Paved Paradise: Municipal Parking Policy and Surface Parking in Downtown Urban Growth Centres

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

In 2006, the Province of Ontario introduced the "Growth Plan for the Greater Golden Horseshoe" ("Growth Plan") with the goal of managing the significant population and employment growth projected for the Greater Toronto–Hamilton Area over the first three to four decades of the 21st century. The Growth Plan's framework includes the identification of twenty-five "Urban Growth Centres" (UGCs) in the region's local municipalities and the establishment of density targets in order to promote intensification within these UGCs.

Considering the impact that public policy often has on the amount of parking provided (among many factors, related to both transportation and land use), and that this impact is connected to development and redevelopment through zoning requirements, there are two plausible but contrasting outcomes when it comes to how intensification might affect the amount of surface parking in the Growth Plan's Urban Growth Centres. On the one hand, policies emphasizing higher-density land uses alongside reduced automobile dependence could lead to decreases in the area devoted to surface parking. On the other hand, the persistence of conventional practices, especially the imposition of minimum parking requirements, could in fact generate greater amounts of surface parking in association with increased development activity.

The research project described in this report was undertaken to explore which of these two outcomes was the more likely. More specifically, the purpose of this project was to explore what sorts of relationships might exist between municipal parking policy and changes in the amount of surface parking in a sample of twelve downtown Urban Growth Centres. Changes in the area devoted to surface parking were measured by visual inspection of aerial photography and using geographic information systems (GIS) software. Policy positions were assessed by performing content analysis on the official plans and zoning by-laws of the same twelve

municipalities. Both qualitative and quantitative analysis were conducted in order to identify possible points of connection between the two sets of results, which in turn could provide potentially fruitful avenues of exploration for future research.

Between 2005/2006 and 2018, eight of the twelve sample municipalities saw decreases in the area devoted to surface parking in and around their UGCs: one of these eight (Kitchener) saw its surface parking area decrease by a significant amount, while the other seven saw relatively modest decreases, one (Peterborough) very close to zero. Two municipalities (Milton and Oshawa) saw significant increases in surface parking area, while two others (Brantford and Waterloo) saw the area devoted to surface parking increase by modest amounts. Within the project sample, larger-scale development projects, particularly large-format retail centres ("power centres") are associated with the greatest increases, while a sizeable portion of the decreases observed can be traced to the conversion of surface parking lots into vacant lands.

Five of the sample municipalities occupy more conventional policy positions with respect to parking—that is, their policies tend to focus more on providing automobile parking on each individual site and to regard parking as something that should be provided abundantly. The other seven municipalities in the project sample occupy positions that, to varying degrees, move away from this more conventional mindset towards positions that involve more area management–oriented approaches and attitudes that regard less parking as being necessary. Policy positions regarding the appropriate or necessary amount of parking appear to be more polarized than positions regarding geographic scope (site-focused versus area-oriented) and regarding parking as infrastructure versus parking as market good. As a general trend, municipalities that occupy less conventional positions regarding parking policy tended to see greater decreases in surface parking within their downtown areas. However, there are some apparent exceptions to this trend that point to ways in which future research can enhance our understanding of the factors affecting the stock of surface parking. There is also evidence to suggest that the establishment of an exemption area (within which land uses are exempt from minimum parking requirements) may be linked to reduced amounts of surface parking, at least within the boundaries of the exemption area itself.

Parking policy reform can be pursued in a number of different ways. The methodology for assessing municipal policy positions presented here represents a valuable diagnostic tool that planners and policy-makers can use to identify which approaches to reform are more likely to succeed in a given context. Moreover, it is important that planners and policy-makers adopt more area management–oriented techniques towards parking in downtown Urban Growth Centres, and to find ways to support and encourage the replacement of surface parking with more "intensified" forms (such as underground parking facilities) in order to address automobile dependence while preserving the vitality of downtown areas in Canada's mid-size cities.

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List of Abbreviations

The following three-letter abbreviations were used to refer to municipalities in Block ID numbers and Parking Lot ID numbers.

BAR .... Barrie
BNF .... Brantford
BRL .... Burlington
CAM .... Cambridge
GUE .... Guelph
HAM .... Hamilton
KIT .... Kitchener
MLN .... Milton
OSH .... Oshawa
PET .... Peterborough
STC .... St. Catharines
WAT .... Waterloo

Introduction: Paved Paradise

They paved paradise
And put up a parking lot
With a pink hotel, a boutique
And a swinging hot spot

— Joni Mitchell, Big Yellow Taxi (1970)

Few people, surely, would think to describe the process as "putting *up* a parking lot"— "up" not exactly being the first word that comes to mind when one thinks of surface parking. Yet this simple preposition helps the opening lines of Mitchell's song succinctly encapsulate some important details when it comes to parking. The use of "up," for instance, calls our attention to the fact that parking is something that humans deliberately construct, like any other part of the built environment.[1] This connection is reinforced by the contrast between the parking lot and the image of a natural, unspoiled paradise, which endows the parking lot with a sense of permanence and irrevocability. Also noteworthy is the fact that these opening lines present the parking lot first, and only then proceed to list the land uses that this parking is presumably meant to serve. In a similar manner, the amount of parking that will be required for a particular development project often plays a predominant role in determining what can actually be built on a particular

[1] Of course, the choice of preposition was likely dictated not by planning-related concerns but by a combination of poetic and practical considerations—most importantly, the fact that the p at the end of "up" plays into the alliteration in the song's first two lines, making it easier to pronounce these words in rapid succession. This is crucial, as the song derives much of its emotional power from the ironic juxtaposition of the lively, upbeat tune with the final verse's description of the titular taxi driving away, leaving the singer behind. In other words, "up," although peculiarly paradoxical, provides perhaps the perfect pick.

parcel of land, at least in North America: "Fitting both a building and the required parking onto the site can be difficult, and the building's design often must be compromised to accommodate the parking" (Shoup, 2005, p. 102).

Surface parking can be easy to overlook—figuratively and literally—but it is both an important component of the transportation system and a durable element in the physical fabric of cities. This oversight might be traced in part to the frequent association of automobiles with the idea of movement—despite the fact that, on average, cars spend around 95 percent of their lives standing still (Shoup, 2005, p. 6). As Weinberger (2012) points out, parking spaces are the automobile's terminal facilities, yet this "critical element of the transportation system is administered through zoning and building codes which make limited, if any, reference to the overall transportation system in setting their requirements" (p. 93). On the whole, land use regulations regarding the provision of automobile parking tend to go "largely unnoticed—or at least, unquestioned," despite how widespread they usually are (Taylor & van Bemmel-Misrachi, 2017, p. 288)—a "blind spot" that has affected not just planning and policy but also research on the subject: "Studies focusing on the effects and impacts of parking as a 'static form' of car use came much later than that on other issues on transport–land use relations" (Liu et al., 2017, p. 3303).

The research undertaken for this project was motivated by a desire to contribute to a fuller understanding of parking, particularly parking in Canada. This easily overlooked component of the transportation system merits much more attention than it has historically received from researchers, for parking now occupies a significant proportion of the North American urban landscape and has far-reaching implications for what our cities look like and how the people who live in them travel (Chester et al., 2015; McCahill & Garrick, 2010, 2014).

More specifically, the purpose of this project was to explore possible relationships between municipal parking policy and changes in the amount of surface parking within a specific context, namely in the downtown areas of mid-size cities in the Greater Toronto–Hamilton Area (GTHA) in Ontario, Canada, where provincial policy has been emphasizing growth management and intensification through the establishment of density targets.

The remainder of this introduction lays the groundwork needed to understand the context for this project, with sections that address (1) parking's role as an important driver of urban sprawl in North America, (2) the challenges that excessive amounts of surface parking present for the economic health and overall vitality of downtown areas, and (3) the Province of Ontario's "Growth Plan for the Greater Golden Horseshoe," which provides the specific policy framework guiding intensification with the GTHA. The chapter closes with an overview of the contents of this report.

Parking, urban sprawl, and the "durability of the built environment"

"Big Yellow Taxi" was written during a brief trip to Hawaii in 1969; Mitchell's official website suggests that the "pink hotel" in the third line of the song is "most likely the Royal Hawaiian in Honolulu," which was constructed in 1927 and, with 526 rooms, is "the landmark hotel on Waikiki Beach" (*Big yellow taxi*, n.d.). The Royal Hawaiian is located in Honolulu's "Resort Mixed Use Precinct (Waikiki Special District)" (City and County of Honolulu, 2020), within which hotels are required to provide a minimum of 0.25 parking spaces "per dwelling or lodging unit," according to Honolulu's Land Use Ordinance (2020, p. 21-106). Thus, if it were built today, the hotel would be required to provide at least 132 parking spaces, not counting the spaces that would be required for the “boutique” and the “swinging hot spot” (1 space per 800 square feet for each within the Waikiki Special District; Land Use Ordinance, 2020, p. 21-106).[2]

Honolulu’s ordinance also stipulates that a standard parking space must be at least 18 feet long and 8 feet, 3 inches wide (Land Use Ordinance, 2020, p. 21-107), or approximately 5.49 metres by 2.51 metres. If the 132 required spaces were laid out in six rows of 22 spaces, with one parking aisle—minimum width of 22 feet (6.71 metres) for a 90-degree parking angle (Land Use Ordinance, 2020, p. 21-107)—between each pair of rows, then the resulting parking lot would require minimum dimensions of 174 feet by 181.5 feet (53.04 metres by 55.32 metres), an area of 31,581 square feet or just over 2,934 square metres. For comparison, a North American professional hockey rink measures 200 ft. by 85 ft. (60.96 m by 25.9 m), for an approximate area of 17,000 sq. ft. (1,578.9 m^2). The required parking lot would therefore take up a little less area than two hockey rinks placed side by side.[3]

With this much parking being required for a single hotel—in an area with reduced requirements, to boot—it is not difficult to see how parking has become a major factor driving urban sprawl and a significant hindrance to the achievement of higher population and employment densities (Blais, 2010, p. 144). In Canada and the United States, the overwhelming glut of parking is driven by two related factors: (1) that zoning regulations usually require that a minimum number of parking spaces be provided for most development and redevelopment, and (2) that, for almost all automobile trips, parking is provided at no cost to the driver (Blais, 2010, p. 145; Shoup, 2005, p. 16). As a result, Blais (2010) writes, “Free parking is both the most

[2] Elsewhere in the city, a hotel with 526 rooms would be required to provide a minimum of 395 parking spaces, or 0.75 spaces per lodging unit (Land Use Ordinance, p. 21-104). A boutique (retail establishment) would require 1 space per 400 square feet of floor space; a “swinging hot spot” (eating and drinking establishment, presumably) would require 1 space per 300 square feet if the drinking establishment represents at least half of the developed floor area on its lot, or 1 space per 400 square feet if this is not the case (Land Use Ordinance, 2020, p. 21-103).
[3] Again, this is only within the Waikiki Special District. Elsewhere in the city, this parking lot would need to be three times as large.

significant and most ignored contributor to urban sprawl" (p. 204), which she argues is largely the result of inaccurate price signals (free parking being one example) and "distorted market forces" caused "largely by public policy" (p. 226) that incentivize less efficient forms of development: "An unfettered market with accurate price signals would curb sprawl, not create it" (Blais, 2010, p. 226). The provision of free parking greatly reduces the cost of owning and operating a private automobile, which means that individual preferences are heavily skewed in favour of this mode of transportation. As Storper and Manville (2006) put it, because driving and many other "facets of urban life could be correctly priced but are not" (p. 1262), our understanding of individuals' preferences is greatly flawed: "We would have a better idea of what people 'want' in a city if people had a better idea of what various urban amenities really cost" (p. 1270).

Arriving at a more complete understanding of what it is that people "want" is made more challenging by what Storper and Manville (2006) refer to as the "persistence of the built environment" and the "durability of past preferences" (p. 1267): "Cities are accumulations of past preferences and our choices for housing and density are frequently predicated on the choices made by those before us" (Storper & Manville, 2006, p. 1262). Each generation, they write, inherits a built environment that embodies the preferences and choices of those who came before, which in turn limits the ways in which individuals might express their preferences (Storper & Manville, 2006). The "persistence of the built environment" provides "bundles of goods and amenities … [that] obscure the way people rank their desires" (Storper & Manville, 2006, p. 1262), and "[n]ew preferences can only be revealed on the margins, in the form of new construction, and of course new construction today will further constrain preferences tomorrow" (p. 1267).

From this perspective, many cities have inherited a built landscape that reflects the emphasis that earlier generations placed on improving mobility by private automobile and on reducing traffic congestion. According to Brown et al. (2009), automobile congestion—a phenomenon that was "qualitatively different than what came before" (p. 163)—was one of the biggest problems that confronted North American transportation planners in the early part of the twentieth century.[4] These early planners also regarded suburbanization not as the issue it is considered today, but rather "as a strategy for allowing people in congested cities to escape to areas where they could enjoy higher quality housing, healthier lifestyles, and parks and open space" (Brown et al., 2009, p. 162). Over the next few decades, engineering goals such as maximizing traffic flow and minimizing costs "while adhering to uniform design standards" (Brown et al., 2009, p. 170) came to predominate over planners' more "holistic vision of transportation planning that recognized its symbiotic interaction with land use" and that "embraced multimodalism" (pp. 162–163). In the United States, the preferred course of action was to construct urban freeways, which was greatly facilitated by federal funding in the 1950s and 1960s (Brown et al., 2009). The ultimate result was the dispersal of low-density suburban development over large areas outside the central city, and it was only in the 1990s that a "multifaceted process of urban resurgence" began to take place, bringing with it a renewed interest in central city revitlatization (Storper & Manville, 2006, p. 1248).

Urban freeways are much less common in Canadian cities than they are in the United States. Nonetheless, similar patterns of rising automobile dependency and increasingly diffuse urban morphology have occurred north of the border as well, particularly in the decades following the Second World War. Using Halifax, Nova Scotia as a case study, Millward and Xue

[4] It should be noted that this problem was not limited to North America: Taylor and van Bemmel-Misrachi (2017) write that Melbourne, Australia's 1929 Plan for General Development "was concerned in large part with traffic, and with speeding up traffic flow" (p. 289).

(2007) investigated changes over time to the "morphological properties of local urban form," specifically the densities and development patterns of buildings and roads (p. 54). Their findings confirm "well-known historical trends" (Millward & Xue, 2007, p. 69): over time, the intensity of land use decreases, with building footprints increasing in area and the buildings themselves occupying larger lots as they become spread further apart (p. 69). Millward and Xue also found that these well-known trends were related to "trends in road/lot layout and land-use separation," particularly as expressed in the "street-related measures of road density, junction density, and junction frequency, all of which decreased over time" (p. 69).

More generally, Bunting et al. (2007) find that "most mid-sized metropolitan areas in Canada are characterized by reduced densities at the core alongside overall flat, low-density profiles" (p. 30).[5] In this regard, they write, Canada's mid-size cities are distinct from the country's larger metropolitan areas: when it comes to density, "mid-size metros appear as veritable flat-liners whose core parts barely approach densities found in suburban parts of larger places" (Bunting et al., 2007, p. 30). The result is an urban landscape that is much more amenable to travel by automobile than by other modes, which in turn leads to destinations that offer abundant free parking and easy accessibility by automobile in order to cater more and more to drivers in a "self-perpetuating, land use/transportation dynamic, characterized by core area depletion partnered with expansive styles of outward growth" (Bunting et al., 2007, p. 47).

Unique places: The vitality of downtown areas

This "self-perpetuating dynamic" of dispersed development and automobile dependence has been a major contributing factor to the "serious difficulties" confronting downtown areas in

[5] For Bunting et al. (2007), the term "mid-size metropolitan area" refers to the 13 Census Metropolitan Areas (CMAs) in the 2001 Statistics Canada Census of Population with total populations between 100,000 and 500,000—a groupt that includes Halifax, the subject of Millward and Xue's (2007) case study.

many of Canada's mid-size cities (Bunting et al., 2007, p. 41). An earlier survey conducted by Filion et al. (2004) presented planners and those in related professions with a list of 202 North American small-metropolitan regions (177 in the United States and 25 in Canada)[6] and asked respondents to rate them based on the perceived success of their downtowns. Out of the 202 metro regions listed, only 19 had downtown areas that were characterized as "successful," which according to Filion et al. "confirm[s] the widespread observation that the vast majority of the downtowns of small metropolitan regions experience serious difficulties" (p. 332). Filion et al. observe that the 19 successful downtowns all possessed at least one of the following: "a university that is in or close to downtown; presence in a metropolitan region with a strong visitor orientation; a well preserved historical district; and a state capital or provincial legislature" (p. 334). Overall, they write, downtown success appears to derive from a healthy mix of activities, a pedestrian-friendly environment, and some element of unique character—a place's "ability to provide activities and settings that are unique within their metropolitan regions" (Filion et al., 2004, p. 340).

More recent research appears to corroborate the importance of a downtown possessing unique attributes. Sciara et al. (2018) investigated the effects that the opening of a large-format retail store (Target) in Davis, California, had on the behaviour of local shoppers. Their findings indicate that those most affected by the new store, which was located about 6–7 kilometres from downtown Davis, were not downtown retailers but rather "[o]ther big box stores and smaller chain stores offering products and shopping experiences similar to Target's" (Sciara et al., 2018, p. 57), most of them located outside the downtown area. The impacts on downtown Davis were "limited," in large part because the items sold at Target were not important contributors to the

[6] Filion et al. (2004) define small-metro regions as having between 100,000 and 500,000 people (p. 328), the same range used by Bunting et al. (2007).

downtown retail environment and because many of the trips made to downtown were, "not surprisingly, for purposes other than shopping" (Sciara et al., 2018, p. 56). The conclusions drawn by Sciara et al. echo the earlier findings of Filion et al. (2004): "Planners who want to fortify their own downtowns from the potential harms of big box stores could focus on enhancing downtown vitality by supporting a wide variety of activities and promoting the experiential aspects of shopping downtown" (Sciara et al., 2018, p. 57).

In other words, maintaining a successful downtown means resisting the urge to replicate dispersed suburban development patterns in a misguided effort to cater solely to the private automobile. Rather, success depends upon retaining a distinct downtown environment, one that is "generally favourable to pedestrian-based synergies" (Filion et al., 2015, pp. 34–36). Filion et al. (2015) cite Chicago and Toronto as examples of larger metropolitan areas that have maintained healthy activity levels in their downtowns, observing that one important factor has been the absence of the sort of auto-oriented "interventions"—namely, the construction of urban freeways and massive parking lots—that have been greatly detrimental to other downtown areas: "In both, highways were routed around the exterior of the core and public transit investment prevented the two downtowns from having to devote most of their space to vehicles" (Filion et al., 2015, p. 34).

Of course, cities like Chicago and Toronto have not been completely spared the effects of auto dependence. In recent years, the Toronto region has seen a "growing number of New Urbanist projects" (Xu, 2017, p. 814), with the goal of building more compact suburban communities that will more effectively support multimodal transportation. Looking at regional development patterns, Xu (2017) finds that this trend has indeed resulted in new forms of suburban development, with greater densities, better connected street networks, and more walkable distances between different destinations. Nonetheless, according to Xu, this pattern has "failed to achieve the two primary goals of New Urbanist design: to create a pedestrian-friendly environment by developing street-oriented retail, and to reduce car dependency by integrating a variety of land uses" (p. 829).

Xu's (2017) conclusions corroborate the earlier work of Hess and Sorensen (2015), who similarly found that development in the Toronto region continues to support automobile dependence. Hess and Sorensen argue that the region's patterns of residential development ought not to be characterized as "sprawl," insofar as these patterns reflect "orderly and consistent development" that "does not conform well to conventional notions of sprawl based on American city-regions" (p. 147). However, they point out, if "sprawl" is more simply defined as a pattern of development that fosters auto dependence, then "Toronto's urban form is indeed sprawl" (Hess & Sorensen, 2015, p. 147).

According to Hess and Sorensen (2015), one factor in the continuing dominance of the private automobile is "the role of the arterial roads grid and the super-blocks that it creates" (Hess & Sorensen, 2015, p. 147). Developments seeking to implement design principles inspired by New Urbanism or by similar schools of thought tend to take place within the cells of this arterial grid, with little to connect them to other "super-blocks." Xu (2017) observes something similar, noting that, although the Toronto region's New Urbanist communities tend to feature well-connected internal environments, their external connections remain very limited. As a result, "many of the existing New Urbanist design strategies only help to create self-contained neighbourhoods that are equipped with pedestrian infrastructure but without a variety of destinations for activities to take place" (Xu, 2017, p. 830).

