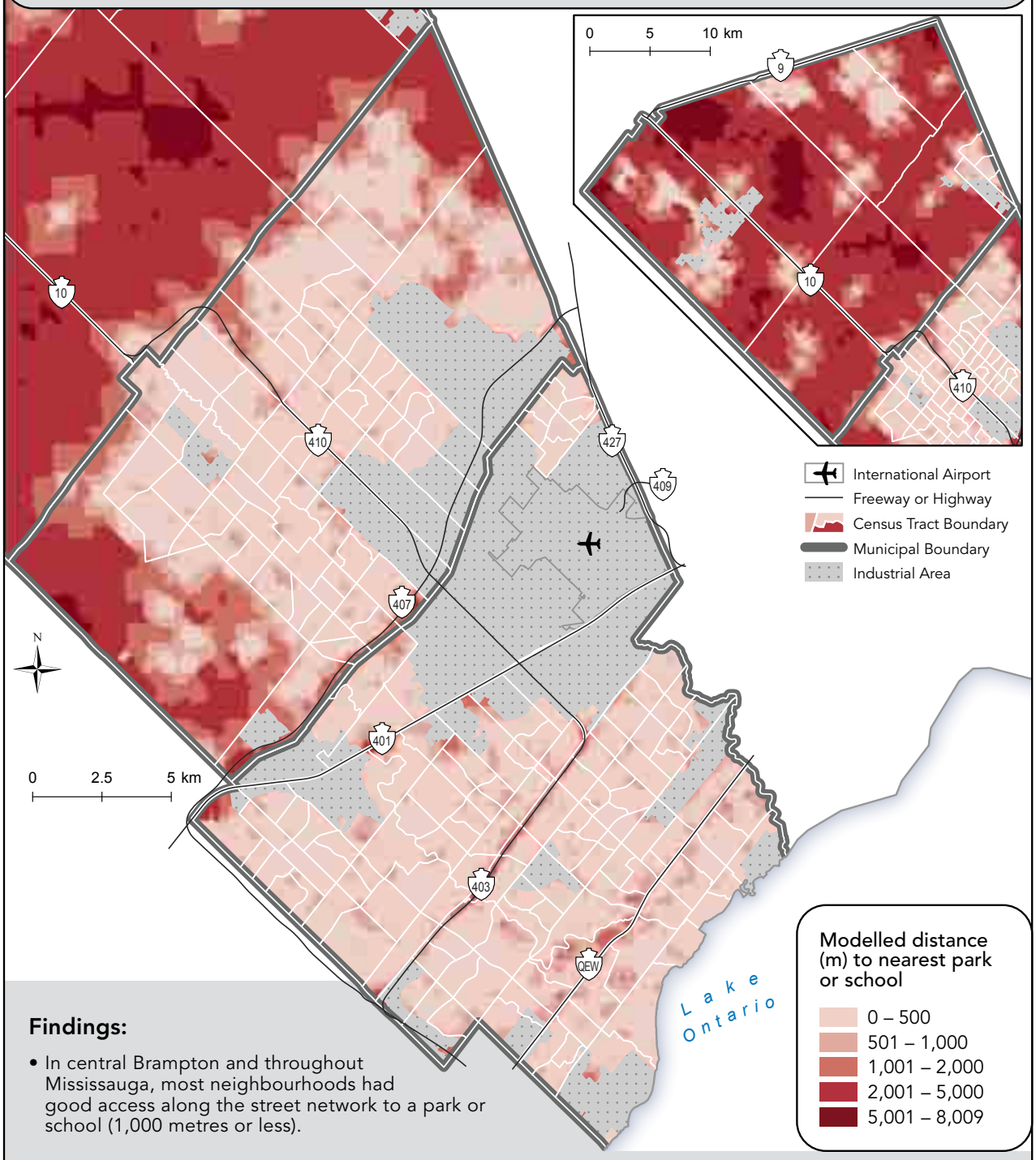
Exhibit 6.6. Public recreation facilities (including community centres, arenas and swimming pools) [2010] per 10,000 population [2006], by census tract [2006], in Peel region



Findings:

- Certain neighbourhoods in northwest Caledon, west and central Brampton, and central and southeast Mississauga had the highest density of public recreation facilities per capita (compared with the rest of Peel).
- A much larger number of census tracts throughout Peel had few or no facilities per capita. However, most of these areas had a relatively high density of parks and schools (Exhibit 6.3).

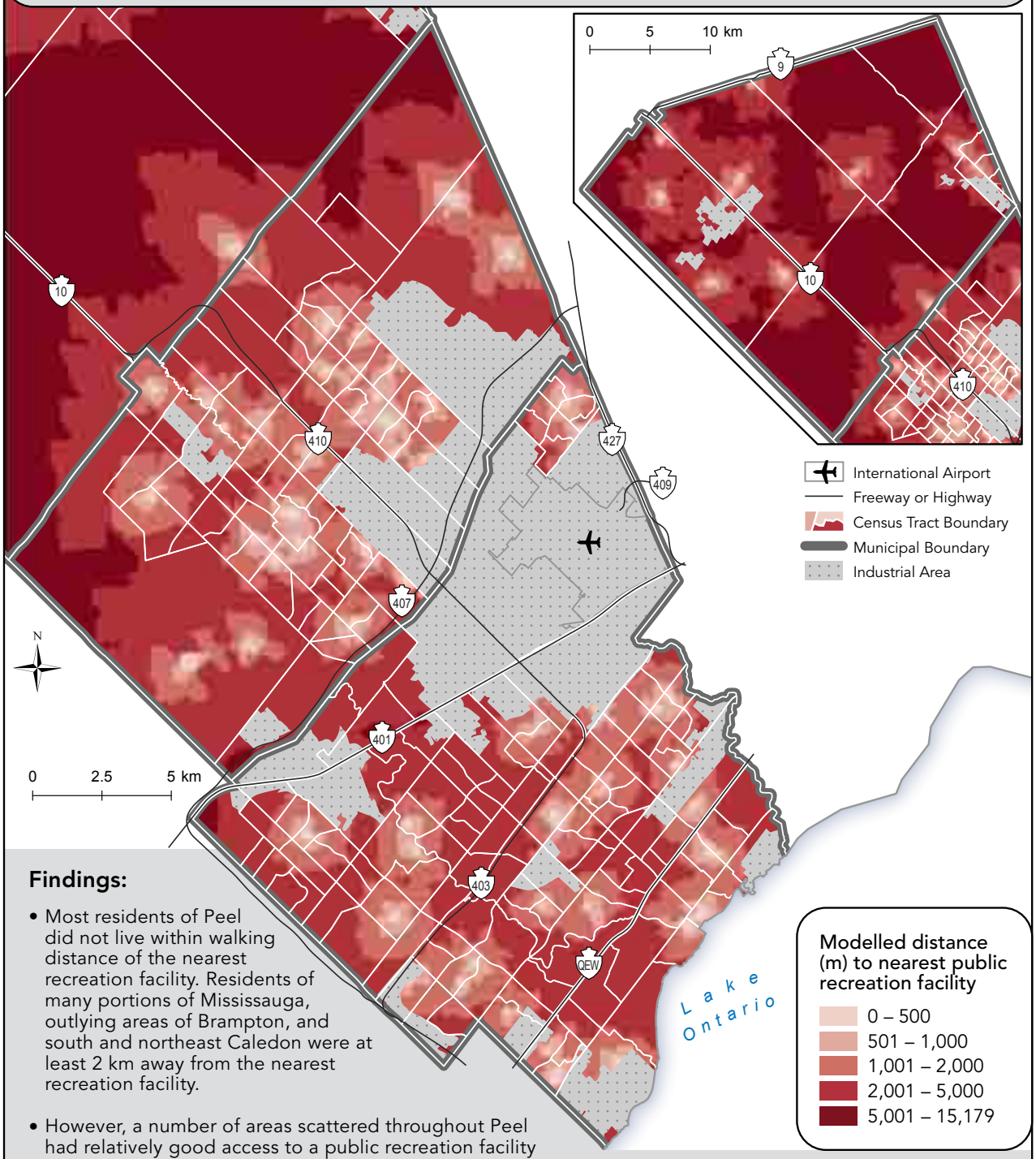
Exhibit 6.7. Modelled travel distance along the road network [2009] to the nearest location of a park [2009] or school [2009], in Peel region



Findings:

- In central Brampton and throughout Mississauga, most neighbourhoods had good access along the street network to a park or school (1,000 metres or less).
- Distance to the nearest park or school appeared to be longer (2 km or more) in most areas of Caledon, outlying areas of Brampton and in some parts of Mississauga (particularly along the major highways). However, most of these areas were non-residential (e.g., rural, undeveloped or commercial areas).

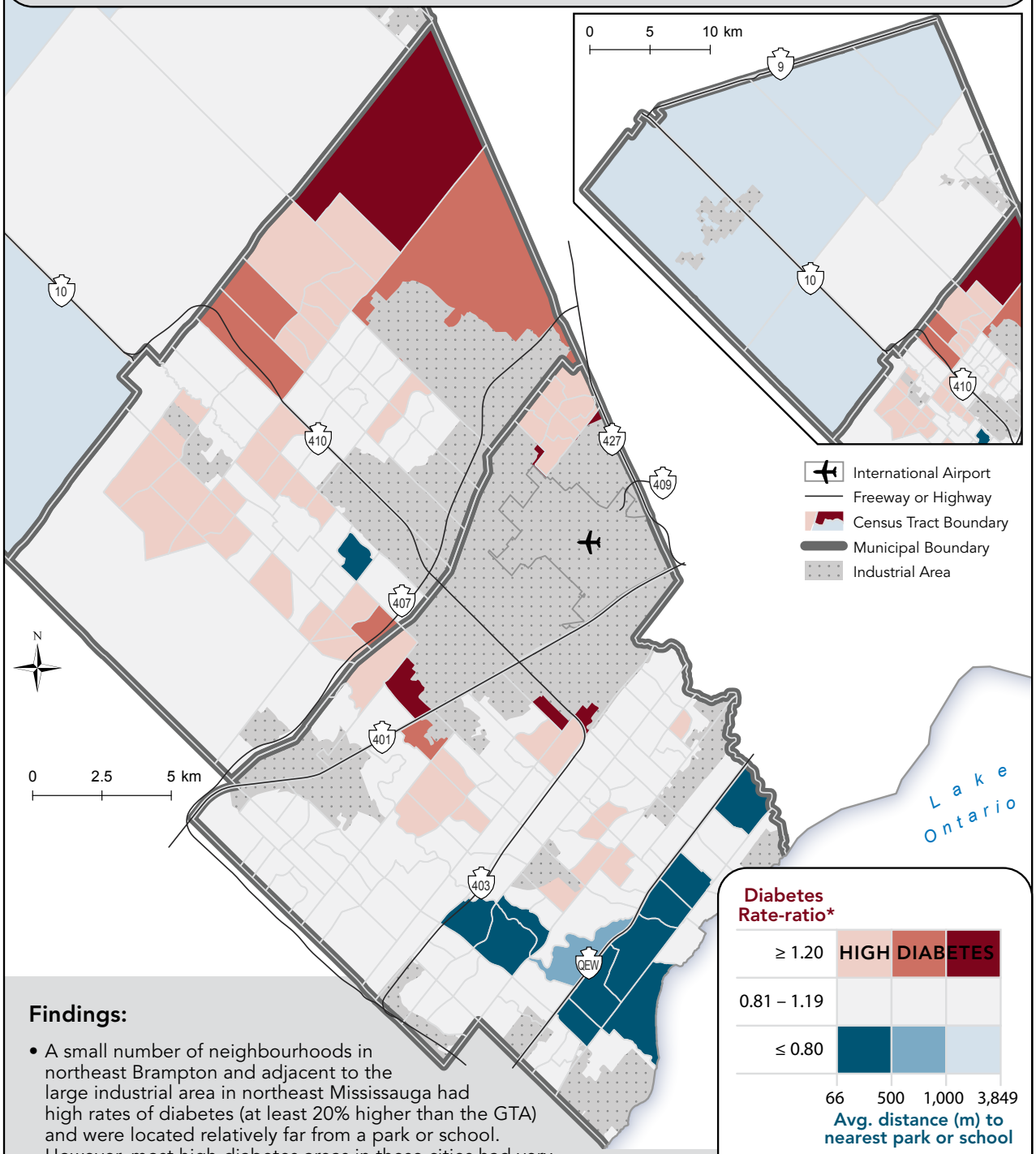
Exhibit 6.8. Modelled travel distance along the road network [2009] to the nearest location of a public recreation facility (including community centres, arenas and swimming pools) [2010], in Peel region



Findings:

- Most residents of Peel did not live within walking distance of the nearest recreation facility. Residents of many portions of Mississauga, outlying areas of Brampton, and south and northeast Caledon were at least 2 km away from the nearest recreation facility.
- However, a number of areas scattered throughout Peel had relatively good access to a public recreation facility (within 1,000 metres or less).
- Access to recreation facilities was poorer than access to parks and schools, particularly in Mississauga and in southwest and northeast Caledon (Exhibit 6.7).

Exhibit 6.9. Spatial relationship between the average road network distance to the nearest park [2009] or school [2009] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

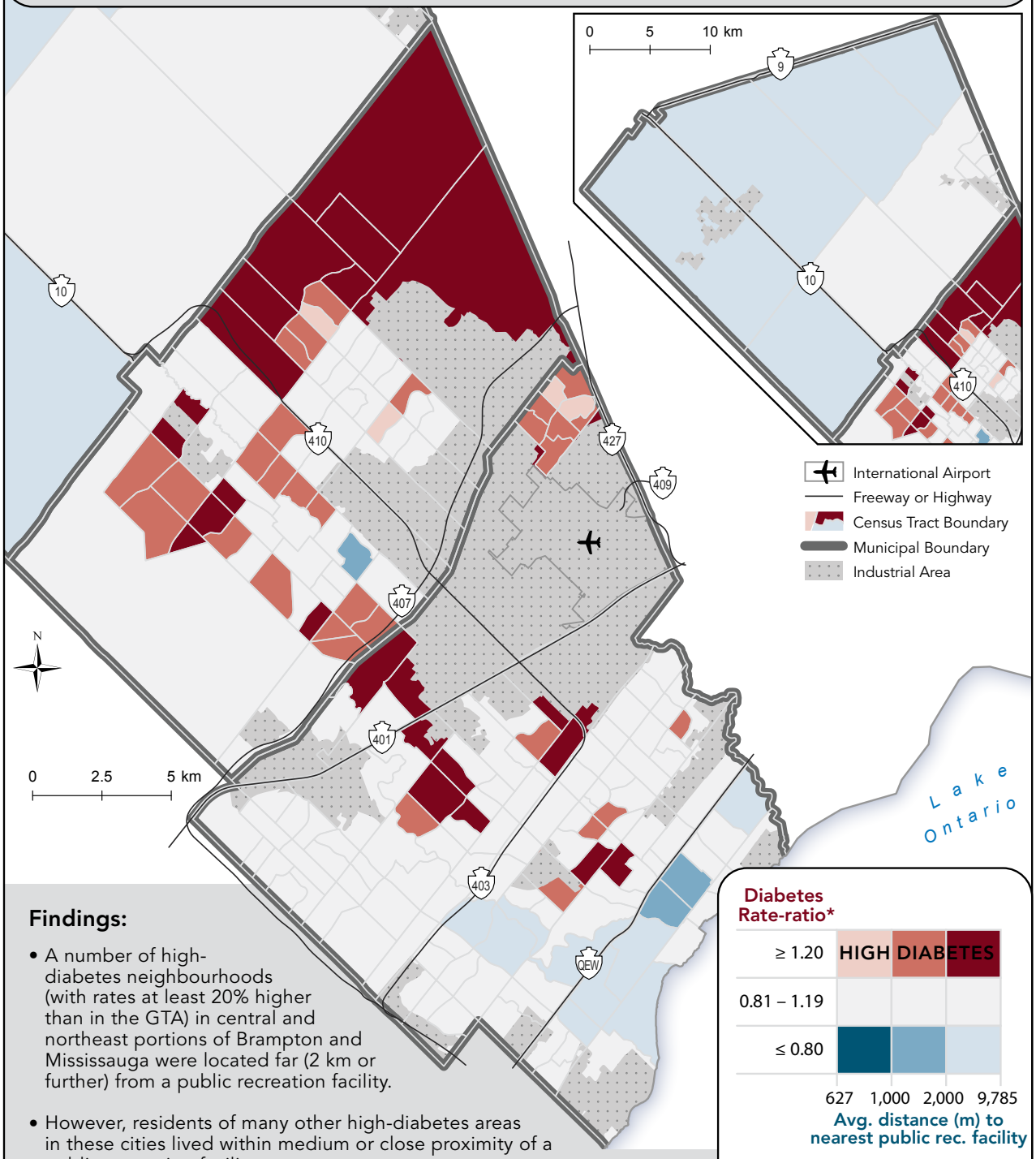
- A small number of neighbourhoods in northeast Brampton and adjacent to the large industrial area in northeast Mississauga had high rates of diabetes (at least 20% higher than the GTA) and were located relatively far from a park or school. However, most high-diabetes areas in these cities had very good access to parks and schools.
- In south Mississauga, several adjacent areas with lower rates of diabetes (at least 20% below the GTA) had very good access to the nearest park or school.

*Rate-ratio calculated as:

$$\frac{\text{census tract rate for pop. aged 20+}}{\text{GTA rate for pop. aged 20+}}$$

Overall Greater Toronto Area (GTA) diabetes rate: 9.0%

Exhibit 6.10. Spatial relationship between the average road network distance to the nearest public recreation facility [2010] and age- and sex-standardized diabetes prevalence ratio-ratios* [2007], by census tract [2006], in Peel region



Findings:

- A number of high-diabetes neighbourhoods (with rates at least 20% higher than in the GTA) in central and northeast portions of Brampton and Mississauga were located far (2 km or further) from a public recreation facility.
- However, residents of many other high-diabetes areas in these cities lived within medium or close proximity of a public recreation facility.
- Some areas in north and west Caledon and in south Mississauga had both lower rates of diabetes (at least 20% below the GTA) and long distances to the nearest recreation facility.

Diabetes Rate-ratio*

≥ 1.20	HIGH DIABETES
0.81 – 1.19	
≤ 0.80	

627 1,000 2,000 9,785

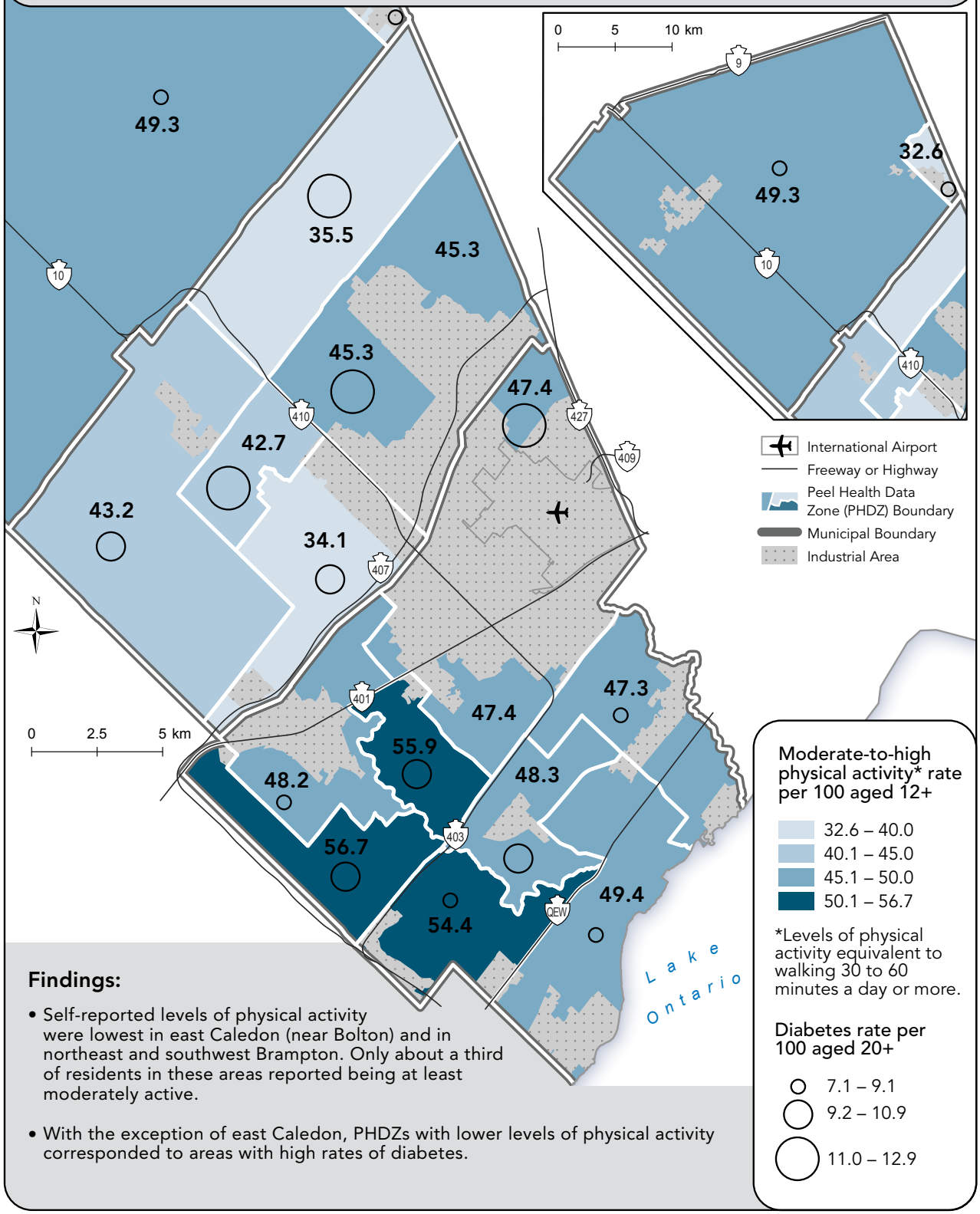
Avg. distance (m) to nearest public rec. facility

*Rate-ratio calculated as:

$$\frac{\text{census tract rate for pop. aged 20+}}{\text{GTA rate for pop. aged 20+}}$$

Overall Greater Toronto Area (GTA) diabetes rate: 9.0%

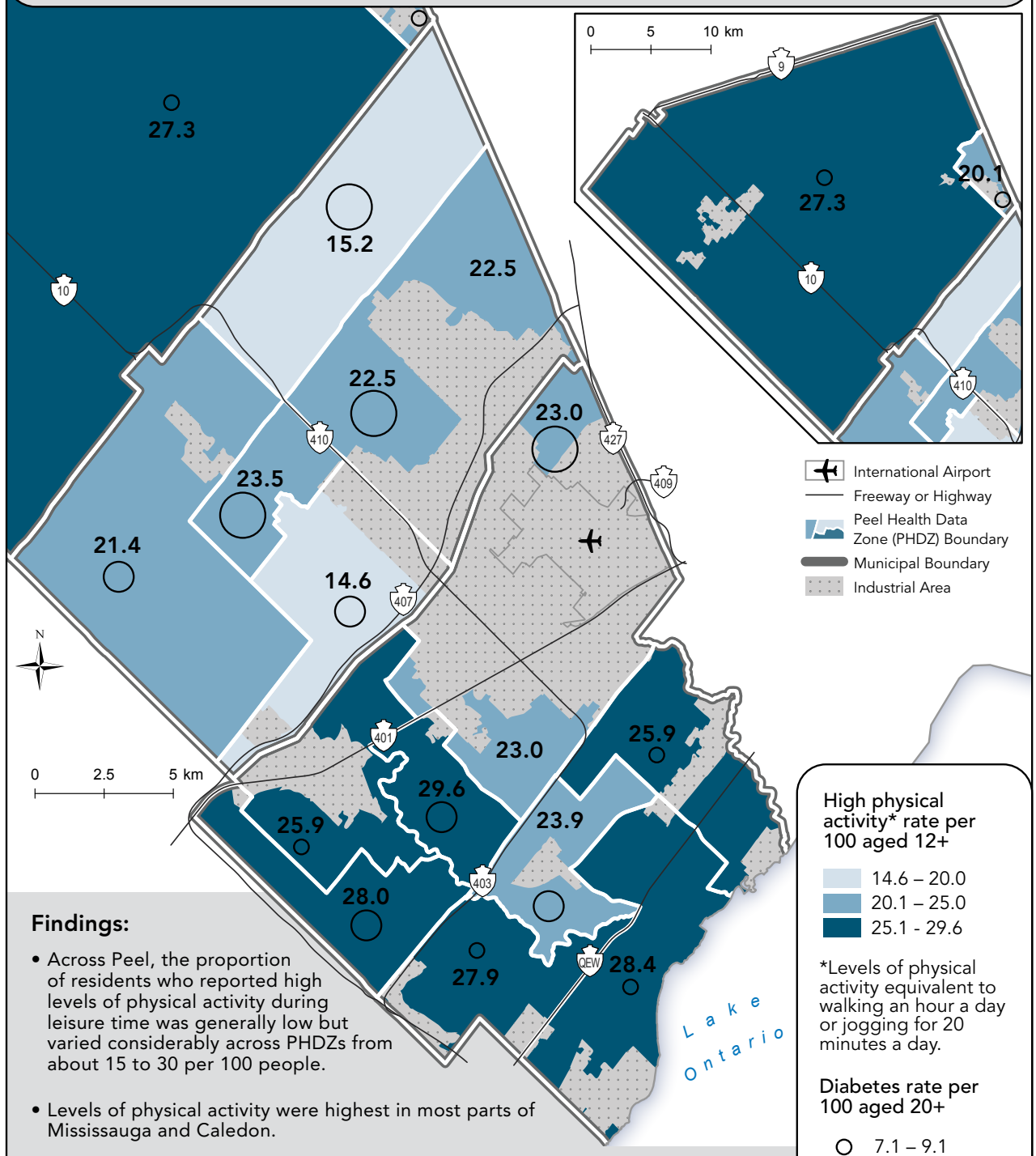
Exhibit 6.11. Age- and sex-standardized rate of moderate-to-high physical activity* in leisure time per 100 people aged 12+ [2003–08] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by Peel Health Data Zone (PHDZ) [2006], in Peel region



Findings:

- Self-reported levels of physical activity were lowest in east Caledon (near Bolton) and in northeast and southwest Brampton. Only about a third of residents in these areas reported being at least moderately active.
- With the exception of east Caledon, PHDZs with lower levels of physical activity corresponded to areas with high rates of diabetes.

Exhibit 6.12. Age- and sex-standardized rate of high physical activity* in leisure time per 100 people aged 12+ [2003–08] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by Peel Health Data Zone (PHDZ) [2006], in Peel region



Findings:

- Across Peel, the proportion of residents who reported high levels of physical activity during leisure time was generally low but varied considerably across PHDZs from about 15 to 30 per 100 people.
- Levels of physical activity were highest in most parts of Mississauga and Caledon.
- Especially low activity rates were reported in Brampton (particularly in the southwest and northeast portions), in east Caledon, and in central and northeast Mississauga. Except for east Caledon, these regions corresponded to areas with high rates of diabetes.

DISCUSSION

Availability of Parks, Schools and Recreation Spaces

Parks and schools

Park systems (e.g., school parks, city parks and parkettes, conservation areas, provincial parks) are popular recreation destinations for Peel residents. They serve not only local residents, but also people who live outside the neighbourhood. Large parks often serve a different purpose from local, small green spaces located within communities.[30] Large parks are frequently the location for community-based fairs, picnics, walks, bicycle routes and sporting events. Smaller green spaces are typically used as children's playgrounds and for dog-walking.[30]

Since most schools have yards or playgrounds that are readily accessible to the general public, they can also serve as important local settings for residents to engage in light or vigorous physical activity.[30] Peel schools were distributed fairly evenly throughout the region with the great majority of schools located inside residential zones.

Parks and schools were fairly evenly distributed throughout residential areas in Peel. However, park area per capita varied significantly: a number of areas along the Credit River and in south Mississauga, in fringe areas of Brampton and in north Caledon had relatively ample park area per capita. However, in many other areas of Peel, particularly around Mississauga City Centre, in west, east and northeast Mississauga, and throughout central Brampton, residents had relatively little park area per capita compared with other areas of Peel. This may be due, in part, to a shift in urban design from smaller neighbourhood parks to fewer, larger "destination" park facilities. Nonetheless, the relatively low density of parks per capita in some areas of Peel is an important finding since people living in more densely populated neighbourhoods with little or no personal green space such as backyards or gardens (particularly residents of apartment buildings) may depend more on nearby parks for exercise and outdoor activity.

Park settings can include a variety of features such as paved trails, bicycle paths, open green space and play structures. In Ontario, park size and the number of park features were among the strongest predictors of adults using a park for physical activity.[23, 31] Since smaller parks tend to lack a variety of facilities (e.g., trails, wooded areas), residents of central Brampton and Mississauga who live far from larger park areas may lack access to public outdoor settings that most strongly support a variety of physical activities (e.g., walking, running or bicycling along park trails). Unfortunately, no data on park features and amenities in Peel were available for analysis.

Public and private recreation facilities

Public recreation facilities play an important and distinct role in supporting physical activity and provide important settings for residents to participate in organized sports.[30] Private facilities (i.e., those not operated by local municipalities) may not be financially accessible to all members of the general public; nonetheless, they serve as important and popular settings for individuals and families to take part in a variety of physical activities. Both private and public indoor facilities are particularly important locations for people to exercise and play sports comfortably during the winter months.[30]

In these analyses, a variety of public recreation facilities, including community or sports centres, swimming pools and arenas, were examined. These facilities were widely distributed across Peel's residential areas with some clustering of facilities in several pockets of central Brampton and in parts of Mississauga. This clustering of facilities was reflected in the highly varied density of facilities per 10,000 population – while most census tracts in Peel contained no recreation facilities, a few census tracts in central and northwest Caledon, west and central Brampton, and southeast Mississauga had up to 10 different facilities per 10,000 residents. However, most areas lacking public recreation facilities had relatively good access to parks and schools, which for some residents may at least partially compensate for the lack of nearby indoor recreational spaces.

The locations of private recreational facilities, including gyms, health clubs, martial arts and yoga studios, hockey and soccer clubs, golf courses and horseback riding facilities, across Peel were also examined (for a more comprehensive list of facilities, please see Appendix 6.A). Many private facilities were located near public recreation facilities (e.g., in the Bolton area, within downtown Brampton and in south Mississauga) and along major roads. A number of private facilities were concentrated within or near non-residential areas (e.g., industrial or commercial areas).

Geographic Access to Parks, Schools and Public Recreation Facilities

Public access to the nearest park or school (measured using modelled travel distance along the road network) was generally very good throughout Peel's residential areas. In most residential areas, the nearest school or park was less than 500 metres away. This represents a range of distances that most people can walk in less than seven minutes. There are a small number of areas with somewhat worse access to the nearest park or school (within 1,000 m or further), particularly along Highway 403 and the QEW in Mississauga, and in outlying areas of Brampton. Despite the generally short distances to schools and parks across Peel, there was no information about which mode of transportation residents commonly use to access these resources (e.g., walking or driving). Because of the largely suburban, car-oriented layout of many Peel neighbourhoods (e.g., lack of sidewalks on both sides of the street; wide roads with high speed limits which create concerns about traffic safety for pedestrians), it is possible that many residents rely on cars or school buses to access nearby amenities.