The arterial roads grid represents one way in which the built environment retains the forms dictated by past preferences. Thus, even though there appears to be some appetite for change, the "durability of past preferences" (Storper & Manville, 2006, p. 1267) presents a formidable challenge, as existing development patterns that foster and encourage automobile dependence continue to feed into the "self-perpetuating dynamic" observed by Bunting et al. (2007, p. 47). Even so, there is growing interest in developing urban environments that support more sustainable travel behaviours, and downtown areas present an important opportunity. Not only do downtowns tend to be among the oldest areas of cities—and thus more likely to express an earlier, less automobile-focused set of past preferences—but, as the work of Filion et al. (2004, 2015) and others suggests, reduced auto dependence and the development of pedestrian-friendly environments are important contributors to a downtown's overall health. Reform efforts seeking to improve the downtown environment, therefore, have the potential to support non-automobile modes of travel as well as to contribute to healthy levels of activity within the city centre.

The *Growth Plan for the Greater Golden Horseshoe*

In 2006, the Government of Ontario introduced the Growth Plan for the Greater Golden Horseshoe ("Growth Plan"), which established density targets both for new development and for redevelopment in built-up areas (along with a number of other directives concerning growth management, natural features, housing, employment lands, and public transit) for the municipalities in the Greater Toronto–Hamilton Area, referred to as the "Greater Golden Horseshoe" or "GGH." The primary purpose of the Growth Plan is to manage the significant population growth expected to take place in the region, from 3.7 million people in 2001 to 11.5 million in 2031, according to the forecasts in the initial version of the plan (Ontario Ministry of

Municipal Affairs and Housing [MMAH], 2006, Section 2.1). The Growth Plan's strategies for achieving its goals include "directing a significant portion of new growth" to already built-up areas (Ontario MMAH, 2006, Section 2.2.2, Policy 1.a), promoting intensification within defined areas (Section 2.2.2, Policy 1.b), and reducing automobile dependence "through the development of mixed-use, transit-supportive, pedestrian-friendly urban environments" (Section 2.2.2, Policy 1.d). The Growth Plan has been significantly amended twice since its inception, but the core principles and objectives remain the same.

A central feature of the Growth Plan was the establishment of twenty-five "Urban Growth Centres" (UGCs) within twenty-one of the GGH's local municipalities. Each Urban Growth Centre has been assigned a density target—400 combined residents and jobs per hectare for the five UGCs located within the City of Toronto, and either 150 or 200 combined residents and jobs per hectare for the other twenty UGCs (Ontario MMAH, 2006, Section 2.2.4, Policy 5). The purpose of these targets is to promote city centres as focal points for development and investment in order to "accommodate a significant share of population and employment growth" (Section 2.2.4, Policy 4). Municipalities were directed to include these UGCs in their official plans and to "develop and implement … a strategy and policies to phase in and achieve intensification" (Section 2.2.3, Policy 6).

In addition to its intensification targets, the Growth Plan contains a number of policies regarding the transportation system. The original version states that the system is meant to "provide connectivity among transportation modes for moving people and for moving goods" while "offer[ing] a balance of transportation choices that reduces reliance upon any single mode and promotes transit, cycling and walking" (Ontario MMAH, 2006, Section 3.2.2, Policy 1.a; Policy 1.b). The most recent version of the Growth Plan (May 2019) has made this more specific by replacing “reliance upon any single mode” with “reliance upon the automobile” (Ontario MMAH, 2019, p. 32 [Section 3.2.2, Policy 1.b]). Despite its emphasis on reducing auto dependence, however, the Growth Plan appears to suffer from the same “blind spot” that Weinberger (2012) has pointed out—namely that parking, a “critical element of the transportation system” (p. 93), receives very little attention. To be fair, the most recent version of the Growth Plan does indeed include “parking facilities” in its definition of the term “Transportation System” (Ontario MMAH, 2019, p. 87)—an improvement upon the original version, which omitted this particular element from its definition. Beyond this, however, the 2019 Growth Plan mentions automobile parking only twice: (1) Section 2.2.4, Policy 9.c, which directs municipalities to support development in major transit station areas, “where appropriate,” by “providing alternative development standards, such as reduced parking standards” (p. 18); and (2) Section 2.2.5, Policy 4, which states that “surface parking will be minimized” within employment areas (p. 19).[7]

This is certainly not meant to cast aspersions upon the Growth Plan, but rather to point out that the achievement of one of its policy goals (intensification and increased development within built-up areas and urban centres) could possibly undermine others (reduced auto dependence). According to performance indicators published by the Province of Ontario in 2015, municipalities within the Greater Golden Horseshoe region appear to be “achieving or exceeding their required intensification target[s]” when it comes to residential development within the built-up area, and densities within Urban Growth Centres appear to be increasing, suggesting that these areas are beginning to emerge as focal points for growth and development (Ontario MMAH, 2015).

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[7] The fact that the Growth Plan defines the transportation system as one “for the *movement* of people and goods” (Ontario MMAH, 2019, p. 87; my emphasis) recalls Liu et al.’s (2017) suggestion that parking has often been overlooked because it is “a ‘static form’ of car use” (p. 3303).

However, if this growth and development take place under the traditional "Suburban New World" policy regime, which involves setting minimum parking requirements "at levels that eliminate almost all possibilities of on-site shortages" (Barter, 2015, p. 146), then growth and intensification could very well play into the "self-perpetuating dynamic" described by Bunting et al. (2007), wherein more parking improves downtown automobile accessibility but, in doing so, makes that environment less hospitable to other transportation modes and detracts from the qualities that make the city centre unique. Surface parking is surely among the least dense land uses imaginable; if local policies possess a similar "blind spot" with respect to parking, then increased development activity in the downtown areas of GGH municipalities could conceivably generate increased amounts of surface parking, which would make it more difficult for these municipalities to achieve their density targets.

Parking stands at an important nexus in the transportation–land use system: it represents terminal capacity for the private automobile as well as a land use that consumes significant amounts of urban land (McCahill & Garrick, 2014). Thus, there are many factors related to both transportation and land use that influence the amount of parking that exists; these factors include the modal splits of transportation modes in a given context, levels of automobile ownership, the price of land, land ownership patterns, interest rates, property tax rates, and various costs associated with construction and, where necessary, remediation. Among these factors, we have already seen that public policy and regulations play an important role in determining the supply of parking. Zoning regulations are a principal means of administering this "critical element of the transportation system" (Weinberger, 2012, p. 93), and these regulations usually emphasize the provision of free parking through minimum parking requirements, which themselves have become the primary factor behind the excessive supply of parking found in North American cities (Blais, 2010; Shoup, 2005). Furthermore, McCahill and Garrick (2014) have found that "differences in parking provision are due in large part to differences in policy approaches" (p. 51).

Given the impact that policy has on the amount of parking supplied, and that this impact is connected to development and redevelopment through zoning requirements, it seems reasonable to expect that the Growth Plan's promotion of intensification in urban centres will influence the supply of surface parking in those areas. In fact, there are two conceivable, contrasting outcomes when it comes to how intensification and higher-density development might affect the amount of surface parking in the Growth Plan's Urban Growth Centres:

- on the one hand, the establishment of an overarching, regional policy framework that emphasizes intensification and higher-density land uses in city centres, as well as reduced auto dependence, could lead to decreases over time in the area devoted to surface parking;
- on the other hand, higher levels of development and redevelopment in circumstances where local parking policies may be more conventional—that is, where zoning by-laws require a certain minimum number of parking spaces to be provided at no cost to drivers and where parking regulations go "unnoticed" or "unquestioned" (Taylor & van Bemmel-Misrachi, 2017, p. 288)—could very well generate increases in the amount of surface parking provided.

The research described in this report was undertaken with the goal of discovering which of these two outcomes was more likely to be the case, and, should different municipalities show vastly different outcomes, to understand what differences in local policy might have contributed to the disparity.

Structure and overview of thesis

The next chapter provides a review of the relevant literature on parking regulations and policy, on parking's role in fostering auto dependence, and on the impact of surface parking on urban form and the built environment. While some aspects of parking policy, such as minimum parking requirements and pricing, have received a reasonable amount of attention, others remain in need of more thorough exploration. Moreover, existing studies on parking in Canada tend to be rather narrowly focused, providing little in the way of a "bigger picture" understanding of the parking supply and parking policy in Canadian cities. The second chapter concludes by presenting the specific research questions that guided this project, while the third describes the methods used in answering those questions, which involved three phases: (1) a mapping phase, which involved measuring the change in surface parking area in a sample of twelve downtown Urban Growth Centres; (2) a policy analysis phase, in which the policy positions expressed in the official plans and zoning by-laws of those twelve same municipalities were characterized; and (3) a final analysis phase, which considered the results of the previous two phases alongside one another.

The fourth chapter presents the results of this research, which found that only four of the twelve municipalities saw increases in the area devoted to surface parking in and around their UGCs. Some intriguing trends emerge when we consider the observed changes alongside a characterization of municipal policy positions, pointing towards possible relationships that merit further study. These potentially fruitful avenues for future exploration are presented in the Discussion chapter, which explores the implications the project results have for planners, policy-makers, and researchers. Finally, a short conclusion reviews the important findings from this project, summarizes their implications for research and for practice, and makes the case that planners and municipalities need to take a more active role in managing the supply of surface parking, and of parking in general, in order to support the vitality and well-being of Canada's mid-size cities.

Literature Review

As Liu et al. (2017) have remarked, the “effects and impacts of parking as a ‘static form’ of car use” started to receive attention from researchers much later than other facets of transportation–land use planning (p. 3303). Studies over the past couple decades have begun to remedy the deficiency, and certain aspects of parking and parking policy have received a good deal of attention from researchers. Over time, a general consensus has emerged on a number of points, perhaps the most important being the recognition that the imposition of minimum parking requirements through zoning regulations has been ineffective at solving the problems it was supposed to address, and that furthermore this practice has had many detrimental effects on urban form and has promoted unsustainable travel behaviours by making it easier—and much cheaper—to travel alone by car.

Despite the overall consensus, however, minimum parking requirements remain fixtures in planning practice, especially in North American cities. Efforts at policy reform are often met with considerable resistance, in large part because the impression persists that easy access by automobile is necessary for an area’s economic well-being (Marsden, 2006; Willson & Roberts, 2011). On top of this, different approaches to reform tend to be conflated despite important distinctions between them, which often results in confusion (Barter, 2015). Nonetheless, certain alternatives to the standard policy approach, such as demand-based pricing and parking “cash-out” for commuters, have received a fair amount of attention in the literature. Commuting has also been the focus for the majority of research conducted on parking in Canada, although these studies in general tend to be narrowly focused and to concentrate on the largest cities, meaning that a "bigger-picture" understanding of parking policy in the country's mid-size cities has yet to be established.

This literature review presents the work that has been done to establish the points of consensus mentioned above, while also pointing toward some areas on the subject where our understanding can yet be improved. The sections in this chapter have been organized around the following topics:

1. Minimum parking requirements, their role in generating a significant over-supply of parking, and their stubborn entrenchment in zoning regulations.
2. Parking policy, which includes a general overview of the objectives and evolution of parking policy in North America, Australia, and Europe, as well as a more specific focus on Barter's (2015) typology of policy approaches, which is central to the policy analysis portion of this research project.
3. Two avenues for reform suggested by Shoup (2005)—demand-based pricing for curb-side parking and parking "cash-out" for commuters—that have been implemented in some cities in the United States.
4. Parking's influence on the travel behaviour of Canadian commuters.
5. Residential parking, including its influence on travel behaviour and its relationship with housing development activity.
6. Parking's relationship with discretionary trip-making, its role in downtown areas, and its ramifications for urban form.

The chapter closes by presenting the specific questions that directed the research undertaken for this project.

Minimum parking requirements

The touchstone for pretty much any discussion of the literature on parking is Donald Shoup's 2005 book, *The High Cost of Free Parking*, whose fundamental premise is that the provision of free off-street parking (as required by most North American zoning by-laws and ordinances) is in fact heavily subsidized by society as a whole. The actual costs of providing and maintaining these so-called "free" parking spaces are actually incorporated into the price of everything else we buy, with the result that we all end up subsidizing parking "with almost every commercial transaction we make because a small share of the money changing hands pays for parking" (Shoup, 2005, p. 2). In addition to being the "most significant" factor driving urban sprawl (Blais, 2010, p. 204), "free" parking skews individual transportation choices towards the private automobile by drastically reducing the full cost of owning and operating a car (Shoup, 2005).

Shoup (2005) traces the source of most parking problems to "the treatment of curb parking as a commons" (p. 6): free on-street, curb-side parking is a public resource that is available for anyone to use but also relatively scarce. This presents a situation in which "self-restraint does not produce any individual reward," even though the imposition of restraints would benefit everyone collectively (Shoup, 2005, p. 7). According to Shoup (2005), city planners have "misdiagnosed" the problem "not as the city's failure to charge market prices for curb parking, but as the market's failure to supply enough off-street parking" (p. 8) and have prescribed a solution—establishing a minimum required number of off-street parking spaces for almost all land uses—with far-reaching deleterious consequences for urban environments.

Perhaps the biggest issue with requiring each development to provide a minimum number of parking spaces, Shoup (2005) argues, is that this is generally done under the assumption that parking will be provided for free. The resulting abundance of free parking significantly distorts the demand for parking that might otherwise be observed: "Believing that the problem is a parking shortage, planners require enough off-street spaces to satisfy the *peak* demand for *free* parking" (p. 23; emphases added). The distortion is bolstered by the fact that, in the United States, minimum parking requirements (MPRs) are generally derived from rates reported in the ITE's (Institute of Transportation Engineers) *Parking Generation* report. Shoup (2005) calls these rates "questionable" for a number of reasons, in large part because they focus on peak parking demand at "suburban sites that lack public transit" (p. 32). Furthermore, MPRs often ignore the immediate local and neighbourhood context and instead apply a single standard across an entire city, and in many cases, Shoup (2005) contends, planners appear to have simply copied the standards used in other jurisdictions (p. 27; p. 31).

MPRs and excess supply

Since the publication of Shoup's work, a general consensus has emerged that MPRs represent, at best, a blunt policy instrument. As Jung (2011) puts it, if the objective has been to eliminate "spillover" parking and reduce traffic congestion, then MPRs "are an overly blunt and highly inefficient form of parking management" (p. 77). Not only have MPRs failed to effectively address the problems they were meant to solve, but they have also encouraged greater dependence on the private automobile by greatly reducing operating and ownership costs. McCahill and Garrick (2014) have identified minimum parking requirements as one of two primary reasons behind increases in the parking supply (p. 35),[1] and a number of studies concur

[1] The second reason is that developers, perceiving there to be a certain level of demand, are wary of providing "what they consider to be too little parking," often under the apprehension that providing less parking will prevent them from attracting tenants or from securing loans from financial institutions (McCahill & Garrick, 2014, p. 35). However, McCahill and Garrick (2014) point out, developers are usually willing to provide less parking once they come to understand that "there is an existing abundance in parking supply" (p. 35).

that MPRs do indeed contribute greatly to the excessive over-supply of parking in North American cities. Not surprisingly, a surfeit of off-street parking has detrimental effects on urban density and the compactness of the built environment, both in theory (Brueckner & Franco, 2017, p. 121) and in practice (Liu et al., 2017, pp. 3313–3314). Minimum requirements have been incredibly successful in producing higher levels of driving and greater dependence on the private automobile (Chester et al., 2015; McCahill et al., 2016; Taylor & van Bemmel-Misrachi, 2017), but have been far less effective in reducing congestion, as they were originally intended (Chester et al., 2015, p. 279). MPRs have received a fair bit of attention in the literature, attention that has been warranted, according to McCahill and Garrick (2014), since the parking spaces mandated by MPRs become durable features of the built environment: "they establish a lower limit on parking supply that is essentially permanent and relatively inflexible" (p. 36).

In one specific instance, Smith (2013) conducted a ground survey of thirteen shopping centres near light-rail transit stops in San Jose, California, with the goal of gathering empirical evidence to show that the City's parking requirements for this particular land use were too high (p. 27). The study found that the two survey periods—the holiday shopping season, representing the peak demand period, and mid-February, representing the period of lowest parking demand (p. 30)—were remarkably similar in terms of utilization rates: Smith reports a range of utilization rates for the thirteen lots between 29% and 78% in December, with an average rate of 57%, and a similar range for the so-called low-demand period, between 24% and 84%, with an average of 55% (p. 32). Smith also notes that transit service was not a significant factor in the occupancy levels observed, explaining that there appeared to be "very little use of the VTA [Santa Clara Valley Transportation Authority] light rail lines on the two Saturdays that parking utilization counts were conducted" (p. 33). The results agree with previous studies that Smith cites, which found "shopping center parking lots to be underutilized, even during the holiday shopping season" (p. 28), and which point to MPRs as a major factor in the over-supply of parking.

Interested in gauging how large the excess might be in a denser, more transit-supportive environment, Ewing et al. (2017) compared the levels of parking demand and vehicle trip generation specified in ITE guidelines with the levels observed at five transit-oriented developments (TODs) across the United States. The observed trip generation rates proved to be substantially lower than those given in ITE guidelines, with the five TODs generating vehicle trips at rates ranging from 34.7% to 69.8% of the rates predicted in ITE's *Trip Generation Manual*—standards that the ITE has established based on "suburban, auto-oriented developments" (Ewing et al., 2017, p. 73). Ewing et al. also found that, in most cases, the five TODs supplied parking at levels well below those recommended by ITE.[2] Despite the apparent "under-supply," however, none of the five cases saw peak parking demand levels exceed the actual amount supplied, which indicates, according to Ewing et al., "just how wildly over-parked these developments would be" if they strictly followed ITE guidelines (p. 75).

To be perfectly fair to the ITE, the supply guidelines laid out in its *Parking Generation* reports are not intended to be the sole basis for setting municipal MPRs: "*Parking Generation* recognizes that parking recommendations should not be taken at face value but should be a starting point for the estimation of parking demand, although it seems that many municipalities have glossed over this statement" (Smith, 2013, p. 29). There is certainly a consensus in the literature that, rather than adopting a single, one-size-fits-all solution, municipalities ought to base their parking policies on solid, empirical evidence, ideally with community involvement, and that these policies should be sensitive to local context and formulated within a broader

[2] The lone exception was the supply of residential parking at Englewood TOD in Denver (Colorado), which provided 114.3% of the amount recommended by ITE guidelines (Ewing et al., 2017, p. 75).

comprehension of strategies and policy goals (Barter, 2015; Engel-Yan et al., 2007; Willson & Roberts, 2011). As Manville (2013) puts it, a minimum requirement “presents a developer with a problem (the need for off-street parking) and also tells the developer how to solve that problem (provide a set number of covered spaces onsite with every unit)” (p. 57), rather than allowing for other, more creative solutions that might be more appropriate for the site and its vicinity.

Reduced requirements, reduced supply?

If minimum parking requirements do indeed contribute to excessive amounts of parking, then the question that naturally follows is whether reducing these requirements will in turn lead to reductions in the amount of parking provided. Engel-Yan et al. (2007) set out to answer this question by conducting ground surveys at over 1,000 retail and office sites across the six former municipalities that now make up the City of Toronto. Their findings show that “a surprisingly high number” of sites (over 40% of general retail, large retail, general office, and medical office sites) provided less parking than existing minimum standards required (p. 106).[3] However, the opposite was observed for banks and large grocery stores, which tended to provide parking at levels well above those required by minimum standards. Engel-Yan et al. attribute this second finding to the “high peak customer densities” experienced at such sites as well as to the large share of grocery shoppers who bring their purchases home by car (p. 107). Overall, they conclude that reducing minimum requirements “for general office, medical office, and general retail uses will prove a successful strategy in encouraging new development to provide fewer parking spaces on average” (Engel-Yan et al., 2007, p. 109), but that reductions would likely not be significant at large grocery stores and banks (p. 110).

[3] Engel-Yan et al (2007) present a number of possible reasons this could be the case, suggesting that perhaps development on some sites had taken place before the current zoning by-law came into effect, had been granted variances, or had benefitted from more flexible policies regarding on-site parking (p. 106).

Engel-Yan et al.'s (2007) suggestion that developers would be willing to provide less parking if they were permitted to do so is supported by later research performed separately by Manville (2013) and by Li and Guo (2014). Manville (2013) investigated how developers responded to the City of Los Angeles's Adaptive Reuse Ordinance (ARO), which, among other things, granted an exemption from parking requirements for projects that converted vacant downtown buildings into housing. Manville found that many developers did indeed provide less parking than would normally have been required, and that even where the total amount provided was close to the usual minimums, parking was provided "in ways that zoning would have prohibited," such as on other sites (p. 56). Similarly, Li and Guo (2014) found that there was a "sharp reduction" in the amount of parking provided in new residential development applications in Greater London (UK) following a policy change that replaced minimum requirements with maximum standards, suggesting that developers would willingly provide less parking than had previously been required.

Resistance to change

Despite the general agreement regarding MPRs and the detrimental effects of excessive parking, and despite at least some developers' apparent willingness to provide lesser amounts of parking, most North American jurisdictions persist in the imposition of minimum requirements. As Barter (2010) puts it, the practice has proven "remarkably resistant to the attacks upon it" (p. 572), and efforts to pursue a different approach to parking policy often "encounter resistance from planners, traffic engineers, community members, and local elected officials" (Willson & Roberts, 2011, p. 54). Even where policy-makers have moved away from the conventional approach, the steps taken can often be overly cautious. One example can be found in Miami's new form-based code, "Miami 21," which Hananouchi and Nuworsoo (2010) compared to the

City's previous zoning ordinance and to recommendations set out in two other sources, Duany Plater-Zyberk and Company's *SmartCode* (2009, as cited in Hananouchi & Nuworsoo, 2010) and the handbook *Form-Based Codes* (Parolek et al., 2008, as cited in Hananouchi & Nuworsoo, 2010). Hananouchi and Nuworsoo found that Miami 21's new requirements did not differ all that much from the standards that had already existed, and that, in fact, the new code's urban core transect[4] "requires considerably more parking than the existing CBD zone" (p. 141). Furthermore, they note, "the extent of transect, civic, and district zones in the Miami 21 form-based code closely matches existing use-based zones," although Miami 21 does provide more opportunities for mixed uses (Hananouchi & Nuworsoo, 2010, p. 140). The similarities in parking requirements were in part the result of pressure both from politicians and from community members: "Because of fears of parked cars from multifamily residences overflowing into adjacent neighborhoods, local residents wanted to increase the one space per dwelling unit proposed by the SmartCode for the urban center (T5) and urban core (T6) transects" (Hananouchi & Nuworsoo, 2010, p. 141).

At the moment, then, minimum parking requirements remain stubbornly entrenched in policy, particularly in North America and what Barter (2015) calls the "Suburban New World," whose policy approach "frames parking as ideally an ancillary service in development sites with spillover seen as an externality, like pollution" (p. 146). This framing, Barter writes, reflects the expectations and experiences of planners and suburbanites and represents a "mindset" that "seems 'natural' in the context of automobile-oriented areas where planning assumes that most people arrive by car and that almost none walk between nearby sites" (p. 146).

[4] The template provided by DPZ's SmartCode (2009) features six "transect" zones along a form-based gradient, ranging from natural environment (T1) to urban core (T6). According to Hananouchi and Nuworsoo (2010), Miami 21 omits the "rural" transect (T2) but includes the other five transects found in SmartCode (p. 140).

Parking policy

One reason that decision-makers can be resistant towards change when it comes to parking policy is the assumption that relatively high levels of automobile accessibility are necessary for an area's economic well-being (Marsden, 2006). In general, the countries of the "Anglophone 'New World'" have maintained rather similar approaches to parking policy, with a predominant mindset that regards parking as something that needs to be provided on each site and in amounts that will exceed any foreseeable level of demand (Barter, 2015, p. 146). The notion of "mindsets" is central to the typology that Barter (2015) has developed to categorize different approaches to parking policy and policy reform. This typology, in turn, has significantly informed the policy analysis portion of this project, and is therefore described in detail at the end of this section.

Objectives and evolution of parking policy

In his review on the topic of urban parking policy, Marsden (2006) observes that three particular objectives "are frequently perceived to be in conflict" (p. 448). Each of these conflicting objectives regards parking policy as a means towards a different end: (1) revitalizing some particular urban area, such as the downtown core, by improving automobile accessibility and thus attracting customers and businesses; (2) reducing dependence on travel by auto and thus contributing towards achieving sustainability goals; and (3) generating revenue, either simply to cover costs or in order to provide a surplus with which additional programs might be funded (Marsden, 2006, pp. 448–449). The first of these objectives assumes that economic well-being is contingent upon accessibility by automobile, and in doing so strongly hints at why efforts to move away from MPRs can encounter such strong opposition. However, Marsden suggests that this underlying assumption may be misguided, observing that, "[d]espite the prominent concerns of the impacts of parking restraint on urban vitality, little evidence exists to support such concerns" (p. 452). Although he regards the published evidence base as not being "as strong as it should be," Marsden nonetheless maintains that enough evidence exists to "challenge the orthodoxy … that parking restraint will discourage economic development" (pp. 455–456). Moreover, he cites evidence that restraint-based policies like parking maximums do not drive existing businesses out of a particular area (p. 451), pointing out that considerations regarding parking and transportation generally only become factors once the decision to relocate has already been made (p. 450).

Marsden (2006) also provides evidence to support the position that parking needs to be addressed on a regional scale, rather than by focusing on specific portions of the city. According to Marsden, even though individuals are sensitive to increases in walk time between parking location and their final destination, people are usually willing to walk further if the parking space is free—meaning that parking problems will "migrate" if restrictive policies do not cover a sufficiently large area: "As would be expected, restraint based policies in the urban core whilst lax parking standards exist in edge of town sites acts against the effectiveness of the city centre policies" (Marsden, 2006, p. 456). Young and Miles (2015) have reached the same conclusion with regard to parking in the Melbourne (Australia) metro region, arguing that the distribution of parking strongly suggests that restrictive policies focused on the region's Central Business District (CBD) have contributed towards decentralization and auto use in the outer suburbs. They observe that parking "concentration," the demand per unit area, decreases with distance from the city centre, whereas the parking *rate*, as measured in spaces per number of jobs, increases, as does parking use, which is "the consequence of the interaction between parking demand and supply" (Young & Miles, 2015, p. 28). Overall, they emphasize the "need to consider parking at a metropolitan level, rather than focusing parking policy in particular parts of the city" (Young & Miles, 2015, p. 31).

As Taylor and van Bemmel-Misrachi (2017) describe it, transportation policy in the Melbourne region has generally seen parking "recede… as a strategic policy issue" (p. 295). The 1954 Melbourne Metropolitan Planning Scheme (not the earliest plan for the Melbourne metropolitan area, but the first one that was implemented) regarded parking "as a problem around which other uses needed to be reconfigured" (Taylor & van Bemmel-Misrachi, 2017, p. 291), with congestion in the city centre being the most pressing concern. In response to the difficulty of accessing the Central Business District by car, the 1954 plan emphasized decentralization: "Car ownership was something that could reduce 'pressure' on the CBD by providing 'access by car' to other centres" (Taylor & van Bemmel-Misrachi, 2017, p. 291). Some important changes in thinking had taken place by the development of the 1981 Metropolitan Strategy, which replaced minimum requirements in the CBD with maximums, while outside the city centre "more car parking was positioned as essential in order to 'increase the appeal' of centres, and parking problems were framed as ones of inadequacy" (Taylor & van Bemmel-Misrachi, 2017, p. 292). However, the 1981 strategy was the last one to explicitly address parking as "a strategic planning and transport policy issue" (p. 292). More recent plans have devoted little attention to parking, and Melbourne's minimum parking requirements have seen very little change over the past sixty years or so (Taylor & van Bemmel-Misrachi, 2017, p. 295). The specific case of parking policy in Melbourne shares a number of characteristics with the general state of policy in North America, where parking is usually "an expected but unnoticed land use" (Taylor & van Bemmel-Misrachi, 2017, p. 287).

Whereas North American policy-makers have tended to pursue and maintain a course centred on MPRs, urban parking policy in most of Europe's cities has evolved according to a general three-stage process, according to Mingardo et al. (2015). The first phase, dating from the inception of parking regulations in the 1960s and lasting until the 1980s, was governed by what they call a "predict and provide" principle, wherein parking was provided for free, although pressures from increasing demand eventually led to the imposition of time limits (Mingardo et al., 2015, pp. 271–272). The introduction of paid parking, first in the highest-demand areas and then elsewhere, marked the beginning of the second phase (Mingardo et al., 2015, p. 274), while the third phase has seen policy-makers moving towards more comprehensive parking demand management programs, which has involved a "major shift" from reactive measures to a more strategic approach (Mingardo et al., 2015, p. 278). At the moment, they write, most of Europe's urban areas are either in this third stage or in the process of entering it, though in many jurisdictions there still exists "a tension between the reactive/operational approach to managing parking, and the more strategic, evidence based approach that we advocate here" (Mingardo et al., 2015, p. 279).

There appears to be an overall lack of research looking specifically at parking policy in Canada, which instead tends to get "lumped in" with the United States as "North America." In some respects this is justified, as there are many "economic and governance similarities between United States and Canadian city-regions" (Hess & Sorensen, 2015, p. 148). At the same time, development patterns in the two countries contrast in some important ways (Hess & Sorensen, 2015), and we do both ourselves and Canadian decision-makers a disservice by neglecting to take a closer look at parking policy in Canada's cities and thereby constructing a more complete understanding of the "bigger picture."

Barter's (2015) typology of parking policy

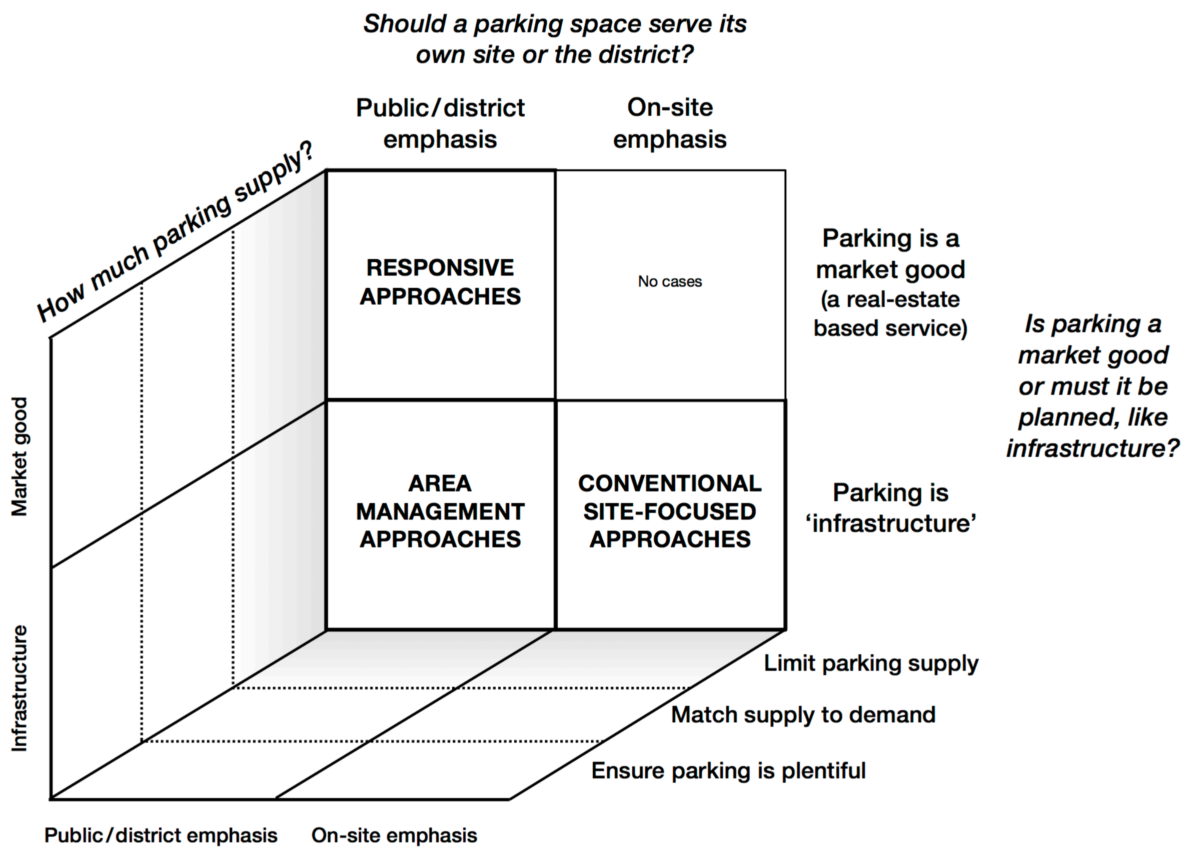
In presenting his typology of approaches to parking policy, Barter (2015) remarks on the fact that previous attempts to develop such a classification system "have been limited" (p. 136), observing that "[n]o widely used classification of parking policy approaches has so far emerged" (p. 137) and that [f]ew systematic attempts … have been published" (p. 141). While some existing classification systems (Litman, 2006; Willson, 2013) provide "useful partial accounts of parking policy diversity" (Barter, 2015, p. 141), many fall prey to one-dimensional dichotomies and false binary choices, with most systems offering "limited insight into the mindsets associated with parking policy types" (p. 145). The result, he writes, is a considerable amount of confusion when it comes to alternative approaches to parking policy (Barter, 2015). According to Barter (2015), MPRs have become so dominant in the "Anglophone 'New World'" (p. 146) that alternative approaches to regulating or managing parking "tend to be conflated and assumed to be essentially similar" (p. 137). Furthermore, the emphasis on "mindsets" in Barter's (2015) typology brings into consideration a key psychological factor that contributes to the persistence of minimum parking requirements, despite the many logical arguments that can be made against their continued use.

The typology Barter (2015) has developed involves two main criteria: (1) whether parking is "seen as something that should be provided on every site or as something that can serve many sites" in a given area (p. 138); and (2) whether parking is regarded as a sort of infrastructure, "something to be planned based on 'engineering' guidelines," or is instead seen as a "market good" (p. 139). There are four possible combinations of these two criteria, from which Barter derives the three main approaches in his taxonomy (Fig. 1), with each approach representing a different "mindset":

1. *Conventional, site-focused approaches*, of which minimum parking requirements are the most prevalent example, regard parking as a sort of infrastructure that should be provided on the same site as the land use it serves “in order to avoid unwanted spillover of demand into nearby streets and sites” (Barter, 2015, p. 139).
2. *Area management approaches* still view parking as infrastructure, but see it as something that can serve multiple sites within a given area (and thus need not be

Figure 1

System for Classifying Parking Policy Approaches



Note. Diagram based on “Figure 1: Simple version of the new parking policy classification approach” (Barter, 2015, p. 140).

provided separately on each site): "In this thinking, parking is local transport infrastructure […] It must be planned, if not necessarily provided, by government" (Barter, 2015, p. 139).

3. *Responsive approaches* treat parking not as infrastructure but as a "market good" that can serve multiple sites. With this mindset, "it becomes natural to think of parking as a real-estate-based service, […] the supply and pricing of which can largely be left to market processes" (Barter, 2015, p. 139).

The fourth possible combination—parking as a market good within a site-focused framework—is excluded as a practical possibility, since, according to Barter (2015), it is "conceivable as a description of parking practice on isolated sites" but "cannot be the basis for comprehensive municipal parking policy" (p. 140). (This is the quadrant labelled "No cases" in Figure 1.)

Barter (2015) includes an additional factor— the attitude towards the parking supply (represented as the diagonal extension in Figure 1)—in order to make further distinctions within each of the three main approaches (p. 140). He presents three examples in order to illustrate the possible range of attitudes: (1) that parking should be abundantly supplied, (2) that the parking supply should closely match the demand, and (3) that limits should be imposed upon the supply (Barter, 2015, p. 140). In practice, this third factor is "more obviously a continuous spectrum than the other two dimensions" (Barter, 2015, p. 140).

The policy analysis portion of this project relies heavily upon Barter's (2015) typology, which is considered as representing a three-dimensional "policy space." The three separate "axes" of this space correspond to the different dimensions in Barter's typology:

- the *geographic* axis, which appears at the top of Figure 1, represents the distinction between mindsets that believe parking should be provided on every site ("On-site emphasis" in Figure 1) and those that see it as able to serve many sites in an area ("Public/district emphasis" in Figure 1)
- the *economic* axis, which in Figure 1 is shown vertically on the right-hand side of the diagram, represents the distinction between parking as infrastructure and parking as a market good; and
- the *attitudinal* axis, which is shown extending diagonally from the square of approaches in Figure 1, represents the range of possible attitudes regarding the appropriate or necessary level of parking supply.

This new typology, Barter (2015) argues, is more capable than previous classification systems of describing the diverse range of parking policies found around the world (p. 140). Perhaps most importantly, the focus on "mindsets" captures psychological factors, such as attitudes and assumptions, that play a significant role in policy development but that may be omitted from categorization schemes that rely upon purely "rational," objective criteria. The acknowledgment of different mindsets also offers insight into the various directions available for parking policy reform efforts to pursue (Barter, 2015, p. 151). Barter distinguishes between "three distinct dimensions of reform away from conventional practice" (p. 151):

1. *"Right-sizing"* approaches to reform generally involve a shift in mindset along what we are calling the attitudinal axis, from ensuring an abundant supply towards more carefully matching supply with demand, while maintaining the view that parking needs to be provided on each site (p. 151). Barter (2015) observes that this type of

reform is starting to become more common in North America, Europe, and Australia (p. 147).

2. *"Area management"* reform involves a shift along the attitudinal axis similar to that seen in right-sizing approaches, but, as the name implies, also requires movement along the geographic axis towards a mindset that allows parking to serve multiple sites (p. 151). Reform efforts in this category can involve initiatives such as cash-in-lieu of parking (p. 148) or more extensive management of both off- and on-street parking (pp. 148–149).
3. *Market-based* proposals involve a change in mindset along the infrastructure–market good axis (Barter, 2015, p. 151), which we are calling the economic axis, as well as some adjustment to the attitude towards supply. Market-based reforms also necessarily require an area management mindset (since, as Barter has pointed out, a market-good, single-site mindset cannot form a coherent basis for parking policy, p. 140). Market-based reform thus represents the most radical departure from conventional North American practice: "It requires simultaneous or sequential changes on the adequacy of supply, on the site-focus versus district-emphasis, AND on the infrastructure versus market-good dimensions" (Barter, 2015, p. 152; emphasis in original).

Among other things, this finer distinction among different types of parking policy reform shows us how modest reforms might be possible in situations where more radical approaches might be impractical or unpopular.

In light of Barter's (2015) classification system, we can return to the three conflicting policy objectives identified by Marsden (2006) (revitalizing the city centre, reducing automobile dependence, and generating revenue) and appreciate how each in fact expresses a different mindset. The primary distinction between the three arises in their positions along the attitudinal axis: the first objective (revitalizing downtown) implies that parking needs to be provided abundantly, whereas the second (reducing auto dependence) suggests that supply should be strictly limited as part of a demand management system. While all of these mindsets regard parking as a sort of infrastructure, the third objective (generating revenue), with its focus on costs and revenue, moves somewhat towards viewing parking as a market good, and at the same time strongly suggests that the parking supply should be closely matched with the demand, so as not to incur unnecessary costs by providing more parking than the market can bear.

Alternative approaches to parking in North America

Throughout his work, Shoup (2005) develops a number of ideas for how parking policy in the United States might be reformed and presents various alternative approaches towards regulating parking. Two of these approaches in particular—demand-based pricing for curb-side parking and parking “cash-out” for commuters—have been implemented in some American cities and have thus garnered attention from the literature.

Demand-based pricing programs

The second part of *The High Cost of Free Parking* (Shoup, 2005) focuses on the widespread practice of “cruising” for curb-side parking and the significant role it plays in generating traffic congestion. Shoup (2005) argues that charging an appropriate, demand-based price for curb-side parking would do much to alleviate the situation. Demand-based pricing programs fall under the category of market-based reform proposals in Barter’s (2015) typology, which usually involve “more radical” shifts along the various axes (Barter, 2015, p. 152).

Despite their more “radical” approach to policy reform, however, the literature reports on a couple demand-based pricing programs that have been undertaken by cities in the United States.

San Francisco. In 2009, the San Francisco Municipal Transportation Authority (SFMTA) undertook a pilot project for one such program, dubbed “SF*park*,” with the first demand-responsive pricing adjustments being made in August 2011 (SFMTA, n.d.). The program remains in operation today, having been expanded in December 2017 to include all 28,000 parking meters in the city (Jose, 2017). Pierce and Shoup (2013a) used data from the pilot’s first year to assess how parking prices may have affected occupancy at different locations, and found evidence to “suggest that SF*park* has made considerable progress toward solving the important problems of severe overcrowding on some blocks and very low occupancy on others” (p. 77). One important way in which the program could be improved, Pierce and Shoup suggest, would be to prevent the “abuse of disabled placards,” which under California law (at the time) allowed vehicles to park at meters without paying and for an unlimited amount of time (pp. 77–78). Pierce and Shoup’s suggestion is supported by earlier observations made by Manville and Williams (2012), who found that the use of disabled placards was a key factor in the “widespread” legal non-payment occurring at parking meters in Los Angeles (p. 290). According to Manville and Williams, vehicles displaying placards accounted for half of the total number of unpaid occupied spaces (p. 290). Furthermore, because a placard exempts the vehicle from time limits, their use contributed to lower turnover rates at meters: the average parking duration for a vehicle with a placard was 229 minutes, whereas the average without a placard was only 32 minutes (Manville & Williams, 2012, p. 297).