Access to public recreation facilities followed a different pattern from access to parks and schools. Because of the much smaller number of such facilities in Peel compared with parks or schools, as well as their clustering in certain locations, only a fraction of residential areas had relatively good access to public recreation facilities (within 1,000 m or less, which corresponds to about a 14-minute walk or less). This means that the great majority of Peel residents lived two kilometres or further from the nearest public recreation facility (which represents about a 30-minute walk each way). This is a concerning finding because it represents a lack of public recreation facilities near where most people live. Long distances to recreation facilities may discourage residents from accessing such facilities by active transport or from accessing them at all.

Diabetes Rates and Geographic Access to Parks, Schools and Public Recreation Facilities

Many areas of Brampton and northeast and central Mississauga had high rates of diabetes among their residents (see Chapter 2). Many of these neighbourhoods had a high proportion of lower education, lower income and visible minority residents (see Chapters 3 and 4).

Proximity to parks and schools did not appear to have a strong association with patterns of diabetes prevalence. While a small number of census tracts (in northeast Brampton and adjacent to the airport in Mississauga) had worse access to parks and schools (at least 1,000 m away), the majority of areas with high rates of diabetes among their residents were located less than 500 m away from the nearest park or school. A number of areas in south Mississauga with lower rates of diabetes among their residents also had very good access to parks and schools.

Similar to parks and schools, there was no observed spatial concordance between geographic access to public recreation facilities and rates of diabetes. This may be due at least in part to a low level of variation in access to these facilities across Peel (i.e., most areas were located relatively far from a public recreation facility). With the

exception of four census tracts in Brampton and northeast Mississauga, the majority of high-diabetes areas were located relatively far from the nearest public recreation facility. In Brampton, most areas with high rates of diabetes among their residents were located at least 1,000 m away from a public recreation facility (at least a 14-minute walk each way), while many others were at least 2,000 m away (at least a 30-minute walk each way). In Mississauga, roughly half of all high-diabetes areas had moderately long travel distances (1,000 to 2,000 m) and half had even longer distances to these resources. Similarly, the majority of lower diabetes areas in Caledon and south Mississauga also had relatively long travel distances to the nearest public recreation facility. However, these lower diabetes areas are generally comprised of higher income populations that may be less dependent on local and lower cost public recreation facilities.

There are few public recreation facilities within walking distance of where most residents of Peel live. This means that most Peel residents probably need to drive a car to access a public recreation facility. Having such facilities within walking distance (along with other common destinations such as shops and services) may encourage routine physical activity for utilitarian purposes (e.g., walking to get to and from places).[22, 29] This is an important point because utilitarian activity is the most important source of physical activity in the general population. Additionally, living in close proximity of a

recreation facility may be especially important for providing a comfortable space to be physically active in a climate like Canada's with long, cold winters – particularly for families with young children and older people.

Physical Activity

About half of Peel residents reported being moderately-to-highly physically active during leisure time (equivalent to walking 30 to 60 minutes a day or more), and about a quarter reported high levels of activity (equivalent to jogging 20 minutes or walking an hour a day). These levels were very similar to both provincial and national averages.[32] Despite the overall similarity, there was a lot of variation in levels of activity across Peel Health Data Zones. The proportion of residents who were at least moderately or highly active was highest in west and south Mississauga, and in Caledon (except in east Caledon). Residents of Brampton and east Caledon (near Bolton) generally reported the lowest levels of physical activity in the region. Residents of northeast and central Mississauga also reported lower levels of physical activity. With the exception of east Caledon, these were the same areas that also had high rates of diabetes prevalence among their residents (9.6% or higher).

Although many health organizations recommend accumulating at least 150 minutes of moderate- to vigorous-intensity physical activity per week for optimal health benefits, there is growing evidence that even lower levels of activity provide important health benefits. Just 15 minutes of moderate-intensity activity a day (e.g., brisk walking) significantly reduced the risk of premature death in men and women of various ages, as well as in people at high risk for cardiovascular disease.[33] This is important for individuals who are currently inactive – increasing activity levels by a small amount is much more feasible than immediately achieving high levels of physical activity. This has important implications for developing programs and messages to increase levels of routine physical activity in the general population (e.g., to facilitate higher levels of daily walking or bicycling for transportation).

Separate rates of physical activity for men and women in Peel were not available. However, men (particularly younger and older men) are more likely to participate in leisure-time physical activities than women of similar age.[32] Other individual-level factors related to being less physically active include older age, lower socioeconomic status, being an immigrant and non-White ethnicity.[32, 34] An additional limitation of these analyses is the measurement of only one type of physical activity (i.e., physical activity during leisure time), which represents a portion of a person's total daily activity. While some people who are inactive during their leisure time may be sufficiently active during non-leisure hours (e.g., during work hours) to derive health benefits, most people who are inactive in their leisure time are also less active in other aspects of their lives.[32] Finally, there were no data on levels of sedentary activities (e.g., sitting for long periods). Sedentary activities increase the risk of chronic disease and premature death independent of a person's levels of physical activity.[4, 14, 15]

In contrast to the strong spatial correspondence between rates of physical activity and diabetes, there was no clear spatial relationship between access to parks, schools or public recreation facilities, and rates of physical activity. That is, rates of physical activity were not consistently lower in areas that had worse access to such physical activity resources, nor were activity rates consistently higher in areas with better access to these resources. This suggests that other factors besides spatial proximity to places to be physically active may be more important in shaping individuals' patterns of activity. Compared with Whites, all immigrant and ethnic minority groups (except Aboriginals) in Canada reported lower levels of overall physical activity and were less likely to participate in certain types of activities, including walking, endurance activities (e.g., jogging, swimming) and sports (e.g., basketball, ice hockey).[34] However, the same groups were more likely to participate in more conventional forms of exercise such as home-based exercise and aerobics classes.

Ethnocultural characteristics may also influence whether a person is aware that local recreation facilities exist and knows of the various programs/amenities they offer. Patients of South Asian background with coronary heart disease were much less aware of any facilities for physical activity near where they lived compared with White patients; they were also more likely to have diabetes.[35] Such results highlight the fact that geographic access to recreation spaces does not necessarily equal access as individuals perceive it. This is an inherent limitation of most measures of geographic access that readers must keep in mind when interpreting the results of these and similar analyses.

CONCLUSIONS AND IMPLICATIONS

Being physically active is critical for both preventing and managing diabetes. Limited access to places to be physically active can pose a real obstacle to achieving adequate levels of activity required to achieve health benefits. In this chapter, the availability of and access to various recreation resources across Peel, as well as rates of diabetes and leisure-time physical activity among Peel residents, were examined.

Parks and schools were generally well distributed across Peel's residential areas. Most residents lived within less than a 10-minute walk of the nearest park or school. In contrast, access to larger park spaces (which may support physical activity more strongly than smaller parks) and public recreation facilities was less even, with the majority of residents not living within walking distance of such a resource (which may hinder use). Land use patterns in Peel that separate residential areas from all other types of land uses may be responsible for some of these trends. In areas where access to recreation resources is poor, community programs and other initiatives to encourage people to be more active may be ineffective and insufficient if residents cannot easily access appropriate spaces and facilities.

The analyses in the atlas show no clear correspondence between access to public recreation spaces and rates of diabetes or physical activity. This may be due, at least in part, to a low level of variation in access to these facilities across Peel (i.e., most areas were located relatively far from a public recreation facility). These findings also highlight the fact that the existence of recreation resources in a neighbourhood does not ensure that residents will actually use these resources.[30] It is certainly not only the spatial proximity to a resource, but also the aesthetics, design and safety of recreation spaces, and cultural and social factors, that influence whether people will use a resource.[34-36] Thus, in areas where there is good access to parks and recreation facilities, health promoters should focus on increasing residents' awareness that these resources exist and on overcoming any social, environmental and cultural barriers to their use. Across Peel, population-wide efforts to increase residents' awareness of the importance of achieving optimal levels of physical activity for health will also continue to be very important.

Overall levels of leisure-time physical activity self-reported by Peel residents were very similar

to the provincial and national averages. However, activity levels varied considerably across the region: residents of east Caledon, Brampton and portions of central and northeast Mississauga reported the lowest levels of activity. This is of great concern because the majority of these areas are also home to a large proportion of residents belonging to ethnic groups that have a genetic predisposition to developing type 2 diabetes at a younger age and lower body weight (see Chapter 4 for a more detailed discussion of ethnicity in relation to diabetes).

Health promotion initiatives must consider ethnocultural factors when designing interventions to increase levels of physical activity among Peel residents, particularly for those at high risk of being physically inactive and of developing chronic disease. For example, programs designed to target specific ethnocultural or immigrant subgroups in Peel may include consultation with local residents to find out which types of physical activity these groups prefer.[34]

APPENDIX 6.A – RESEARCH METHODOLOGY

Data Sources

Parks, schools and recreation facilities

- Data on park locations and park areas in 2009 were obtained from the Region of Peel. The following categories of parks were included: school parks (including private schools), conservation areas, forest management areas, city parks and parkettes, and provincial parks. In these data, some parks were represented as multiple adjacent polygons. These adjacent polygons were aggregated and park boundaries were generalized to reduce the computational power required for analysis. In total, 1,134 parks ranging in size from 89 square metres to 4.6 square kilometres were included in these analyses.

- The Region of Peel supplied data on all public and other (e.g., Catholic) schools for 2009, which totaled 425. Four schools in these data were marked as closed and were thus removed, leaving 421 schools that were included in the analyses.
- The Region of Peel provided data on public recreation facilities in the region in 2010. These facilities included community centres, recreation centres, indoor and outdoor swimming pools, arenas, artificial ice rinks, gymnasiums and sports centres, soccer fields and tennis courts. There was some overlap between spaces of recreation and parks, since many soccer fields are located within city parks.
- The locations of 416 private recreation facilities (i.e., facilities not operated by local municipalities) in 2010 were obtained from a proprietary commercial database (Dunn & Bradstreet, Inc). These facilities included private athletics clubs and gyms, health clubs, martial arts and yoga studios, golf or country clubs, curling clubs, racquetball and squash clubs, tennis clubs, ice-skating and in-line skating rinks, swimming clubs, gymnastics clubs, soccer and hockey clubs, horseback riding facilities and sailing clubs. Although these facilities are not universally accessible, their locations were included in the analyses because they may serve to fill in gaps in public facilities' services, especially in higher income neighbourhoods.
- For density of resources per 10,000 population by census tract, the 2006 Canadian Census was used to derive the total population within each census tract.

Diabetes Prevalence

- Age- and sex-standardized diabetes prevalence rates per 100 people were calculated using the Ontario Diabetes Database (ODD) and other administrative data sources held at the Institute for Clinical Evaluative Sciences (ICES) (see Appendix 2.A for a more detailed description).
- In order to remove any influence due to differences in the population's age and sex distribution across census tracts or Peel Health Data Zones (PHDZs), the rates of diabetes prevalence were standardized to the 1991 Canadian Census population.

Physical Activity

- Data on self-reported physical activity during leisure time among Peel residents age 12 or older came from Statistics Canada's Canadian Community Health Surveys (CCHS). Due to the size and sampling of the CCHS, levels of physical activity could not be reported by census tract; instead, the larger PHDZs were used. In order to reach an adequate sample size, CCHS cycles 2003 (Cycle 2.1), 2005 (Cycle 3.1) and 2007/2008 were combined using statistical methods that take into account the survey design and weighting techniques.
- To determine levels of physical activity, the derived variable "Leisure Time Physical Activity Index" in the CCHS was used. This index categorizes respondents as being "active", "moderately active" or "inactive" based on the total amount of energy – in kilocalories per kilogram of body weight – that each respondent expends on an average day. This total energy expenditure was estimated from all activities lasting more than 15 minutes that respondents reported engaging in during their leisure time over the previous three months. To determine patterns of physical activity among Peel residents, the proportion of all respondents who were classified as either at least moderately active or active was calculated. Individuals classified as moderately active used between 1.5 and 3 kilocalories per kilogram of body weight per day (e.g., walking 30 to 60 minutes a day or engaging in three, hour-long exercise classes per week).[32] Individuals classified as active used 3 or more kilocalories per kilogram of body weight per day (e.g., walking an hour a day or jogging 20 minutes a day).[32]
- In order to remove any influence due to differences in the population's age and sex distribution across census tracts or PHDZs, the physical activity rates were standardized to the 1991 Canadian Census population.

- Statistics Canada's specific guidelines for reporting estimates based on CCHS data was followed (see Appendix 2.A for more details about these reporting guidelines). Separate rates of physical activity in men and women were not reportable because of the large coefficient of variation in many PHDZs for the sex-specific rates.

Analysis

The availability and accessibility of parks, schools and public recreation facilities across Peel region was examined. Availability was depicted in two ways on maps included in this chapter:

- The first method used symbols to show the locations of resources (e.g., recreation facilities across the region). This method provided an opportunity to determine where services were located and whether certain resources existed in specific neighbourhoods.
- The second method used choropleth (shaded) maps to show the density of resources in each area, taking population into account (i.e., the number of recreation facilities per 10,000 residents). This method identified where resoures were located in relation to where people lived and which neighbourhoods had more resources per capita than others.

Access/accessibility, as shown on the accessibility maps, was measured as the shortest distance (along the street network) from each point across Peel region in a 150-metre grid of starting points to the nearest resource location (e.g., the distance along the network of streets and highways leading to a recreation centre).

The spatial relationship between the accessibility measures and rates of diabetes prevalence that were either much higher (20% or more) or much lower (20% or less) than the GTA average diabetes rate (9%) were also evaluated. For each Peel census tract, the diabetes rate was divided by the overall GTA rate in order to calculate a rate-ratio. Census tracts with diabetes rates that were meaningfully higher than in the GTA as a whole (rate-ratio of ≥1.2) were depicted in shades of red, while tracts with rates much lower than

in the GTA (rate-ratio of ≤ 0.80) were depicted in shades of blue. All census tracts whose rates did not differ substantially from the GTA rate (rate-ratio between 0.81 and 1.19) were depicted using a single grey colour.

Finally, the average rate of leisure-time physical activity in each PHDZ was depicted using shaded (choropleth) maps. Associated rates of age- and sex-standardized diabetes prevalence in each PHDZ were overlaid on this map using proportional symbols (circles). The three categories of diabetes prevalence were derived from population-weighted tertiles of PHDZs (i.e., all PHDZs were ordered from lowest to highest diabetes prevalence and then divided into three groups with equal populations). This method was used to create a reasonable distribution of rates across the small number of these relatively large spatial units.

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Chapter 7

The Local Retail FOOD ENVIRONMENT and Diabetes

INSIDE

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HIGHLIGHTS

Issue

- Healthy eating is essential to maintaining good health and preventing many chronic diseases, including type 2 diabetes.
- Food choices are shaped not only by individual characteristics, but also by the environment in which those choices take place.
- In this chapter, geographic access to common retail food outlets across Peel and rates of fruit and vegetable intake among residents are examined. Levels of economic disadvantage and rates of diabetes among Peel residents are also assessed relative to access to food retail.

Key Findings

- In Peel, sources of healthy food (i.e., supermarkets and grocery stores) and less healthy food (i.e., fast-food/take-out restaurants and convenience stores) were generally located in the same areas. In all areas, sources of less healthy food greatly outnumbered sources containing more healthy food by a factor of at least five to one.
- Access to both healthy and less healthy food outlets was very good near Bolton, throughout central Brampton and in many parts of Mississauga. Limited access existed in Caledon, northeast Brampton and in south Mississauga. This pattern of food outlet distribution coincided with locations of other commercial and retail services and with patterns of population density in Peel.
- Unlike many cities in the United States, economically disadvantaged areas of Peel generally had better access to sources of healthy food compared with the wealthiest areas. However, these areas also had better access to sources of less healthy food.
- Areas home to a high proportion of residents living with diabetes were generally well served by both sources of healthy and less healthy food. In contrast, lower diabetes areas had reduced access to food retail of any type.
- In most areas of Peel, only 40% – 45% of residents reported consuming fruits and/or vegetables at least five times a day. These rates were similar to Ontario and Canada, overall.
- Rates of fruit and/or vegetable intake varied little across Peel. There was no apparent association between rates of fruit and vegetable intake and rates of diabetes.

Implications

- Access to both healthy and less healthy food shapes individuals' eating behaviours.
- While many forces that shape the food environment are outside the local setting, many important initiatives can be undertaken at the community level to encourage and better support healthy eating.
- Given the rising rates of overweight/obesity and type 2 diabetes in Peel and across Canada, public health measures to encourage and support healthy eating must be considered major priorities.

INTRODUCTION

Health and diet (i.e., what we eat and drink) are inextricably linked. Individuals who consume a healthy diet (e.g., one that is high in fresh fruits, vegetables and whole grains) have a lower risk of developing chronic diseases such as type 2 diabetes, cardiovascular disease and some cancers.[1] In addition, for people living with diabetes or cardiovascular disease, eating a healthy diet is among the key strategies to better manage their condition.[1] Unfortunately, major technological and economic changes in the food system over past decades have resulted in a food supply that is higher in sugar and more energy-dense, and replete with highly-processed foods.[2] These changes have very much shaped the Western diet, which is characterized by frequent consumption of highly-processed energy-dense foods that are low in fibre and high in fat, added sugars, refined grains and sodium. Individuals who consume the Western diet are at higher risk of developing chronic diseases, including type 2 diabetes.[1]

What are Canadians eating?

Although food availability data suggest that Canadians have been consuming more fruits and vegetables over the past two decades and fewer calories per day between 2001 and 2009,[3] the overall quality of most people's diets continues to be of great concern. A recent national survey of Canadians' eating habits showed that seven out of 10 Canadian children and half of adults ate less than the historically recommended five servings of vegetables and fruit each day.[4] This trend is worrisome considering that in 2007 Canada's Food Guide increased the recommended daily intake of fruits and vegetables to a range of seven to 10 servings for teens and adults.[5] The overall diet quality of the average Canadian has been classified as "poor," with less than 1% of Canadians following a diet consistent with Canada's Food Guide.[6]

One concern is that Canadians are consuming too many "other foods" (eg. sweetened beverages and foods such as salad dressings and potato chips that are not part of the four major food groups) – foods that are high in calories and very low in nutrients.[4] These foods comprised a quarter of total daily calories among Canadian teenagers.[4] Furthermore, reflecting the growing availability and popularity of ready-to-eat convenience foods, one in four Canadians reported eating at least one fast-food item on the previous day.[4] Teenagers and young men were most likely to have eaten something from a fast-food restaurant (30% and 39%, respectively). This is a troubling trend because common fast foods like pizza, hot dogs and soft drinks tend to be high in calories, salt, and low in nutrients. Frequent consumption of fast foods has been associated with lower intake of healthy foods and increased risk of becoming obese and developing type 2 diabetes.[7-9]

What shapes a person's diet?

Individuals' dietary preferences and choices are highly complex and are shaped by many different factors. At the individual level, these factors include age, sex, family composition and sociocultural factors (e.g., socioeconomic status, ethnocultural or religious background).[10-13] Household income is particularly important because a diet high in fresh fruit and vegetables, lean meats and fish tends to cost more than a less-healthy diet high in calories and highly-processed foods.[14] Canadian households with higher levels of income and education consistently purchase more nutritious foods and have a better quality diet.[15-17] Purchasing fruit and vegetables is particularly sensitive to financial constraints: Canadians with lower levels of education or those living in lower income households tend to buy and eat fewer fruit and vegetables compared with individuals with higher levels of education or income.[13,16] Limited time for grocery shopping and cooking is often another important influence on food intake among low-income individuals working long hours or multiple jobs, and particularly for single-parent households.[18] Higher socioeconomic (SES) groups tend to be more responsive to dietary recommendations, have more knowledge about nutrition and may be more aware of the relationship between diet and health compared to lower SES groups.[16,19]

A person's ethnocultural characteristics also play an important role in food choices. Canadians belonging to Aboriginal, Southeast Asian and Chinese ethnic groups were less likely to report eating fruit and vegetables at least five times a day compared with other ethnic groups including Latin American, White, South Asian and Black.[11]

Individuals' food choices are guided not only by personal factors, but also by the choices available to them within different settings (e.g., work, school, community). Messages that encourage these choices from other individuals, the media and institutions are also very influential. To better understand these influences, researchers are increasingly studying the role that the "food environment" (i.e., the food choices available to individuals in various settings of daily life) plays in promoting or hindering healthy eating.[20] These settings include the organizational food environment (e.g., school, work, home), the consumer environment (i.e., availability, quality, portion size and price of foods in stores and eating places), the community environment (i.e.,

availability and accessibility of various types of stores and eating places in communities) and the information environment (i.e., media and advertising).[21] The consumer and community environments are particularly important because any changes in these domains will have broad-reaching effects on the population. For this reason and because data on various types of settings are difficult to obtain, the analyses in this atlas focus only on the community or "local" food environment. In this chapter, the term "local food environment" is used interchangeably with the term "community food environment".

The local food environment and diet

Sources of fresh, healthy and affordable food are essential resources for healthy eating in communities. If an area does not have good access to healthy affordable food, residents must travel some distance outside their neighbourhood to obtain these foods, or rely on more readily available and often less healthy options sold in nearby convenience stores or eating places. In many urban settings, convenient access to both healthy and less-healthy food in neighbourhoods can be particularly important for lower income groups and individuals with limited access to a private vehicle for food shopping purposes.[22]

To date, there is a lack of Canadian research that examines the effects of the local food environment on individuals' diets. The majority of published studies on this topic were conducted in the United States (U.S.), Europe and Australia, and present conflicting evidence on the extent to which the local retail food environment shapes dietary patterns. While some studies did not find that having better access to healthy food was related to healthier eating, others showed that residents living near supermarkets or large grocery stores had better quality diets.[20, 23,24]

Researchers are also increasingly paying attention to retail sources of less healthy food, such as convenience stores and fast-food outlets. Although they provide convenient locations and extended operating hours, convenience stores consistently stock few healthier options and sell foods at significantly higher prices than larger grocers.[25, 26] Canadians are also increasingly patronizing fast-food and take-out restaurants (outlets that lack table service and where customers generally pay before receiving their meal).[4] Such outlets are easily accessible in most communities, provide a source of relatively inexpensive meals and commonly offer large portions of highly-processed and nutrient-poor foods and drinks.

Access to fast-food restaurants and convenience stores may play a role in shaping the diets of local residents.[23, 27] U.S. residents who lived near more fast-food restaurants were more likely to consume fast food near their home and were less likely to have a healthy diet overall.[28] In Australia and England, children with better access to fast-food outlets and convenience stores near their home ate fewer fruits and vegetables and more snack foods than those with less access to such outlets.[29, 30] In the U.S., low-income men who lived near more chain fast-food restaurants (within one to three kilometres) consumed fast food more frequently than those with less access to such food sources.[31] These findings reinforce the notion that the local food environment may be a stronger influence on the diet and health of certain population groups (e.g., those with limited financial resources or transportation options). Additionally, individuals with certain personality traits, such as increased sensitivity to reward, are more susceptible to environmental cues and are thus less able to resist the temptation of highly ubiquitous unhealthy foods that they encounter within their daily activity spaces.[32]

The local food environment and health

Residents of areas in the U.S., Europe and Australia/New Zealand with better access to supermarkets and less access to fast-food outlets have lower prevalence of overweight/obesity than those living in areas with limited access to large grocers or with better access to fast food.[23] In Ottawa, there were more obese residents in neighbourhoods with a high concentration of fast-food restaurants and more people with healthy weights in areas with additional specialty stores.[33]

It is not only the presence or absence of particular food retail outlets in an area, but also the relative proportion or mix of different food outlets, that may be an important component of the food environment. In Edmonton, the prevalence of obesity among local residents increased as the number of less-healthy food outlets (i.e., convenience stores and fast-food outlets) within a 10-minute walk increased relative to healthier outlets (i.e., supermarkets and grocery stores) in the same range.[34] In California, the relative abundance of less-healthy to healthy food outlets was similarly related to higher rates of obesity, as well as to higher rates of diabetes.[35] However, there is limited research in the area of food environment and diabetes, and findings are inconsistent.[36,37]

Neighbourhood socioeconomic status (SES) and the local food environment

Because both diet and health differ between groups of varying levels of socioeconomic status (SES) (see Chapter 3), it is important to examine whether features of the local environment may be shaping these differences. For example, researchers in Canada, the U.S., the United Kingdom and Australia have examined whether lower income groups or racial/ethnic minority groups are more likely to live in areas with limited access to healthy, affordable food (areas known as "food deserts").[22] To date, there is fairly consistent evidence that in the U.S., access to healthy and affordable foods (i.e., supermarkets or large grocery stores) is indeed limited in many neighbourhoods with a high proportion of lower income and/or African American residents.[22, 38] High levels of residential segregation along SES and/or ethnoracial lines in the U.S. is likely a key driver of this pattern.[39] The closing or lack of a supermarket in a marginalized community often indicates a disinvestment in that community which can lead to disinterest in further investment.[40]

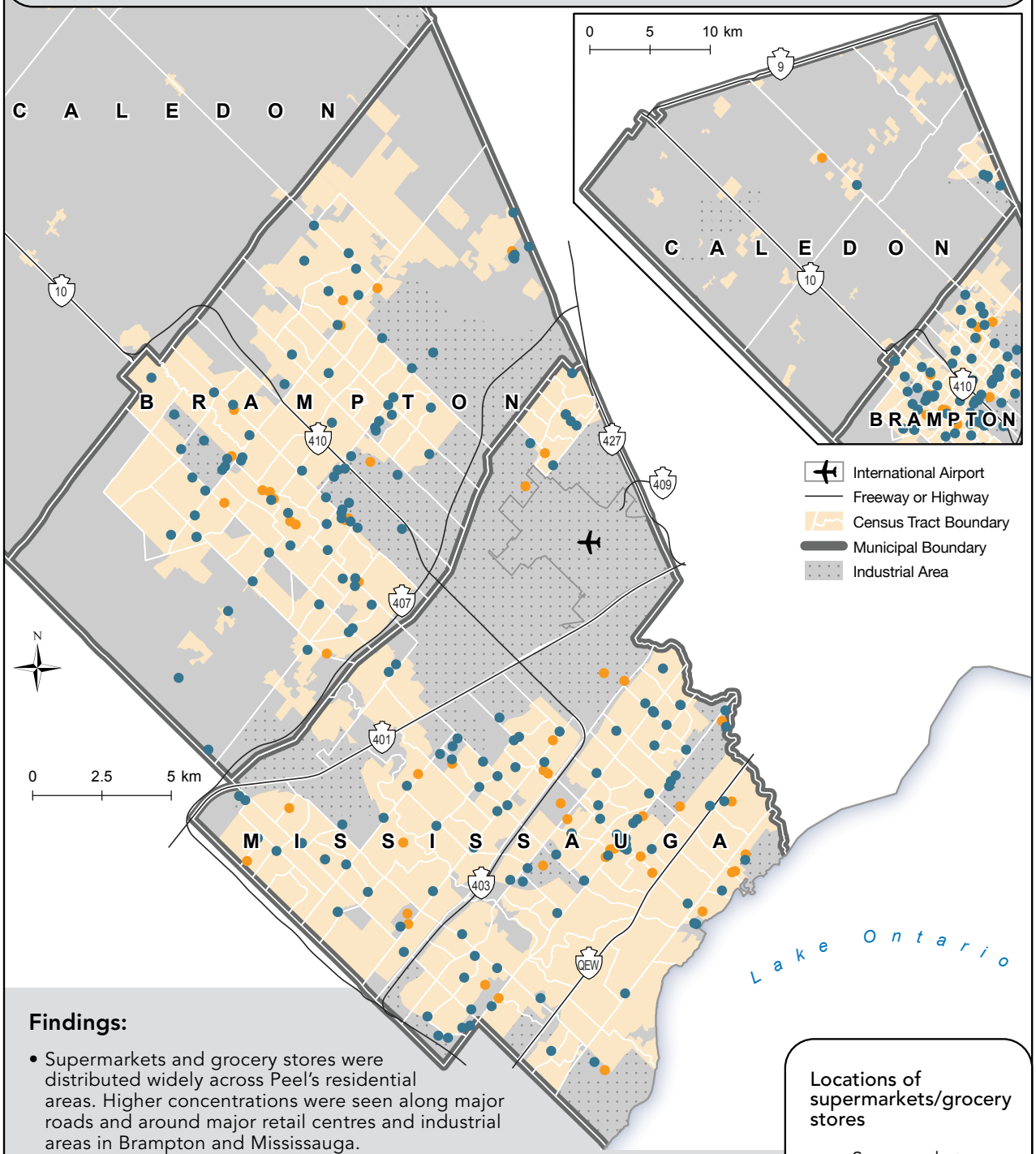
In contrast, the existence of food deserts in other developed countries, including Canada, is much less consistent. For example, in Montreal, access to supermarkets and other stores selling fruits and vegetables did not differ between neighbourhoods of different income levels.[41-43] Similar patterns existed in Edmonton and in metropolitan areas of British Columbia, where low-income areas generally had similar or even better access to supermarkets than wealthier areas.[44-46] In Quebec City, the quantity and variety of fruit and vegetables sold in supermarkets and greengrocers was the same regardless of levels of neighbourhood deprivation.[25] However, different patterns were seen in other Canadian cities. For example, several inner-city, low-SES neighbourhoods in London (Ontario) had the poorest access to supermarkets. The differences in access to supermarkets had increased over time as a number of supermarkets in the inner city had closed down and new supermarkets were built in the suburbs.[47] In Edmonton, although the majority of low-income neighbourhoods had very good access to supermarkets, there was a handful of inner-suburban neighbourhoods with high rates of low income and low vehicle ownership that had much more limited access (i.e., these areas appeared to be food deserts).[45] These mixed findings within Canada suggest that the food environment may differ both across communities within a given province, as well as across provinces and countries, reflecting different social, economic and regulatory environments and histories that shape the distribution of food retail outlets in different settings.

In this chapter, the geographic availability (i.e., locations and density) and accessibility (i.e. distance along the street network) of grocery stores, supermarkets, convenience stores, as well as fast-food and take-out restaurants are examined. Geographic access to these common food retailers as it relates to levels of economic disadvantage and rates of diabetes among Peel residents is also assessed. Finally, rates of fruit and vegetable intake in relation to diabetes rates across Peel are examined.

LIST OF EXHIBITS

EXHIBITS AND FINDINGS

Exhibit 7.1. Locations of supermarkets and grocery stores [2011] in Peel region



Findings:

- Supermarkets and grocery stores were distributed widely across Peel's residential areas. Higher concentrations were seen along major roads and around major retail centres and industrial areas in Brampton and Mississauga.
- Pockets with no supermarkets or grocery stores were visible in east, northeast and northwest Brampton, and in south Mississauga.
- There were few supermarkets/grocery stores in Caledon.