Although Pierce and Shoup (2013a) rely primarily on occupancy for their assessment of the SF*park* program, they devote a sizeable portion of their discussion to elasticities of demand calculated from the price and occupancy data. This drew some criticism from Millard-Ball et al. (2013), who simulated rate adjustments based on random fluctuations in curb-side parking demand and found they were able to derive elasticities similar to those reported by Pierce and Shoup. Based on these results, Millard-Ball et al. suggest that "claims that parkers in aggregate are changing their behavior in response to price may be unfounded" (p. 334).[5] They are careful to point out, however, that while the impact of price adjustments on short-term demand may be questionable, it is nonetheless plausible that parkers will "adjust their behaviour in the longer term as awareness of price differentials increases, and as the cumulative rate changes mount" (p. 334). Responding to these critiques, Pierce and Shoup (2013b) conceded that the estimated elasticities "should be treated with caution," but nonetheless argue that evidence gathered from the second year of the program "strongly suggests that its benefits are real and not a statistical artifact" (p. 336).

Washington, D.C. More recently, Dey et al. (2019) reported on the results of another pilot program for a demand-based parking pricing system, this one in Washington, D.C. The District Department of Transportation (DDOT) conducted its pilot between 2015 and 2017, with the goals of decreasing parking search times, reducing traffic congestion and emission levels, improving safety, and developing "cost-effective asset-lite parking management solutions" (Dey et al., 2019, p. 341). According to Dey et al.'s assessment, the DDOT pilot program was successful in reducing search times and time spent cruising, with a "levelling out" of demand similar to that seen with SF*park* (i.e., increased availability on high-demand blocks and higher occupancy levels on underutilized blocks). The program was also successful in communicating

[5] A recent meta-analysis undertaken by Lehner and Peer (2019) would seem to support a cautious approach towards elasticities. While they were able to obtain a plausible range of values for three types of price elasticity related to parking (parking occupancy, parking volume, and parking dwell time), Lehner and Peer reach the overall conclusion that "parking price elasticities are widely context-dependent" and that the sample size of their meta-analysis "seems insufficient to capture the full heterogeneity present across study contexts" (Lehner & Peer, 2019, p. 183).

with customers: “Since the first price change was implemented in 2016, the number of people who have found regulations and pricing easy to understand has increased by almost 15%” (Dey et al., 2019, p. 347). Dey et al. report that the program had no “substantial impact”—positive or negative—on traffic congestion (p. 349) or on economic activity (p. 350), but may have encouraged the use of other transportation modes, as utilization of the District’s bike-share program and metro system both increased over the study period (p. 351).

Demand-based prices are not pure free-market prices, since programs like SF*park* set their prices based on target occupancy ranges—as Pierce and Shoup (2013a) point out, a “price that achieves one or two open spaces per block is not a free-market price” but rather “a public price for a public service” (p. 68). In terms of Barter’s (2015) typology, SF*park* adopts an area management approach, while its pricing system maintains some of the mindset that parking is a form of infrastructure—not to mention the fact that the program is managed by a single agency, which would not be seen in a purely market-driven system. At the same time, the use of demand-based prices as a “rationing tool” for parking as a commons (Barter, 2015, p. 149) moves us somewhat, though not fully, along the economic axis towards parking as market good, which illustrates how the different dimensions in Barter’s model can be regarded as continuums rather than as presenting simple either–or propositions.

Cash-out and commuting

Another avenue of reform for parking policy that has received a good deal of attention in the literature is what Shoup (2005) has called “cash out.” Parking cash-out involves presenting commuters with the option of exchanging their “free” parking space at work, the provision of which has actually been subsidized by their employer, for its equivalent monetary value. In addition to showing drivers that “free” parking does indeed have a cost, a cash-out policy offers an incentive to change travel behaviour (instead of "penalizing" existing behaviour the way a parking fee would): it "raises the effective price of commuter parking without charging for it" (Shoup, 2005, p. 262).

Three recent studies, each using a different methodology, have shown that cash-out can indeed be an effective policy option. At a theoretical level, Brueckner and Franco (2018) use econometric modelling to demonstrate that employer-subsidized workplace parking leads to "inefficiently high road usage and capacity investment along with an inefficiently high degree of suburbanization" (p. 40). According to their model, a cash-out policy restores the efficiency of this system, "leading to the first-best outcome" (Brueckner & Franco, 2018, p. 41). Evangelinos et al. (2018) use behavioural modelling, based on the results of a survey of commuters in Dresden (Germany) to establish that parking cash-out "has a negative and significant impact on private car use" (p. 374). Regardless of the specific model used, the introduction of a cash-out policy leads "to significant shifts in travel mode choice behaviour" (Evangelinos et al., 2018, p. 375). Finally, Khordagui (2019) has analyzed data from the 2012 California Household Travel Survey, finding that, on average, a 10% increase to the price of parking leads to a 1–2% decrease in a commuter's probability of driving alone to work (p. 488). According to Khordagui, cash-out can be effective in reducing the number of people driving alone to work, though he notes that the elimination of employer-paid parking "will have the anticipated effect only if parking in the workplace neighborhood is not free of charge" (p. 489). (We are reminded here of Marsden's (2006) observation that drivers are willing to walk further if parking is free and that parking problems will simply "migrate" if reform efforts do not cover a broad enough area.)

One possible reason behind the effectiveness of cash-out policies is the significant influence that parking availability at work has on an employee's decision to drive. Liu et al.

(2017), for instance, have found that office workers in areas with more parking "drive more because of the ease of finding a space to park" (p. 3313). Similarly, using data from the 2013–14 Norwegian National Travel Survey, Christiansen et al. (2017) have found that "free and generous parking availability" at the workplace corresponds to a four-fold increase in the probability that a commuter will drive (p. 202). Their results show that reduced parking availability at both the start and end points of the trip to work "significantly reduces" the likelihood of a commuter driving (Christiansen et al., 2017, p. 204); thus, they conclude, restrictions on the workplace parking supply can be quite effective in reducing automobile use for commuting trips (p. 205).

Research by de Groote et al. (2019) shows that increases to parking fees at work can reduce demand, especially during peak hours. Specifically, de Groote et al. investigated hospital employees' responses to two fee increases, both of which were based on the employee's residential proximity. The first increase was to the daily peak-hour fee: those living within 2 km saw the daily rate increase from €0.75 to €3, while those living more than 7 km away saw fees increase from the same €0.75 to only €1 (p. 47)—an adjustment that de Groote et al. calculate resulted in a 5% decrease in parking demand. The second increase was the introduction of a monthly subscription fee (required for any employee who wished to use the hospital's parking facilities), which ranged from €1 for those living farthest away to €5 for those living closest. Overall, de Groote et al. estimate that the monthly fee produced a decrease in demand of about 2%, although they admit that this effect is "less straightforward to measure" (p. 52).

It is not surprising to find that drivers are sensitive to changes in the cost of parking. Interestingly, though, Yan et al. (2019) have shown that, in some cases, drivers are actually more affected by increases to "egress time" (the time it takes to walk from the parking location to the final destination). Using data gathered from students, faculty, and staff at the University of

Michigan's campus in Ann Arbor, Yan et al. observe that the primary response to changes in parking policy was a change of parking location rather than a change in travel mode (p. 48). This finding suggests that one way to reduce demand in over-crowded, central lots is to improve connections with more distant parking lots, thereby reducing egress time. However, Yan et al. point out, this can have the simultaneous effect of actually encouraging automobile use (p. 48). One implication is that, in certain situations, price changes alone will not necessarily discourage driving: increasing the cost of parking in a central lot but not in a peripheral one will simply cause many drivers to change where they park. Nonetheless, prices are still the "single most effective" tool for altering travel behaviour, in part because the price of parking is often the easiest characteristic to change (Yan et al., 2019, p. 49).

Another implication of Yan et al.'s (2019) findings is that, in some situations, increases to the parking supply will not always be the best investment. This is demonstrated by Rivandeneyra et al. (2017), using UC Berkeley as a case study. Looking at the specific situation where it would be necessary to replace a surface parking lot with a parking structure in order to meet the existing level of demand, Rivandeneyra et al. show that the more economical decision would be to spend the same amount of money on measures to reduce the demand for parking rather than on increasing the supply. Because of the high costs associated with the construction, operation, and maintenance of a parking structure, the university would be required to increase the price of parking "substantially to cover costs—potentially by as much as $70/mo., a 70% increase" (Rivandeneyra et al., 2017, p. 164). On the other hand, a 30% increase to fees for existing drivers (those who already hold parking permits) could fund travel demand management (TDM) initiatives that would reduce demand enough to render the increase in supply unnecessary (Rivadeneyra et al., 2017, p. 165). In the latter case, "parkers would be equally well off and non-parkers would benefit from spending on TDM" (Rivadeneyra et al., 2017, p. 165).

Commuting in Canada

The majority of the work done on parking in Canada has focused on the impacts parking policy may have on the travel decisions of commuters. Most of this research focuses on the country's three largest urban areas (the Greater Toronto Area, Montréal, and Greater Vancouver), with another two studies focusing on transit utilization in Kingston, Ontario. Overall, the consensus is that appropriate policies, particularly parking fees, can be used to encourage Canadian commuters to switch from driving to using transit, especially if improvements to transit service are made.

The two studies that have looked at transit ridership in Kingston are Agarwal and Collins (2016) and Collins and MacFarlane (2018); the second of these was conducted after the introduction of express service to Queen's University, one of the city's largest employers. According to a 2013 survey of Queen's employees conducted by Agarwal and Collins (2016), measures aimed at improving transit reliability and at reducing the availability of parking on and near campus would likely increase employees' use of public transit. Moreover, both irregular and non-users of transit "indicated than an employer-subsidized public transit pass would encourage them to use transit" (Agarwal & Collins, 2016, p. 7). According to Agarwal and Collins, the survey results emphasize that both owning a car and having a parking permit are "important determinants of transit use (or non-use)" (p. 8). They also argue that, despite the fact that auto ownership is "pervasive and usually unavoidable" in Canada's mid-sized cities, policy changes can be made to encourage reduced auto use, since "existing parking policies indirectly lead to more frequent driving to work" (Agarwal & Collins, 2016, p. 8).

Following the introduction of express service between 2013 and 2015,[6] Kingston Transit saw an increased share of commuters (although driving alone retained the greatest mode share; Collins & MacFarlane, 2018, p. 688): between 2013 and 2016, transit "generated the greatest seasonal and year-round increases" (p. 688), with the year-round transit share doubling, "from 3.9% in 2013 to 7.8% in 2016" (p. 691). Collins and MacFarlane (2018) found that those who switched to using transit were more likely to live between 3 and 20 km away from the university, to have a household annual income less than $90,000, and to be female (p. 691). As one might expect from the earlier work of Agarwal and Collins (2016), Collins and MacFarlane also found that transit switchers were less likely to have a parking permit (p. 691). Overall, their results show a "modest but statistically significant" change in commuting patterns (p. 691).

Of course, transportation mode choice for commuting trips involves more factors than whether parking is available at work (and whether that parking is free or not); among other things, we must consider both the residential parking supply as well as the availability of parking at transit stations and other such locations *en route* for those who switch modes during the commute. For instance, Zahabi et al.'s (2012) research into the travel behaviour of commuters in Montréal has found that transit attributes such as fare and travel time, as well as the cost of parking, "appear to have significant effects on [the] transportation mode choice of downtown commuters" (p. 114). Zahabi et al. have also taken residential location and self-selection effects into account, finding that commuters living in areas with better transit access were more likely to select that mode than commuters living in more peripheral parts of the city (p. 114), and that "young commuters to downtown, without children or car access[,] prefer to reside near their workplaces" (p. 117). An increase to the number of cars owned by a household decreased the

[6] Kingston Transit introduced three express routes servicing Queen's University, one in September 2013 and two more in May 2015 (Collins & MacFarlane, 2018, p. 686).

likelihood that its members would choose to live in neighbourhoods with greater density and better access to transit (Zahabi et al., 2012, p. 114).

As for parking *en route*, Habib et al. (2013) conducted a stated-preference survey of commuters in Greater Vancouver in order to assess respondents' willingness to pay for parking at park-and-ride transit stations (or to pay an increased amount at stations that already charged for parking). According to Habib et al., the model developed from the survey responses "clearly indicates" that there are two segments to the commuting population, "captive" users and "choice transit" users (p. 168), the latter of whom respond much more elastically to increases in parking costs. On the whole, the model suggests that increases to the cost of parking at park-and-ride stations would generally cause more commuters to switch to using transit for the entire trip than would switch to using a private automobile (Habib et al., 2013, p. 168). A few years later, Rashedi et al. (2017) used the results of a combined stated-preference/revealed-preference survey of cross-regional commuters in the Greater Toronto–Hamilton Area to determine that introducing parking fees at transit stations would lead to "losing some regional transit users" in favour of driving (p. 11). However, they point out, the impact that the cost of parking has on the number of people driving, carpooling, or using park-and-ride is not as great as the impact of other associated costs, such as transit fare and egress time (Rashedi et al., 2017, p. 8). According to Rashedi et al., automobile drivers are more sensitive to increases in the cost of parking at their final destination than at park-and-ride stations, with a 50% increase to the cost of parking at work leading to a 2.35% decrease in auto mode share (pp. 11–12).

Studies devoted to commuting travel behaviour and connections to transit, topics that have received the bulk of the attention when it comes to research on parking in Canada, tend to concentrate on the country's largest metro regions, with many focusing narrowly on some particular aspect of parking's role in the transportation system. This is certainly not intended as a criticism—in many cases, a narrow focus is necessary—but is rather meant to point out that we have yet to establish a broader perspective on parking policy and its relationship to the form and development of Canada's mid-size cities.

Residential parking

The existence of park-and-ride facilities raises the question of whether parking is indeed the best use of the land surrounding transit stations, an issue investigated by Duncan (2010), who looked at ridership patterns and passenger counts on San Francisco's Bay Area Rapid Transit (BART) system in order to better understand the "trade-offs involved in using the scarce land adjacent to stations for parking or development" (p. 162). Duncan finds that replacing parking around most BART stations with transit-oriented development would "not represent a practical strategy with regard to ridership" (p. 176), at least with respect to current travel behaviours, because existing parking facilities had larger "commuter catchment areas" than would have been provided by development surrounding those same stations: "For most BART park-and-ride stations, the model indicates that more than one new housing unit or job must be placed adjacent to the station for every parking space that is removed" (Duncan, 2010, p. 162). However, Duncan notes that, in the longer-term, "if development is encouraged around the parking facility," then replacing parking with TOD "may eventually become more feasible" (p. 176).

When it comes to TOD, Chatman (2013) suggests that neighbourhood characteristics and factors in the built environment can be effective at reducing commuting by automobile, regardless of transit service levels. According to a survey of households living near rail stations in New Jersey, the lower levels of auto ownership and auto use observed in TODs appear to be the result not of proximity to rail transit but "from lower on- and off-street parking availability," better bus service, and higher density (Chatman, 2013, p. 28). In particular, Chatman finds that the decreased availability of residential off-street parking “remains very significantly associated with lower probability of commuting via auto, with the odds decreasing from 63% to 57%” (p. 25). While these findings leave open the question of residential self-selection, they nonetheless point to an important connection: “Off-street parking scarcity, and low on- and off-street parking availability, are among the most powerful variables in this model” (Chatman, 2013, p. 23).

Weinberger et al. (2009) have investigated off-street parking as a contributing factor to “driver hot spots” in New York City—neighbourhoods that have significant shares of commuters travelling to downtown Manhattan by automobile (pp. 25–26). Weinberger et al. find that ease of access is a critical determinant of whether a car is used for the commute, and suggest that off-street parking “could well account” for the higher auto share of downtown commuting trips seen in “hot spots” (p. 27): “From neighborhood comparison, the evidence suggests that households with on-site, off-street parking are inclined to drive more than their neighbors are” (p. 29). A few years later, Weinberger (2012) revisits the question of how having “private, on-site, residential parking” affects New Yorkers’ commuting behaviour (p. 95). Using aerial photos alongside the City’s Primary Land Use Tax-lot Output (PLUTO) database, she detects a “clear relationship between increased access to guaranteed parking at home and a propensity to drive to work,” finding that more off-street parking correlates with more driving both directly, by making it easier for residents to use their cars, and indirectly, by contributing to higher levels of car ownership (Weinberger, 2012, p. 100).

As for on-street residential parking, Guo and Schloeter (2013) have taken an interesting approach by examining the standards for residential street widths in the U.S., particularly in suburban areas, where streets are usually wide enough to accommodate two lanes of traffic along with two dedicated lanes of curb-side parking (p. 456). They find two principal reasons behind road-width standards: traffic safety and the perceived demand for parking by residents, which engineers tend to assume “as a given that must be satisfied” (Guo & Schloeter, 2013, p. 465). Here again we see the importance of mindsets—in this case, the attitude that residential on-street parking should be supplied in abundance as a form of publicly provided infrastructure. Guo and Schloeter argue that parking needs to be “‘brought back’ into the debate on street standards,” with a focus on removing what they call the “mandate” for on-street parking (p. 467).

The subject of residential parking requirements—both minimum requirements for off-street parking and the on-street parking “mandate” identified by Guo and Schloeter (2013)—leads to the important issue of how such policies might affect the stock of housing, particularly when it comes to housing affordability. Lehe (2018) has set out a theoretical model showing how exactly minimum parking requirements for residential development could lead to less affordable housing. Essentially, Lehe argues, MPRs prevent developers from building units “with little or no parking” and thus make it less profitable for them to build units that will serve lower-income segments of the market (p. 1311).[7] Moreover, Lehe writes, the costs of excess parking may be “passed on” to consumers if developers build fewer units as a result of MPRs, thus driving “some units out of the market at a given rent, thereby reducing the supply of housing on offer” (p. 1315). An example might be found in the results derived by Jung (2011) from real estate data sets for condominium sales in Edmonton: Jung’s analysis suggests that “the consumer’s marginal willingness to pay for an additional non-surface space may be substantially less than the cost to create that space” (p. 75). This means that MPRs could conceivably place a financial burden on developers that may adversely impact affordability—although, as Jung himself points out, “the

[7] More specifically, according to Lehe (2018), since “the optimal amount of parking” to provide for any given renter “rises and falls linearly with the renter’s income,” a minimum parking requirement will prevent developers from profitably providing units for renters whose income is below a certain threshold (p. 1313).

data sets employed in this paper suffer from serious deficiencies, and the results should be interpreted with caution" (p. 77).

Finally, Li and Guo (2014, 2018) have examined the effects of parking policy reform in London (UK), which in the early 2000s replaced minimum parking requirements with parking maximums. Li and Guo are particularly interested in the potential impact on housing development in Greater London. Their earlier study (Li & Guo, 2014) finds a "sharp reduction" in the amount of parking provided in new residential development applications, with almost 60% of developments in Inner London[8] being car-free (p. 360). Most of the reduction, they point out, can be attributed to the removal of minimum requirements, rather than the imposition of parking maximums (Li & Guo, 2014, p. 364). Li and Guo's later work (2018) focuses on the effects of the same reform on the stock of multifamily housing developments, finding that the imposed restrictions had opposite influences in Inner and Outer London: the maximum parking limits were "associated with fewer multifamily homes in low-density, car-dependent outer London boroughs" but appeared to "actually promote multifamily housing developments, especially car-free ones, in inner London" (Li & Guo, 2018, p. 195). Once again, Li and Guo's (2018) findings point to the importance of a regional approach, as applying restrictive maximums only in city centres could make "peripheral areas without parking restraints … more attractive for those inner-city residents with higher perceived values for private parking," leading to less development in the centre (p. 195).

[8] Consisting of the City of London, as well as the boroughs of Camden, Hackney, Hammersmith & Fulham, Haringey, Islington, Kensington & Chelsea, Lambeth, Lewisham, Newham, Southwark, Tower Hamlets, Wandsworth, and Westminster.

Discretionary trips and downtown cores

As we have already seen, a survey of commercial sites in Toronto (Engel-Yan et al., 2007) found that banks and large grocery stores tend to provide parking well above minimum requirements (p. 107). In a similar vein, Chatman (2013) has found that for grocery trips and other such "non-work trips requiring goods carrying, the auto is doubly attractive," even in a transit-supportive environment, with the supply of on- and off-street parking appearing to have little effect on mode choice (pp. 27–28). Indeed, an important distinction needs to be made between commuting and non-work trips, which respond differently to changes in parking policy; Marsden (2006), for instance, observes that non-work trips exhibit "a far greater stated range of responses to parking pricing increases and supply restrictions" than commuting trips do (p. 452).

Surely much of the difference can be explained by the more discretionary nature of non-work trips—after all, it is reasonable to assume that commuters have much less freedom when it comes to choosing their destination and when they arrive. For example, Habib et al. (2012) have found that parking choice is a significant influence on the activity-scheduling decisions made by automobile users (p. 163), an area where commuters certainly have fewer options. Greater freedom to choose provides individuals with more opportunities to express their particular preferences: those who place less value on search time will likely spend longer "cruising" for an available (free) on-street space, whereas those who consider search time to be very important are more likely to choose to pay for on-street parking, given the option (Antolín et al., 2018, pp. 28–29).

Parking at retail destinations

Discretionary trip-making gives us a chance to see the mutually reinforcing nature of the relationship between automobile dependence and free parking. The popularity of the private automobile leads to retail environments that cater heavily to the car—suburban shopping malls, "power centres," and the like—and this in turn makes the retail environment more and more inhospitable to any other mode of travel. According to models developed by Ersoy et al. (2016), parking at suburban shopping malls serves as a "loss leader"—that is, parking will be priced artificially low in order to attract customers (p. 110). The basic version of their model shows that the equilibrium parking fee "is always less than the mall's marginal cost of providing a parking space" (Ersoy et al., 2016, p. 103); various extensions of the base model show that parking remains a loss leader in almost all cases, a result that stems from customers' decisions regarding transportation mode (Ersoy et al., 2016, p. 110).

There is some evidence—though it is not particularly strong—that shoppers might be willing to pay for parking at malls, at least in Europe. Newmark and Shiftan (2007) have analyzed the results of a stated-preference survey of shoppers at four suburban malls in Prague (Czechia), finding that income and the number of passengers in the vehicle were positively correlated with a willingness to pay, whereas age was negatively correlated.[9] Newmark and Shiftan conclude that "substantial parking revenues can be raised with little loss of patronage" (p. 101)—although whether or not such revenues can overcome the contributions of parking as a loss leader remains an open question. The introduction of paid parking at the Woensel Shopping Center in Eindhoven (Netherlands) prompted van der Waerden et al. (2009) to conduct what they call a "before–after study" (p. 16)—although the "before" and "after" portions were both conducted at the same time, with survey administrators simply asking respondents to recollect their previous visits (p. 17). In terms of consumer response, van der Waerden et al. found that the duration of visits to the shopping centre as well as the mean amount spent by shoppers had both

[9] It is worth pointing out that their findings indicate that grocery shoppers would be less willing to pay for parking than would those shopping for non-food items (Newmark & Shiftan, 2007, p. 99), which fits alongside the observations of Chatman (2013) and Engel et al. (2007).

decreased significantly, with the decrease being highest for “non-weekly” purchases (i.e., more discretionary items such as clothing and shoes; pp. 17–18). Their results also suggest that the change may have driven shoppers to seek out other, more local options: “The research findings indicate that the effect of the number of alternative shopping opportunities is negative, meaning that if an individual lives in a neighbourhood with good access to local shopping facilities (usually small neighbourhood centers), the duration of visiting the Woensel Shopping Center decreases, implying decreasing expenditures” (van der Waerden et al., 2009, p. 22).

In Ersoy et al.’s (2016) model, there is one situation in which parking ceases to serve as a loss leader for shopping malls: when traffic congestion becomes a significant concern, at which point it is “easier to attract customers by having bus riders internalize the discomfort externalities they impose on each other” (p. 106). This finding suggests that in denser urban environments, where congestion is more likely to occur, free parking becomes less important for shoppers. Indeed, we have already seen Dey et al.’s (2019) finding that demand-based pricing in Washington, D.C., had no significant negative impact on economic activity (p. 350). As for the parking supply, Arancibia et al. (2019) have found that the replacement of on-street parking with a bicycle lane along a stretch of Bloor Street in Toronto did not have a detrimental effect on the local economy—in fact, according to Arancibia et al., the business environment actually improved over the study period: visitor spending and the frequency of visits increased, customer counts grew, and vacancy rates “held steady” (pp. 475–477). One main reason for the increased activity was that, while the proportion of shoppers arriving by automobile “remained unchanged at 9%,” the share of those arriving by bicycle “rose considerably from 8% to 22%” (p. 477). According to Arancibia et al., initial resistance from merchants to the replacement of parking with bike lanes may have been motivated by a tendency to overestimate the number of customers arriving by automobile (p. 464), suggesting that "[m]erchant concerns regarding loss of car parking may reflect overestimations in car mode share among their customers" (p. 479). The findings of Dey et al. (2019) and Arancibia et al. (2019) provide more pieces of evidence to, as Marsden (2006) has put it, "challenge the orthodoxy that exists amongst decision-makers that parking restraint will discourage economic development" (pp. 455–456).

It is important to recognize, however, that on-street parking still plays an important role in the downtown environment. Marshall et al. (2008) conducted two separate studies on parking in New England (reporting the results of both in a single paper). In the first, they examined the amount of parking, both on- and off-street, in six town centres, finding that on-street parking represents the "most cost-efficient way to provide parking" (p. 47), and is an important factor in "ensuring that enough land is available in the center for more productive uses" (p. 48). According to their second study, on-street parking also makes important contributions to pedestrian safety: Marshall et al. found a "strong correlation" between the free-flow speed of traffic and the presence of on-street parking (p. 49), observing that "low-speed streets" (those with traffic moving at less than 35 miles per hour) with on-street parking exhibit the lowest accident and fatality rates "by far" (pp. 50–51). Overall, they write, areas with on-street parking "tend to be safer and more walkable, require less parking, and have much more vitality" (Marshall et al., 2008, p. 51).[10]

[10] In a slightly different context—a mid-sized city in Ecuador—Hermida et al. (2019) have generated results that might suggest the opposite, showing that the presence of on-street parking spaces "had a negative effect on pedestrian counts, with an expected reduction of 57%" (p. 783). However, the lower number of pedestrians may be a product not of the parking itself but of narrower sidewalks: one of the recommendations that Hermida et al. make is "reducing parking space and using that space to increase the width of sidewalks" (p. 785).

Parking and the built environment

McCahill and Garrick (2010, 2012, 2014) have looked extensively at parking policy and its visible impact on the built environment. Their work, alongside that of McCahill et al. (2016), points to important links between off-street parking provision, on the one hand, and both increased automobile use and decreases in population and employment densities, on the other. In a study examining twelve cities across the U.S., each with a population of around 100,000 people, McCahill and Garrick (2012) used aerial photos and census data to quantify the relationships between automobile use, land consumption, and what they call "human density"—the number of residents and employees per unit area (p. 225). Their findings indicate that a 10% increase in automobile mode share among commuters was, "on average[,] … associated with an increase of more than 2500 m^2 of parking per 1000 people and a decrease of 1700 people/km^2" (McCahill & Garrick, 2012, p. 226). Overall, they write, infrastructure devoted to automobile use consumes a large amount of land, meaning it is "very challenging to serve a high concentration of activities primarily by automobile" (McCahill & Garrick, 2012, p. 226).

Their earlier work (McCahill & Garrick, 2010) looked more closely at the historical evolution of Cambridge (Massachusetts) and Hartford (Connecticut). According to McCahill and Garrick (2010), the contrast between the two cities shows communities that stand on "opposite ends of the spectrum in changes in travel patterns over the past four decades" (p. 123). Examining changes in the physical environment alongside policy decisions documented in council records, McCahill and Garrick describe how, over time, Cambridge shifted from a "relatively conventional approach in the 1960s and 1970s to one in which parking is explicitly linked to TDM" (p. 127), whereas Hartford maintained a much less organized approach, at times recognizing parking as an issue but, in the long run, showing "a lack of a clear vision or a consistent direction relating to parking" (p. 125). The difference, they argue, can now be seen in these cities' physical landscapes as well as in the travel behaviour of their citizens: while both cities saw overall increases in the amount of parking between 1960 and 2000, the spatial distribution of parking, particularly in the downtown core, "significantly influences the form and function of each city today" (McCahill & Garrick, 2010, p. 128), and Cambridge's greater levels of non-motorized travel "are strongly reflective of the differences in the built environment and in municipal policies" (p. 129).

In a similar comparison, this time between Cambridge and New Haven (Connecticut), McCahill and Garrick (2014) again argue that "differences in parking provision are due in large part to differences in policy approaches" (p. 51), with New Haven setting its *minimum* parking requirements at levels that "are 20% higher than the *maximum* allowed parking anywhere in Cambridge" (p. 47; emphasis added). Echoing earlier comments made by Marshall et al. (2008), McCahill and Garrick maintain that parking "uses up land that could otherwise be invested more productively" (p. 40) and that a ready supply of parking "may be one of the most influential factors affecting decisions to drive when other options are available" (p. 41). McCahill et al. (2016) push the argument further in an article subtitled "Inferring Causality": rather than simply tracking the variables of interest over time, McCahill et al. apply a set of nine criteria taken from the field of epidemiology (known as the Bradford Hill criteria) that are "intended for inferring causality when an association already exists" (p. 160).[11] They find a "clear, consistent association" between parking provision and automobile use (p. 161), with "an increase from 0.1

[11] The nine criteria are (1) strength of association, (2) consistency of observations, (3) specificity (meaning that the treatment given is "the only clear explanation for an outcome"; McCahill et al., 2016, p. 162), (4) temporality, (5) biological gradient (i.e., a "clear dose–response curve"; p. 162), (6) plausibility, (7) coherence with existing knowledge, (8) corroboration by experimental results, and (9) analogy with other cases in which causality is already known. McCahill et al. (2016) point out that this collection of criteria is not intended as a "checklist" but rather is meant to answer the question, "What aspects of the association should be especially considered before it is decided that the most likely interpretation is causality"? (Bradford Hill, 1965, as cited in McCahill et al., 2016, p. 160).

to 0.5 parking space per resident and employee … [being] associated with an increase in commuter automobile mode share of roughly 30 percentage points" (p. 164). The results, they argue, provide "compelling evidence that even though the relationship between parking and driving is complex, parking provision appears to be the primary leading factor" (McCahill et al., 2016, p. 162) and present a "strong case" for the reduction and restriction of the urban parking supply, especially if the objective is to decrease automobile use (p. 164).

Important points from literature review

Although it has been something of a "latecomer" to the scene as a research topic, parking has started to receive its fair share of attention from researchers in recent years. Nonetheless, our understanding can still be improved in many areas, particularly when it comes to parking policy and the provision of parking in Canada.

The following points are the most important that have emerged from the preceding review of the literature:

- Many studies point to minimum parking requirements (MPRs) as a significant factor in the over-supply of automobile parking in North American cities.
- Even so, MPRs remain a fixture in parking regulations, with policy-makers often being resistant towards change and reluctant to pursue different possible reform agendas.
- There is evidence to suggest that some alternative approaches, including demand-based pricing for curb-side parking and "cash-out" for commuters, can be successful in achieving their policy objectives.
- Studies on parking's influence on the travel behaviour of Canadian commuters (which has received much of the literature's attention when it comes to parking in

Canada) generally agree that appropriate policies, especially parking fees and improvements to transit service, would encourage more commuters to switch from driving to transit.

- Parking availability at home is an important factor in automobile ownership and in decisions to commute by driving. Some research suggests that more restrictive policies on residential parking could actually promote the development of multi-family housing in higher-density areas.
- Parking often serves as a "loss leader" for retail outlets, at least in the absence of significant traffic congestions. Denser areas, including downtowns, benefit from accessibility by other transportation modes and less off-street parking, although on-street parking can help improve pedestrian safety.

Research questions

One goal of the research undertaken for this project was to address parking's aforementioned status as a relative "latecomer" when compared to research on other aspects of automobile transportation. While certain areas of parking policy and policy reform have garnered healthy shares of attention, others remain in need of further exploration. We are also currently lacking a "bigger picture" understanding of parking policy in Canada, particularly when it comes to cities that do not happen to be among the "big three" (Toronto, Montréal, and Vancouver). Parking has an important role to play in the downtown areas of Canada's mid-size cities, especially considering that automobile ownership in these regions is "pervasive and usually unavoidable" (Agarwal & Collins, 2016, p. 8). It is therefore vitally important to find an appropriate balance between providing some measure of accessibility by automobile, on the one hand, and, on the other, maintaining healthy activity levels, unique features, and higher densities that will contribute towards pedestrian-friendly and transit-supportive environments. This means that it is crucial for decision-makers and planners to understand how different policy decisions are likely to affect the stock of surface parking in downtown areas. Moreover, where policy reform is necessary, it is important to know what directions for reform are available and which approaches to reform are more likely to succeed, which the application of Barter's (2015) typology helps make possible.

At the end of the Introduction, we saw that the establishment of the Province of Ontario's "Growth Plan for the Greater Golden Horseshoe" presents us with two plausible but opposing outcomes with respect to the amount of parking in the region's downtown Urban Growth Centres. On the one hand, the Growth Plan's emphasis on intensification and higher densities could lead to less off-street surface parking, perhaps in conjunction with more on-street parking so that surface lots might be converted to more productive uses (Marshall et al., 2008, p. 42). In this scenario, we would likely see increased shares for other modes of transportation, as it is "very challenging to serve a high concentration of activities primarily by automobile" (McCahill & Garrick, 2012, p. 226). On the other hand, however, it is also quite conceivable that we might see local municipalities persist in more conventional approaches to policy, in which parking regulations go "largely unnoticed—or, at least, unquestioned" and where parking is an "expected but unnoticed land use" (Taylor & van Bemmel-Misrachi, 2017, p. 288; p. 287). This conventional approach, coupled with increased development activity, might easily lead to greater amounts of surface parking in downtown Urban Growth Centres.

The research described in this report was undertaken in order to discover which of these two outcomes was more likely. More specifically, the purpose of this project was to explore the relationships between municipal parking policy and changes in the amount of surface parking in the Growth Plan's downtown Urban Growth Centres. With all of this in mind, then, the main research question guiding this project is as follows:

Main question: What sorts of relationships exist between municipal policy positions and changes in the amount of parking over time?

This primary research question relies in turn upon determining the answers to two sub-questions:

Sub-question #1: How has the amount of off-street surface parking in downtown Urban Growth Centres changed since the Growth Plan first came into effect in 2006?

Sub-question #2: What parking policies do local municipalities have in place, and how would the mindsets represented by these policy positions be characterized according to Barter's (2015) typology?

The main question presumes that there is indeed some relationship between policy and real-world outcomes. This presumption seems justified, as previous work by McCahill and Garrick (2014) has suggested that "differences in parking provision are due in large part to differences in policy approaches" (p. 51). (Furthermore, if there is no link between policy and outcome, then the entire exercise of policy-making is rendered futile.) However, even finding no apparent relationship would in itself still mean something—in this case, that existing policies regarding parking appear to be ineffective when it comes to parking.

The next chapter outlines the methods that were chosen to answer these research questions and describes the work that was performed over the course of the project. The majority of this work was divided into two phases, each focusing on one of the two sub-questions presented above, before a third and final phase that brought together the results these two phases together to address the main question. In addition to improving our understanding of parking policy in Canada’s mid-size cities, the results of this research point to some potentially fruitful avenues for future researchers to explore.

Methodology

The research undertaken for this project was primarily exploratory, since, as the literature review has established, few studies to date have examined parking policy in Canada's mid-size cities or looked in depth at the supply of surface parking in these cities' downtown areas. Moreover, the existence of two plausible but contrasting "rival hypotheses" (presented at the end of the Introduction and again to close the previous chapter) means that it is unclear from the outset what we should expect to find. On the one hand, we can expect that cities with zoning by-laws that set out minimum parking requirements (MPRs) will be more likely to supply excessive amounts of parking (Ewing et al., 2017; McCahill & Garrick, 2014; Shoup, 2005; Smith, 2013), especially considering the reluctance to move away from MPRs because of concerns about the potential impacts of reduced supply levels (Barter, 2010; McCahill & Garrick, 2014; Willson & Roberts, 2011). However, the literature also shows us that there is some willingness to provide less parking if permitted, suggesting that lower MPRs, coupled with a mindset less worried about the parking supply, should eventually lead to the provision of less parking (Engel-Yan et al, 2007; Li & Guo, 2014; Manville, 2013).

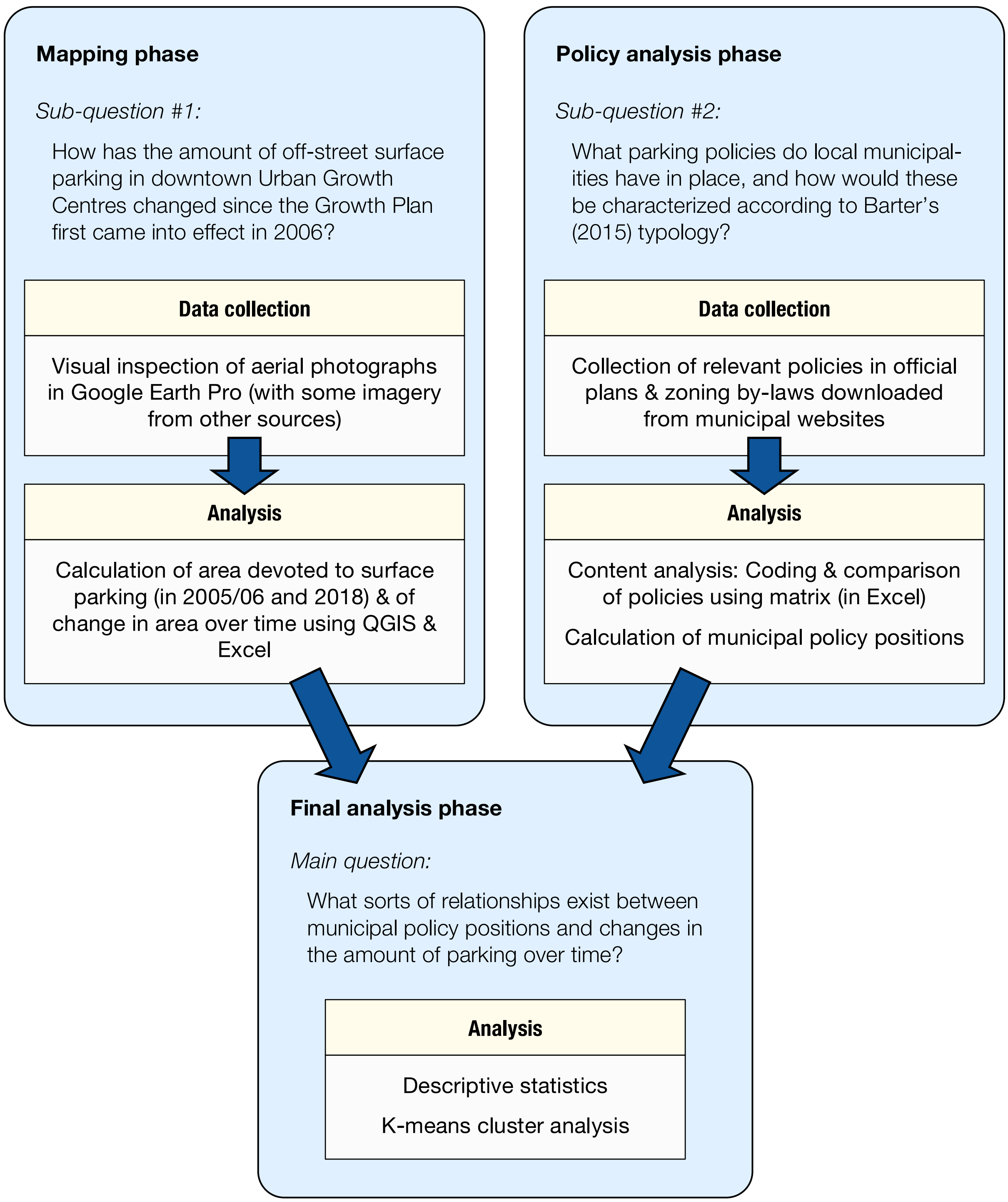
The main purpose of this project was to explore possible relationships between municipal parking policy and the supply of surface parking in downtown areas in the specific context of the Growth Plan and its density targets for Urban Growth Centres. As we saw at the end of the previous chapter, addressing this main question requires us to answer two "sub-questions" regarding (1) how the supply of parking in downtown UGCs has changed since 2006 and (2) what parking policies are in place in the municipalities in which these UGCs are located. The project was divided into three phases, each focused on one of the research questions (two sub-questions and the main question). Figure 2 identifies the three phases, presents the question associated with each phase, and illustrates the chronological and conceptual relationships between the project phases. The majority of the work was concentrated in the first two phases—referred to as the "mapping" phase and the "policy analysis" phase—each of which involved both data collection and analysis. The third phase, which combined the results of the first two in order to address the main research question, is referred to as the "final analysis" phase.