Exhibit 7.2. Locations of convenience stores [2011] in Peel region

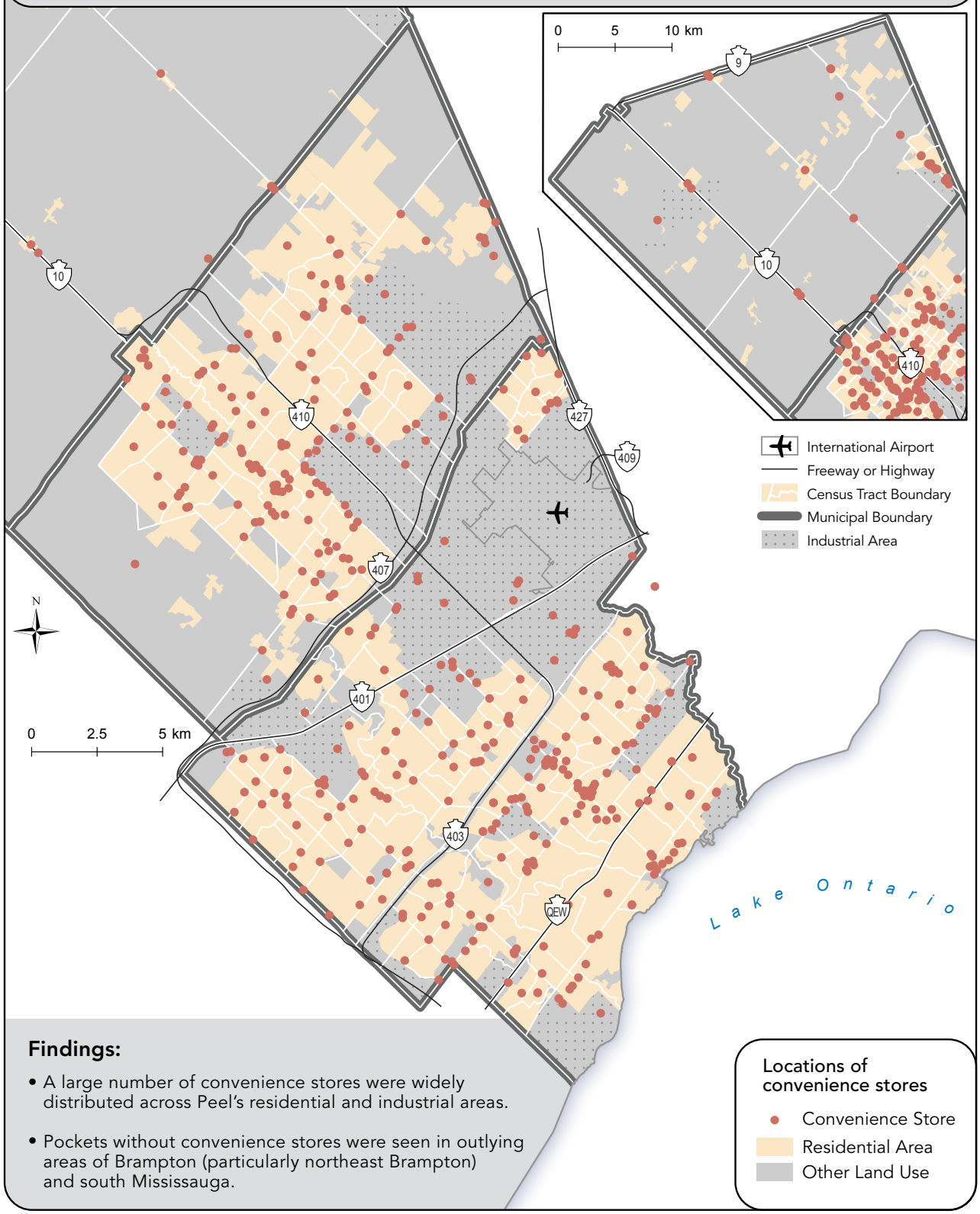
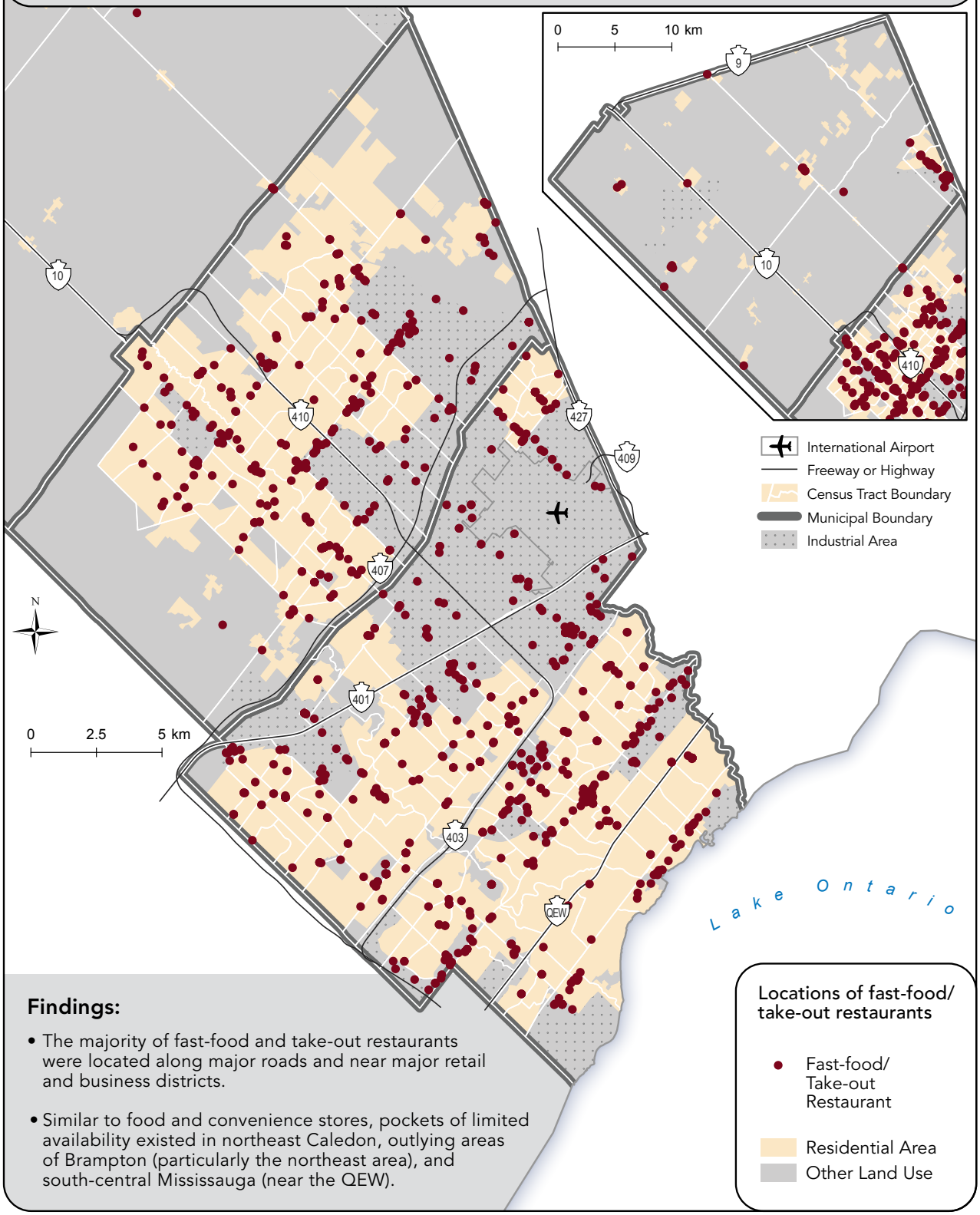


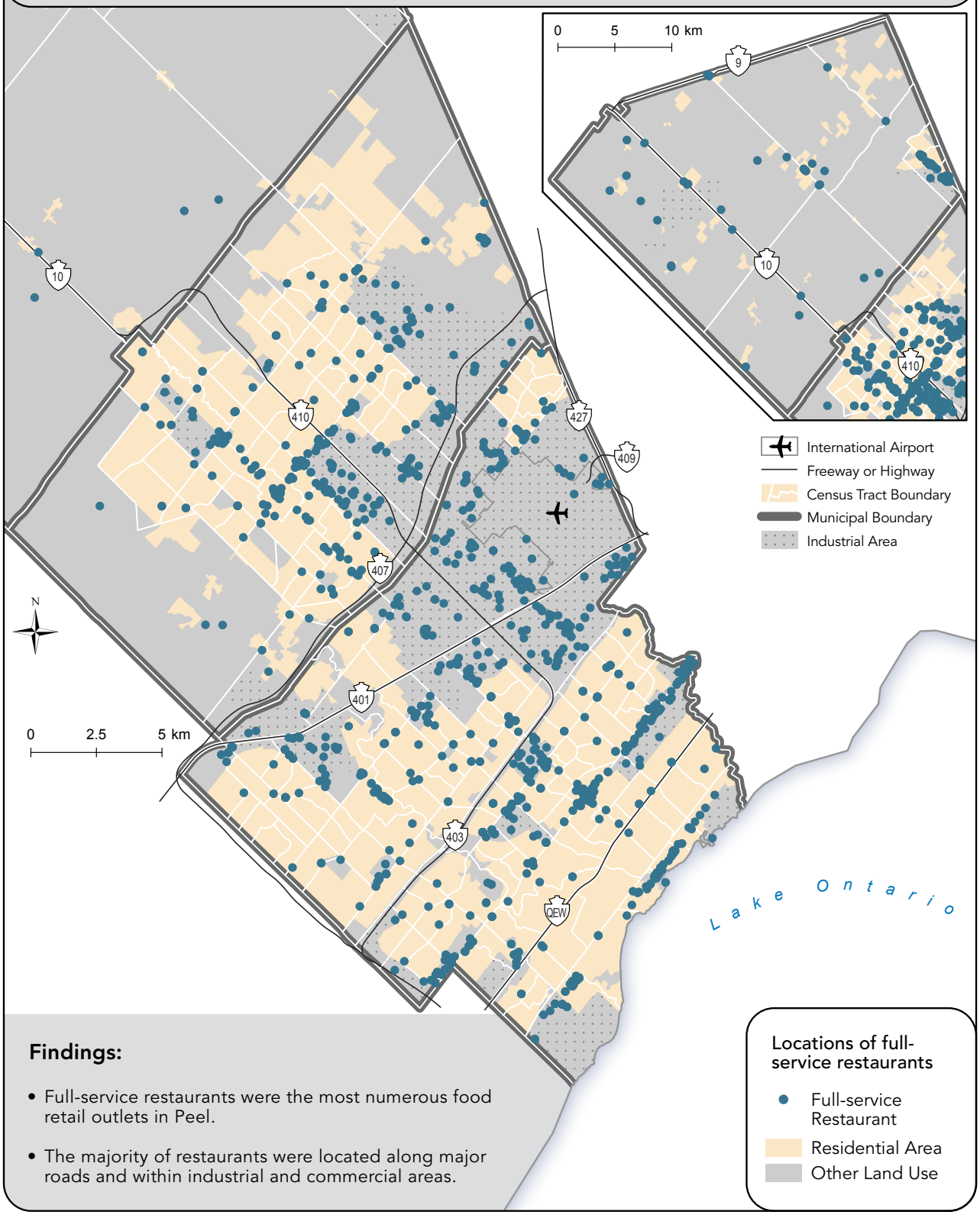
Exhibit 7.3. Locations of fast-food and take-out restaurants [2011] in Peel region



Findings:

- The majority of fast-food and take-out restaurants were located along major roads and near major retail and business districts.
- Similar to food and convenience stores, pockets of limited availability existed in northeast Caledon, outlying areas of Brampton (particularly the northeast area), and south-central Mississauga (near the QEW).

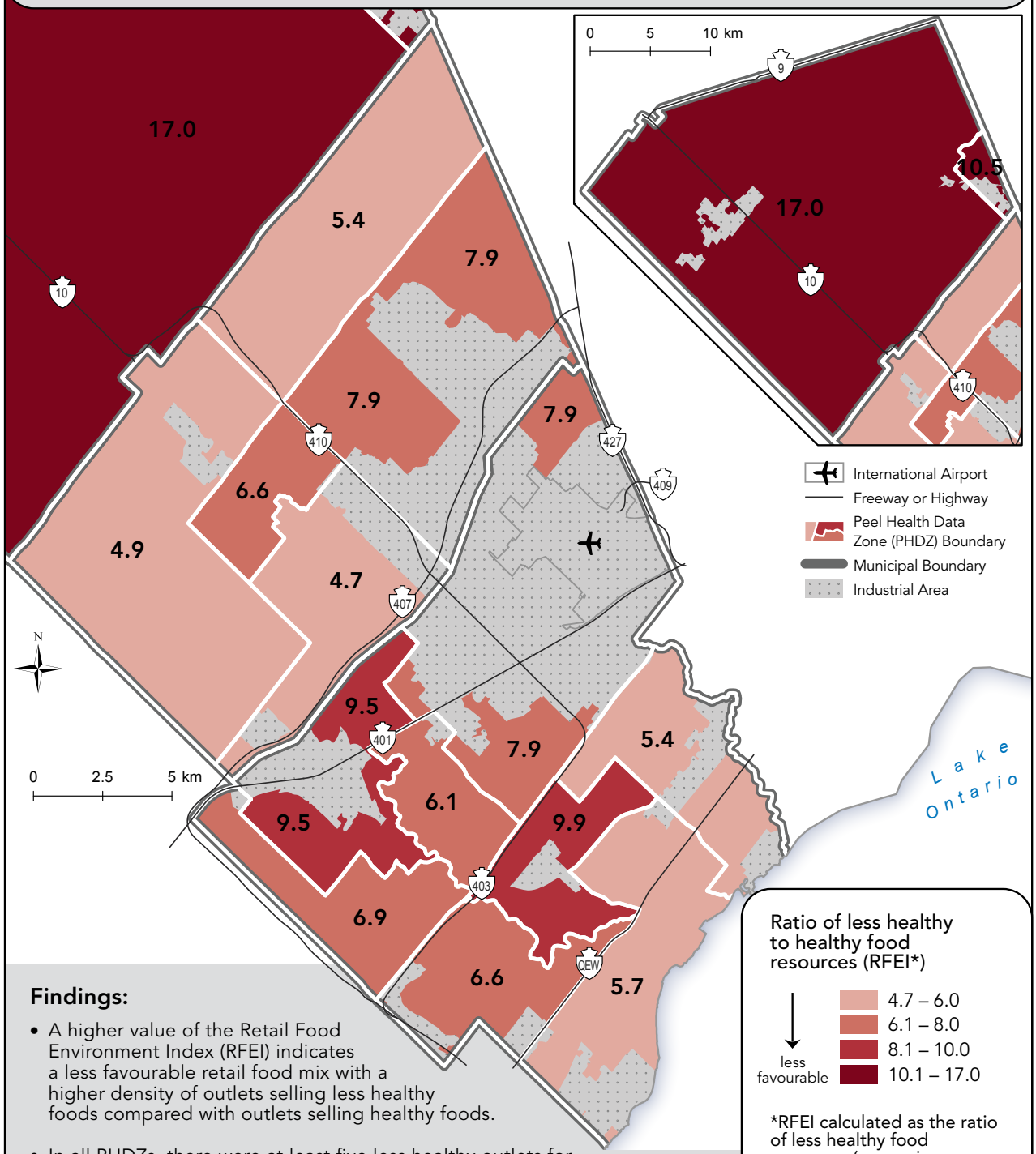
Exhibit 7.4. Locations of full-service restaurants [2011] in Peel region



Findings:

- Full-service restaurants were the most numerous food retail outlets in Peel.
- The majority of restaurants were located along major roads and within industrial and commercial areas.

Exhibit 7.5. Retail Food Environment Index (RFEI, ratio of less healthy to healthy food resources*) [2011], by Peel Health Data Zone (PHDZ) [2006], in Peel region

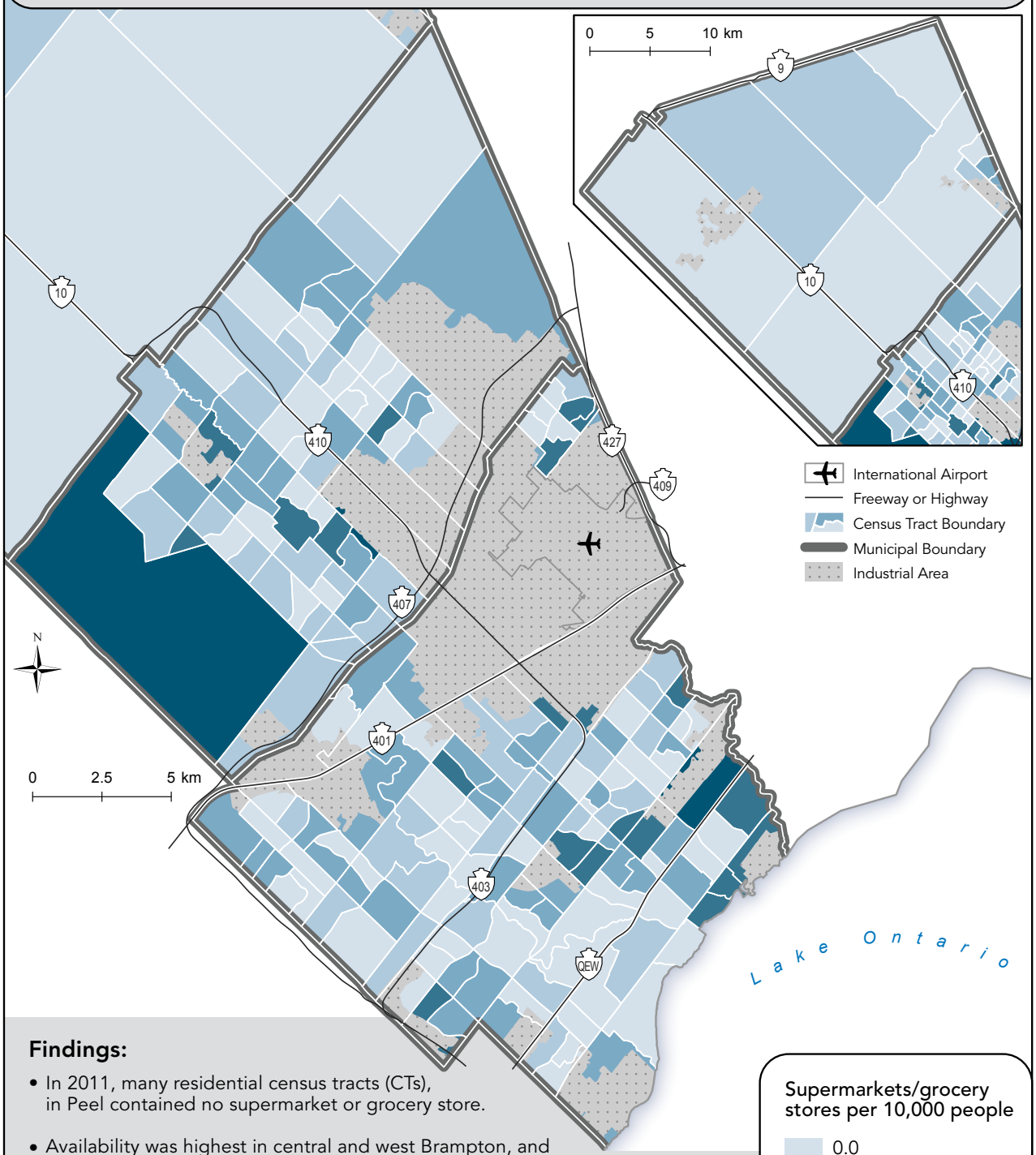


Findings:

- A higher value of the Retail Food Environment Index (RFEI) indicates a less favourable retail food mix with a higher density of outlets selling less healthy foods compared with outlets selling healthy foods.
- In all PHDZs, there were at least five less healthy outlets for every healthy outlet. The highest RFEI was seen in Caledon.
- In Brampton and Mississauga, the RFEI was somewhat lower, ranging from about five to 10 less healthy outlets for every healthy outlet.

*RFEI calculated as the ratio of less healthy food resources (convenience stores, fast-food and take-out restaurants) to healthy food resources (supermarkets and grocery stores), within a Peel Health Data Zone.

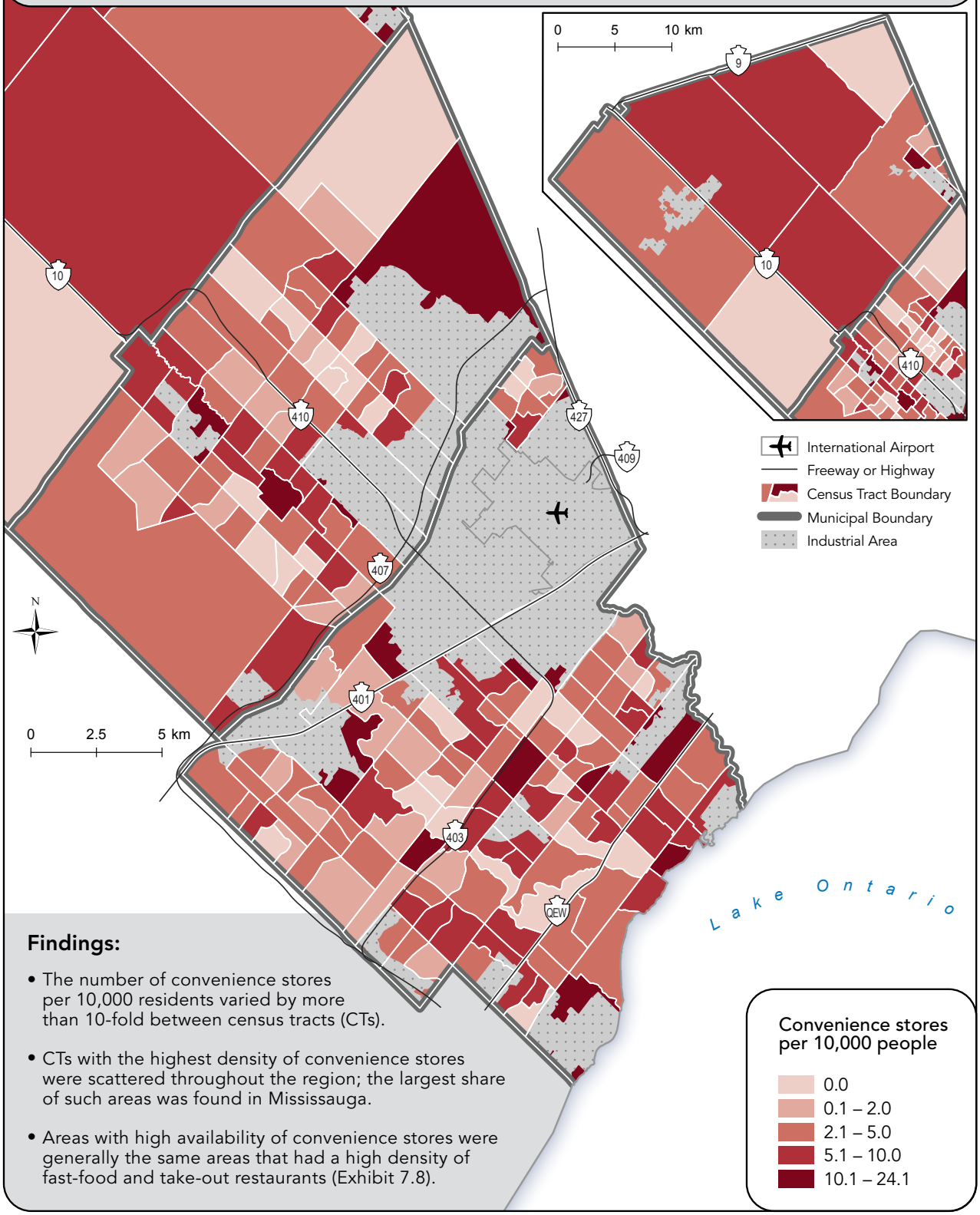
Exhibit 7.6. Supermarkets and grocery stores [2011] per 10,000 population [2006], by census tract [2006], in Peel region



Findings:

- In 2011, many residential census tracts (CTs), in Peel contained no supermarket or grocery store.
- Availability was highest in central and west Brampton, and in various areas of Mississauga, particularly the southeast portion.
- CTs with more supermarkets/grocery stores per capita generally coincided with areas where fast-food/take-out outlets and convenience stores were also more available (Exhibits 7.7 and 7.8).

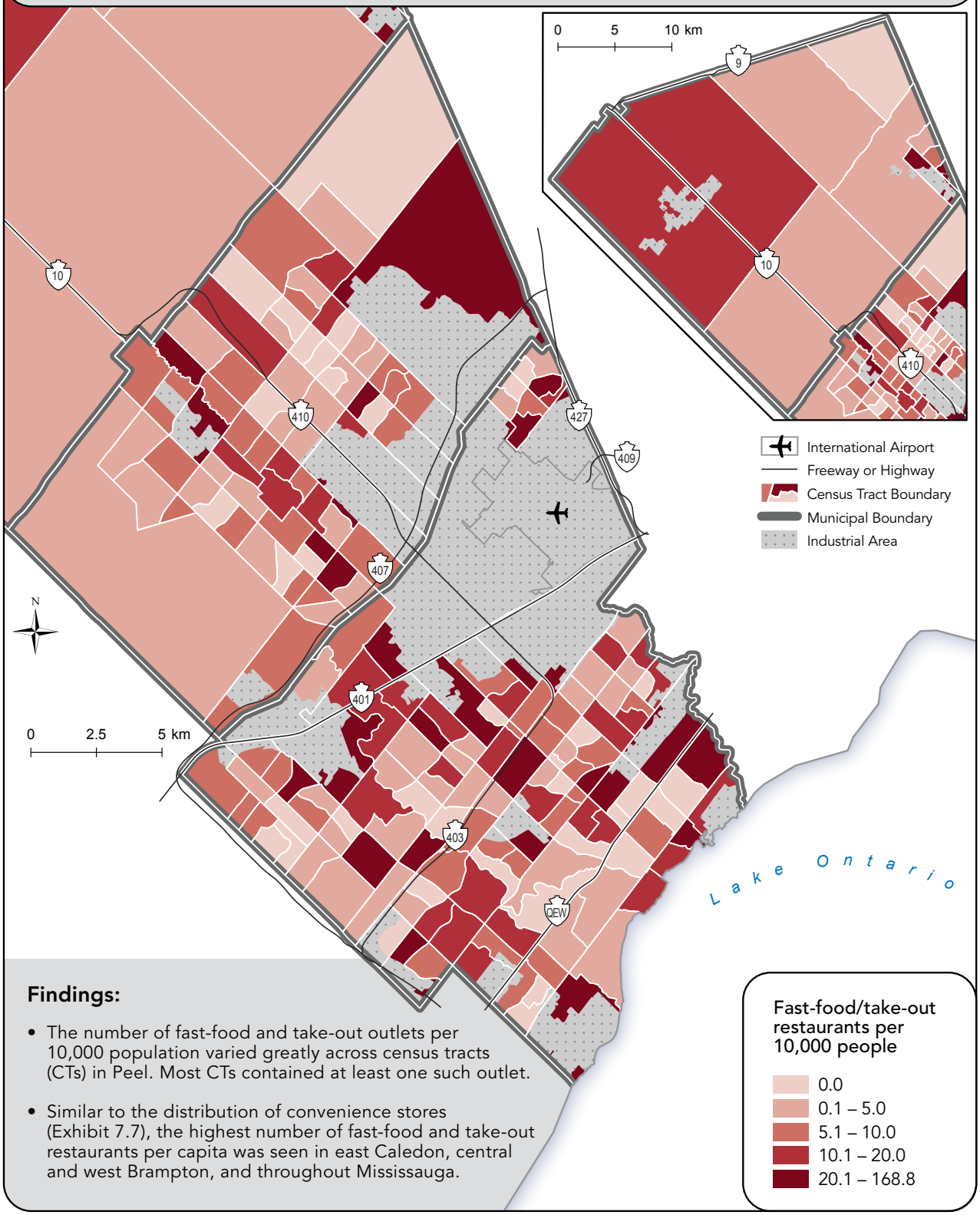
Exhibit 7.7. Convenience stores [2011] per 10,000 population [2006], by census tract [2006], in Peel region



Findings:

- The number of convenience stores per 10,000 residents varied by more than 10-fold between census tracts (CTs).
- CTs with the highest density of convenience stores were scattered throughout the region; the largest share of such areas was found in Mississauga.
- Areas with high availability of convenience stores were generally the same areas that had a high density of fast-food and take-out restaurants (Exhibit 7.8).

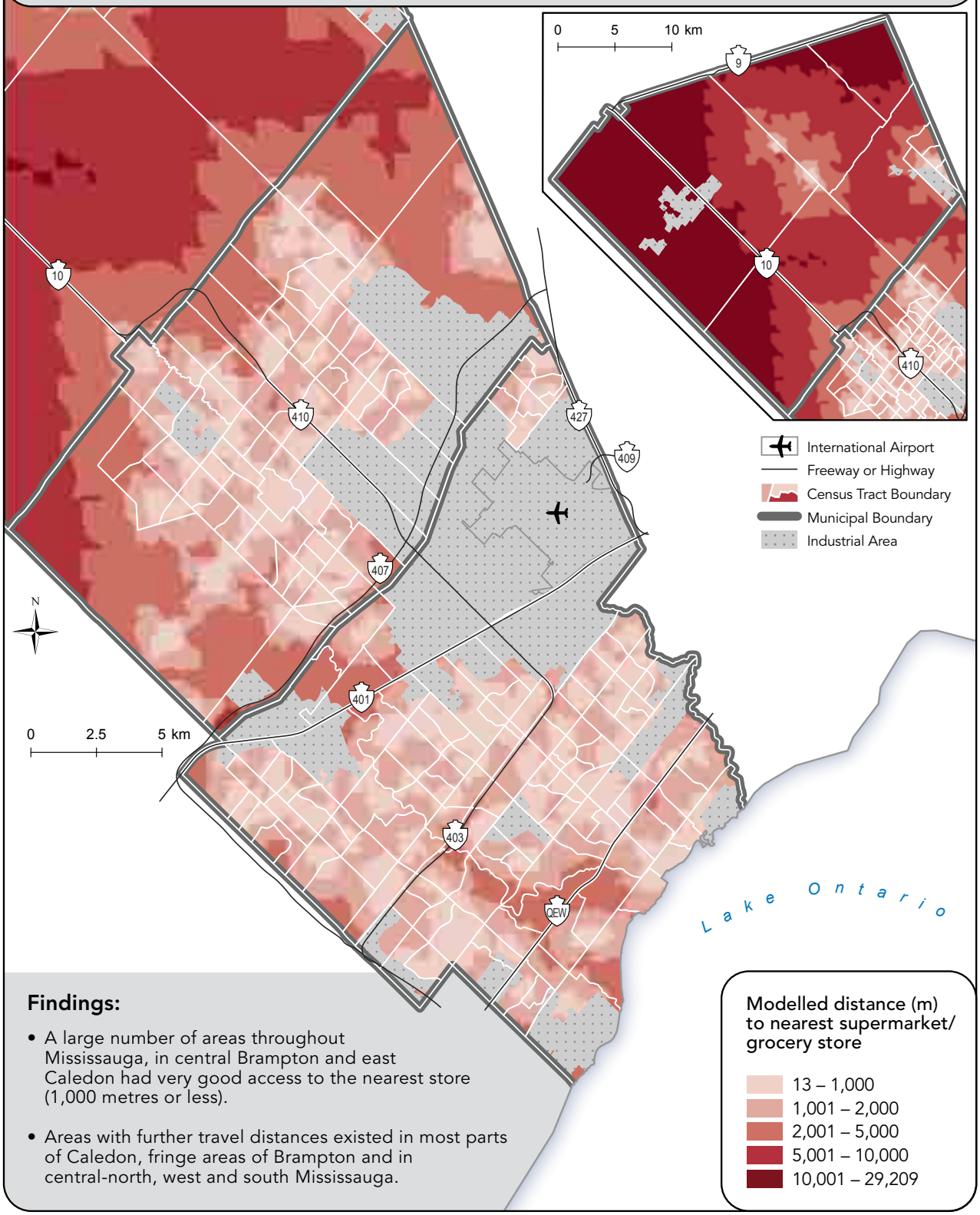
Exhibit 7.8. Fast-food and take-out restaurants [2011] per 10,000 population [2006], by census tract [2006], in Peel region



Findings:

- The number of fast-food and take-out outlets per 10,000 population varied greatly across census tracts (CTs) in Peel. Most CTs contained at least one such outlet.
- Similar to the distribution of convenience stores (Exhibit 7.7), the highest number of fast-food and take-out restaurants per capita was seen in east Caledon, central and west Brampton, and throughout Mississauga.