The data collection for this project employed unobtrusive methods using data obtained from secondary sources. The mapping phase made use of aerial photography, primarily from Google Earth Pro, employing a methodology very similar to that used by McCahill and Garrick (2014) and by McCahill et al. (2016). Aerial photography offers the most efficient way of achieving a reasonably comprehensive survey of a given area. Moreover—and more importantly—other methods, such as field observations, are simply "not available for estimating the historical parking supply" (McCahill et al., 2016, p. 160). The land area devoted to surface parking was determined using geographic information systems software (QGIS 3) and tabulated in Microsoft Excel. Data collection for the policy analysis phase involved collecting policies related to parking from the official plans and zoning by-laws of the municipalities selected; these were coded and analyzed in a comparison matrix (also in Excel) using a method derived from the categories of Barter's (2015) typology.

The final analysis phase brought together the results from the two previous phases. It is important to point out here that the final analysis was relatively rudimentary, mostly because of the small sample size used for this project. The Growth Plan identifies twenty-five Urban Growth Centres; only twelve of these (not counting the Downtown Toronto UGC) are located in the historical downtown cores of their respective municipalities. This means that the sample size

Figure 2

Project Research Design



for this project was rather small (even though the twelve municipalities selected essentially represent the entire "population"), which imposes some important limitations on the final analysis. Nonetheless, the overall results do indeed provide some answers to the main research question and, more importantly, point to some avenues of inquiry for future researchers, which was the goal of this exploratory project.

Mapping phase

The mapping phase was divided into three steps: (1) a preliminary step, which involved creating base maps in QGIS for each of the twelve municipalities in the project sample; (2) data collection, which involved the creation of data feature layers to represent the parking lots within each municipality's "area of interest" as observed at two points in time (2005/2006 and 2018); and (3) analysis, which involved calculating the overall area devoted to parking at both points in time and calculating the change over the period in question.

Creating base maps

Before proceeding with data collection for the mapping phase, it was necessary to create a base map for each Urban Growth Centre (UGC) in QGIS 3 in order to establish the "area of interest" for each municipality. This "area of interest" consists of the city blocks located either wholly or partially within the boundaries of the UGC.[1] Each base map consists of feature layers that represent hydrological features, basic transportation infrastructure (road network and

[1] The twelve Urban Growth Centres included in the sample for this project are the Downtown Barrie UGC, Downtown Brantford UGC, Downtown Burlington UGC, Downtown Cambridge UGC, Downtown Guelph UGC, Downtown Hamilton UGC, Downtown Kitchener UGC, Downtown Milton UGC, Downtown Oshawa UGC, Downtown Peterborough UGC, Downtown St. Catharines UGC, and Uptown Waterloo UGC. (Technically speaking, the inclusion of Hamilton stretches the traditional definition of "mid-size city"—according to the most recent census, the Hamilton Census Metropolitan Area had a population of 747,545 in 2016, with a population of 536,917 for the City of Hamilton proper (Statistics Canada, 2017a). It has been included partly because it is an Urban Growth Centre located within a tradition downtown area and partly because Hamilton, as a city, has not received much attention in the literature (in other words, and to be perfectly frank, because it is not Toronto).

railways), and building footprints in the vicinity of the municipality's UGC. The base map also shows the boundary of the UGC, as defined in the Growth Plan, which in turn was used to determine the area of interest for each municipality.

Hydrological features were taken from a data layer showing the lakes and rivers in Ontario (Natural Resources Canada, 2017), obtained through the Government of Canada's Open Government portal. Data feature layers representing roads, railways, building footprints, and

Table 1

Data Feature Layers Downloaded from Municipal Open Data Portals

Municipality	Railways	Roads[a]	Parcels	Buildings	Other Layers
Barrie	x	x		x	Urban Growth Centre
Brantford		x	x	x	Zoning Districts
Burlington	x	x		x	Zoning By-Law
Cambridge	x	x		x	
Guelph		x	x	x	
Hamilton	x	x		x	
Kitchener	x	x		x	Downtown Boundary
Milton					
Oshawa		x	x	x[b]	
Peterborough	x	x	x	x	
St. Catharines[c]		x		x	Land Usage
Waterloo	x[d]	x[e]		x	Municipal Boundary

[a] Road network features were provided as line segments in all data layers except for the one downloaded from the City of Barrie's Open Data portal, which provided the road features as polygons. [b] Downloaded from Durham Region Open Data portal. [c] Feature layers for St. Catharines were downloaded from Niagara Region's Open Data portal. [d] Railway feature layer from Region of Waterloo, downloaded from City of Cambridge's Open Data portal. [e] Road network feature layer from Region of Waterloo, downloaded from City of Waterloo's Open Data portal.

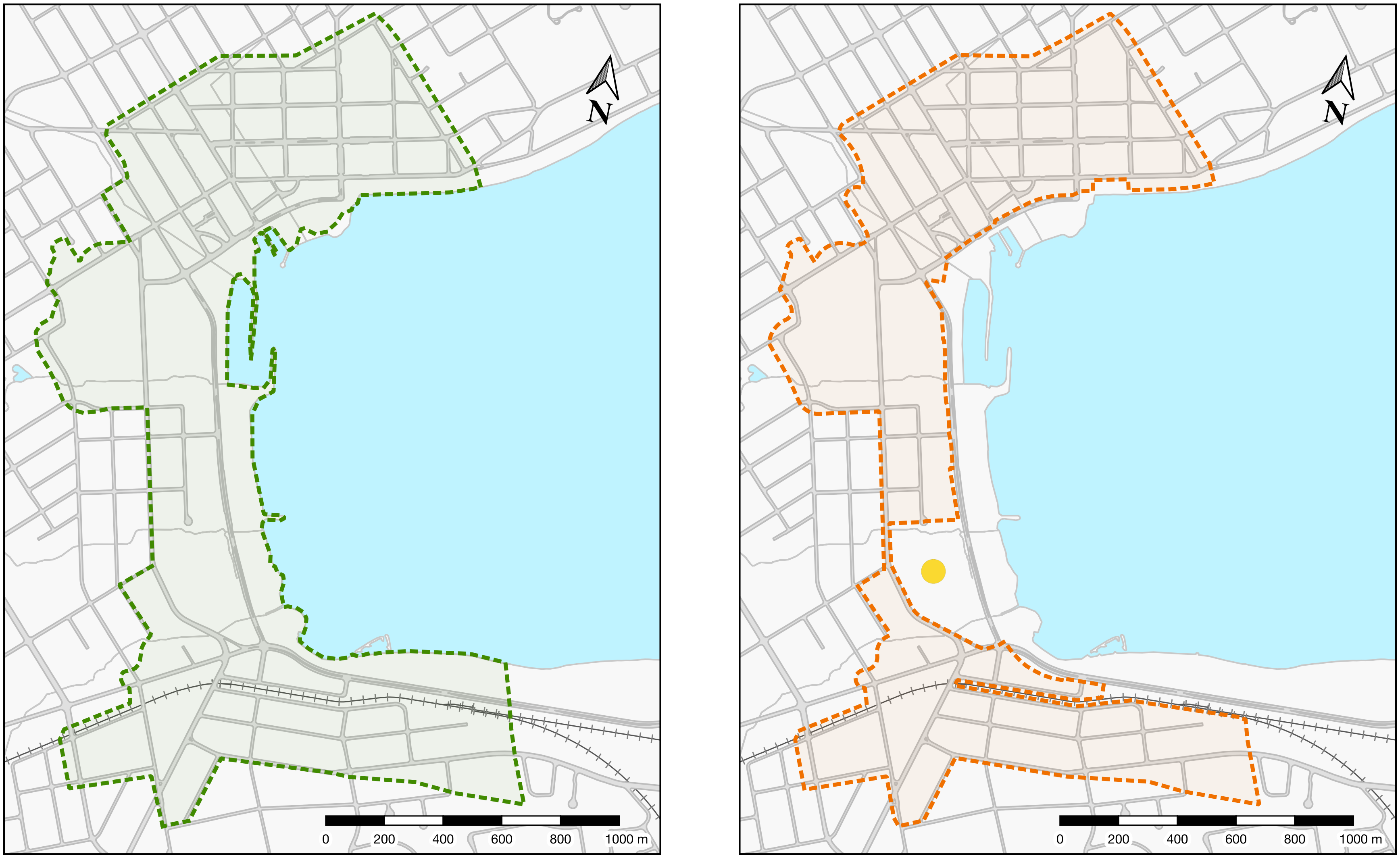
parcel fabric were downloaded from various public Open Data portals where available. Table 1 provides a summary of the feature layers available through and downloaded from municipal Open Data portals (both upper- and lower-tier, as necessary). As indicated in Table 1, five municipalities did not have railway feature layers available. For three of these (Brantford, Guelph, and Milton), railway lines in the vicinity of the Urban Growth Centre were drawn as precisely as possible based on the most recent aerial images available in Google Earth Pro using the "Add Line" tool, saved as KMZ files, and imported into QGIS in order to create a railway layer. Although Oshawa and St. Catharines also did not have railway layers available,[2] neither of these two municipalities has any railways in the immediate vicinity of its UGC, and so it was not necessary to create one.

A data layer containing the boundaries of all twenty-five Urban Growth Centres was obtained through Land Information Ontario's GeoHub portal (Ontario Ministry of Municipal Affairs and Housing [MMAH], 2017). The data features on this layer show the original boundaries as established in the initial 2006 version of the Growth Plan; however, a few UGCshave since seen changes to their boundaries. Perhaps the most extreme example is the Downtown Barrie Urban Growth Centre, whose original boundary, shown on the left in Figure 3, was subsequently modified in a number of places, most noticeably to exclude the municipal wastewater treatment plant (whose approximate location is indicated by the yellow circle in Figure 3). Changes were also made along most of the Lake Simcoe shoreline and in the vicinity of the Allandale GO Transit station at the southern end of the UGC. It was therefore necessary to make minor adjustments to the perimeters of most of the features in the UGC feature layer provided through the provincial data portal. (As Table 1 shows, Barrie and Kitchener were the

[2] A railway feature layer for Oshawa was made available through the Region of Durham's Open Data portal in March 2019, well after the completion of the base maps.

Figure 3

Downtown Barrie Urban Growth Centre, Original (2006) and Current (2019)



Note. Left: from Ontario Ministry of Municipal Affairs and Housing (2017). Right: from City of Barrie (2019b).

only two municipalities with feature layers for their UGC boundaries available through their Open Data portals.) In most cases, these changes simply involved small adjustments to bring the perimeters on the Province's data layer into agreement with various features included in municipal layers, such as street centrelines, zoning boundaries, and parcel fabric. The UGC boundaries were made to match the delineation provided in municipal policy documents as closely as possible. (Appendix A provides details on the policy documents used to establish UGC boundaries and on the adjustments made to the features on the provincial data layer.)

Whenever a feature layer for the municipality's parcel fabric was available, the parcels were used to construct the individual city blocks within the area of interest (including St. Catharines, whose "Land Usage" data feature layer is very similar to the parcel fabric). The Kitchener road segment layer included data on the ROW width for each feature, which was applied using the "Buffer" function in QGIS to approximate individual blocks. For other municipalities, the outlines of individual blocks were approximated based on visual estimations of road widths made in Google Earth Pro. (Because blocks were mainly used for reference purposes, these approximations did not have any effect on the results obtained.) In some cases, it was necessary to make blocks smaller than they would have been had the street network alone been the sole determinant of their extent; blocks that are not bounded on all sides by streets are listed with relevant details in Appendix B.

Each block within the area of interest was assigned a unique identification code, consisting of a three-letter code to represent the municipality and a two-digit number (three digits for Hamilton, whose area of interest has 103 blocks). The number system used was somewhat arbitrary, as numbers were only used for reference purposes, but where possible, block numbering adheres to a general north-to-south, west-to-east order. The three-letter codes are given in the List of Abbreviations on p. xiv. Maps showing the full extent of the blocks included in this study, along with the numbering scheme used for all twelve municipalities, can be found in Appendix C.[3]

The greatest challenge during this initial phase was presented by the Downtown Milton UGC. The Town of Milton's Open Data portal did not have any relevant feature layers available, which meant that it was necessary to generate the base map layers from scratch, with the exception of hydrological features, which were taken from the Natural Resources Canada (2017) data layer. The boundaries of the Dissemination Blocks used in the 2016 Census (Statistics Canada, 2017b) provided the starting point for delineating Milton's road network. These line segments were verified in Google Earth Pro and adjusted where necessary, with additional features being created to account for a number of courts and culs-de-sac omitted from the Dissemination Block layer. City blocks overlapping the Downtown Milton UGC were defined based on the resulting road network layer and drawn as individual features in Google Earth Pro before being imported into QGIS. Approximate building footprints were similarly traced in Google Earth Pro and imported into QGIS. (This layer only includes features for buildings located within the UGC. Features were not created for the footprints of buildings located outside the UGC but within the area of interest, mostly because of the extra time this would have required.)

Data collection: Creating parking lot feature layers

The data collection portion of the mapping phase culminated in the creation of two feature layers for each of the twelve sample municipalities, one layer composed of features representing surface parking lots according to the most recent aerial photographs and a second

[3] Throughout this report, the use of the term "blocks" in a general sense refers specifically to the subset of blocks making up the "area of interest" for each municipality (and not to all blocks located within the municipality).

Table 2

Dates of Aerial Photographs Used

Municipality	Date of earlier photo	Date of later photo
Barrie	2004[a]	2016[a]
Brantford	May 7, 2006	July 7, 2018
Burlington	December 30, 2005	May 7, 2018
Cambridge	April 18, 2006	July 7, 2018
Guelph	May 2, 2005	July 7, 2018
Hamilton	December 30, 2005	July 8, 2018
Kitchener	April 26, 2006	August 9, 2018
Milton	December 30, 2005	June 8, 2018
Oshawa	December 30, 2005	May 7, 2018
Peterborough	May 5, 2005[b]	May 6, 2018
St. Catharines	April–May 2006[a]	July 8, 2018
Waterloo	April 26, 2006	August 9, 2018

[a]More specific date information not provided. [b]Date of aerial photographs from City of Peterborough Historical Imagery.

layer with features for surface lots according to the most recent aerial photographs available from before June 2006, when the Growth Plan first came into effect. Table 2 lists the dates for the sets of imagery used. For the most part, data collection was based on the aerial photography provided through Google Earth Pro, although in a few cases it was necessary to use other sources:

- *Barrie*. The City of Barrie's Open Data portal ("Aerial Imagery REST Services") provides aerial photographs that are of higher resolution than Google Earth Pro's images of Barrie. The photographs downloaded from the City's portal were imported into Google Earth Pro and used in place of Google's aerial imagery. The most recent photographs available from the City of Barrie are dated 2016; the information obtained from these images was supplemented by a ground survey conducted in August 2019. This survey resulted in a few important changes being made to the 2016 features, most significantly in the downtown area on the north end of the UGC and along Lakeshore Drive along the western shore of Kempenfelt Bay (Lake Simcoe). The earlier aerial photos obtained from the City are dated 2004.

- *Burlington*. Imagery available through the City of Burlington's "Explore Burlington" web application was used to verify the perimeters of some of the parking lots observed in Google Earth Pro's 2018 photographs.
- *Hamilton*. Imagery available through the City of Hamilton's "Open Hamilton: Interactive Mapping" web application was used to verify observations made in Google Earth Pro, both for 2005 and for 2018.
- *Oshawa*. An orthographic image from 2018, accessed using the City's "mapOshawa" web application, was used to verify observations made in Google Earth Pro.
- *Peterborough*. Aerial photographs from City of Peterborough Historical Imagery, dated May 5, 2005, and June 2018, were used as the main point of comparison between the two parking lot layers. Parking lot features for the 2005 feature layer were traced in Google Earth Pro as accurately as possible based on the City of Peterborough's images.
- *St. Catharines*. The aerial photographs available in Google Earth Pro, dated June 30, 2003, were of too low a resolution to be of any practical use. Instead, imagery from 2006, accessed using the Region of Niagara's "Niagara Navigator," was used to identify parking lots, which were traced as precisely as possible in Google Earth Pro to create individual features.

Data collection started with the more recent (2018) aerial images for each municipality. The parking lots situated within each municipality's area of interest were outlined using the "Add Polygon" tool in Google Earth Pro. The resulting shape was saved in ".KMZ" file format and imported into QGIS, where individual parking lots were merged to create a single feature layer. For reference purposes, each individual parking lot was assigned a unique identifier, consisting of the letter "P" and a two-digit number (starting with "01") prefixed by the ID number given to the block on which the parking lot was located.

The completed feature layer representing all parking lots according to the 2018 aerial photographs (which will be referred to simply as the "2018 layer") was saved as a SHP file and imported into Google Earth Pro, where the polygons representing parking lots as observed in 2018 were made partially transparent and laid overtop of the earlier (2005 or 2006) aerial photograph.[4] If no discernible change had been made to a parking lot when compared to the earlier photograph, then the feature was simply copied from the 2018 layer to the earlier (2005/2006) feature layer. This ensured that the parking lot would retain the same area, and also preserved the ID number that had been assigned to the feature in QGIS. If a parking lot had been expanded or reduced in area between the earlier and later photographs, then the outline was adjusted to match the perimeter of the earlier version of the parking lot. A suffix (".2005" or ".2006", as appropriate) was appended to the lot's ID number, and this modified outline was saved as a separate KMZ file. Parking lots that existed in the earlier photograph but not the later were also outlined and given unique ID numbers, along with the same ".2005" or ".2006" suffix. The shapes corresponding to the earlier parking lots were imported into QGIS and merged with

[4] It was sometimes necessary to apply a minor translation to the SHP file in order to have its features match the exact positioning of Google Earth's earlier aerial imagery. These translations were reversed once the feature layer for the earlier parking lots had been completed, although the translation process may have introduced a very small degree of error into the area calculations performed in QGIS.

those copied from the 2018 layer (which had not undergone any changes) as a separate feature layer representing all parking lots observed according to the earlier images (generally referred to from here on as the "2005/2006 layer").

During data collection for the mapping phase, it was necessary to make some important decisions regarding what should or should not be considered a parking lot. (An area being "considered" a parking lot means that the area in question was included as a feature on the data layers created during the mapping phase.) In particular, it was important to differentiate between what should be considered a parking lot, on the one hand, and, on the other, what should be considered a driveway. The need for such a distinction was based on the important functional difference between the two, namely that a parking lot is primarily intended to be used for the *storage*, whereas the purpose of a driveway is to provide *access*.

Because this project relied on aerial photographs as the primary data source for the mapping phase, the distinction between a parking lot and a driveway was also articulated in morphological terms. The following two definitions were applied consistently throughout this project:

- A *parking lot* (or *parking area*) is defined as a surfaced area, intended for motorized vehicles and not situated on a right-of-way, whose physical construction permits vehicular movement along multiple "axes" (i.e., in multiple directions).
- A *driveway* is defined as a surfaced area, intended for motorized vehicles and not situated on a right-of-way, whose physical construction allows for vehicular motion only along a single axis (in other words, back-and-forth in a single direction).

Driveways were not considered to be parking lots for the purposes of this project. Throughout this report, the appearance of quotation marks around the word "driveway" indicates that the term is being used to refer to an area that, in everyday parlance, would be called a driveway (i.e., a long, narrow strip intended for vehicles) but that was considered a parking lot based on the above definitions.

Once an area had been identified as a parking lot, the total parking area was deemed to include the entire paved or otherwise surfaced area contiguous with the portion used for parking, including any portions that on their own would be considered driveways, up until the surfaced area meets the street (or the sidewalk, where clearly discernible).

Even with the distinction between a parking lot and a driveway having been made, there were some cases that still presented challenges. Two configurations in particular were prevalent across the twelve sample municipalities:

- *"Side-by-side" driveways*—which consist of two driveways directly adjacent to one another, each associated with a separate unit, that are contiguous along their entire length without any intervening surface or barrier—were not considered to be parking lots.
- *"Double-width" driveways*—which consist of two separate lanes for vehicle movement on one contiguous surface, where each lane provides access to a single vehicle berth within a double garage—were not considered to be parking lots. However, without a double garage requiring two separate lanes to access each berth, such an area was considered to be a parking lot.

Finally, it is necessary to remark that some driveways were indeed included as features on the final data layers, but *only* if (1) the earlier set of aerial images indicated that the area in question had previously been a parking lot, or (2) the later set of images indicated that what had previously been a driveway had since been expanded into a parking lot.

The reader who is interested in the process that went into making these determinations can find a full description in Appendix D ("What Is a Parking Lot?").