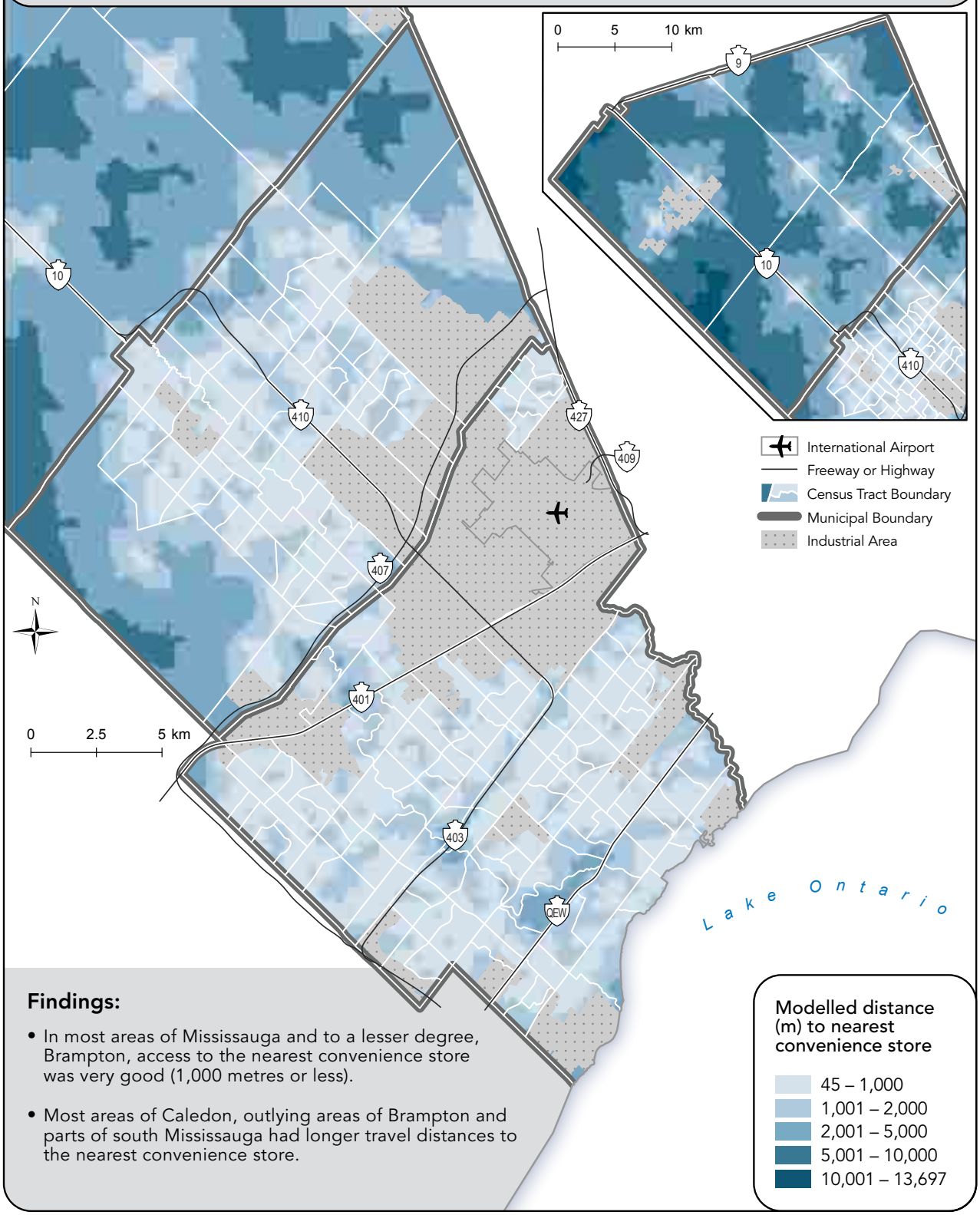
Exhibit 7.9. Modelled travel distance along the road network [2009] to the nearest location of a supermarket or grocery store [2011], in Peel region



Findings:

- A large number of areas throughout Mississauga, in central Brampton and east Caledon had very good access to the nearest store (1,000 metres or less).
- Areas with further travel distances existed in most parts of Caledon, fringe areas of Brampton and in central-north, west and south Mississauga.

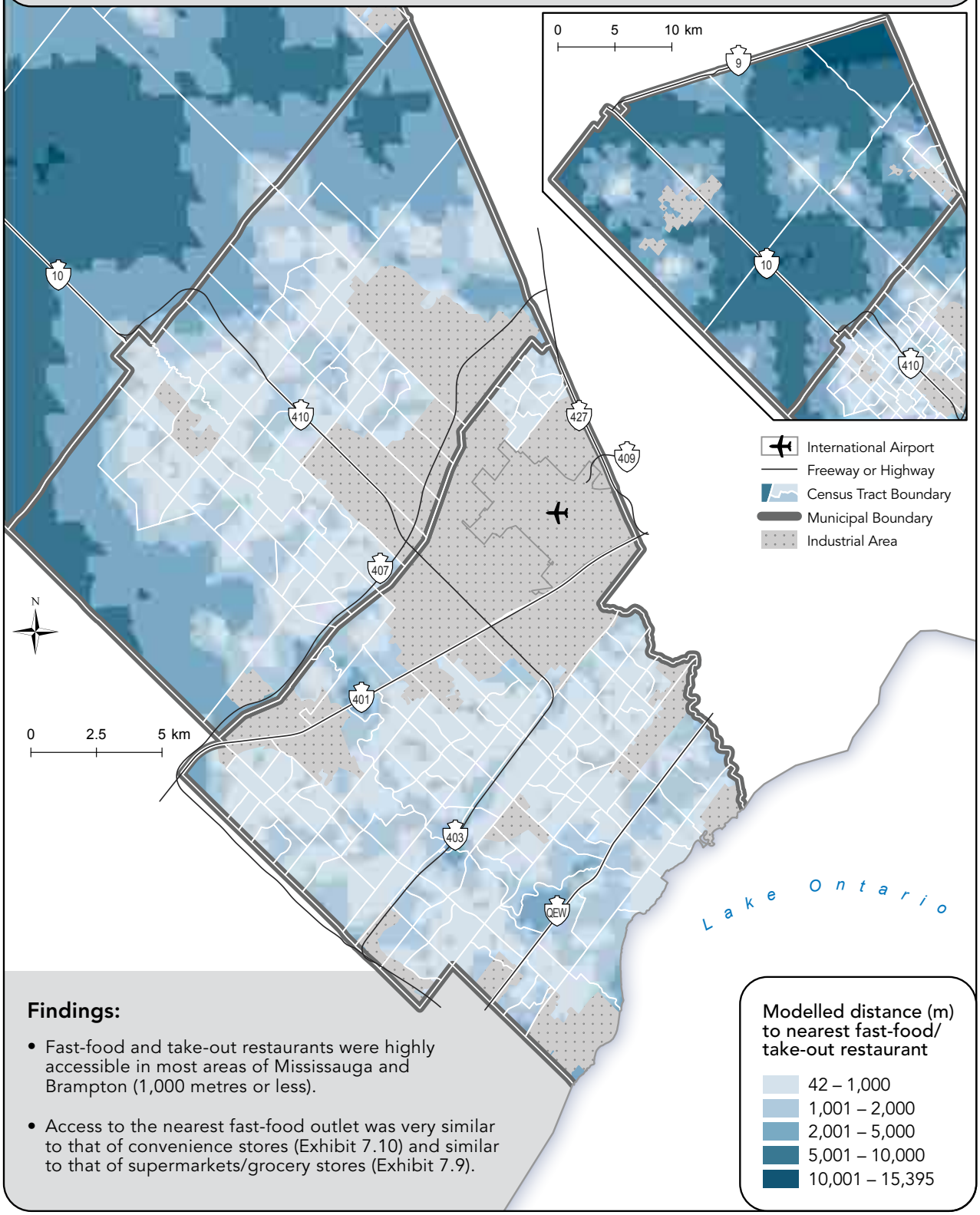
Exhibit 7.10. Modelled travel distance along the road network [2009] to the nearest location of a convenience store [2011], in Peel region



Findings:

- In most areas of Mississauga and to a lesser degree, Brampton, access to the nearest convenience store was very good (1,000 metres or less).
- Most areas of Caledon, outlying areas of Brampton and parts of south Mississauga had longer travel distances to the nearest convenience store.

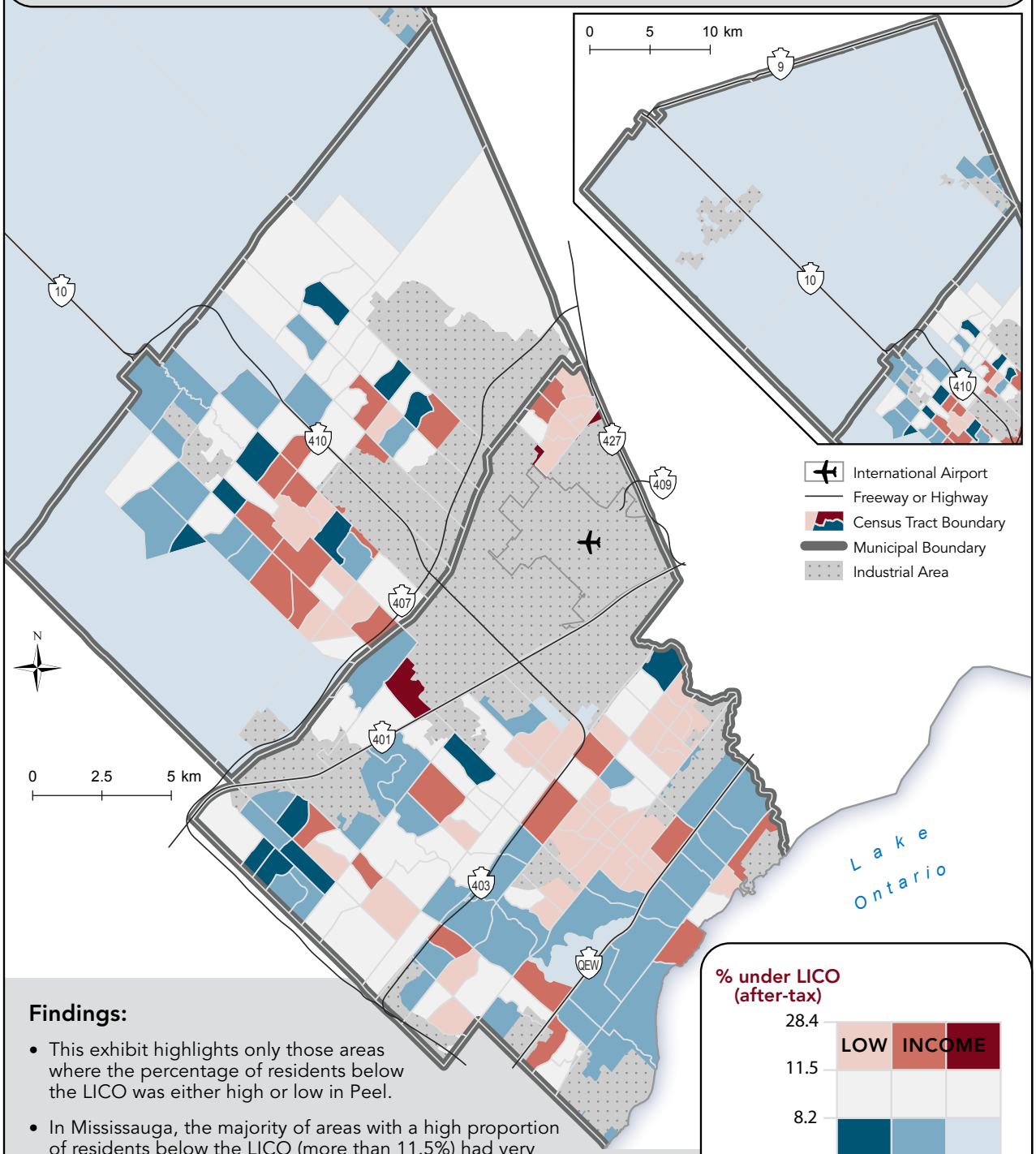
Exhibit 7.11. Modelled travel distance along the road network [2009] to the nearest location of a fast-food or take-out restaurant [2011], in Peel region



Findings:

- Fast-food and take-out restaurants were highly accessible in most areas of Mississauga and Brampton (1,000 metres or less).
- Access to the nearest fast-food outlet was very similar to that of convenience stores (Exhibit 7.10) and similar to that of supermarkets/grocery stores (Exhibit 7.9).

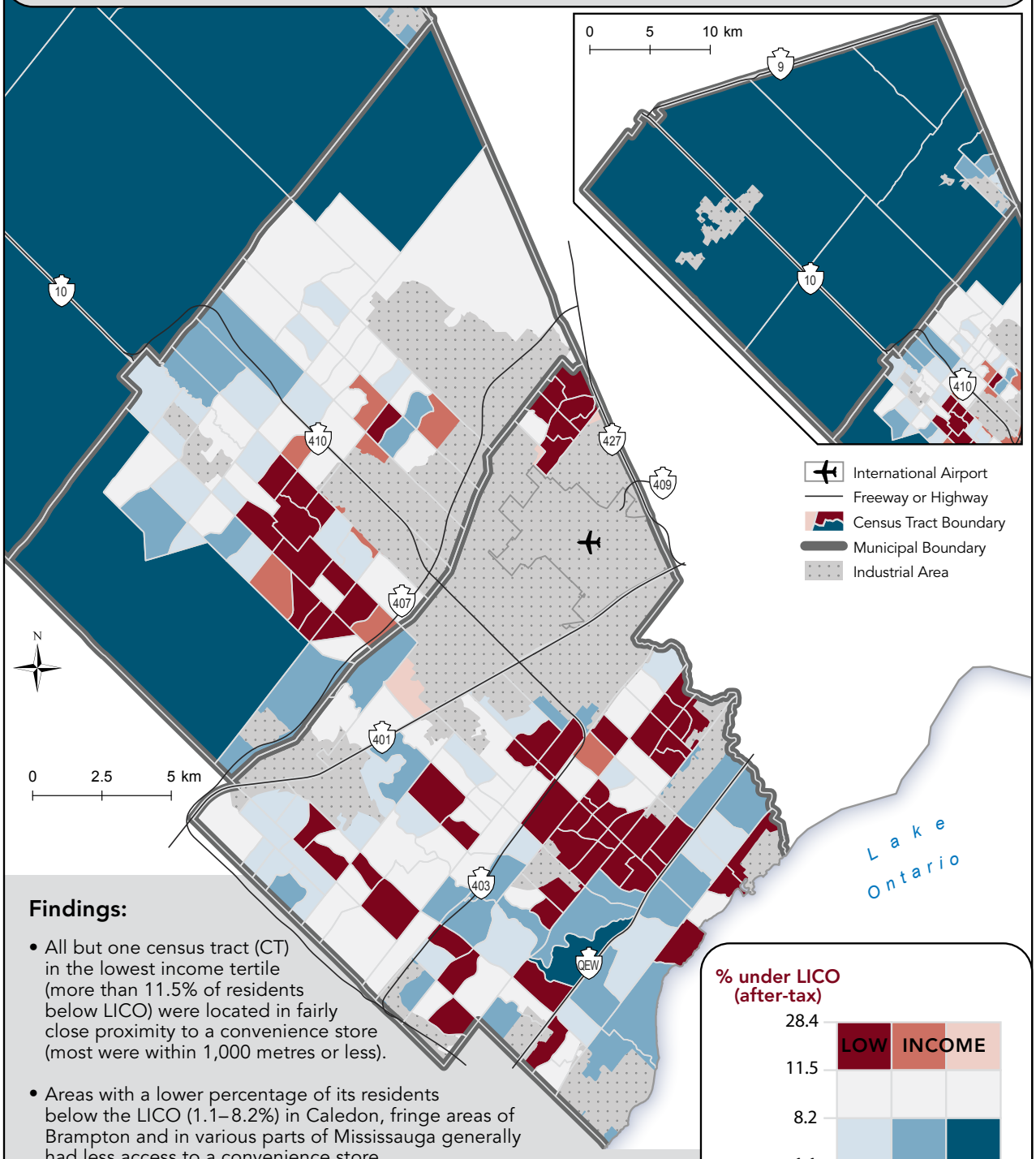
Exhibit 7.12. Spatial relationship between average road network distance to the nearest supermarket or grocery store [2011] and per cent of the population below Statistics Canada's low income cut-off (LICO; after-tax) [2005], by census tract [2006], in Peel region



Findings:

- This exhibit highlights only those areas where the percentage of residents below the LICO was either high or low in Peel.
- In Mississauga, the majority of areas with a high proportion of residents below the LICO (more than 11.5%) had very good access to a grocery store or supermarket (1,000 metres or less). In Brampton, access was more mixed.
- Only one lower income area was located further than 2,000 metres from the nearest supermarket or grocery store.

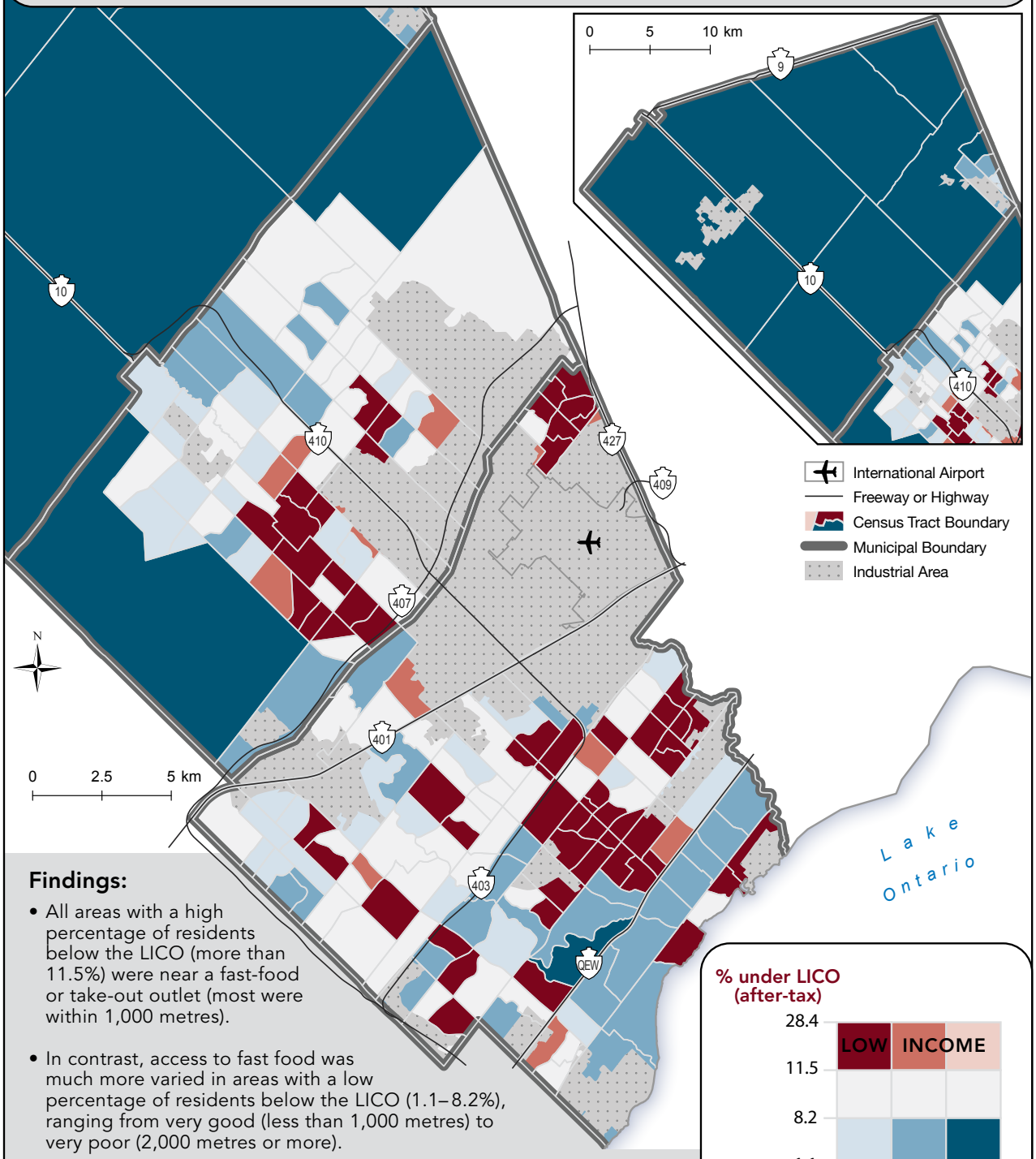
Exhibit 7.13. Spatial relationship between average road network distance to the nearest convenience store [2011] and per cent of the population below Statistics Canada's low income cut-off (LICO; after-tax) [2005], by census tract [2006], in Peel region



Findings:

- All but one census tract (CT) in the lowest income tertile (more than 11.5% of residents below LICO) were located in fairly close proximity to a convenience store (most were within 1,000 metres or less).
- Areas with a lower percentage of its residents below the LICO (1.1–8.2%) in Caledon, fringe areas of Brampton and in various parts of Mississauga generally had less access to a convenience store.
- The spatial association between access to convenience stores and the percentage of residents falling below the LICO followed a similar pattern to that of access to supermarkets and grocery stores (Exhibit 7.12).

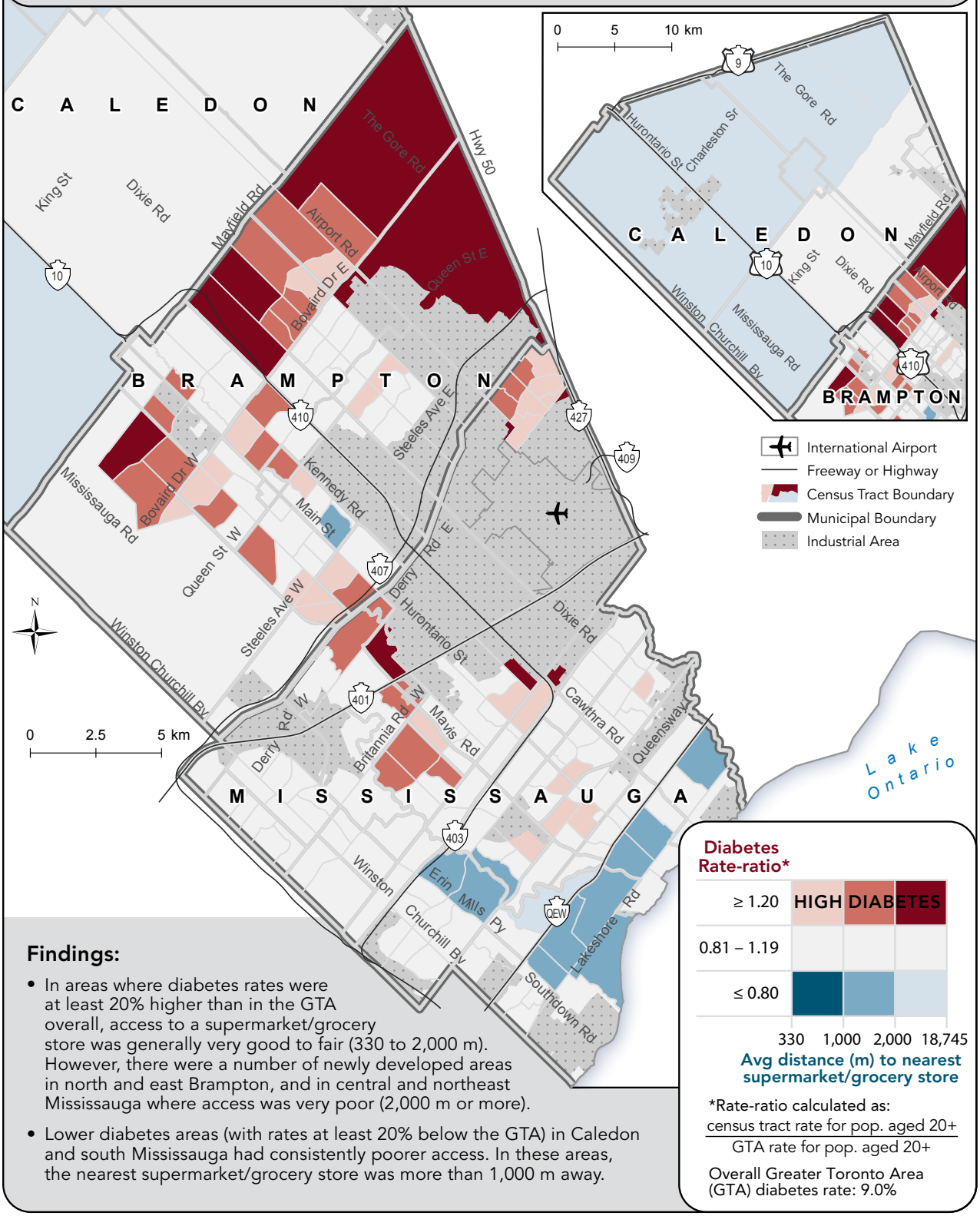
Exhibit 7.14. Spatial relationship between average road network distance to the nearest fast-food or take-out restaurant [2011] and per cent of the population below Statistic Canada's low income cut-off (LICO; after-tax) [2005], by census tract [2006], in Peel region



Findings:

- All areas with a high percentage of residents below the LICO (more than 11.5%) were near a fast-food or take-out outlet (most were within 1,000 metres).
- In contrast, access to fast food was much more varied in areas with a low percentage of residents below the LICO (1.1–8.2%), ranging from very good (less than 1,000 metres) to very poor (2,000 metres or more).
- Access to fast-food or take-out restaurants in areas with either a high or low percentage of residents falling below the LICO was nearly identical to that of convenience stores (Exhibit 7.13) and very similar to that of supermarket/grocery stores (Exhibit 7.12).

Exhibit 7.15. Spatial relationship between average road network distance to the nearest supermarket or grocery store [2011] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

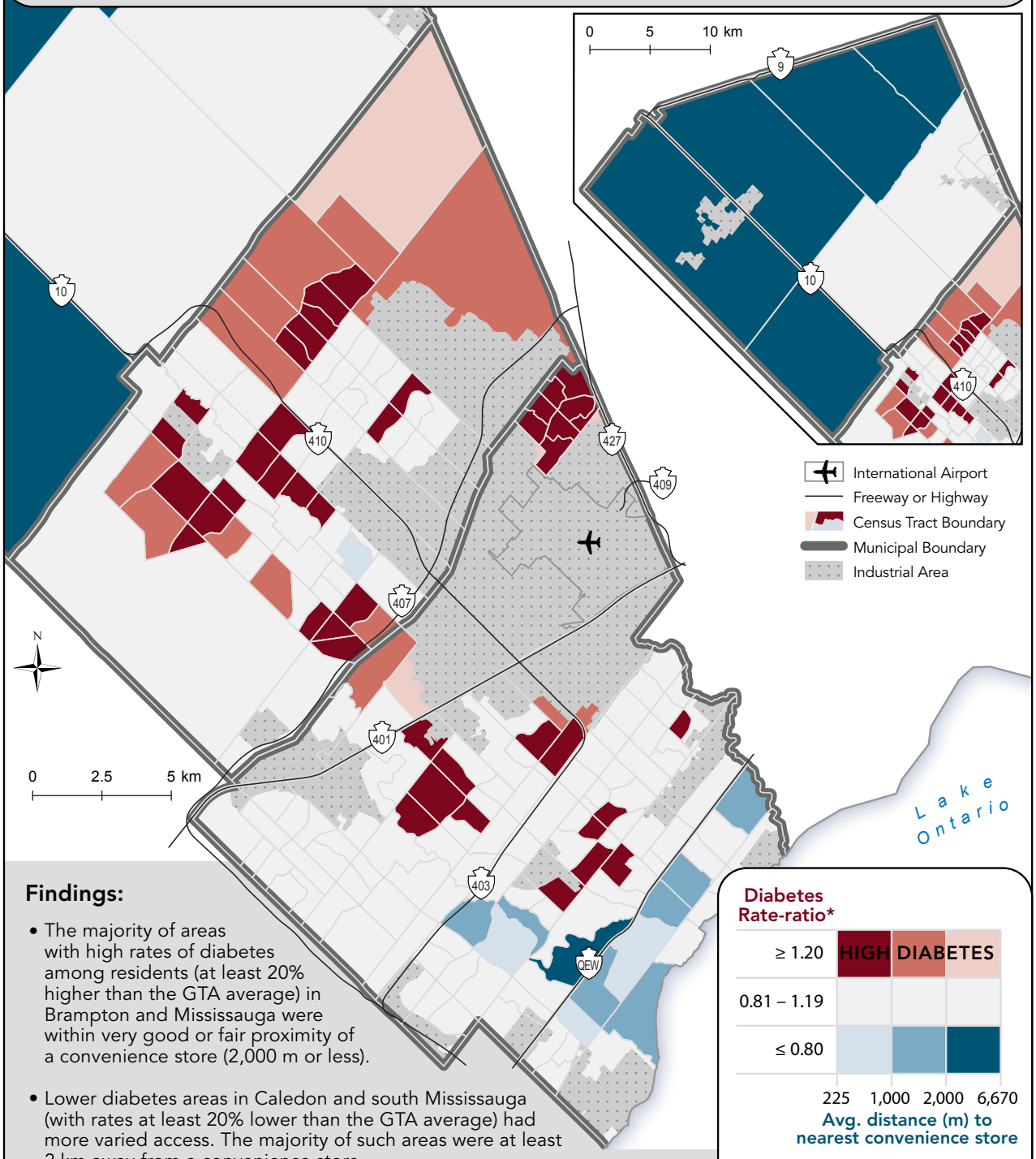
- In areas where diabetes rates were at least 20% higher than in the GTA overall, access to a supermarket/grocery store was generally very good to fair (330 to 2,000 m). However, there were a number of newly developed areas in north and east Brampton, and in central and northeast Mississauga where access was very poor (2,000 m or more).
- Lower diabetes areas (with rates at least 20% below the GTA) in Caledon and south Mississauga had consistently poorer access. In these areas, the nearest supermarket/grocery store was more than 1,000 m away.

*Rate-ratio calculated as:

$$\frac{\text{census tract rate for pop. aged 20+}}{\text{GTA rate for pop. aged 20+}}$$

Overall Greater Toronto Area (GTA) diabetes rate: 9.0%

Exhibit 7.16. Spatial relationship between average road network distance to the nearest convenience store [2011] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

- The majority of areas with high rates of diabetes among residents (at least 20% higher than the GTA average) in Brampton and Mississauga were within very good or fair proximity of a convenience store (2,000 m or less).
- Lower diabetes areas in Caledon and south Mississauga (with rates at least 20% lower than the GTA average) had more varied access. The majority of such areas were at least 2 km away from a convenience store.
- Most areas with good access to a convenience store also had relatively good access to a supermarket or grocery store (Exhibit 7.15) and very good access to fast food (Exhibit 7.17).

Diabetes Rate-ratio*

≥ 1.20	HIGH DIABETES
0.81 – 1.19	
≤ 0.80	

225 1,000 2,000 6,670

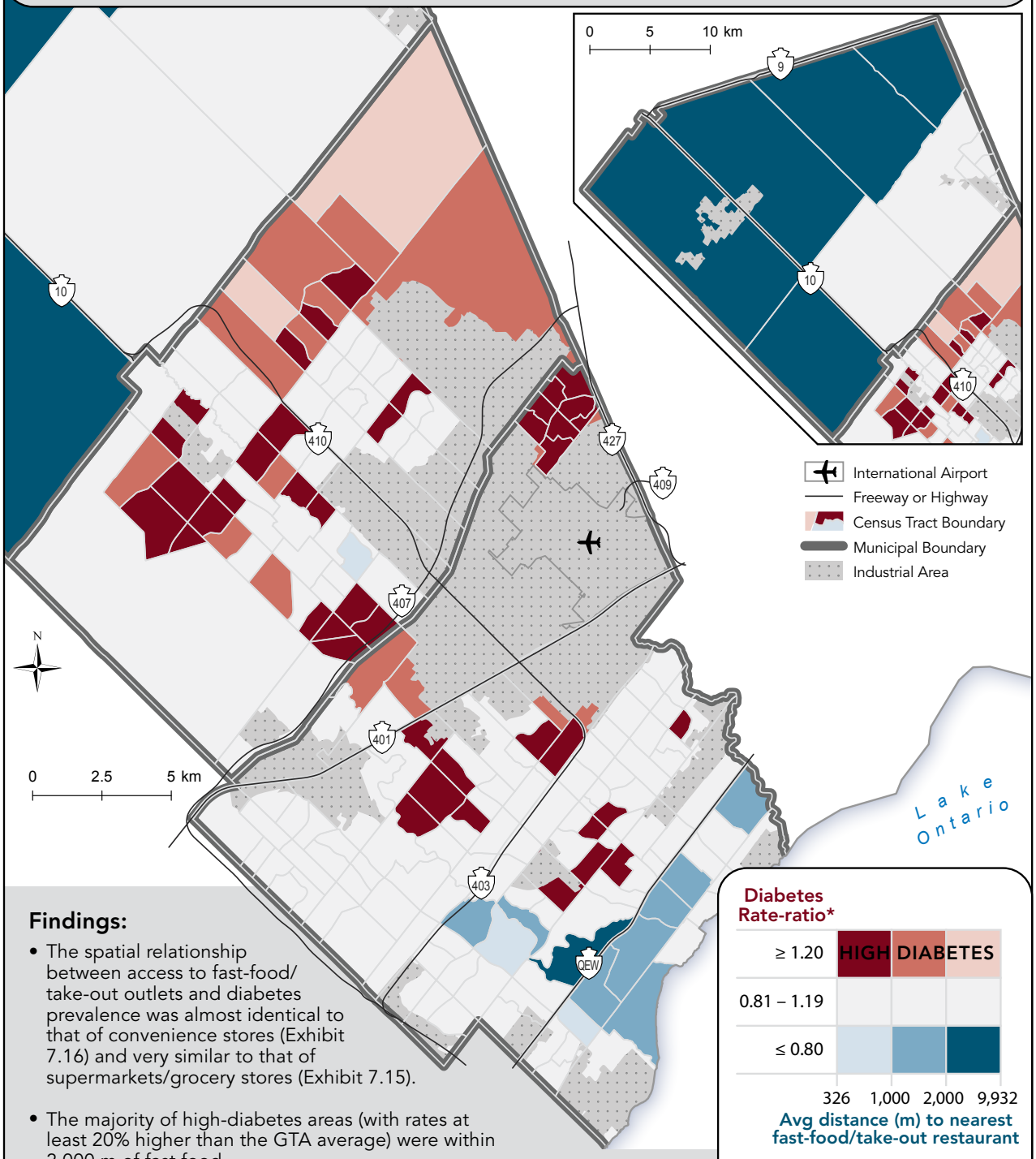
Avg. distance (m) to nearest convenience store

*Rate-ratio calculated as:

$$\frac{\text{census tract rate for pop. aged 20+}}{\text{GTA rate for pop. aged 20+}}$$

Overall Greater Toronto Area (GTA) diabetes rate: 9.0%

Exhibit 7.17. Spatial relationship between average road network distance to the nearest fast-food or take-out restaurant [2011] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



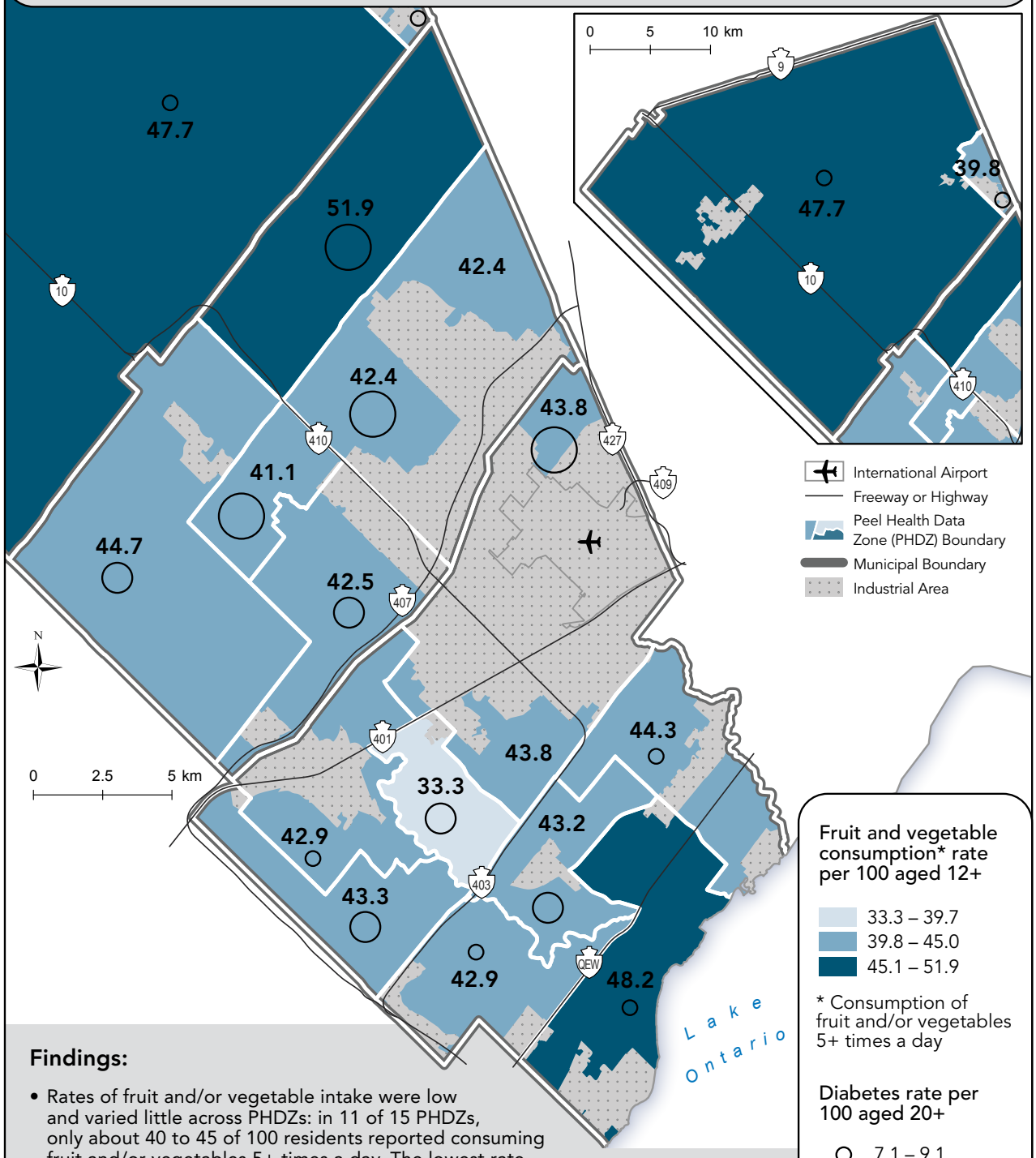
*Rate-ratio calculated as:
census tract rate for pop. aged 20+ / GTA rate for pop. aged 20+

Overall Greater Toronto Area (GTA) diabetes rate: 9.0%

Findings:

- The spatial relationship between access to fast-food/ take-out outlets and diabetes prevalence was almost identical to that of convenience stores (Exhibit 7.16) and very similar to that of supermarkets/grocery stores (Exhibit 7.15).
- The majority of high-diabetes areas (with rates at least 20% higher than the GTA average) were within 2,000 m of fast food.
- Lower diabetes areas (with rates at least 20% below the GTA average) were generally further away from a fast-food/take-out restaurant. Most such areas in Mississauga and all of Caledon were at least 2,000 m away.

Exhibit 7.18. Age- and sex-standardized rate of fruit and vegetable consumption* per 100 people aged 12+ [2003–08] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by Peel Health Data Zone (PHDZ) [2006], in Peel region



Findings:

- Rates of fruit and/or vegetable intake were low and varied little across PHDZs: in 11 of 15 PHDZs, only about 40 to 45 of 100 residents reported consuming fruit and/or vegetables 5+ times a day. The lowest rate was seen in central-west Mississauga (33.3 per 100 persons).
- There was no clear relationship between consuming fruit and/or vegetables 5+ times a day and rates of diabetes prevalence.

DISCUSSION

The local food environment in Peel: availability and accessibility of various food retail outlets

The availability and accessibility of supermarkets, grocery stores, convenience stores, full-service restaurants and fast-food/take-out restaurants varied across Peel, with some areas having much higher availability of outlets than others. In general, both sources of healthy foods (i.e., supermarkets and grocery stores) and less-healthy foods (i.e., convenience stores and fast-food or take-out restaurants) were located in the same areas (e.g., within a single shopping centre). The reverse was also true: areas with fewer stores of one type also had fewer outlets of other types. This pattern of availability paralleled the general land usage patterns across Peel, where retailers cluster in shopping centres and strip-malls that are separated from residential areas by busy roads and large parking lots. This type of zoning pattern discourages walking and promotes the use of cars (for more information, see Chapter 5).

In 2011, supermarkets and grocery stores were widely distributed across residential areas in Peel. Within many areas of Mississauga and Brampton, residents lived within 330 metres to 2,000 metres of the nearest grocery store or supermarket, which represents very good to fair access. Areas with very poor access to these stores were found throughout Caledon, in fringe areas of Brampton and in south Mississauga. These were the same areas with very poor access to other types of retail services (see Chapter 5), as well as recreational facilities (see Chapter 6). All of these areas had low population density (see Chapter 1) and were generally more affluent (see Chapter 3); some areas were recently developed subdivisions (i.e., north and east Brampton).

Fast-food/take-out restaurants and convenience stores were highly prevalent and accessible in most parts of Peel. In east Caledon, central Brampton and throughout much of Mississauga, residents had very easy access to the nearest fast-food or take-out restaurant and convenience store (within 1,000m or less). These food retailers were consistently clustered together; they were also generally located near supermarkets and grocery stores.

The analysis using the Retail Food Environment Index (index of relative availability of less-healthy and healthier food) outlets across Peel Health Data Zones (PHDZs) showed that in all areas, sources of less-healthy food outnumbered sources of more healthy food by a ratio of at least five to one. This finding is not surprising and confirms the well-documented ubiquity of ready-made convenience foods across North America. Many experts believe that limiting the abundance of less-healthy foods within the various settings of daily life will serve as a key step in creating supportive food environments that make the healthy food choice the default choice.[2]

The locations of full-service (i.e., dine-in) restaurants were also very similar to that of other food retail outlets, with a few minor exceptions – most restaurants were located along major roads and a large number were concentrated near or within industrial areas in Brampton and Mississauga. This type of distribution provides easy access to restaurants along major traffic routes, as well as easy access to people who work in nearby areas. No examination of whether better access to full-service restaurants was related to rates of diabetes was conducted. Research to date has not shown a consistent link between weight gain and related health outcomes, and eating at dine-in restaurants.[7, 48]

The local food environment and socioeconomic status

In Peel, there was an association between levels of socioeconomic status (SES) in census tracts and access to food retail. Census tracts with the highest proportion of economically disadvantaged residents (as defined by low income cut-off (LICO); see Appendix 7A) had better access to all types of food retail (i.e., supermarkets, grocery stores, convenience stores and fast-food/take-out restaurants). In fact, all lower income areas had fair access to a supermarket or grocery store, with no area located more than 2,000 metres away from such a store. Similarly, all lower

income areas were located within very good or fair proximity to a convenience store or fast-food outlet. In contrast, access to food retail varied much more widely within the most affluent areas in parts of Mississauga, Brampton and throughout Caledon, with very good access in some areas and much more limited access in other areas.

Housing options for lower income residents are generally more available in closer proximity to major retail centres which contain food stores and eating places (e.g., near Mississauga City Centre). In contrast, more affluent residents of Peel have the option to settle in purely residential areas located far from any commercial or retail activity (e.g., in south Mississauga). Since zoning and commercial siting processes are key determinants of how food retail outlets become distributed, it is possible that in wealthier areas, residents may more effectively advocate the enforcement of zoning laws that keep areas purely residential.[46] Additionally, wealthier areas tend to be more sparsely populated which is another key factor that may discourage stores from moving in (i.e., a smaller population provides a smaller customer base). Low population density very likely accounts for the low availability of supermarkets and grocers across Caledon and in south Mississauga.

The finding that lower income residents in Peel generally had fairly good access to sources of healthy and affordable food is consistent with findings from other Canadian cities that fail to identify pervasive food deserts (i.e., a pattern whereby areas with a high proportion of socially or economically disadvantaged residents consistently have limited access to sources of healthy and affordable foods).[41-46] Furthermore, the finding that lower income residents in Peel were exposed to more sources of unhealthy food than residents of more affluent areas is also consistent with findings from several other Canadian settings.[44, 49, 50] For example, in Edmonton, more economically disadvantaged neighbourhoods (e.g., with higher proportions of low-income residents and renters) had much better access to fast food than more advantaged areas.[44, 49] This pattern is concerning because a number of recent studies found that residents of areas with better access to fast food and convenience stores had worse quality diets and heavier body weights.[23, 27, 34] Additionally, lower income residents may be more sensitive to a local food environment offering abundant unhealthy food choices due to limited transportation options, time constraints and value for money (i.e., tasty, filling and ready-to-eat foods sold at low cost).[31, 49]

The local food environment and rates of diabetes

In Peel in 2011, areas that had a high proportion of residents living with diabetes were generally well served by food retail of all types (i.e., supermarkets, grocery stores, fast-food/take-out outlets and convenience stores), with a few exceptions in parts of Brampton and Mississauga. In contrast, lower diabetes areas, which were home to a higher proportion of wealthier and non-visible minority residents (see Chapters 3 and 4), had lower availability of and limited access to both healthier and less healthy food retail outlets. One explanation for this pattern may be that wealthier individuals have access to other means of transportation for food shopping, including cars and taxis. Interestingly, even neighbourhoods with fewer physical activity resources had lower rates of diabetes if they were affluent (see Chapter 6). This pattern of findings suggests that individuals with higher incomes may have more opportunities to achieve a healthier lifestyle regardless of the resources available (or unavailable) near their homes, and this may protect them against developing type 2 diabetes.[40] Additionally, residents of higher income areas may have a lower risk of diabetes due to a smaller population of residents belonging to ethnic groups with increased genetic susceptibility to developing type 2 diabetes (see Chapter 4).

Patterns of fruit and vegetable intake

The self-reported rates of consuming five or more fruits and/or vegetables per day were low and varied little across PHDZs from 2003 to 2008. In the majority of PHDZs, between 40% and 45% of Peel residents aged 12 years or older reported consuming fruits and/or vegetables five

or more times per day. This represents a much less than ideal level of consumption, but one that is very similar to average levels in Ontario and the country as a whole.[51] In Peel, there was little association between rates of fruit and vegetable consumption with rates of diabetes.

Limitations of these analyses

Several important limitations of these analyses deserve mention. In this analysis, rates of fruit and/or vegetable consumption were based on a survey question that measured the number of times respondents reported consuming fruits and/or vegetables, rather than the quantity consumed. Thus, this measure does not reflect the number of servings of fruits and vegetables that an individual consumed per day, which forms the basis of Canada's Food Guide. There were no additional measures of diet quality, such as the amount of total calories consumed or how often a person consumed energy-dense or highly-processed foods. Canadian data of this type are currently very limited, but will be very important to collect and monitor, so that future studies can use more specific and sensitive measures of a person's diet in order to better assess its relationship with diabetes and other diet-related conditions.

Additionally, geographic availability and accessibility of food retail outlets are only two of the many factors that shape when, where and how individuals access food. Other important factors that were not considered in these analyses include a person's physical mobility status, financial resources and attitudes/beliefs about food and food preparation, as well as wider social and cultural norms shaping how individuals access food and their dietary patterns.[41] For example, families with a limited budget who live near a supermarket such as Loblaws may rarely shop at this store and instead travel outside of their local area in order to do the bulk of their grocery shopping at a discount supermarket (e.g., No Frills or Food Basics). Furthermore, in this chapter, only a single setting within the overall food environment (i.e., the local or community food environment) was examined. Other important settings include the food environment within organizations and institutions, within stores and restaurants, as well as the information environment (e.g., food marketing).

Although several types of food stores and commonly patronized eating places were examined, the availability and accessibility of other types of retail food outlets (e.g., bakeries, specialty stores, farmers' markets, cafeterias) were outside the scope of this analysis. Furthermore, the classification of healthier and less-healthy food outlets was based solely on the venue type and not on the inventory of foods actually sold within each outlet.[34, 35] This classification scheme may have inaccurately classified a subset of Peel's stores or eating places. The classification of healthier food outlets was intended to identify stores where a variety of fresh produce is commonly available at a reasonable cost, while less-healthy outlets were those where such foods are in very limited supply and where the balance of food choices weighs heavily toward less healthy ones. Thus, although most supermarkets and large grocery stores carry a variety of less healthy food products, these stores also tend to be a reliable and affordable source of a wide variety of fresh produce. In contrast, the menus of most fast-food and take-out restaurants are dominated by foods and/or beverages high in calories, fat, sodium and sugar and low in fibre. Even though many such outlets offer a limited number of healthier or "better-for-you" choices, traditional less-healthy foods, foods and/or beverages high in calories, fat, sodium, sugar and low in fibre, remain the dominant default within many fast food restaurants; these foods are also the most heavily marketed both inside and outside of restaurants.[52] Additionally, the sale volume of healthier foods like salads within many major chain fast-food franchises such as McDonald's lags far behind the sale of less healthy menu choices, suggesting that traditional fast foods (e.g., burgers and fries) continue to be the most popular choices among patrons of fast-food establishments.[53]

Finally, convenient access to stores selling ethnically-specific foods is another key issue for the many ethnoculturally diverse groups living in Peel. Unfortunately, there was no data on the locations of various ethno-specific food stores in Peel.

CONCLUSIONS AND IMPLICATIONS

A healthy diet is essential for both the prevention and control of type 2 diabetes; it is also a key component of maintaining a healthy body weight.

In Peel, sources of healthy food (i.e., supermarkets and grocery stores) and less healthy food (i.e., fast-food/take-out restaurants and convenience stores) were generally located in the same areas. In all areas, sources of less healthy food greatly outnumbered sources of healthy food by a factor of at least five to one. Access to all types of food retail outlets was very good near Bolton, throughout central Brampton and in many parts of Mississauga, while limited access existed in other parts of Caledon, northeast Brampton and in south Mississauga. The patterns of food outlet distribution paralleled a high concentration of other retail services in the same areas, as well as patterns of population density in Peel.

More economically disadvantaged areas, as well as areas home to a higher proportion of residents living with diabetes, were generally better served by sources of healthy food compared with the wealthiest areas. However, these areas also had better access to sources of less-healthy food, which greatly outnumbered sources of healthy food. In contrast, both higher income and lower diabetes areas had reduced access to food retail of any type. The finding that areas with lower income and higher diabetes rates were exposed to more sources of unhealthy food is concerning because of growing evidence that better access to less-healthy foods – regardless of access to healthy food – may be related to poorer diet and weight gain.

In Peel, efforts to ensure that all residents have easy access to sources of nutritious, affordable food will continue to be important. Many newly developed and sparsely populated areas in Peel, including several areas with a high proportion of residents with diabetes in east and north Brampton, have limited access to retail services of any kind. In new developments and in rapidly developing areas, there is a real opportunity to shape the local food landscape by introducing economic incentives or changes to zoning regulations to encourage the location of healthy and culturally-appropriate food retailers such as large food stores and smaller ethno-specific or specialty stores.

As public schools across Ontario adopt a new healthy food policy which shifts the balance of food choices toward more healthy ones,[54] it will be equally important for Peel's public health professionals and residents to re-examine the menu of retail food choices available within their communities. As this chapter illustrates, the current balance of the local retail food environment weighs much more heavily toward outlets offering energy-dense, highly-processed and lower-nutrient foods, such as the types of foods most frequently available for purchase in fast-food outlets and convenience stores. There is clear evidence that limiting the consumption of such foods is important for preventing obesity and both preventing and managing diabetes. Given the current ubiquity and popularity of ready-made convenience foods across Canada, policies to promote healthier food choices among consumers, as well as initiatives that encourage fast-food outlets and other eating places to create healthier menus and reduce portion sizes, should be promoted.

While many forces that shape our food environment lie well outside community-level settings (e.g., food marketing practices; global trade and agricultural policies that promote the production of particular food products such as high-fructose corn syrup), many important initiatives could be undertaken at the local level to help create supportive environments for healthy eating in communities. For example, working with local business owners to increase offerings of fresh produce and/or ethno-specific foods within convenience stores or gas stations is one promising avenue for future community-led initiatives. Limiting access to less-healthy food through changes in zoning regulations in settings such as schools may also be an avenue toward creating environments that encourage and better support healthy eating on a daily basis.

Given that most Canadians do not follow healthy eating recommendations and more than half are overweight or obese, public health measures to encourage and support healthy eating must be considered a major priority. To achieve population-wide improvements in eating, such actions must be undertaken at multiple levels (i.e., local, provincial, federal) and must target the multiple food environments and conditions that influence people's daily food choices.

APPENDIX 7.A – RESEARCH METHODOLOGY

Data Sources

- The locations of all outlets serving or selling food in Peel in 2011 were provided by Peel Environmental Health. From this food premise list, we selected the five most common food retailer types: supermarkets, grocery stores, convenience/variety stores, fast-food or take-out restaurants, and full-service restaurants. We generally followed the same classification of stores and eating places as those provided in the food premise database, but completed some additional re-classifying to suit the needs of our analyses. Table 1 defines each type of food retail venue included in our analyses and provides examples.
- The low-income cut-off (LICO) is a derived variable from the 2006 Canadian census which reflects 2005 income data. The low-income cut-off (LICO) was derived for economic families and persons aged 15 years or older in private households who were not in economic families. The LICO refers to income levels whereby an individual spends a significantly higher than average proportion of their total income on food, shelter and clothing.
- Age- and sex-adjusted diabetes rates were calculated using data from the Ontario Diabetes Database and other administrative data sources held at the Institute for Clinical Evaluative Sciences (see Chapter 2, Appendix 2.A for full details).
- Data from the 2003 (cycle 2.1), 2005 (cycle 3.1) and 2007/2008 waves of the Canadian Community Health Survey (CCHS) were used to determine rates of self-reported fruit and vegetable consumption in Peel Health Data Zones (PHDZs). Fruit and vegetable consumption was examined by calculating the percentage of the Peel population aged 12 or older who reported eating fruit and/or vegetables at least five times per day. This variable examines the frequency of consumption, and not the quantity consumed. Thus, this variable does not translate to number of daily servings.[51]
- In order to remove any influence due to differences in the population's age and sex distribution across PHDZs, we standardized the rates of fruit and/or vegetable intake to the 1991 Canada census population.
- Statistics Canada's specific guidelines for reporting estimates based on CCHS data were followed (see Appendix 2.A for more details about these reporting guidelines).

Analysis

The availability and accessibility of various retail food establishments throughout Peel region was examined. Availability was depicted in two ways on maps included in this chapter:

- The first method used symbols to show the locations of resources (e.g., supermarkets across the region). This method allowed us to determine where services were located and whether certain resources existed in specific census tracts.
- The second method used choropleth (shaded) maps to show the density of resources in each area, taking population into account (i.e., the number of convenience stores per 10,000 residents). This method shows where resources were located in relation to where people lived and which areas had more resources per capita than others.

The Retail Food Environment Index (RFEI) was calculated in each PHDZ as follows:

$$\text{RFEI} = \frac{\text{Convenience stores} + \text{Fast-food restaurants} + \text{Take-out restaurants}}{\text{Supermarkets} + \text{Grocery stores}}$$

The RFEI represents the mix or ratio of less-healthy retail food sources to healthier food outlets within a given geographic area. Larger areas (the PHDZs) were used to calculate this measure because many smaller areas (i.e., census tracts) contained no food outlets of any kind, or contained no healthy food outlets (which yields 0 in the denominator).

Access or accessibility as shown on the accessibility maps was measured as the shortest distance along the street network to the nearest resource location from each point in a 150-metre grid of starting points located across Peel region. That is, the distance along the network of streets and highways from each starting point to the nearest food retail outlet of each type was measured.

To assess the spatial relationship between accessibility to stores/eating places and the level of economic disadvantage in Peel, three categories of the per cent of the population below the LICO at the census tract level were created. All census tracts were ordered according to the per cent of their population below the LICO (from lowest to highest) and then divided into three groups with an equal number of census tracts. To compare the least and most economically disadvantaged areas, the first and the third group (i.e., areas with the lowest and highest per cent of its population below the LICO) were selected. The levels of accessibility to the nearest supermarkets/grocery store, convenience store and fast-food/take-out restaurant were depicted for each group. Areas with a medium percentage of their residents below the LICO (8.0%–12.0%) were depicted in a single grey colour.

The spatial relationship between food retail accessibility measures and rates of diabetes prevalence that were either much higher (20% or more) or much lower (20% or less) than the Greater Toronto Area (GTA) average diabetes rate of 9.0% were evaluated. For each Peel census tract, the diabetes rate was divided by the overall GTA rate to calculate a rate-ratio. Census tracts with diabetes rates that were meaningfully higher than in the GTA as a whole (rate-ratio of ≥1.2) were depicted in shades of red, while tracts with rates much lower than in the GTA (rate-ratio of ≤ 0.80) were depicted in shades of blue. All census tracts whose rates did not differ substantially from the GTA rate (rate-ratio between 0.81 and 1.19) were depicted using a single grey colour.

Finally, the average rate of consuming five or more fruit and/or vegetables per day was depicted for each PHDZ using a shaded (choropleth) map. Associated rates of age- and sex-standardized diabetes prevalence in each PHDZ were overlaid on this map using proportional symbols (circles). The three categories of diabetes prevalence were derived from population-weighted tertiles of diabetes prevalence in PHDZs (i.e., all PHDZs were ordered from lowest to highest diabetes prevalence and then divided into three groups with equal populations). This method was used in order to create a reasonable distribution of rates across the small number of these relatively large spatial units.

Table 1. Food Retail Descriptions

Food outlet type (number of outlets)	Description
Supermarket (184)	Large food stores offering a full line of grocery products and may include specialty departments such as deli, bakery, butcher shop, seafood counter and pharmacy.
Grocery store (60)	All other smaller retail food stores, other than a supermarket or convenience store, selling a line of dry grocery, canned goods or perishable food items.
Convenience/variety store (474)	Small establishments selling a limited selection of grocery and other basic daily-living items. These stores are open outside of normal operating business hours. Stores located inside gas stations were included.
Fast-food or take-out restaurant (1,165)	Multi-national and national franchised or locally-owned limited- or quick-service restaurants (i.e. where there is no table service and where customers pay before receiving their food) that serve either full meals or snacks. Includes pizza shops, coffee shops and food court vendors.
Full-service restaurant (1,223)	Eat-in restaurants with table service where customers generally pay at the end of their meal. Both locally-owned and larger national and multi-national chain restaurants were included.

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Chapter 8

Community-Based HEALTH SERVICES and Diabetes

INSIDE

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HIGHLIGHTS

Issue

- Access to and regular use of health services is essential for the prevention, early diagnosis and optimal management of diabetes as well as the prevention of diabetes-related conditions.
- Diabetes is a leading cause of blindness, heart disease, stroke and kidney problems. Good diabetes care and management can prevent or delay the onset of these complications. Because diabetes can be complicated to manage, people with this disease require close follow-up by a multidisciplinary team of health care professionals, which may include their primary care provider, diabetes educators (nurse and dietitian) and a range of specialists (including an eye care specialist and endocrinologist), as needed. People with diabetes also play an essential role in their own self-care.
- The purpose of this chapter is to examine the distribution of and geographic access to health service providers in Peel who are involved in caring for people with diabetes. The spatial distribution and accessibility to family physicians/general practitioners, diabetes specialists (i.e., endocrinologists, ophthalmologists, optometrists) and diabetes education programs is the focus of this chapter.