Analysis: Calculating area and change over time

The data collection process produced twenty-four separate feature layers, two for each Urban Growth Centre. Calculating the area of each individual feature is a simple matter in QGIS. The overall parking area that had not changed over the intervening time period—that is, the area that was used for parking both in 2005/2006 and in 2018—was identified using the "Clip" function in QGIS, which produced a new feature layer from the overlapping areas on the two existing layers.[5] Similarly, the "Difference" function was used to generate data layers showing the total area that had been added and the total area that had been removed over the intervening period.

Area measurements for individual parking lots on both the 2005/2006 and the 2018 layers were exported from QGIS into Excel, where they were combined to produce a list of all parking lots in the area of interest for each Urban Growth Centre, along with the area of each lot at both points in time. Lots that had been added or removed were simply assigned an area of zero for the appropriate point in time. Data for the "clipped" area for each lot, representing the area that had remained unchanged, was likewise exported into Excel. The unchanged area and the total area for each individual lot were used to calculate the area that had been added or removed for that particular lot, where the area added was equal to the unchanged area subtracted from the lot's

[5] There was actually an intermediate stage that has been omitted from the present discussion: parking lots were first categorized individually and five separate layers compiled showing (1) all lots that did not change between the earlier and later photographs; (2) lots that had been added, i.e., that did not exist in the earlier photograph; (3) lots that had been removed, i.e., that did not exist in the later photograph; (4) lots that had been expanded between the earlier and later photographs; and (5) lots that had been reduced over this period. However, in cases where new parking lots replaced older ones on the same site, there was some uncertainty regarding whether the earlier lot had been expanded or reduced or whether it had been removed and the new one added. This question about individual parking lot "identities" was essentially eliminated by considering only the total area that had been changed or that remained unchanged.

total area in 2018, and the area removed was equal to the unchanged area subtracted from its total area in 2005/2006.[6] Finally, the changes in area for the individual parking lots on each block were combined to calculate the net change in parking area on that block.

As a simple example, consider Figure 4, which represents a parking lot (designated STC53.P01) located within the Downtown St. Catharines Urban Growth Centre that has replaced the previous parking lot on the site (designated STC53.P02.2006). The earlier lot, shown in the top panel of Figure 4 in pink, had an approximate area of 7,130 m^2 (all area values have been rounded to the nearest multiple of five), whereas the lot that replaced it, shown in green in the middle panel, has an area of approximately 3,580 m^2. The brown portion in the bottom panel represents the "clipped" area where the two lots overlap, which measures 2,440 m^2. Thus, the total area that was added (the green portion of the bottom panel) is equal to 1,140 m^2, while the area removed (the pink portion) is 4,690 m^2. As these are the only two parking lots on block STC.53, the net change on the block is a decrease of 3,550 m^2.

The parking maps that were generated during the mapping phase of the project, showing the changes that occurred across all twelve UGCs, have all been included in Appendix E.

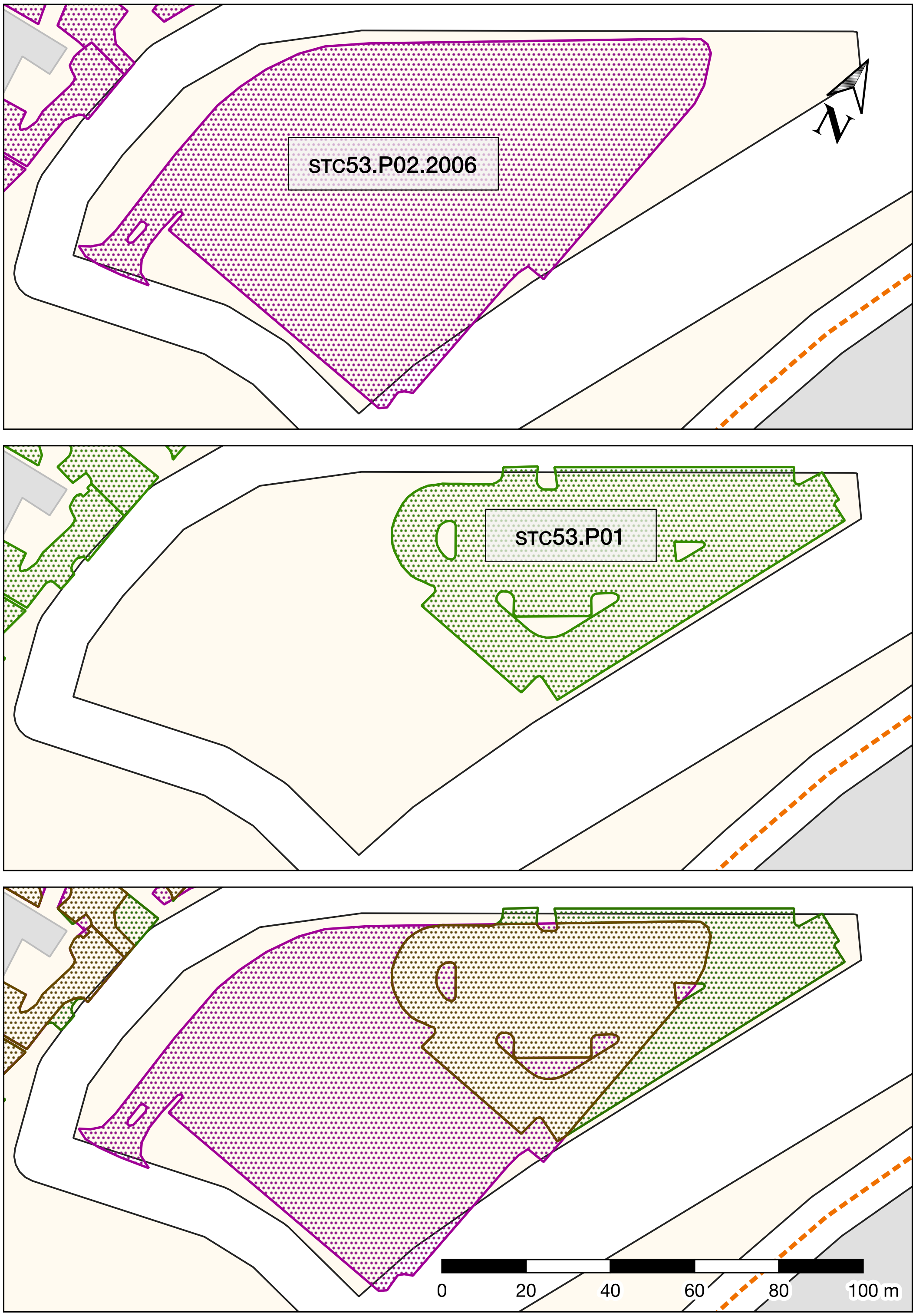
Policy analysis

Data collection for the policy analysis phase of the project involved downloading electronic versions of each municipality's official plan and zoning by-law from the municipal website, and identifying, extracting, and compiling any policies in these documents related to parking. For the analysis portion of this phase, policies were categorized using keywords for the particular aspect of parking addressed. Each municipality's position within each category was

[6] In some cases, the subtraction resulted in negative values for area, which served to cancel out overlapping areas (i.e., where area added to one parking lot overlapped area removed from another) in order to produce the correct values when calculating the net block-level change.

Figure 4

Downtown St Catharines UGC, Block STC.53: Parking Area in 2006 (Top) and in 2018 (Middle), with Overlap Shown at Bottom



assessed using a comparison matrix in order to determine its policy position according to the three “axes” identified based on Barter’s (2015) typology.

Data collection: Identifying and compiling relevant policies

The first step in the data collection process for the policy analysis phase involved gathering the official plans and zoning by-laws for all twelve municipalities included in the project sample. Electronic versions of these documents were downloaded as PDF files from municipal websites. The decision was made to focus on official plans and zoning by-laws because the former serve to express the municipality’s overall mindset regarding its policy goals and because the latter are the primary implementation tool when it comes to parking regulations.

The Growth Plan first came into effect in June 2006. Three municipalities have zoning by-laws that were enacted after this date—Barrie (2009), St. Catharines (2013), and Waterloo (2018)—while six of the official plans considered here—Barrie (2009), Cambridge (2012), Hamilton (2011), Kitchener (2014), St. Catharines (2010), and Waterloo (2012)—received approval after 2006. The different dates that each document came into effect presents challenges when attempting to compare different municipalities’ positions over a given period of time, which represents the main drawback to relying solely on these documents. (This was compounded by the fact that versions of former official plans and earlier zoning by-laws are not generally available from municipal websites.) Table 3 lists the approval dates for the official plans of the twelve municipalities included in this study and the dates on which their current zoning by-laws were originally passed.

Relevant policies were identified and extracted from all twenty-four documents. This includes the entirety of any section devoted to the subject of parking as well as any individual policies that mention “parking,” which were identified simply by searching for that word within

Table 3

Approval Dates of Official Plans and Effective Dates of Zoning By-laws

Municipality	Approval date of current official plan	Effective date of current zoning by-law
Barrie	April 23, 2010	August 10, 2009
Brantford	November 4, 1987	October 9, 1990
Burlington	March 5, 1997	June 21, 1999
Cambridge	November 21, 2012	October 27, 1986
Guelph	December 20, 1995	June 19, 1995
Hamilton	March 16, 2011	May 25, 2005
Kitchener	November 19, 2014	1985[a]
Milton	December 19, 1997[b]	July 7, 2004[c]
Oshawa	February 12, 1987	June 6, 1994
Peterborough	September 6, 1984[d]	October 27, 1997
St. Catharines	July 31, 2012	December 16, 2013
Waterloo	November 21, 2012	September 10, 2018

[a]More specific date information not available from City of Kitchener website. [b]Date of issuance of Ontario Municipal Board (OMB) Order No. 1840; Town of Milton Official Plan adopted by Council on August 26, 1996. [c]Date on which Town of Milton Zoning By-law 144-2003 received approval from OMB. [d]Date of latest partial approval by Minister of Municipal Affairs.

each downloaded document. The principal focus was on general policies that apply across the entire municipality, although policies for secondary plan areas and special policy areas as identified in official plans were also collected. Site-specific provisions resulting from amendments to the zoning by-law were not collected, in large part because of the prohibitive amount of time this would have required.

Analysis: Categorizing policies by keyword and "axis"

Once they had been compiled, policies were coded by assigning each of them one or two keywords identifying the particular aspect of parking addressed in the policy;[7] each keyword was itself assigned to one of three "axes." The three axes are based on the dimensions of Barter's (2015) typology: (1) the *geographic* axis, which differentiates between site-focused and area-oriented mindsets; (2) the *economic* axis, which differentiates between mindsets that regard parking as "infrastructure" or as a "market good"; and (3) the *attitudinal* axis, which distinguishes between various mindsets regarding how much parking ought to be supplied. (For more detail, see the discussion of Barter's typology in the Literature Review, pp. 31–35.) The keywords and the axes to which each has been assigned are presented in Table 4.

Some policies were relevant to multiple axes—for instance, policies regarding cash in lieu of parking pertain both to the geographic axis, as Barter (2015) considers cash-in-lieu under the rubric of area management (p. 148), and to the economic axis, since cash-in-lieu policies

Table 4

Axes and Keywords Used in Categorizing Parking Policies

Axis	Keywords associated with axis
Geographic axis	Cash in lieu of parking, community benefits, exemption area, off-site parking, on-site parking, on-street parking, parking for multiple uses on same site, public parking, shared parking arrangements
Economic axis	Commercial parking, community improvement projects/areas, infrastructure/municipal service, municipal parking facilities, pedestrian safety/traffic calming, pricing
Attitudinal axis	"Adequate" or "sufficient" parking, adverse effects/externalities, demand management, exemptions from requirements, maximum parking standards, parking demand, parking supply, reduced parking requirements, required parking areas, rounding

[7] In many cases these "keywords" were actually phrases; the term "keyword" will continue to be used in the interests of concision, but should be understood to include such "key phrases."

require municipalities to take a more active role in the provision of parking as a form of public infrastructure. Similarly, the existence of a particular area within which development is exempt from minimum parking requirements clearly indicates a certain attitude towards the supply of parking, and at the same time implies an area management approach that sees existing parking facilities as capable of satisfying demand within the area. On the other hand, a fair number of policies that refer to parking did not directly relate to any of the three axes; examples include regulations regarding surface treatment, the location of parking areas on individual lots (setbacks, etc.), driveways and street access, landscaping, and other design requirements. Some of these provisions relate to Shoup's (2005) argument that planners need to pay more attention to the quality of parking, rather than its quantity, and suggest that we might look for ways to expand the system used in order to consider such policies. These points are taken up more fully in the Discussion (see pp. 185–186).

Analysis: Comparing "mindsets" and assessing policy positions

Each policy and its assigned keyword(s) were collected in an Excel spreadsheet. In order to facilitate comparison between municipal mindsets in each policy category (i.e., under each keyword), a specific question was developed for each keyword to help clarify each municipality's position regarding that aspect of parking policy. The different "answers" to each question were organized into a series of "tiers," which represent estimated positions along the continuum of possible answers for that keyword's question.

Certain categories can be said to have more of a bearing on their particular axis than others. For example, the keywords "on-site parking" and "community benefits" are both assigned to the geographic axis. The "on-site parking" category encompasses zoning regulations stipulating that required parking spaces be provided on the same lot as the use requiring them, whereas “community benefits” involves policy statements that make public parking facilities one of the benefits that a municipality can require in exchange for permitting increased height or density for development. In other words, the former policy category involves enforceable zoning provisions, whereas the latter represents simple statements of intent, and thus the two cannot reasonably be expected to have equal bearing on a municipality’s mindset along the geographic axis. To address such situations, each keyword was given a “weight” to represent its relative importance to its axis.

The paragraphs on the following pages provide a brief explanation regarding why each keyword was assigned to its particular axis, along with the rationale for the weighting it has been given.

Geographic axis. The nine keywords assigned to the geographic axis relate in some way to the distinction between whether parking is “seen as something that should be provided on every site or as something that can serve many sites” (Barter, 2015, p. 138). Table 5 shows the questions associated with each category/keyword under this axis, along with the possible answers to each question and the tier values assigned to those answers. The weighting of these categories, along with a summary of the rationale for the weighting given, is presented in Table 6. Higher tier values for these categories correspond to more of an area management approach (in other words, to mindsets that see parking as able to serve larger areas), and lower values to the more traditional site-focused mindset (which regards parking as serving a small area).

On-site parking. The requirement that parking be provided on the same site as the use requiring it is a defining feature of the geographic axis, as it epitomizes the site-focused mindset. This keyword has been given a weighting of 3 to reflect its importance and to underscore the

Table 5

Questions, Answers, and Tier Values Associated with Policy Categories/Keywords – Geographic Axis

Category/Keyword	Question	Tier values and answers
On-site parking	Does the municipality specifically require that parking be provided on the same lot as the use requiring it?	(1) Yes
Off-site parking	How willing is the municipality to permit the provision of required parking on a different lot from the use that requires it?	(5) Willing to permit in many cases (4) Willing to permit in some cases (3) Willing to permit on a somewhat limited basis (2) Willing to permit on a limited basis (1) Not willing to permit
Exemption area	Does the municipality have a defined parking exemption area, and, if so, how much of a reduction or exemption is it willing to grant, and to which land uses?	(5) Exemption for all uses within area and reduction for surrounding areas (4) Exemption for all uses within area (3) Exemption for non-residential uses within area (2) Exemption for certain uses within area (1) No exemption area defined
Parking for multiple uses on same site	What is the municipality's position regarding different uses on the same site sharing parking facilities?	(3) Standard approach with some on-site sharing (2) Standard approach with some exceptions (1) Standard approach
Shared parking arrangements	How amenable is the municipality to permitting shared parking arrange-ments, particularly in exchanged for reduced on-site parking requirements?	(5) Quite amenable (4) Amenable (3) Willing to consider (2) Willing to consider on a limited basis (1) Does not contemplate shared parking
Cash in lieu of parking	How amenable is the municipality towards the provision of cash in lieu of required parking?	(5) Generally amenable, and encourages within central area (4) Generally amenable (3) Amenable within central area (2) Amenable in limited number of cases (1) Will not accept
Public parking	How does the municipality regard the availability of public parking facilities with respect to the pro-vision of required parking on-site?	(4) As possible alternative to required parking (3) As possible alternative in certain cases and as supplement within central area (2) As supplement within central area (1) As supplement in general

Category/Keyword	Question	Tier values and answers
Community benefits	How open does the municipality leave itself to using community benefit provisions to request the provision of public parking facilities?	(5) May use community benefits provisions (4) May use similar provisions (3) May use for non-surface forms of parking (2) May use, but permitted increases should avoid adverse effects (1) Will not use; permitted increases should avoid adverse effects
On-street parking	How amenable is the municipality towards permitting on-street parking in connection with objectives related in some way to area management?	(3) Somewhat amenable (2) Amenable in limited set of circumstances (1) Not amenable

Table 6

Weighting of Categories – Geographic Axis

Category/Keyword	Weight	Explanation/Rationale for weighting
On-site parking	3	Defining feature of axis. Epitomizes site-focused mindset.
Off-site parking	3	Defining feature. Represents important shift from site-focused to area-focused mindset.
Exemption area	3	Heavily implies area management approach; takes advantage of existing parking facilities.
Parking for multiple uses on same site	2	Form of "on-site area management." Generally addressed in zoning by-law provisions, which carry greater weight.
Shared parking arrangements	2	Step towards area management approach. Usually addressed in zoning by-law provisions.
Cash in lieu of parking	2	Generally requires funds to be invested in public parking facilities. Implies some degree of area management.
Public parking	2	Can support area management approaches when used to justify full or partial exemption from requirements. Some overlap with cash-in-lieu.
Community benefits	1	Usually addressed in simple statements.
On-street parking	1	Differs from conventional approaches to on-site parking. Not explicitly addressed in Barter's (2015) typology.

greater legal weight that zoning provisions possess as compared to official plan policies. Incidentally, the answer to this question was "Yes" for all twelve municipalities.

Off-site parking. Permitting the provision of required parking on a different site represents a clear shift away from a site-focused mindset towards an area management approach. This category has also been assigned a weight of 3 for much the same reasons as those given for on-site parking.

Exemption area. A number of the municipalities included in this project have some sort of area in which land uses are at least partially exempt from parking requirements. The establishment of such an area in a zoning by-law (generally within the downtown or central area) heavily implies an area management approach, as the exemption generally takes advantage of existing parking facilities within the defined area. For these reasons, this keyword has also been given a weighting of 3 for the geographic axis.

Parking for multiple uses on same site. Allowing multiple uses on the same lot to share parking amounts to a kind of "on-site area management." For the purposes of this category and question, "multiple uses on the same site" includes residential uses in non-residential buildings and home occupations. This category has been given a weighting of 2: it is not as crucial to the geographic axis as the previous categories, but provisions regarding this category carry more weight because they appear in zoning by-laws. The use of the term "standard approach" in the tier descriptions (see Table 5) refers to the requirement that the total number of parking spaces provided be equal to the sum of the number of spaces required for each individual use.

Shared parking arrangements. Shared parking arrangements represent a step towards an area management approach, especially if such an arrangement is used to justify granting a reduction in, or exemption from, minimum on-site parking requirements. This category has been given a weighting of 2, as the policies that address this particular aspect tend to appear in official plans rather than zoning by-laws.

Cash in lieu of parking. The adoption of a cash-in-lieu policy generally requires that the funds generated be used to invest in public parking facilities—one reason why Barter (2015) specifically includes cash-in-lieu as an example of an "area management" approach to parking reform (p. 148). The assigned weighting of 2 reflects the fact that statements regarding this aspect of parking policy tend to be simple expressions of intent, particularly when they appear in official plans instead of zoning by-laws.

Public parking. The provision of public parking facilities can be an important area management technique when the availability of such facilities is used to support a full or partial exemption from on-site parking requirements. The weighting of 2 reflects the fact that there is some overlap between this keyword and cash-in-lieu. References in the tier descriptions to parking as a "supplement" mean that public parking is seen as an addition to the existing stock without corresponding reductions elsewhere.

Community benefits. This category and its associated question consider whether public parking facilities are mentioned as a possible community benefit that the municipality can request or require in exchange for increases to permitted height or density. Most of these policies are simple statements that allow for the possibility, and therefore this category has only been given a weighting of 1.

On-street parking. Barter (2015) admits that the management of on-street parking is not explicitly addressed in his typology (p. 149), but does suggest that it could be considered under the rubric of area management because it differs from the more conventional approaches to on-site parking: "Conventional site-focused policy goes with a reluctance to ration on-street parking.

Area management sees on-street parking as part of the district infrastructure" (Barter, 2015, p. 149). We can also consider on-street parking as an area management technique insofar as the parking space is not usually associated with any specific lot or land use. The focus for this category is on whether on-street parking is regarded as a possible replacement for required on-site parking, with other aspects of on-street parking considered more extensively under the economic axis. This category presented a challenge, as most of the municipalities considered generally permit free on-street parking in most locations, and has thus been assigned a weighting of 1.