Key Findings

- There was a fairly even distribution of family physicians/general practitioners (FPs/GPs) across Peel region with a higher concentration located in central Mississauga. FPs/GPs were also well distributed in relation to concentrations of adults aged 20+ with diabetes.
- In north and northeast Brampton and in many parts of Caledon, there were longer travel distances to the nearest location of an FP/GP than in the rest of Peel.
- There was good overall distribution of eye specialists (i.e., ophthalmologists and optometrists, and especially optometrists), but fewer endocrinologists, who were located almost exclusively near major hospitals in Peel. Many areas in Peel had travel distances of 5 km or more to the nearest endocrinologist and parts of west Brampton and most of Caledon had travel distances of 10 km or more.
- Diabetes education programs were offered at relatively few locations in Peel. Programs were scattered throughout Mississauga and Brampton and found in only one location in Caledon (in Bolton). Currently, few or no diabetes education programs are located in the rapidly developing, higher immigration and high diabetes area of north, northeast and east Brampton.

Implications

- Although geographic access to health services in Peel was fairly good, there are other aspects of health service access that was not captured in these analyses, but nevertheless are important facilitators of overall population health. These include difficulties using services due to cultural and social factors, physicians who may be located nearby but are closed to accepting new patients, wait times to get an appointment and long distances to service providers without adequate forms of local public transportation.
- Given the growth in immigration and rising rates of diabetes in Peel, it is important that Public Health and municipal planners take into account the ethnocultural preferences of certain population sub-groups when determining the kinds of programs and health services that best suit community needs, including their accessibility.
- Diabetes education programs and other diabetes services play a critical role in the treatment of diabetes and its complications. The expansion of diabetes education programs and satellite centres should be based on population needs and be located in relatively underserved areas. Programs also need to deliver culturally appropriate services that address the needs of the population living in Peel.

INTRODUCTION

Health Services and Diabetes

Diabetes is one of the most commonly encountered conditions in primary practice[1] accounting for nearly seven million visits to family physicians/general practitioners (FPs/GPs) each year in Ontario alone.[2] Ontarians aged 20 and older with diabetes had a mean of 7.3 FP/GP visits per year.[3]

People with diabetes require access to good quality healthcare to help them navigate the often complicated pathway associated with managing their disease. Intensive management of risk factors associated with diabetes complications can reduce the rate of major complications such as heart attacks, stroke, amputation and death by up to 50%.[4] Regular management, as well as continuity of care (defined as a continuous relationship between patients and their care providers sustained over time), is very important for achieving better outcomes for chronic diseases such as diabetes.[5, 6] Although the majority of diabetes patients are managed by primary care providers, access to specialists (e.g., endocrinologists and ophthalmologists) is necessary for more complex diabetes problems and patients with type 1 diabetes.[7]

Diabetes care depends on the daily commitment of the person with diabetes to self-management practices, preferably with the support of an integrated diabetes healthcare team.[8-10] The diabetes healthcare team should be multi- and inter-disciplinary. It should establish and sustain a communication network among the health and community systems needed in the long-term care of the person with diabetes. Members of the core team should include a family physician/general practitioner and/or a specialist, and diabetes educators (e.g., nurse and dietitian).[8-13] The person with diabetes and his or her family should also be central members of the team. Family support has been shown to benefit the person with diabetes.[14] The membership of the team may also include numerous other personnel (e.g., pharmacist).

Individuals with diabetes often have multiple chronic conditions making diabetes management more challenging. Diabetes treatment is often complex and can be expensive, making it one of the most burdensome and costliest chronic diseases of our time.[3] As a result of the complexity of the disease, it is essential that high-quality health services be provided to assist patients and their families dealing with the many facets of diabetes prevention and care.

Family Physicians/General Practitioners (FPs/GPs)

When Ontarians have a new health problem they usually visit their family physician/general practitioner (FP/GP) first. FPs/GPs contribute to the delivery of most health services in Ontario, including diabetes diagnosis, treatment and management. In Ontario, a large proportion of diabetes management is shouldered by FPs/GPs, with three-quarters of the population receiving diabetes care from their FP/GP only.[2] In fact, FPs/GPs identify diabetes as one of the most common chronic diseases managed in primary health care.[15, 16] Ontarians living with diabetes visit a physician twice as often as members of the general population.[2]

FP/GPs also screen patients who may be at risk for developing diabetes. The Canadian Diabetes Association (CDA) Clinical Practice Guidelines recommend routine screening for diabetes every three years for all adults aged 40 years and older.[17] Earlier and more frequent screening is warranted in specific high-risk groups, including individuals of Asian, African, Hispanic and Aboriginal descent.[17] Screening also identifies individuals with pre-diabetes, which refers to higher than normal levels of blood glucose, but not yet high enough to be diagnosed as type 2 diabetes. Although not everyone with pre-diabetes will develop type 2 diabetes, many will.[17]

It is important to identify pre-diabetes, because the progression to diabetes can be prevented or delayed by lifestyle changes involving dietary improvements, increased physical activity and modest weight loss (5% –7% of body weight), as well as taking certain medications.[18,19] Furthermore, research has shown that some long-term complications associated with diabe-

tes – such as coronary heart disease (CHD) and nerve damage – may begin during pre-diabetes.[20] Screening in primary care can detect people whose estimated cardiovascular disease (CVD) risk is high and potentially modifiable.[21]

Regular diabetes care is important due to the large number of routine screening tests and adjustments to treatment regimens required to optimize the control of diabetes and associated risk factors.[3] The long-term complications of diabetes can be delayed or prevented through specific interventions, such as tight control of blood sugar levels, cholesterol and blood pressure levels.[4] Good glycemic (glucose) control is associated with the prevention or delay of diabetes complications including diabetic eye disease, kidney disease and neuropathy.[17]

Regular diabetes management is critical. Patients with diabetes who failed to see a primary care physician during the previous year had a two-fold higher risk of being hospitalized or being seen in an emergency department for uncontrolled diabetes (blood sugar too high or too low).[22] In contrast, patients who had a regular provider and visited a physician more frequently had fewer of these episodes.[22] It has also been shown that persons with diabetes who saw their FP/GP at least three times a year were one-third less likely to require a diabetes-related amputation over the next five years compared with those with fewer annual visits.[23]

For patients with diabetes, having an ongoing relationship with the same health care provider not only facilitates continuity of care, but provides an opportunity to learn more about the long-term management of the disease. A regular primary care provider conducts important routine screenings that can identify and subsequently help modify and manage the risk factors for diabetes-related comorbidities (concurrent conditions). They also provide the ongoing support and care that patients with diabetes need to help them not only with the day-to-day management of their disease, but to direct them to other resources and care as required.[5, 24] Primary care providers also integrate diabetes care with preventive health care, provide lifestyle counselling, provide care for other acute and chronic conditions, and coordinate care among various specialists, teams and institutions.

DIABETES SPECIALISTS

Endocrinologists

Referral to an endocrinologist is one of a number of measures available to primary care providers to aid patients who are not meeting therapeutic targets. Most endocrinologists provide specialized care for diabetes and have expertise in managing complex diabetes regimens. However, other types of physicians, including specialists in general internal medicine, may also specialize in diabetes management. Endocrinologists may work in either hospital or community-based settings, often in close proximity to centres offering diabetes education programs. Although many patients with diabetes will not need specialist care in order to achieve treatment targets, specialized health care provided by endocrinologists should be available to those who do.

Ophthalmologists and optometrists

Eye problems are a common complication of diabetes that can lead to serious loss of vision or blindness. Fortunately, vision loss associated with diabetes may be averted through prevention strategies, early detection and treatment. Access to an ophthalmologist or optometrist with experience in detecting diabetic eye disease (retinopathy) is essential for preventing vision loss.[25] The Canadian Diabetes Association (CDA) Clinical Practice Guidelines recommend that all patients with diabetes undergo regular screening and evaluation for diabetic retinopathy by an expert professional (i.e., ophthalmologist or optometrist). To do so, a dilated eye examination should be performed at the time of diabetes diagnosis (for those with type 2 diabetes) and annually (in all patients with diabetes).[17] In Ontario, routine retinal screening and other essential eye services for people with diabetes are covered by the Ontario Health Insurance Program (OHIP).[26]

Diabetes education programs

Education is essential in the treatment of diabetes and people with diabetes are encouraged to take an active role in the day-to-day management of their own health care (self-management).[27] However, self-management requires certain skills. These skills can be learned from professionals such as nurses, registered dietitians and trained diabetes educators located within a community- or hospital-based diabetes education program, or a primary care practice setting (e.g., Family Health Team). Other important diabetes professionals may include a social worker, psychologist, foot care specialist (podiatrist or chiropodist), pharmacist or physiotherapist. Diabetes education programs commonly offer group as well as individual counselling to patients on strategies to maintain a healthy diet, undertake regular physical activity, control blood sugar levels and reduce the risk of complications, including how to recognize hypoglycemic (low blood sugar) reactions and treat them appropriately.[27] Most programs also provide advanced training on how to self-administer insulin and adjust its dose. Effectively educating people living with diabetes to better manage their condition can lead to improved glucose control and may reduce their likelihood of developing diabetes complications.[10] Thus, individuals with diabetes play a key role in managing their disease and improving their own quality of life.

Geographic access to health services

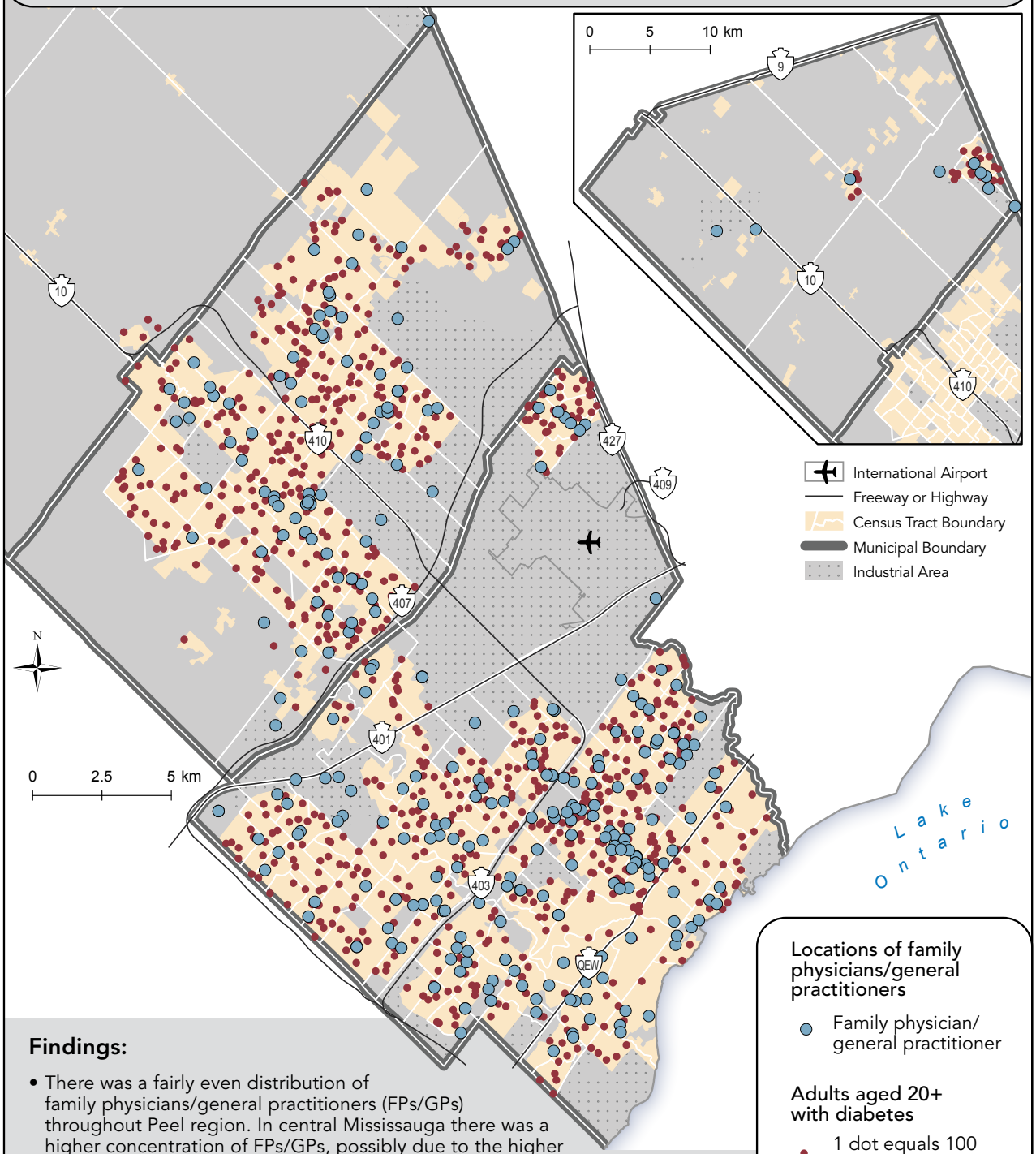
Geographic access to primary care is an important facilitator of overall population health.[28] While having good geographic access is not always sufficient for people to access the health care they need, it is an essential prerequisite for care. For example, geographic proximity to a family doctor may not necessarily mean that doctor is taking on new patients.[29] Additionally, language, social, cultural and transportation issues can also act as barriers to care despite geographic proximity to a healthcare provider.

In this chapter, the geographic distribution of diabetes care providers in Peel is examined. The services provided by family physicians/general practitioners (FPs/GPs), specialists (e.g., endocrinologists, ophthalmologists/optometrists) and diabetes education programs are studied. In addition, geographic access to services (represented by travel time to diabetes care providers and diabetes education programs) is explored in relation to the prevalence of diabetes in Peel.

LIST OF EXHIBITS

EXHIBITS AND FINDINGS

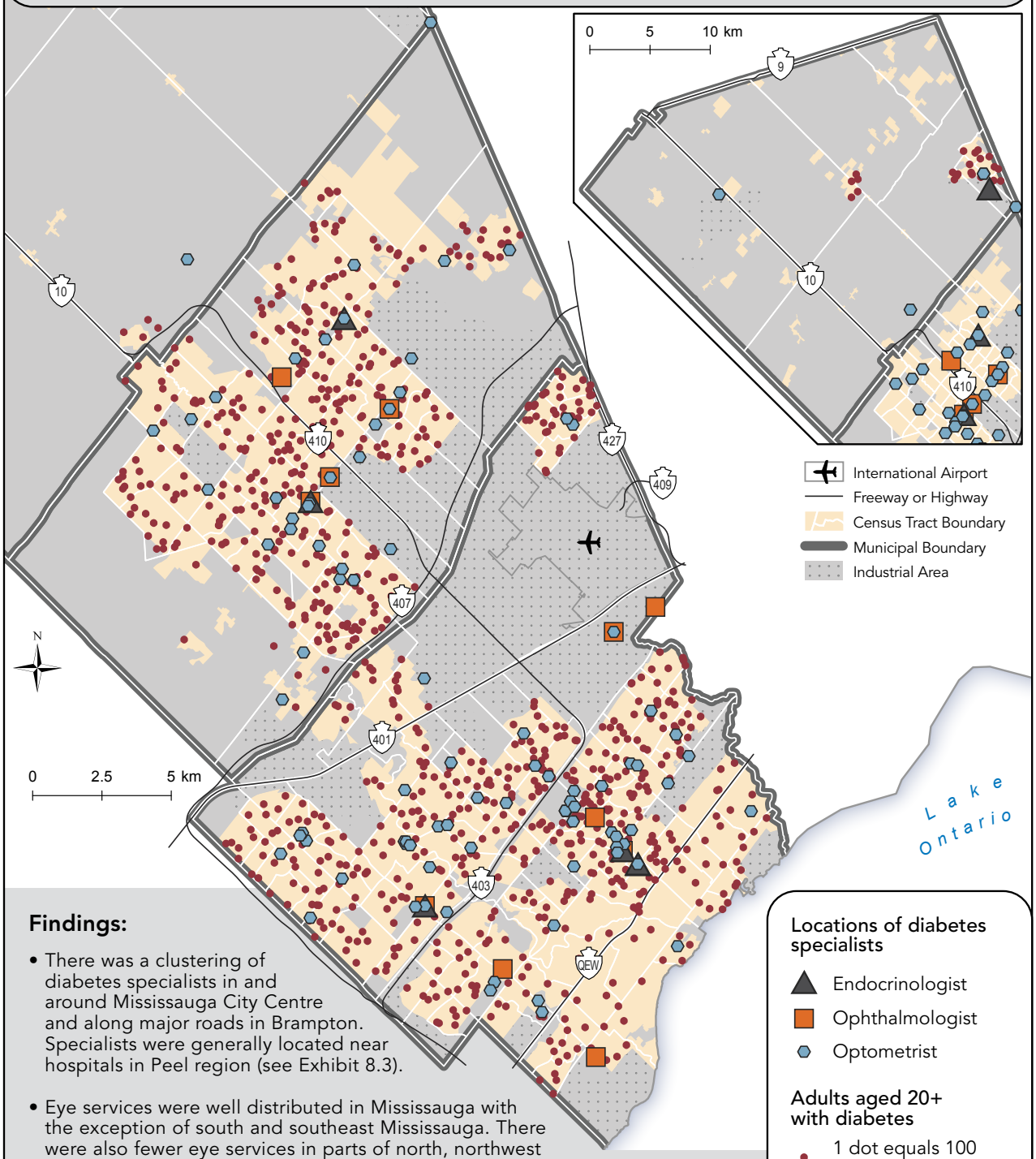
Exhibit 8.1. Locations of family physicians/general practitioners (FPs/GPs) [2009] and distribution of adults aged 20+ with diabetes [2007], by census tract [2006], in residential areas [2009], in Peel region



Findings:

- There was a fairly even distribution of family physicians/general practitioners (FPs/GPs) throughout Peel region. In central Mississauga there was a higher concentration of FPs/GPs, possibly due to the higher population density in this area (see Exhibits 1.9 and 1.10).
- There was a small pocket in central Brampton with fewer FPs/GPs as well as fewer FPs/GPs located in the newly developing areas of north, east and northwest Brampton.

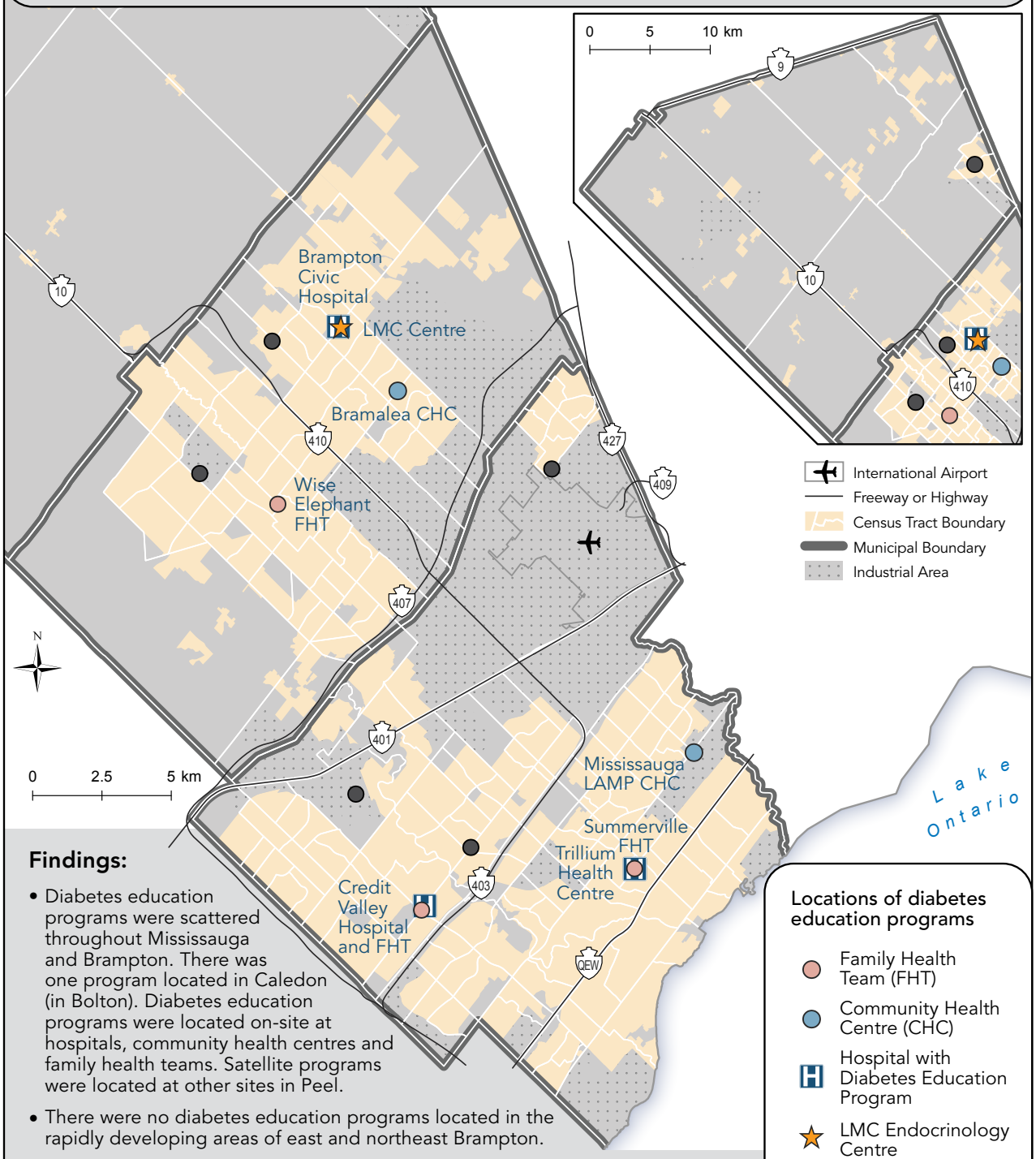
Exhibit 8.2. Locations of diabetes specialists (endocrinologists, ophthalmologists and optometrists) [2011] and distribution of adults aged 20+ with diabetes [2007], by census tract [2006], in residential areas [2009] of Peel region



Findings:

- There was a clustering of diabetes specialists in and around Mississauga City Centre and along major roads in Brampton. Specialists were generally located near hospitals in Peel region (see Exhibit 8.3).
- Eye services were well distributed in Mississauga with the exception of south and southeast Mississauga. There were also fewer eye services in parts of north, northwest and southeast Brampton and in Caledon (with the exception of Bolton).
- Endocrinologists were not as well distributed as eye services. Almost all endocrinologists in Peel were located near major hospitals in Brampton and Mississauga (see Exhibit 8.3).

Exhibit 8.3. Locations of diabetes education programs [2011] in Peel region

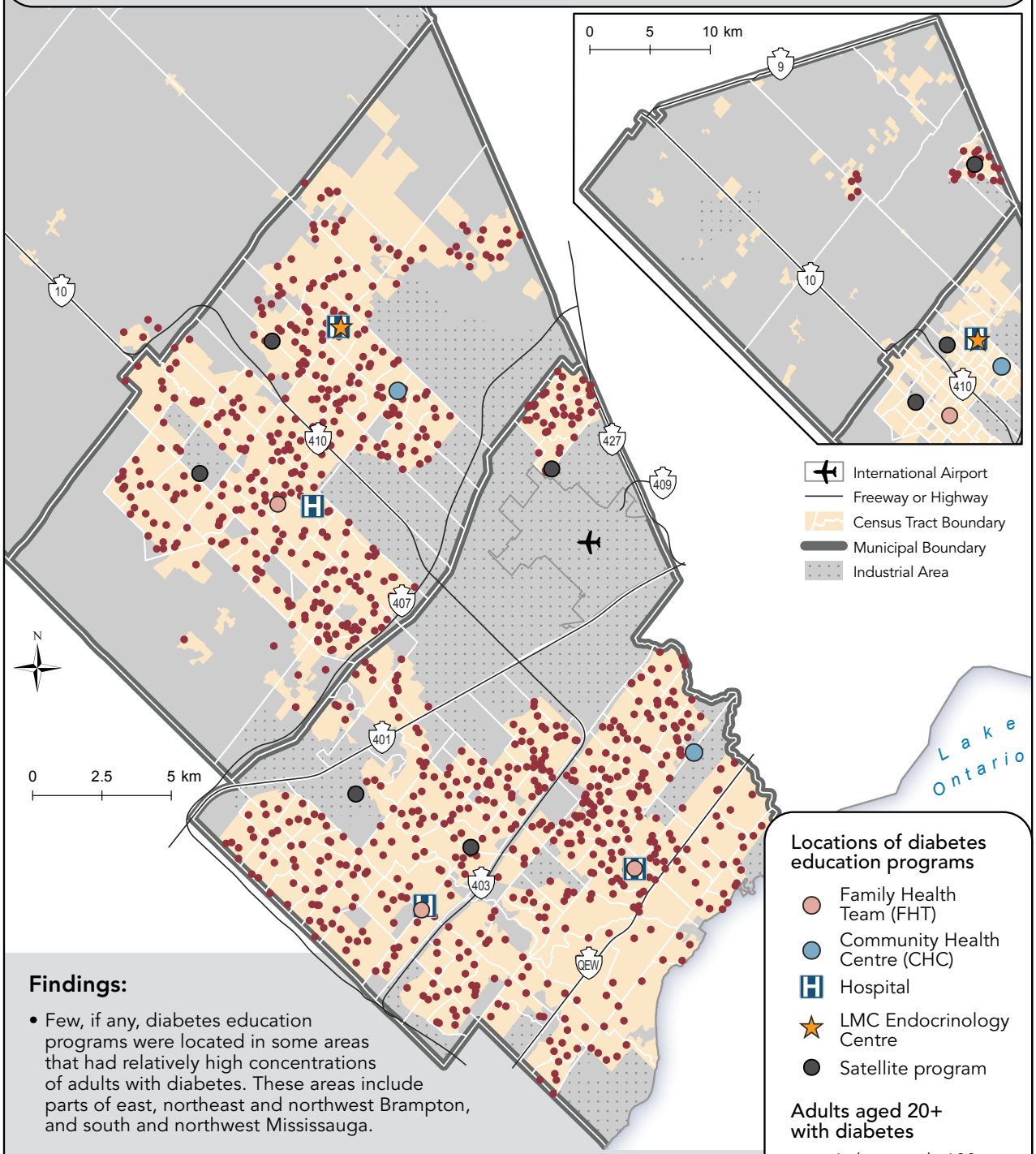


Findings:

- Diabetes education programs were scattered throughout Mississauga and Brampton. There was one program located in Caledon (in Bolton). Diabetes education programs were located on-site at hospitals, community health centres and family health teams. Satellite programs were located at other sites in Peel.
- There were no diabetes education programs located in the rapidly developing areas of east and northeast Brampton.

Note: This map shows the locations of on-site and satellite diabetes education programs/services offered by family health teams (FHTs), community health centres (CHCs) or hospitals in Peel. Diabetes education programs/services offered through individual or other family physician/general practitioner (FP/GP) practices are not shown on this map.

Exhibit 8.4. Locations of diabetes education programs [2011] and distribution of adults aged 20+ with diabetes [2007], by census tract [2006], in residential areas [2009], of Peel region

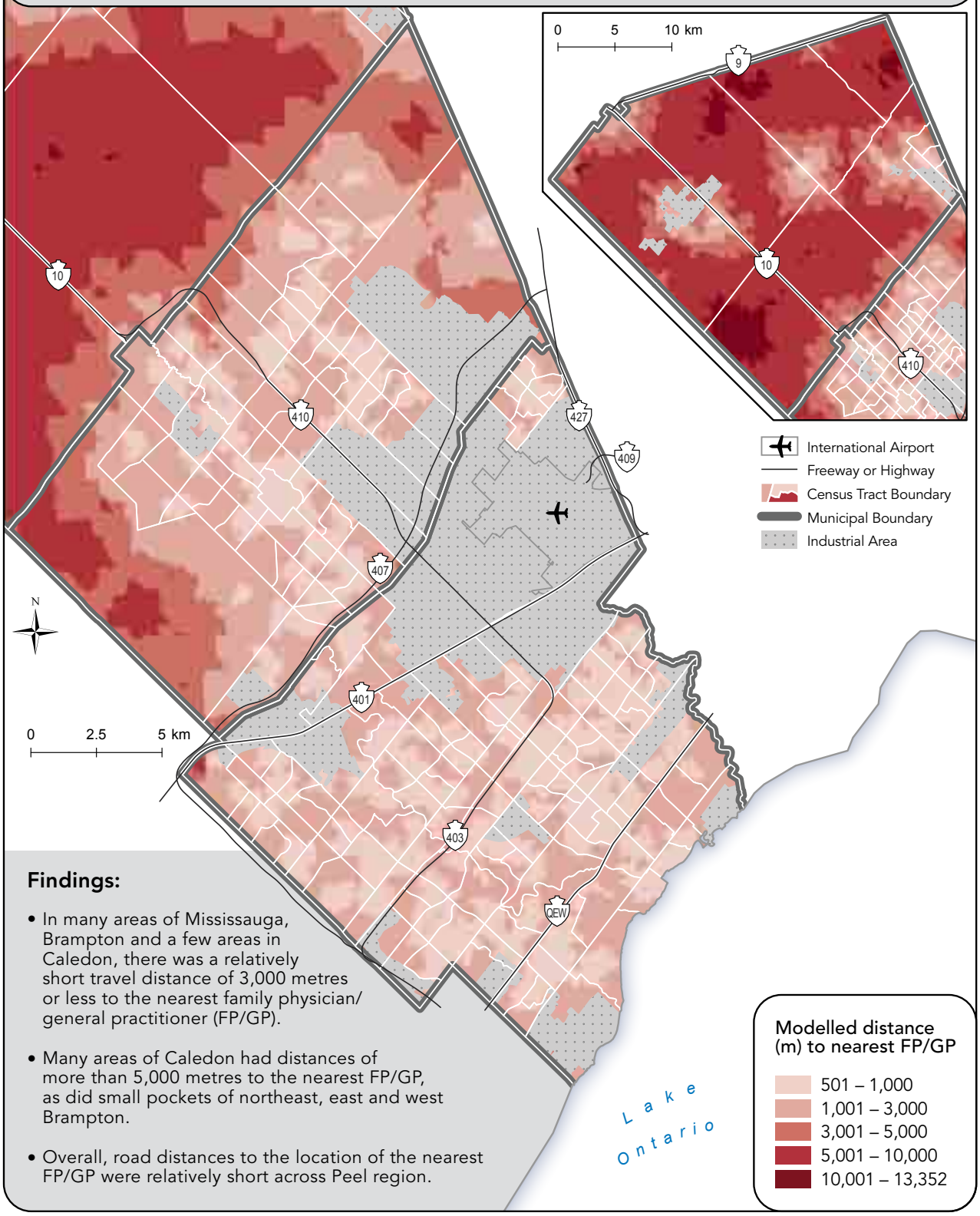


Findings:

- Few, if any, diabetes education programs were located in some areas that had relatively high concentrations of adults with diabetes. These areas include parts of east, northeast and northwest Brampton, and south and northwest Mississauga.

Note: This map shows the locations of on-site and satellite diabetes education programs/services offered by family health teams (FHTs), community health centres (CHCs) or hospitals in Peel. Diabetes education programs/services offered through individual or other family physician/general practitioner (FP/GP) practices are not shown on this map.

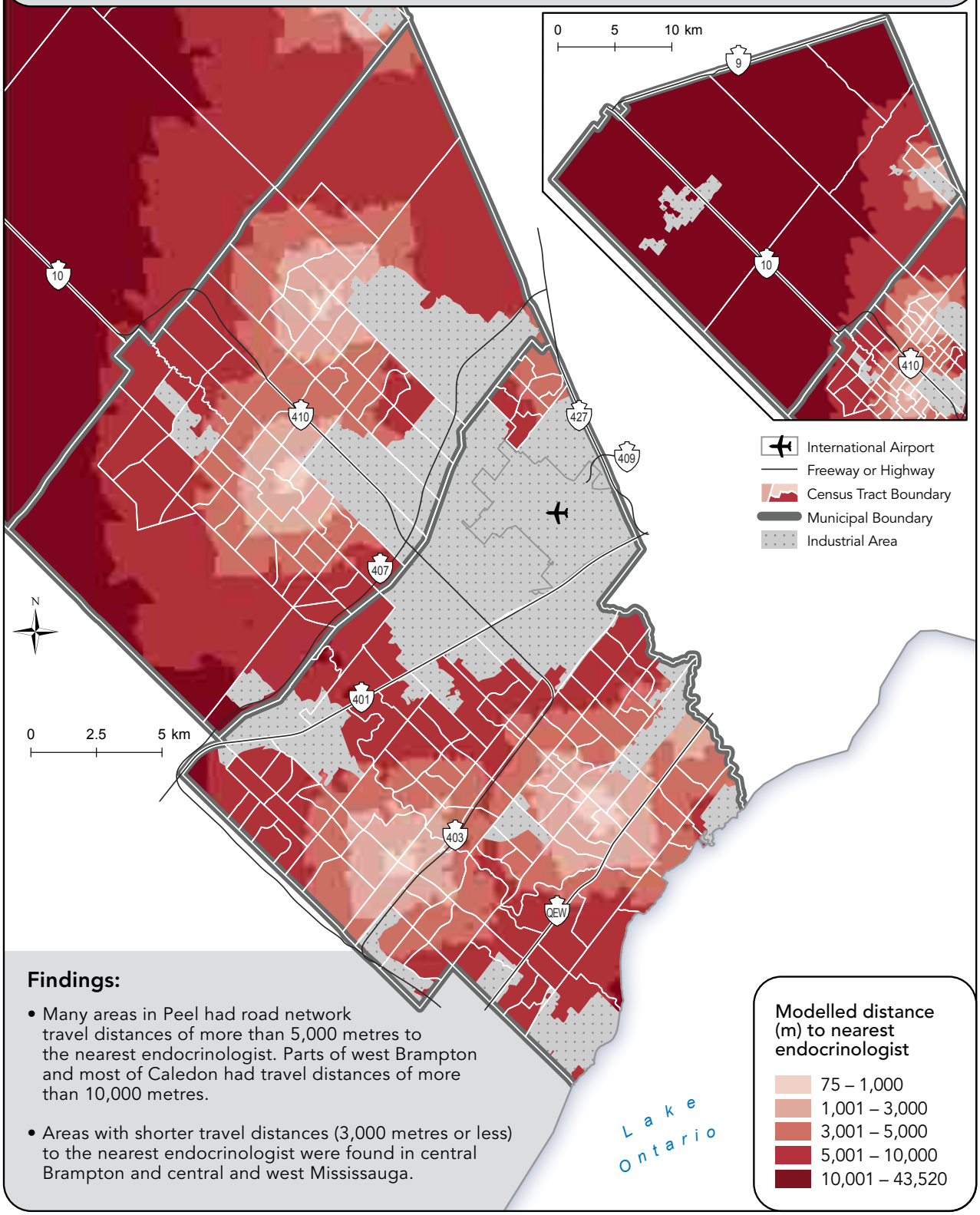
Exhibit 8.5. Modelled travel distance along the road network [2009] to the nearest location of a family physician/general practitioner (FP/GP) [2009], in Peel region



Findings:

- In many areas of Mississauga, Brampton and a few areas in Caledon, there was a relatively short travel distance of 3,000 metres or less to the nearest family physician/ general practitioner (FP/GP).
- Many areas of Caledon had distances of more than 5,000 metres to the nearest FP/GP, as did small pockets of northeast, east and west Brampton.
- Overall, road distances to the location of the nearest FP/GP were relatively short across Peel region.

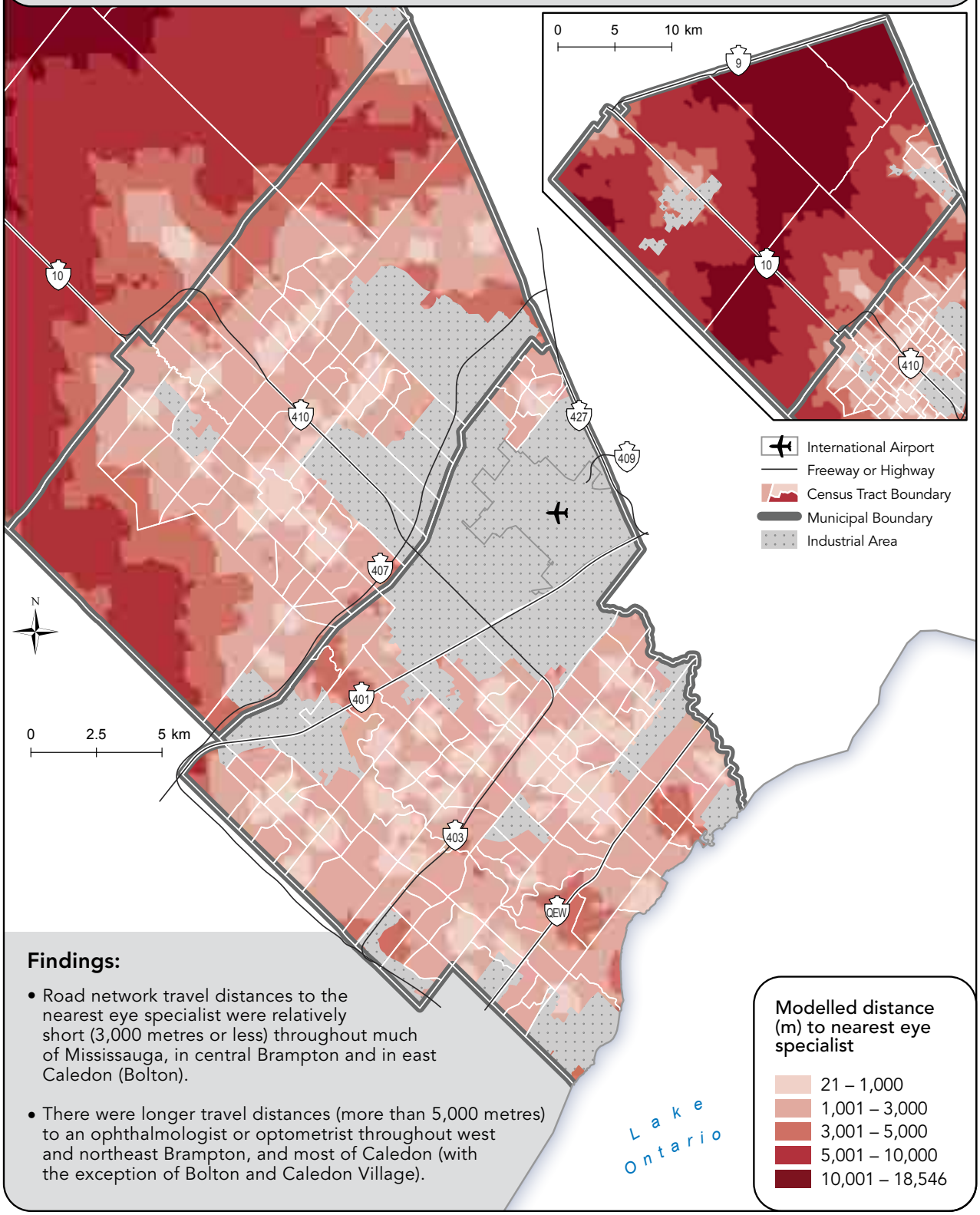
Exhibit 8.6. Modelled travel distance along the road network [2009] to the nearest location of an endocrinologist [2011], in Peel region



Findings:

- Many areas in Peel had road network travel distances of more than 5,000 metres to the nearest endocrinologist. Parts of west Brampton and most of Caledon had travel distances of more than 10,000 metres.
- Areas with shorter travel distances (3,000 metres or less) to the nearest endocrinologist were found in central Brampton and central and west Mississauga.

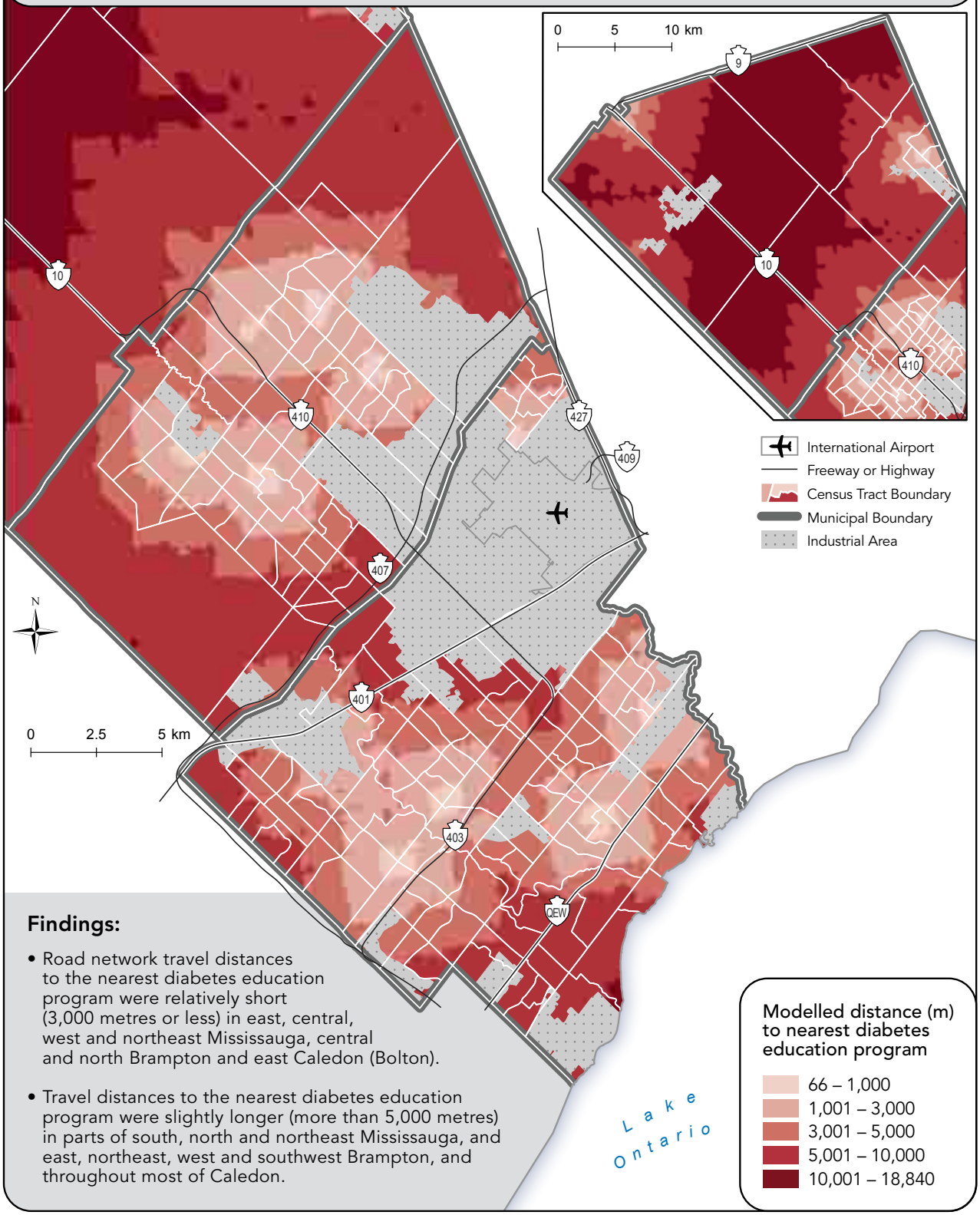
Exhibit 8.7. Modelled travel distance along the road network [2009] to the nearest location of an eye specialist (ophthalmologist or optometrist) [2011], in Peel region



Findings:

- Road network travel distances to the nearest eye specialist were relatively short (3,000 metres or less) throughout much of Mississauga, in central Brampton and in east Caledon (Bolton).
- There were longer travel distances (more than 5,000 metres) to an ophthalmologist or optometrist throughout west and northeast Brampton, and most of Caledon (with the exception of Bolton and Caledon Village).

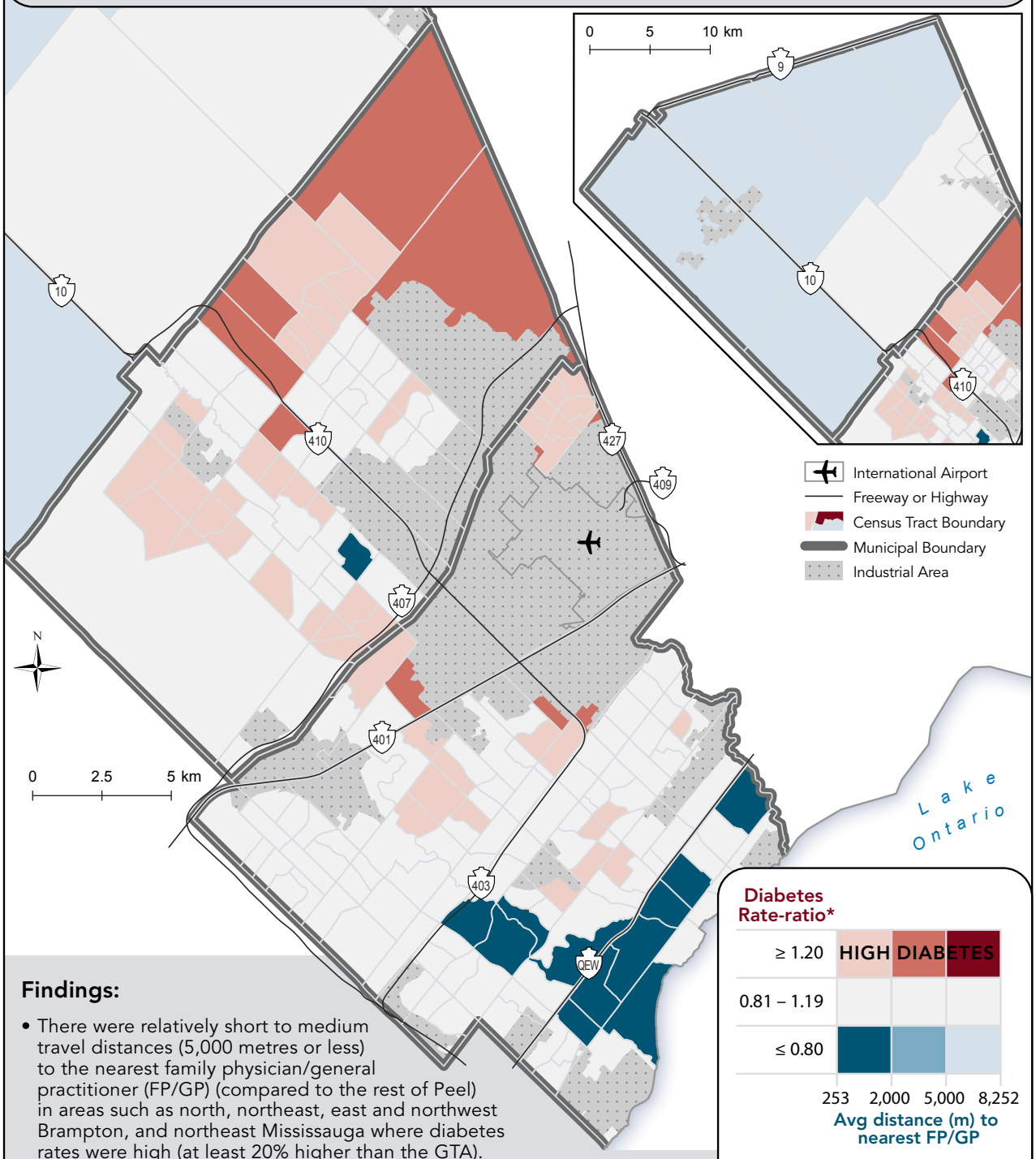
Exhibit 8.8. Modelled travel distance along the road network [2009] to the nearest location of a diabetes education program [2011], in Peel region



Findings:

- Road network travel distances to the nearest diabetes education program were relatively short (3,000 metres or less) in east, central, west and northeast Mississauga, central and north Brampton and east Caledon (Bolton).
- Travel distances to the nearest diabetes education program were slightly longer (more than 5,000 metres) in parts of south, north and northeast Mississauga, and east, northeast, west and southwest Brampton, and throughout most of Caledon.

Exhibit 8.9. Spatial relationship between the average road network distance to the nearest family physician/general practitioner (FP/GP) [2009] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

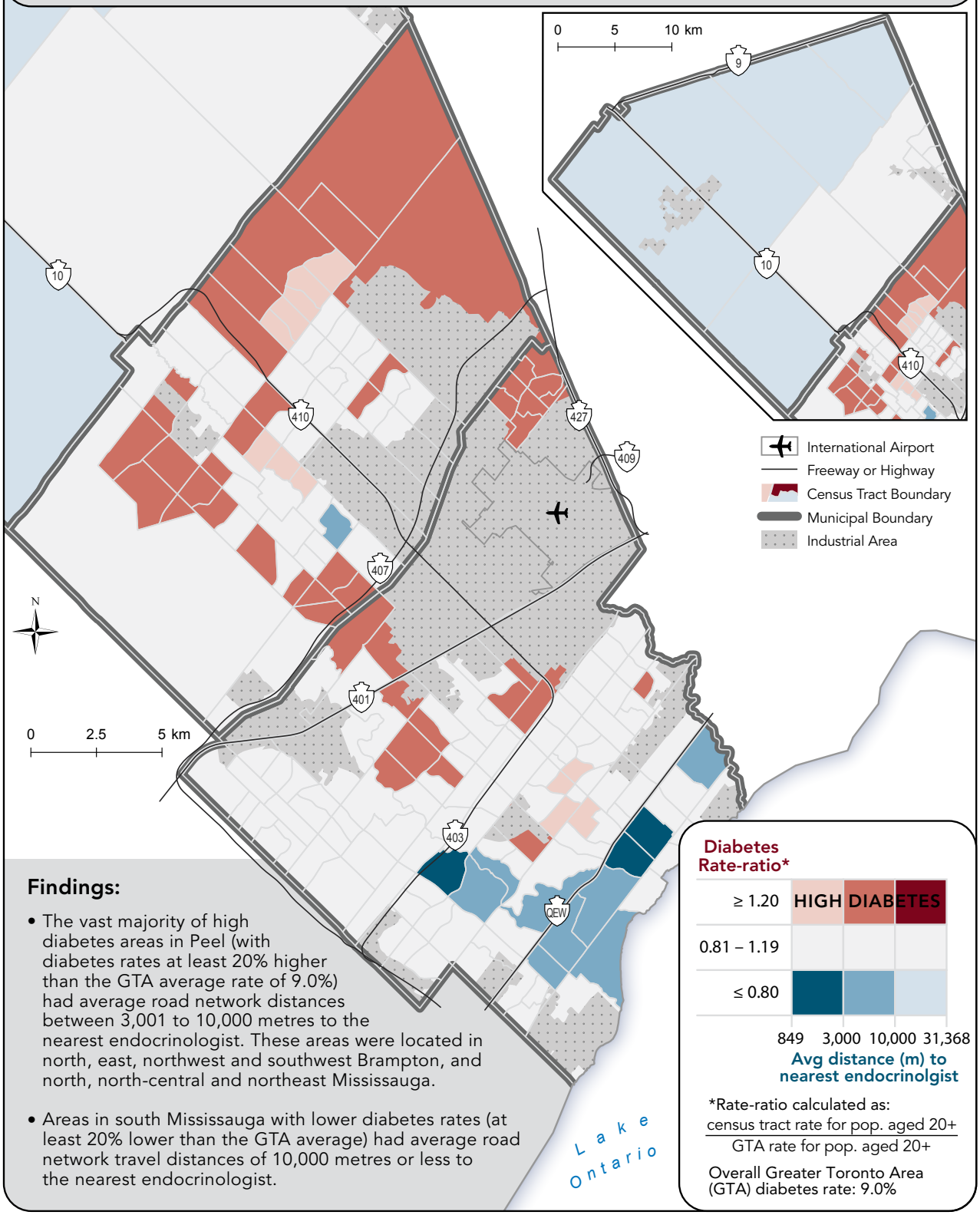
- There were relatively short to medium travel distances (5,000 metres or less) to the nearest family physician/general practitioner (FP/GP) (compared to the rest of Peel) in areas such as north, northeast, east and northwest Brampton, and northeast Mississauga where diabetes rates were high (at least 20% higher than the GTA).
- Portions of southwest Brampton and south Mississauga had lower diabetes rates and short travel distances to the nearest FP/GP (2,000 metres or less). Most of Caledon had low diabetes rates but relatively long distances (more than 5,000 metres) to the nearest FP/GP.

*Rate-ratio calculated as:

$$\frac{\text{census tract rate for pop. aged 20+}}{\text{GTA rate for pop. aged 20+}}$$

Overall Greater Toronto Area (GTA) diabetes rate: 9.0%

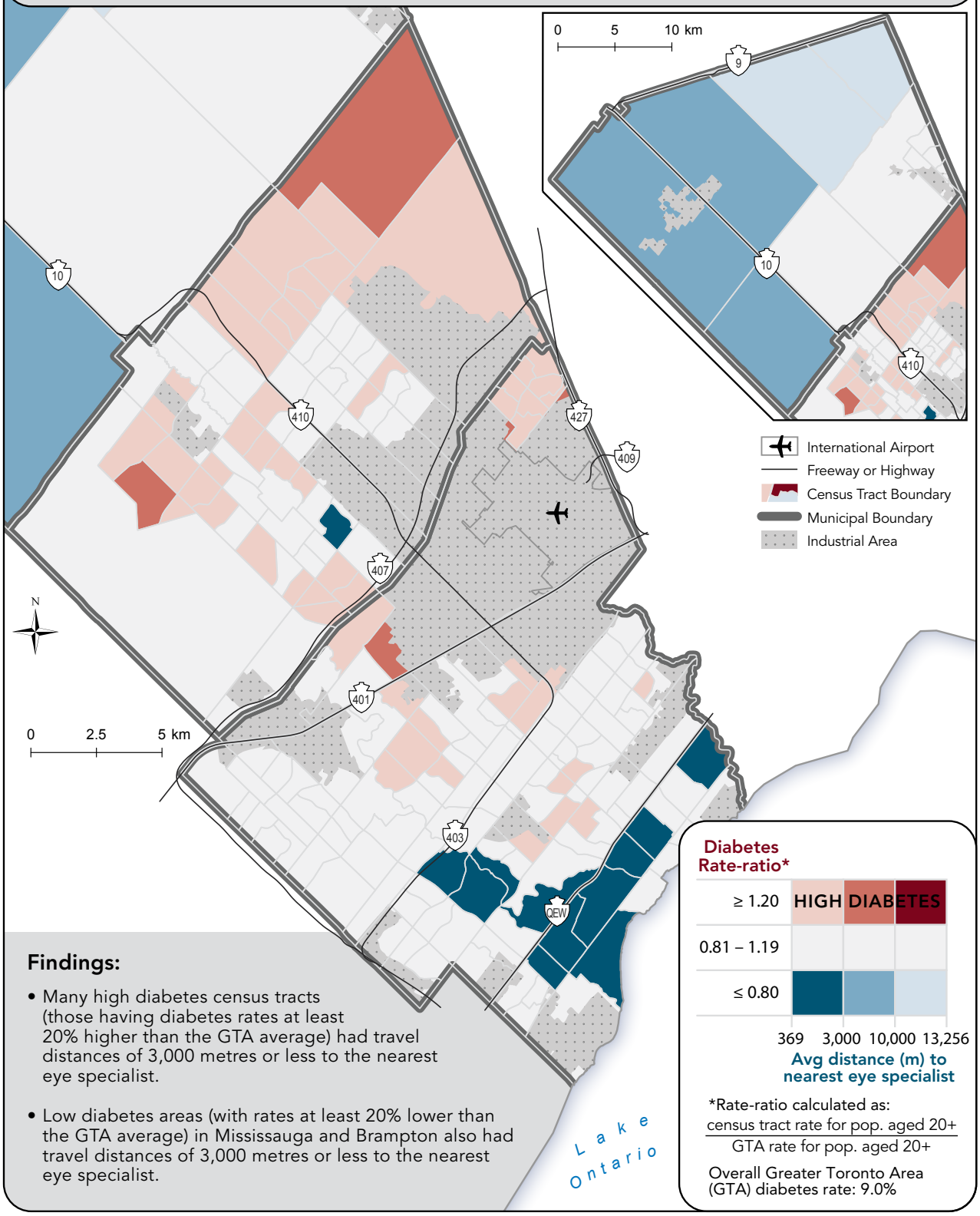
Exhibit 8.10. Spatial relationship between the average road network distance to the nearest endocrinologist [2011] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

- The vast majority of high diabetes areas in Peel (with diabetes rates at least 20% higher than the GTA average rate of 9.0%) had average road network distances between 3,001 to 10,000 metres to the nearest endocrinologist. These areas were located in north, east, northwest and southwest Brampton, and north, north-central and northeast Mississauga.
- Areas in south Mississauga with lower diabetes rates (at least 20% lower than the GTA average) had average road network travel distances of 10,000 metres or less to the nearest endocrinologist.

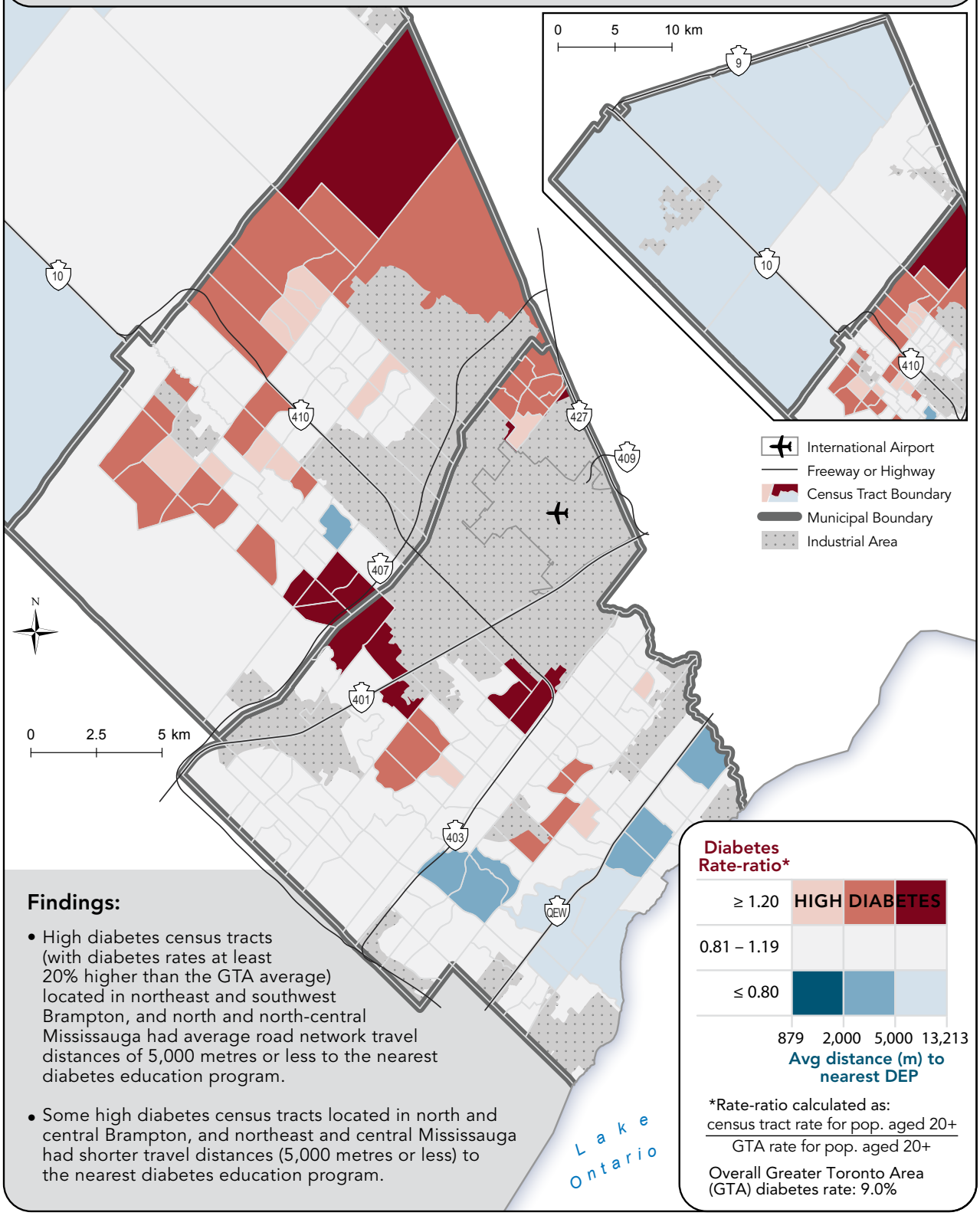
Exhibit 8.11. Spatial relationship between the average road network distance to the nearest eye specialist (ophthalmologist or optometrist) [2011] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

- Many high diabetes census tracts (those having diabetes rates at least 20% higher than the GTA average) had travel distances of 3,000 metres or less to the nearest eye specialist.
- Low diabetes areas (with rates at least 20% lower than the GTA average) in Mississauga and Brampton also had travel distances of 3,000 metres or less to the nearest eye specialist.

Exhibit 8.12. Spatial relationship between the average road network distance to the nearest diabetes education program (DEP) [2011] and age- and sex-standardized diabetes prevalence rate-ratios* [2007], by census tract [2006], in Peel region



Findings:

- High diabetes census tracts (with diabetes rates at least 20% higher than the GTA average) located in northeast and southwest Brampton, and north and north-central Mississauga had average road network travel distances of 5,000 metres or less to the nearest diabetes education program.
- Some high diabetes census tracts located in north and central Brampton, and northeast and central Mississauga had shorter travel distances (5,000 metres or less) to the nearest diabetes education program.

DISCUSSION

In this chapter, the locations of and geographic access to family doctors, medical specialists and diabetes education programs in relation to diabetes prevalence in Peel is reviewed.

Health services in general were well distributed throughout Peel. Family physicians and general practitioners (FPs/GPs) were particularly well-distributed throughout the region. There was a higher concentration of FPs/GPs in central Mississauga, which may be due to the higher population density in this area. There were fewer FPs/GPs located in the rapidly developing areas of north and east Brampton, but road network travel distances to FPs/GPs were generally short (3,000 metres or less) throughout Peel, including in areas with higher diabetes rates. Compared to the rest of Peel, Caledon had the longest travel distances (more than 5,000 metres) to the nearest FP/GP. Given the rural make-up of Caledon, it is not surprising that travel distances would be slightly longer. However, it is unlikely that residents of Caledon would consider a distance of 5,000 metres (or more) to visit an FP/GP as a long trip especially given the rural setting.

Overall, there was a relatively even distribution of and good geographic accessibility to FPs/GPs, which is a positive finding given the key role that FPs/GPs play in the prevention, treatment and care for people with diabetes. This is particularly important in Peel where diabetes rates are high thus necessitating greater need for primary care.

It is important to note that although geographic access to FPs/GPs in Peel was quite good, there are other aspects of access that also play a key role in overall population health that could not be measured. Such aspects included whether or not physicians were open or closed to new patients, the provision of language-specific services and cultural sensitivity to the health care needs of certain immigrant groups.

Medical specialists – endocrinologists, ophthalmologists, optometrists

The majority of endocrinologists, ophthalmologists and optometrists were located in Mississauga (near the City Centre) and along major roads and near hospitals in Peel.

Eye services were generally well distributed throughout the region, but endocrinologists were not as well distributed. There were very few locations of endocrinologists outside the major hospitals in Mississauga and Brampton. Not surprisingly, the longest travel distances (more than 10 km) to an endocrinologist were in Caledon. While the trend for endocrinologists to locate in high-density areas near hospitals is unlikely to change in the short-term, there is movement toward endocrinologists working in non-hospital (community) settings. This provides future opportunities for new specialty practices to open in high-need areas. However, it is not unusual to travel longer distances to a specialist regardless of where one lives. Specialist referrals are often based on a number of factors including the nature of or familiarity with the specialist and not necessarily on proximity to the referring physician or patients' own location.

Diabetes education programs

Diabetes education programs were scattered throughout Mississauga and Brampton. There was one diabetes education program in Caledon (in Bolton).

While some locations in Brampton and Mississauga did not have a diabetes education program, travel distances to the nearest program were 5,000 metres or less in many parts of Mississauga and Brampton, and in Bolton (within Caledon). Slightly longer distances (more than 5,000 metres) to diabetes education programs were found in high-diabetes areas in northeast and southwest Brampton, and north and north-central Mississauga. Conversely, some high-diabetes census tracts located in north and central Brampton, and northeast and central Mississauga had average distances 5,000 metres or less to the nearest diabetes education program.

LIMITATION OF THESE ANALYSES

A couple of limitations of these analyses deserve mention. The physical locations and distribution of family physicians/general practitioners (FPs/GPs) throughout Peel region is shown. However, no assessment to determine if the FPs/GPs at these locations were actually accepting new patients was conducted. As previously discussed in this chapter, access does not only refer to proximity but also to whether an individual provider is accepting new patients.

Secondly, it is important to note that only the locations of on-site and satellite diabetes education programs/services offered by family health teams (FHTs), community health centres (CHCs) or hospitals in Peel was included. Neither diabetes education programs/services offered through individual or other FP/GP practices, nor satellite services offered less than once a week were analyzed.

CONCLUSIONS AND IMPLICATIONS

Peel is home to rapid new development and large recent immigrant and visible minority populations, particularly individuals of South Asian heritage (see Chapter 4 for a definition of visible minority used in this atlas). These groups have considerably higher rates of diabetes compared with other ethnic groups. This relationship was most evident in the high-diabetes areas in west, central and northeast Mississauga, as well as east, central-west, north and northeast Brampton – areas that are home to a high concentration of visible minorities and recent immigrants (see Chapter 4 for more information about ethnicity and immigration in relation to diabetes in Peel region). These demographic trends suggest the need to develop effective programs to prevent diabetes and to target immigrants of all age groups in rapidly expanding areas of Peel.[30] Because there may be a high proportion of residents who may not speak English in areas with high rates of diabetes, there is also a need to provide language-specific health services in these areas.

The importance of culturally-specific services is perhaps one of the most important issues in health service provision in Peel. Traditional diabetes care systems designed for mainstream populations are often of limited relevance to culturally-diverse populations. Such systems commonly emphasize reducing behavioural risk factors and the benefits of self-care behaviours, but ignore the social, cultural, economic and physical environments in which lifestyle practices are shaped and constrained.[17] There is growing evidence to show that diabetes prevention and management strategies that offer group support and services provided by a multidisciplinary/community-based team with an understanding of the cultural and socioeconomic realities of the target ethnic group are associated with improved clinical outcomes and reduced ethnic disparities.[31-39]

Policy-makers must prepare for the rising burden of diabetes on healthcare resources by ensuring that primary prevention strategies are in place.[40] Although diabetes can be prevented through lifestyle changes aimed at increasing activity and improving diet, providing these interventions on an individual basis may not always be feasible.[40] Effective prevention strategies must: identify high-risk populations and their modifiable risk factors; optimize urban planning and resource availability to address the "diabetogenic" environment (i.e., an environment where people have easy access to high fat, high calorie foods); and implement public education campaigns to promote healthier lifestyles.[40]

Newly developing areas in Peel region may be ideal locations for implementing population-based prevention strategies. Northeast and east Brampton, in particular, are areas with a large influx of new residents and more growth planned for the future (see Chapter 1). Future plans should focus on the provision of community-based health care prevention and management programs aimed at high-risk groups in these areas. Programs should be developed and deliv-

ered in partnership with target communities and should reflect local ethnocultural representation.

Other factors also play a role in whether patients use diabetes education services. Fewer than half of the primary care physicians surveyed in Peel (and Halton) region followed the Canadian Diabetes Association (CDA) recommendation to refer patients to diabetes self-management education programs.[41] Common reasons for not referring were patients' unwillingness to attend, lack of evening/weekend appointments, language barriers, long referral waiting lists and inconvenient location for patients.[41] The addition of diabetes educators on-site in family physican/general practitioner (FP/GP) offices might enhance FP/GP referrals and uptake in patient participation.[41]

To address the burden of diabetes, Ontario launched a comprehensive diabetes strategy that builds on internationally accepted best practices and the growing body of evidence supporting the organization of health care around chronic disease management.[42] The strategy includes efforts to prevent diabetes onset, improve access to information and educational materials that promote diabetes self-management, enhance access to comprehensive, team-based care for people with diabetes, and support the optimal management of diabetes in clinical practice through the development of a province-wide diabetes registry.[42]

The availability of and access to high quality health care services are important factors in the prevention and management of diabetes. Primary care providers play key roles in helping patients cope with the day-to-day management of the disease, which may be complicated and overwhelming for many. Other services, such as medical specialists and diabetes education programs, are also essential to reduce the current and future burden of diabetes. However, providing additional health services will not fully solve the issue of overall access. Future plans to extend key diabetes-related health services in Peel should include consideration of how to overcome additional barriers to access besides geographic location. These include language and cultural differences, the current policy that imposes a three-month wait for Ontario Health Insurance Plan (OHIP) for new immigrants, the lack of a convenient, fast and well-connected public transportation system, and sensitivity to services that may be difficult to comply with or may be inappropriate in light of local residents' values and beliefs.

APPENDIX 8.A – RESEARCH METHODOLOGY

Data Sources

Locations of Family Physicians/General Practitioners, Specialists and Diabetes Education Programs

- The locations of family physicians/general practitioners (FP/GP) presented in this chapter were received from the Corporate Provider Database (CPDB; 2009/10) housed at the Institute for Clinical Evaluative Sciences (ICES).

- The locations of diabetes specialists – endocrinologists, ophthalmologists, and optometrists – were received from the Institute for Clinical Evaluative Sciences (ICES;2011).
- The locations of diabetes education programs were received from two sources: Diabetes Regional Coordination Centres (2011) and Peel Public Health (2011).

Diabetes Prevalence

- Age- and sex-standardized diabetes prevalence rates per 100 people were calculated using the Ontario Diabetes Database (ODD) and other administrative data sources held at the Institute for Clinical Evaluative Sciences (ICES) (see Appendix 2.A for a more detailed description).

ANALYSIS

The distribution of and geographic accessibility to family physicians/general practitioners (FPs/GPs), endocrinologists, ophthalmologists and optometrists, diabetes education programs and associated satellite locations across Peel region was examined.

- The distribution of these resources was examined by using symbols to depict their locations throughout Peel (e.g., locations of FPs/GPs across the region). This method provided an opportunity to determine where services were located and whether certain services existed in specific neighbourhoods. Dot density mapping was used to depict concentrations of adults aged 20 or older with diabetes across Peel. On these maps, one dot represented 100 adults 20 or older with diabetes. Dots were placed at random locations within residential areas of census tracts, based on the number of adults aged 20 years or older with diabetes that lived in a given census tract. This allowed for the comparison of the distribution of diabetes-related health services in Peel region with spatial concentrations of adults aged 20 years or older with diabetes.
- Access or accessibility, as shown on the accessibility maps, was measured as the shortest distance along the street network to the nearest resource location (e.g., FP/GP) from each point in a 150-metre grid of starting points located across Peel region. That is, the distance along the network of streets and highways from each starting point to the nearest location of each type of health service was measured.
- The spatial relationship between these accessibility measures and rates of diabetes prevalence that were either much higher (20% or more) or much lower (20% or less) than the GTA average diabetes rate of 9% was evaluated. For each Peel census tract, the diabetes rate was divided by the overall GTA rate in order to calculate a rate-ratio. Census tracts with diabetes rates that were meaningfully higher than in the GTA as a whole (rate-ratio of ≥ 1.2) were depicted in shades of red, while tracts with rates much lower than in the GTA (rate-ratio of ≤ 0.80) were depicted in shades of blue. All census tracts whose rates did not differ substantially from the GTA rate (rate-ratio between 0.81 and 1.19) were depicted using a single grey colour.

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Chapter 9

KEY ISSUES and Opportunities

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KEY ISSUES

Context

Peel region is the second fastest growing region in the Greater Toronto Area (GTA). Compared with the GTA and the rest of Ontario, Peel region has a younger population, fewer people living alone, more persons who self-identify as belonging to a visible minority and much higher levels of immigration. Between 2001 and 2006, the majority of new residents settled in the recently developed outlying areas of Brampton and Mississauga, and high rates of development continue today. Peel region is also a major transportation hub, home to the country's largest airport and crossed by many busy arterial roads including several of the 400-series expressways. It has a few areas of concentrated population, particularly near Mississauga City Centre and in downtown Brampton, but much of the region is characterized by low population density and suburban planning standards that separate residential areas from retail and commercial services. This suburban design is strongly associated with car use and does not readily lend itself to active transportation such as walking or bicycling. At the same time, much of the recent immigration to Peel has been from regions of the world with rising levels of obesity and type 2 diabetes. Genetic predisposition, combined with sedentary lifestyles exacerbated by car dependency and North America's highly-processed and high-calorie diets, creates a confluence of risk for obesity and its consequences, including diabetes (see Chapters 1, 4 and 5 of this atlas for more information).

Diabetes in Peel region

Overall, the prevalence of diabetes was higher in Peel region than in the GTA and the rest of the province as a whole, while the prevalence of overweight and obesity in Peel was slightly higher than in the GTA, but similar to Ontario as a whole. Close to half of Peel residents were overweight or obese, and one in 10 had diabetes. The pattern of obesity in Peel did not closely resemble the pattern of diabetes, likely due to the protective effect of high socioeconomic status in some areas and the development of diabetes at lower body weights in some ethnoracial groups. The highest diabetes rates were found in northeast and outlying areas of Brampton, and northeast Mississauga while the lowest rates were found in south and west Mississauga, and in Caledon. Areas with lower diabetes rates also tended to have higher socioeconomic status and lower proportions of visible minorities. The high rates of obesity and diabetes were expected, given the confluence of risks in many areas of Peel region. Modifiable risk factors include inactive living and poor diets. These behavioural issues are complex and may require attention at the level of the individual (e.g., weight loss counselling), the region (e.g., building walkable neighbourhoods) and the public policy arena (e.g., farm and food pricing policies) (see Chapters 2, 4, 5 of this atlas for more information).

Built environment

As already noted, the physical layout of Peel region is dominated by its role as a major transportation hub. Apart from downtown Brampton, central Bolton, and smaller centres in Mississauga and Caledon, much of Peel region was built after 1945 and followed a typical suburban development pattern. This pattern lends itself to car use; not surprisingly, walking/bicycling trips and use of public transit were quite low, while car trips and car ownership were found to be very high. Walking and bicycling trails were often disconnected, a pattern that does not support active transportation for trips to work, school or running errands. Walkable destinations were sparse in outlying areas of Peel, especially in northeast and outlying areas of Brampton, and in some areas in Mississauga. Many of these areas also had the highest rates of diabetes. Due to data and methodological limitations, some built environment characteristics that influence walking and bicycling could not be investigated. These include sidewalks, street lighting, road width, building setbacks, cleanliness and absence of garbage, and perception of safety. While land use and urban design cannot be transformed quickly, high immigration levels in Peel require a rapid pace of housing starts as

well as the retail, commercial and public services needed to support the growing population. This pace of development provides an opportunity to modify planning and urban design standards in a way that would support active transportation and ready access to healthy resources (see Chapter 5 of this atlas for more information).

Ethnicity

Certain ethnic groups have a higher risk of developing diabetes, especially those from South Asia, sub-Saharan Africa and the Caribbean.[1-3] Much recent immigration to Peel region has been from these high-risk areas of the world. Areas with high rates of diabetes in Peel had high concentrations of South Asian and Black visible minorities, as well as higher proportions of recent immigrants and those not speaking English. While ethnicity itself is not modifiable, many immigrant and ethnic groups have specific cultural preferences and practices that may support or hinder healthy living. On average, new immigrants arrive in Canada equally as healthy or healthier than their Canadian-born counterparts, but their health deteriorates over time.[4] These groups may be accustomed to healthier diets in their home countries than those they encounter upon arrival in Canada. Effective strategies that support the continuation of home-country cultural preferences need to be explored. Policies that help immigrants to surmount language and cultural barriers to obtaining health information and health care may also be important (see Chapter 4 of this atlas for more information).

Socioeconomic status

Income and education are consistently related to diabetes in many areas of the developed world, with higher rates among people with lower socioeconomic status (SES). Using area-level characteristics, Peel region appeared to follow this well-established pattern, with higher rates of diabetes generally found in areas with lower SES. Somewhat different patterns for income and education were seen across the three Peel municipalities. In Brampton, many high diabetes areas were in the middle income category and had lower levels of educational attainment. In northeast Mississauga, a cluster of areas surrounded by industrial land was home to residents with high rates of diabetes, lower income and a higher percentage of residents who did not complete high school. Relatively high SES profiles and low diabetes rates were seen across Caledon and in south Mississauga. The many ways in which low SES contributes to obesity and diabetes are complex. Important pathways may include poor quality diets as a result of the high cost and lower availability of healthy foods, lack of opportunities to be physically active, and cost barriers to obtaining some health services and programs, including medications and devices.[5] These can be considered opportunities for intervention (see Chapter 3 of this atlas for more information).

Resources for healthy living

Regular physical activity is a requirement for good health and its absence is strongly related to obesity and type 2 diabetes.[6] Across Canada, only a minority of people achieve the amount of physical activity thought to be necessary to achieve optimal health benefits and this proportion has been declining over time.[7,8] In Peel region, only a third to a half of residents reported achieving at least a moderate activity level equivalent to walking 30 – 60 minutes per day during their leisure time. Areas with lower rates of moderate activity were generally found to have higher rates of diabetes. Opportunities for physical activity can take the form of local parks, school yards and public and private recreational facilities. Most Peel region residents lived close to a park or school yard, but many lived farther from large parks and from both public and private recreational facilities. Northeast and west Brampton, and scattered areas of Mississauga had the lowest concentration of and longest distances to these facilities. There was not a strong concordance between availability of places to be physically active and diabetes, suggesting that other factors were influencing physical activity. The appropriateness and acceptability of the types of recreational facilities and programs available for the many ethnocultural communities of Peel may require attention.

More Canadians are consuming pre-prepared foods for their meals.[11] The high availability and low cost of energy-dense, highly-processed foods served in large portions is thought to be contributing to the epidemic of obesity and diabetes in the developed world.[9,10] These foods are often less expensive than healthy foods such as fresh fruits and vegetables, whole grains, and lean meats and fish, and they are more readily available in easily accessible convenience stores and fast-food outlets. Existing survey data suggest that fruit and vegetable intake is low among both Canadians and Peel residents.[11] However, while the measure used is considered to be a reasonable proxy for overall diet quality, it may not fully capture adherence to fruit and vegetable intake recommendations from Canada's Food Guide.[12] The availability of less healthy food was found to be at least five times greater than the availability of healthy food in Peel and both food sources were often found clustered in the same areas.

Economically disadvantaged areas in Peel had good access to healthy and less healthy foods, suggesting the absence of food deserts in lower income areas of Peel. Areas with lower rates of diabetes generally had low food availability of any type. These findings suggest major room for improvement in diets, increased availability of more healthy foods and fewer less healthy foods in Peel. Long commuting times and excess exposure to fast food retailers may further impede the ability of Peel residents to maintain a healthy lifestyle.

Health services play a major role in the prevention, detection and treatment of diabetes. This atlas was able to investigate geographic aspects of access to health services, but not their actual availability (i.e., if doctors' offices were accepting new patients), acceptability or appropriateness. Family physicians/general practitioners were well distributed across Peel region, as were optometrists. Specialized health providers and services, including endocrinologists, ophthalmologists and diabetes programs, were clustered in a few areas of Peel region (often near hospitals) that did not always correspond with high-diabetes areas. For example, northeast Brampton had high rates of diabetes, but relatively low access to specialized health services. Availability and use of appropriate, community-based, culturally-specific health services are key factors to reducing the burden of diabetes in Peel (see Chapters 6, 7 and 8 of this atlas for additional information).

OPPORTUNITIES

Overview

Peel region has seen a tremendous rise in the rate of diabetes over the past decade. Peel now has one of the highest rates of diabetes in the province and these levels will likely continue to rise, fuelled by the growing rates of obesity. Fortunately, there is strong evidence that type 2 diabetes itself can be prevented or delayed in high-risk groups (individuals who have pre-diabetes) by achieving a modest degree of weight loss through dietary changes and increased physical activity.[13,14] Moreover, there is mounting evidence that healthier communities – ones that better support physical activity and healthy eating – have lower rates of diabetes.[15,16]

The high rates of diabetes in Peel require enhancing opportunities for diabetes prevention and building on existing programs undertaken by the Region of Peel to understand barriers and facilitators to improving healthy behaviours. Furthermore, findings from this atlas allow the identification of diabetes "hot spots" – communities that have increased rates of diabetes or a high concentration of risk factors for diabetes (e.g., a greater percentage of the population belonging to ethnic groups carrying a high genetic predisposition for developing diabetes) that can be targeted for more directed interventions. This research demonstrates large gaps between optimal and existing levels of physical activity and healthy eating which provides plenty of opportunities to promote healthier lifestyles. The Region of Peel has already done extensive data gathering to gain knowledge about causes of low activity and poor eating behaviours, and has had some success in developing interventions to promote healthier lifestyles in high-risk communities.

Diabetes prevention strategies can be categorized based on their scope, such as global (e.g., whole populations) versus targeted (e.g., high-risk communities or individuals). These include:

a) Population-level strategies – those targeting an entire municipality or region

b) Community-level strategies – those targeting high-risk areas or populations

c) Individual strategies – those targeting high-risk individuals

Given the diverse cultural makeup of the population in Peel, interventions that are undertaken need to be culturally-specific and, ideally, delivered in various languages. A summary of the types of initiatives that could lead to healthier lifestyles and therefore reduced rates of obesity and type 2 diabetes is outlined below.

A. POPULATION-BASED STRATEGIES

Increasing activity by reducing dependence on cars for travel

There is a growing literature on the role of the built environment in promoting or impeding the adoption of a healthy lifestyle.[17-21] Trends in urban development since the 1960s and 1970s have led to residential neighbourhoods with limited opportunities for residents to walk or bicycle as a means of transportation. The following design features have been shown to promote physical activity and may be associated with lower rates of obesity: higher levels of residential dwelling density and intersection density (a measure of street connectivity), greater availability of and access to walkable destinations, and a higher mix of land use (i.e., the mixing of various land uses, including residential, retail, workplace and institutional, in relatively close proximity to each other within the same area or neighbourhood).[22-24]

Given the high rate of growth in Peel, there is a critical need to develop new communities that promote daily active living. The Region has undertaken a substantial initiative towards creating new standards and guidelines for urban development in Peel that would require development submissions to consider the impact of community design on health. Existing communities can also be modified over time. Many cities are now setting limits on further suburban sprawl, instead favouring medium- and high-density development in major employment and retail areas, and along major transportation corridors. Targeting lower-income, higher-immigration areas for greater residential densities, better public transportation and mixed land use may yield important health benefits for vulnerable populations living in these areas.

Improving residential street lighting and aesthetics, ensuring the presence of sidewalks, addressing safety issues and reducing the impact of physical barriers such as highway overpasses and on-ramps by building bridges or tunnels to connect adjacent communities are all potential solutions for improving active transport in Peel. Bicycle and walking trails also provide opportunities for local residents to be physically active. Opportunities include making the existing trails and foot or bicycle paths more connected by linking them together and facilitating their use as a transportation modality or for leisure. Peel could put an emphasis on safe bicycle infrastructure such as increasing connections between existing bicycle routes, creating dedicated pathways and lanes on roadways, and adding more facilities for bicycle storage and lock-up. Ensuring that bicycle infrastructure is safe from vehicle traffic, well lit and attractive should be an important focus to encourage more Peel residents to bicycle on a regular basis. Consideration could be given to linking walking paths within neighbourhoods to allow safe transportation of children to schools and parks, and evaluating whether programs like walking school buses could be safely implemented in some areas. However, promoting active transportation will be optimally effective only if other aspects of the built environment are improved as well.

Enhancing access to recreational spaces

There is some evidence to suggest that children living in areas that have better access to play spaces are more physically active.[25-26] Proximity to schools and smaller parks is generally good in much of Peel. However, there may be an opportunity to enhance the use of existing parks in Peel by improving safety in areas where such concerns exist (e.g., by installing fencing around parks to ensure children's safety from surrounding traffic). School yards may provide an alternative space for recreational activities in communities that have less parkland nearby. In Peel, some school yards may be underused because of a lack of lighting in the evening time or closing of the property after school hours. There may be an opportunity for local governments to partner with school boards or individual schools in order to identify and resolve barriers to opening school yards to the community after hours, or, if necessary, to develop agreements that may share the costs and responsibilities of extending school yard access to the public.

In contrast to parks and schools, public recreational facilities were less evenly distributed, clustering in certain locations. There may be some capacity to augment existing outdoor and indoor play spaces where limited access exists. Furthermore, consideration could be given to providing subsidies to make private indoor play spaces more accessible in lower income areas or supporting not-for-profit organizations to develop and maintain safe and accessible play spaces in high-need areas.

Promoting healthier eating habits

Healthy eating is essential for good health and a critical component of diabetes prevention and management strategies.[27-29] Similar to other Ontarians and Canadians overall, the rates of fruit and vegetable intake among Peel's residents leave a lot of room for improvement, as does the overall food retail landscape which is dominated by retailers serving less healthy foods. Since there are no food deserts in lower income areas in Peel, it is unclear whether incentives for bringing in more healthy retailers into less advantaged communities would help improve residents' eating habits. Overall, it may be more fruitful to focus on global strategies to promote healthier options and smaller portion sizes within existing food stores and eating places.

Given the very high proportion of less healthy food retailers dominating the current food landscape in Peel, there is also a need to consider strategies aimed at reducing the overwhelming exposure to less healthy food. This will be a challenging avenue to pursue because the location of food retail stores and eating places – as well as the food choices offered within these venues – is driven largely by market forces and, thus, commonly seen to be outside the reach of city or regional planning. An example of an initial intervention in this direction could involve amending zoning regulations to limit the number of less healthy retailers (e.g., fast-food outlets) near vulnerable population groups, such as near schools. Furthermore, using incentives to attract healthy and culturally-appropriate grocery stores and supermarkets to rapidly developing areas of Peel (some of which have high rates of diabetes among its residents) may be worthwhile since the food landscape within such areas is not yet established.

Community-level interventions to promote healthier eating patterns could also occur within local workplaces and food businesses by promoting more vegetables, fruit and other healthier options on menus, encouraging options for smaller portion sizes and promoting strategic placement of healthier options within stores. For example, encouraging convenience stores (including those in gas stations) to stock fresh fruits and vegetables may be a way to make healthy choices more available and accessible as residents run their multiple daily errands. Adapting public spaces to create community gardens may be another initiative that could promote healthier eating habits while establishing stronger community ties.[30] Finally, supporting healthier, culturally-specific eating habits among the many

diverse ethnocultural groups in Peel through strategies such as encouraging food retailers to offer healthy culturally-specific foods will continue to be of great importance.

School-based programs

Schools are important settings where children and youth spend a large portion of their day and gain exposure to social norms relating to healthy eating and physical activity. Thus, schools are key venues for promoting and supporting healthy behaviours. The Region of Peel has been and continues to be very proactive in supporting province-wide policies to promote healthy eating and physical activity, as well as undertaking its own local initiatives. A number of recent school-based initiatives, such as the Ministry of Education's School Food and Beverage Policy (2010), that required all schools to offer healthy food and beverage choices, have been fully implemented in Peel. The Region of Peel worked to support these initiatives by providing training and workshops to school board staff on understanding and applying the policy, piloting the policy at 12 schools prior to mandatory implementation and introducing a social marketing campaign related to the policy for both students and the broader community. In the future, it will be important for Peel to monitor the successes and challenges of this policy.

With respect to physical activity among school-age children, Peel Public Health supports the Ministry of Education's Daily Physical Activity (DPA) policy which strives to improve or maintain elementary school children's physical fitness by providing a minimum of 20 minutes of sustained moderate-to-vigorous activity during each school day. Peel Public Health also recently undertook an assessment of levels of physical activity through the Student Health Survey 2012. Continuing and building on such initiatives to shift norms around healthy eating within schools and increase daily levels of physical activity among all school-age children (e.g., by enhancing physical activity both during school hours and in after-school programs) should continue to be a priority in the coming years. Further policy changes may be needed to ensure that children undertake the daily one hour of physical activity recommended by Health Canada, including consideration of expanding physical activity programs within school curricula and after-school programs.[31,32]

B. COMMUNITY-LEVEL STRATEGIES

Information on facilitators and barriers to physical activity and healthy eating gathered by the Region of Peel will be instrumental in designing targeted interventions at the community level. Focusing on areas that have higher rates of diabetes or high-risk populations (e.g., the South Asian community, etc.) could be most fruitful in reducing the illness. Examples of interventions that promote healthy lifestyle changes in target populations implemented by Peel Public Health are the Diabetes Prevention Pilot Project and the Diabetes Prevention Social Marketing Campaign, both geared to Peel's South Asian population. Expanding this type of intervention on a broader scale could have a meaningful impact on lowering the risk of diabetes within high-risk communities. Culturally-sensitive programs promoting physical activity, including community walking programs in residential areas and malls, as well as other recreational programs, could be developed in high-risk communities. Public recreational facilities could be encouraged to offer supportive culturally-appropriate physical activity programs, cooking classes, food shopping classes and other interventions as deemed appropriate. Raising awareness through effective social marketing and advertising about the programs offered, as well as providing transportation support to non-local residents for whom travel distance to recreation venues may be a barrier, could be important strategies to ensure that such interventions serve the widest possible segment of Peel residents. Local municipalities could also consider locating new recreational centres in poorly-served areas, particularly in the new and rapidly developing areas of the region, or seeking alternative venues to offer community programs.

C. INDIVIDUAL STRATEGIES

Although it is widely documented that physical activity and weight loss can delay or prevent type 2 diabetes, interventions targeted at the individual level require intensive resources and their reach to the entire population is limited.[13,14] There is a growing movement within primary care settings to develop structured programs to support dietary changes and exercise programs for individuals with pre-diabetes. Similar programs could be offered in community settings for patients deemed to be at high risk for developing diabetes using a screening tool such as the CANRISK questionnaire (which is currently being implemented and validated by the Public Health Agency of Canada).[33] Additional interventions to be considered include various web-based tools that can support lifestyle changes as these have the potential to reach a broad audience and thus have greater impact.

Access to and regular use of health services is essential for prevention, early diagnosis and the optimal management of diabetes and the prevention of diabetes-related conditions.[32] There was a fairly even distribution of family physicians/general practitioners (FPs/GPs) across Peel region, but diabetes education programs were offered at relatively few locations. Consideration should be given to establishing satellite diabetes education programs within high-need areas, including the rapidly developing, higher immigration and high-diabetes areas of north, northeast and east Brampton. Because there may be a high proportion of residents who may not speak English in areas with high rates of diabetes, there is also a clear need to provide language- and culturally-specific health services in these areas. The Ontario Diabetes Strategy established by Ontario's Ministry of Health and Long-Term Care has led to increased access to diabetes teams (including nurses and dietitians), as well as the development of Diabetes Regional Coordination Centres (DRCC) in each region to promote enhanced access to care for people with diabetes and more effective diabetes care delivery.[34] Developing an alliance with the Central West DRCC to coordinate and build on existing public education strategies, diabetes prevention and management programs may be beneficial. Other priorities include establishing or enhancing existing programs to link new immigrants to health services.

SUMMARY

Stemming the tide of overweight and obesity is critical to addressing the current diabetes epidemic. However, halting the obesity epidemic will require a multifaceted approach that focuses both on individuals at risk and the population as a whole. Lessons can be learned from the successful anti-smoking campaigns from the past two decades which led to a 43% drop in tobacco use among Canadians. Implementing different but complementary approaches simultaneously, including clinical interventions, public education campaigns, and policy changes such as increased taxing, smoking bans and limits to tobacco advertising, resulted in a shift in the public's perception of smoking and tobacco consumption rates fell considerably. The battle against obesity will likely be more challenging given the overall nature and complexity of this condition.

While successful policies and actions to affect broad societal changes in health behaviours must undoubtedly involve multi-pronged approaches at all levels of government (i.e., national, provincial, municipal), it is also the case that a great number of highly successful programs can, and have been built "bottom-up" in towns and cities. Local policy makers have the advantage of being more sensitive to local conditions – that is, the health issues and beliefs of local residents, as well as the opportunities and barriers within the physical and social environments that individuals experience daily, such as neighbourhoods, schools, stores, restaurants and recreational spaces. Because of this sensitivity to local conditions and a greater capacity for creativity and innovation, local policy makers, including public health authorities, are in a prime position to reshape the physical and social environments to make healthy choices the easiest or default options for all residents.

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