Economic axis. The questions associated with the six keywords assigned to the economic axis seek to establish whether municipal policies treat parking as a form of infrastructure or as a market good. Lower values along this axis correspond with the "infrastructure" mindset, with higher values moving towards a "market good" perspective. Table 7 shows the questions, answers and tier values associated with the categories under the economic axis, while Table 8 presents the weighting of each category and the reasons for those weightings.

Infrastructure/municipal service. Some municipalities in the project sample have policies that clearly establish, or outright state, that they consider parking a form of infrastructure or municipal service. This question is a defining one for the economic axis, and so this category has been given a weighting of 3.

Municipal parking facilities. The active provision of parking facilities by a municipality clearly indicates a mindset that is not willing to completely leave parking to market forces. Though not as definitive as the previous question, this category is still important and has been given a weighting of 2.

Table 7

Questions, Answers, and Tier Values Associated with Policy Categories/Keywords – Economic Axis

Category/Keyword	Question	Tier values and answers
Infrastructure/municipal service	How clearly does the municipality consider parking to be a form of infrastructure or municipal service?	(2) Possibly considers as infrastructure or service (1) Clearly considers as infrastructure
Municipal parking facilities	How active a role is the municipality willing to play in the provision of parking facilities?	(3) Unlikely to play active role (2) May play active role (1) Committed to playing active role
Pricing	Does the municipality contemplate pricing parking or the charging of fees, either in general or as a demand management strategy?	(3) May use (2) May consider (1) Will not use
Pedestrian safety/traffic calming	Does the municipality clearly propose on-street parking as a traffic-calming measure or as a way to promote or improve pedestrian safety?	(3) In a limited number of places (2) In some places (1) Generally
Community improvement projects/areas	Does the municipality include the state of parking facilities as a possible criterion in the designation of community improvement project areas?	(3) No (2) Yes, as a general criterion (1) Yes, and has established CIPs to address parking
Commercial parking	Is the municipality willing to encourage a commercial parking market or the establishment of commercial parking facilities?	(3) Yes, may encourage (1) No, will discourage

Table 8

Weighting of Categories – Economic Axis

Category/Keyword	Weight	Explanation/Rationale for weighting
Infrastructure/municipal service	3	Involves explicit statements about mindsets regarding this axis.
Municipal parking facilities	2	Indicates mindset not completely willing to leave parking to market forces. Important but not definitive aspect to axis.
Pricing	2	Represents important step away from purely infrastructural mindset.
Pedestrian safety/traffic calming	1	Involves specific application of parking as a form of infrastructure.
Community improvement projects/areas	1	Indicates mindset not willing to leave parking to market forces. Policies often simply list parking as one of many criteria.
Commercial parking	1	Would be necessary component of market-based system, but does not necessarily preclude municipality from playing role.

***Pricing*.** Establishing a pricing system for parking represents a step away from a purely infrastructural mindset, which is why this category has been given a weighting of 2. Pricing here is taken to mean that an on-the-spot fee of some sort is required (rather than costs being recovered through property taxes or other such less direct mechanisms).

***Pedestrian safety/traffic calming*.** The use of on-street parking as a traffic-calming measure—which some of these policy documents specifically mention—represents a specific application of parking as a sort of infrastructure. However, this category has only been given a weighting of 1, as not using on-street parking for traffic-calming does not necessarily indicate a more market-oriented mindset.

***Community improvement projects/areas*.** The inclusion of parking as a criterion for establishing community improvement projects or areas indicates a mindset that is not willing to leave the condition of parking facilities completely to market forces. (Many policies that fall under this category also specifically refer to parking as physical infrastructure.) This category has only been given a weighting of 1 because most of the policies regarding this question simply list the condition of parking facilities as one of many possible criteria. This lower weighting is also intended to avoid too much overlap with the more general infrastructure question above.

***Commercial parking*.** Commercial facilities would be a necessary component of a market-oriented parking system, although their existence does not necessarily prevent the municipal government from playing a role in the provision of parking as well. Thus, this category has also been given a weighting of 1.

Attitudinal axis. The ten keywords assigned to the attitudinal axis all pertain to the municipality's attitude regarding how much parking needs to be provided. As Barter (2015) points out, positions along this axis can range from the view that parking should be provided in abundance to a mindset that sees the supply of parking as something to be restricted or even actively reduced. Tier values along this axis generally correspond to the “amount” of parking each mindset regards as necessary, with higher values representing an abundant supply and lower ones tending towards more restrictive attitudes. Table 9 presents the questions, answers, and tier values for the attitudinal axis; Table 10 shows how these categories were weighted and summarizes the reasoning behind the weighting given to each.

Parking supply. The answers to the question associated with this particular keyword seek to establish a baseline position for each municipality along the attitudinal axis. As a defining characteristic of the attitudinal axis, this category has been given a weighting of 4.

Parking demand. The question here considers the municipality’s mindset regarding the nature of the demand for parking: is this seen as a “given” that needs to be satisfied, or is it instead considered something that can be managed or reduced? Another central consideration for the attitudinal axis, this category has also been given a weighting of 4.

Reduced parking requirements. Put simply, a greater willingness on a municipality’s part to grant a partial (or full) exemption from parking requirements very strongly suggests a mindset that is less concerned about the supply of parking. This category has been given a weighting of 3, as it is an important question but does not represent a defining characteristic the way the previous two questions do.

Exemptions from requirements. Like the question of reduced requirements, this category has also been given a weighting of 3, and for the same reasons. The exemption category also takes the existence of an exemption area into account, while at the same time trying to avoid too much overlap with that particular question under the geographic axis.

Table 9

Questions, Answers, and Tier Values Associated with Policy Categories/Keywords – Attitudinal Axis

Category/Keyword	Question	Tier values and answers
Parking supply	What is the municipality's general overall policy position regarding the supply of parking?	(5) Provide abundant supply (4) Ensure demand will be satisfied, increase supply as necessary (3) Match supply to demand (2) Limit supply where possible (1) Reduce supply
Parking demand	What is the municipality's general overall position when it comes to the relationship of the supply of parking to demand?	(5) Increase supply to satisfy demand (4) Ensure sufficient supply for demand (3) Match supply to demand (2) Reduce demand (1) Reduce supply, regardless of demand
Reduced parking requirements	How willing is the municipality to consider a reduction in the amount of parking required?	(5) Not at all (4) On a limited basis (3) In some cases (2) Willing to permit (1) Permits in all cases
Exemption from requirements	How willing is the municipality to grant a full exemption from parking requirements?	(5) Not at all (4) On a limited basis (3) In some cases (2) Willing to consider (1) Willing to grant in all cases
Maximum parking standards	Does the municipality apply maximum parking standards, and, if so, to what extent?	(5) Expressly dismisses possibility (4) Does not apply maximum standards (3) May consider (2) Applies for some uses in all areas (1) Applies for all uses in all areas
Adverse effects/ externalities	How concerned is the municipality that various land uses will generate "adverse effects" due to insufficient parking?	(5) Very concerned (4) Concerned (3) Somewhat concerned (2) Not particularly concerned (1) Not at all concerned
Required parking areas	How insistent is the municipality that areas used to provided required parking be maintained exclusively for that use?	(5) Quite insistent (4) Insistent (3) Somewhat insistent (2) Not particularly concerned (1) Not concerned

Category/Keyword	Question	Tier values and answers
"Adequate" or "sufficient" parking	How insistent is the municipality that "adequate" or "sufficient" on-site parking be provided for different land uses?	(5) Quite insistent (4) Insistent (3) Moderately insistent (2) Not particularly concerned (1) Not concerned
Demand management	How much, or how actively, does the municipality encourage or require measures related to transportation demand management?	(5) Prohibits (4) Discourages (3) Considers (2) Encourages or may require (1) Requires
Rounding	Does the municipality require that calculations for the required amount of parking that result in fractional numbers be rounded up or down?	(4) Round up to nearest higher whole number (3) Round down to nearest lower whole number

Table 10

Weighting of Categories – Attitudinal Axis

Category/Keyword	Weight	Explanation/Rationale for weighting
Parking supply	4	Defining characteristic. Establishes baseline position along axis.
Parking demand	4	Defining characteristic of axis.
Reduced parking requirements	3	Important aspect regarding attitude, but not definitive.
Exemption from requirements	3	Important aspect regarding attitude, but not definitive.
Maximum parking standards	3	Suggests more active approach to limiting or restricting supply. Important but not definitive.
Adverse effects/ externalities	3	Addresses important concern for mindsets worried about providing too little parking.
Required parking areas	2	Suggests attitude that parking supply should not be compromised. Has more oblique relationship to axis than other categories.
"Adequate" or "sufficient" parking	2	Common phrases included in policy documents. Somewhat oblique relationship to axis, possible overlap with adverse effects.
Demand management	2	Tends to involve statements that are more prospective or aspirational.
Rounding	1	Pertains to attitudes regarding amount of parking but impacts question of supply in limited manner.

Maximum parking standards. A willingness to impose maximum parking standards suggests a more active approach towards restricting the supply of parking. Another important consideration for the attitudinal axis, this category has been given a weighting of 3.

Adverse effects/externalities. Barter (2015) has observed that the conventional, "Suburban New World" approach to parking policy views spill-over parking as an "externality" that an abundant supply of off-street parking is designed to prevent (p. 146). The desire to avoid any "adverse effects" that might arise from a lack of parking therefore reflects a mindset that sees parking as something to be provided abundantly. Because it addresses a central concern for the attitudinal axis, this question has been assigned a weighting of 3. The policies considered in this category come from both official plans and zoning by-laws, with the latter being given more weight in determining tier values.

Required parking areas. The insistence that areas designated for the provision of required parking spaces be maintained exclusively for that purpose suggests an attitude that the parking supply should not be reduced or compromised in any way. This question has a more oblique relationship to the axis than those we have considered so far, and has therefore been assigned a weighting of 2.

"Adequate" or "sufficient" parking. The requirement that developments provide "adequate" or "sufficient" parking has been given its own category because of the sheer number of times that these phrases appear in various documents. The words "adequate" and "sufficient" are not usually defined in more exact terms, which renders their intended meanings somewhat nebulous. However, judging from the context within which they are used, it is safe to assume that these two adjectives are generally meant in the sense of "adequate or sufficient enough so as not cause any spill-over or other adverse effects." This category has been assigned a weighting of

2, as its relationship to the attitudinal axis is more oblique than some of the other questions considered, and because there is potential overlap with the earlier question regarding adverse effects.

Demand management. Municipalities that see the demand for parking as a given quantity that must be satisfied will not seek to manage that demand, which makes this category relevant to the attitudinal axis. Statements regarding this particular aspect of policy tend to be more prospective or aspirational, and so this question has been assigned a weighting of 2.

Rounding. The question of rounding fractions affects the supply of parking, but only in a very limited manner, and is generally more of a bookkeeping measure than anything else. This category has been included because it does pertain to the attitudinal axis, but has only been given a weighting of 1.

Policy categories not addressed in documents

There were some cases where a municipality's documents did not contain any policies that address a particular category. Two options presented themselves in these situations, the first of which was to assign the municipality a tier value despite the omission. This was done when the omission implied a "default" policy position: for example, with the question of rounding, if a zoning by-law does not state that fractional values generated in calculating the minimum number of required parking spaces should always be rounded up or always rounded down, then it is reasonable to assume a default position that the normal rules for rounding (i.e., to the nearest whole number) should apply.

The second option in these situations was simply not to assign a tier value for the category and to omit it from the calculation of the weighted average. This option was taken when the absence of a policy did not imply any "default" position. For example, the payment of cash in lieu of parking in Ontario is authorized under Section 40 of the *Planning Act* (Revised Statutes of Ontario 1990, chapter P.13), which states that a building owner or occupant and a municipal council may enter into an agreement "exempting the owner or occupant, to the extent specified in the agreement, from the requirement of providing or maintaining the parking facilities" (Section 40, subsection 1). There is no statutory requirement that this be provided for in a by-law or official plan, and therefore the omission of a cash-in-lieu policy does not preclude such an agreement from being entered into.

The following categories are those for which the absence of specific policies were deemed to imply a default position:

Off-site parking (geographic axis). Because all twelve zoning by-laws contain provisions stating that parking must be provided on the same lot as the use requiring it, the omission of provisions that would permit the establishment of required parking on another lot means that such off-site parking is not permitted. Municipalities that did not address off-site parking were therefore assigned to tier 1, "not willing to permit."

Parking for multiple uses on same site (geographic axis). For this category, it was assumed that the default position was the same as the "standard approach" (tier 1), namely that each individual use must provide the amount of parking that it would normally require.

Community benefits (geographic axis). Section 37 of Ontario's *Planning Act* (as it read on July 21, 2020)[8] states that a municipality may, in its zoning by-law, authorize increases to the permitted height or density of development "in return for the provision of such facilities, services or matters as are set out in the by-law" (Section 37, subsection 1) but that, in order to do so, this

[8] The version of Section 37 that was in force and effect over the study timeframe has since been repealed and replaced by Section 9 of Schedule 12 to the *More Homes, More Choice Act, 2019* (Statutes of Ontario 2019, chapter 9 [Bill 108]) and, more recently, by Section 1 of Schedule 17 to the *COVID-19 Economic Recovery Act, 2020* (Statutes of Ontario 2020, chapter 18 [Bill 197]). These changes came into effect on September 18, 2020.

authorization must be provided for in the municipality's official plan (Section 37, subsection 2). The omission of policies that establish parking as a possible community benefit, therefore, implies that it cannot be one of the "facilities, services or matters" in question, and has been assigned a tier value of 1.

Maximum parking standards (attitudinal axis). The omission of zoning standards establishing a maximum amount of parking that may be provided with development means that no such limit can be imposed. Municipalities with no policies regarding maximum standards have therefore been assigned to tier 4, "does not apply maximum standards."

Adverse effects (attitudinal axis). The absence of any statement regarding the "adverse effects" that might occur because of insufficient parking implies a default position that the municipality in question is not concerned about the possibility. This position corresponds with tier 1 ("not at all concerned").

Required parking areas (attitudinal axis). Similar to the question regarding adverse effects, the absence of provisions stipulating that parking areas required by the zoning by-law must be maintained for parking purposes implies a lack of concern regarding the issue, which places a municipality on tier 1 ("not concerned").

Rounding (attitudindal axis). If a zoning by-law does not specify how fractional values should be rounded, then it has been assumed that the normal rules for rounding apply.

The omission of policies regarding any category not included in this list resulted in the municipality in question not being assigned a tier level for that particular category and in the category not being included in the weighted average for that municipality. (For example, if a municipality had no policies regarding cash-in-lieu, then that category was essentially be given a weighting of zero for that municipality, but retained its weighting of 2 for the municipalities that do have policies that address this category.)

Calculation of policy positions using weighted averages

Each municipality's position along each of the three axes was calculated by taking the weighted average of its assigned tier values (using the weightings described above and listed in Tables 6, 8, and 10). The full comparison matrix can be found in Appendix F. The three weighted averages (one for each axis) represent the municipality's position along each of the three axes; taken together, the three axial positions provide a three-dimensional co-ordinate within the "policy space" derived from Barter's (2015) typology. These co-ordinates were used to generate a three-dimensional scatter plot representing the twelve municipal policy positions. (This three-dimensional plot is presented in the Results chapter as Figure 17—see p. 151).

Final analysis phase

The objective of the final analysis phase was to identify possible relationships and points of connection between the results from the two previous phases. The analysis of these two sets of results (the change in area devoted to surface parking from the mapping phase and the municipal policy positions assess during the policy analysis phase) involved both qualitative and quantitative techniques, namely

(1) the use of descriptive statistics to qualitatively characterize municipal positions on parking policy and the nature of the change in parking area observed, and
(2) the use of *k*-means cluster analysis to explore whether municipalities with similar policy positions also saw similar changes in the area devoted to surface parking.

Descriptive statistics

Descriptive statistics were used to arrive at a holistic qualitative characterization of each municipality's position regarding each of the three dimensions derived from Barter's (2015) typology. This characterization was based on an overall assessment of the tier values assigned along each of the three axes during the policy analysis, with an emphasis on the descriptions that correspond to these tier values (i.e., the "answers" to the questions listed in Tables 5, 7, and 9). Just as individual tier values were assigned based on the answer to the question associated with each category, the characterization of policy positions during the final analysis was similarly guided by the following questions regarding each of the three policy dimensions:

- Geographic axis: How amenable is the municipality overall towards strategies that represent more of an area-management approach to parking policy?
- Economic axis: Does the municipality consistently treat parking as a form of infrastructure, or are there places where its policy positions tend away from a purely infrastructural mindset?
- Attitudinal axis: What is the municipality's overall attitude regarding the appropriate or necessary amount of parking to supply and regarding the relationship of that supply to the demand for parking? How amenable is the municipality towards policies that would tend to limit or reduce the parking supply, and how concerned is it that not providing enough parking will generate "adverse effects"?

As the list above indicates, the characterization of positions along the attitudinal axis was guided by two questions, for the most part because this axis involved the greatest number of categories, and also because some of those categories (in particular the "parking supply" and “parking demand” categories) already addressed more holistic considerations of the municipality’s attitude or mindset regarding the amount of parking that should be supplied.

The qualitative characterizations obtained for the different municipal policy positions, based on this set of questions, were used to rank the twelve sample municipalities from “most conventional” to “least conventional.” “Conventional” here has the same meaning as it does in Barter’s typology (see Fig. 1 on p. 32, in which the lower right “quadrant” is labelled “conventional, site-focused approaches”): that is, the conventional approach to parking policy sees parking as something that needs to be provided on every site, considers parking a form of “infrastructure,” and maintains an attitude that parking should be provided in abundance so that the peak demand for free parking can always be satisfied. This ranking, alongside the qualitative description of the change observed in each area of interest, allows us to discern overall trends within the project sample.

K-means cluster analysis

The quantitative analysis of the results from the mapping and policy analysis phases centred on the use of *k*-means cluster analysis, which was used to investigate whether municipalities that had similar policy positions also saw similar outcomes in terms of changes in the area devoted to surface parking. Cluster analysis is often used as part of an exploratory analysis of data (Tan et al., 2006, p. 532), and *k*-means is a simple, widely-used technique that is relatively easy to understand (Tan et al., 2006, p. 497).

K-means cluster analysis uses an algorithm that finds a specific number of clusters (*k*, defined by the user) within a set of data points. It is “typically applied to objects in a continuous *n*-dimensional space” (Tan et al., 2006, pp. 496–497), which aptly describes the three-dimensional “policy space” we have defined for this project. The algorithm characterizes each cluster using a "prototype" or centroid (Tan et al., 2006, p. 496), which in this particular case is simply the mean value of the co-ordinates for each point within the cluster. The algorithm starts by choosing *k* initial points to use as cluster centroids and assigning each data point to the centroid closest to it. The value of each cluster's centroid is then recalculated by taking the mean value of all points assigned to that cluster. Each data point is then once again assigned to the closest of these updated centroids. This process is repeated until none of the data points changes cluster between one iteration and the next. *K*-means produces a partitional clustering—that is, data points are divided into non-overlapping sets, without any "nesting" (clusters within clusters)—that is both exclusive (each point is assigned to a single cluster only) and complete (all points are assigned to a cluster) (Tan et al., 2006, pp. 492–493). For the purposes of this project, *k*-means cluster analysis offers a simple method for finding similarities between municipalities' policy positions.

One of the main challenges involved in *k*-means cluster analysis is selecting a suitable set of values to use as the initial cluster centroids, as different starting values will often result in different clusterings (Tan et al., 2006, p. 501). In this context, we are interested in finding clusterings that minimize the sum-of-squares error (SSE), which is the sum of the square of each point's distance from its cluster's mean value. One common technique is to select initial points randomly, but this can often result in poor or sub-optimal clustering (Tan et al., 2006, p. 502).

This was an instance where the small sample size used in this project was beneficial: rather than selecting random points to use as the initial centroids, an algorithm was developed in Excel's VBA (Visual Basic for Applications) programming environment that used three of the twelve policy positions as starting points. There are 220 possible ways in which three points can be chosen out of a group of twelve; it was therefore possible for this algorithm to run through all

220 possible combinations in a short amount of time. The algorithm recorded the SSE for the clustering produced by each combination of initial values, after which the clustering with the lowest total SSE was selected. This ensured that the clustering produced was the most appropriate for the twelve data points used. The procedure used by this algorithm is described in more detail in Appendix G.

Summary of methodology

Overall, the methodology described in this chapter was successful in answering the research questions, especially the two sub-questions regarding changes in surface parking area and municipal policy positions. The mapping phase answered the first sub-question ("How has the amount of off-street surface parking changed since 2006?") by generating detailed tables in Excel that contain data on (1) the change in area over time of individual lots, (2) the net change in area on each individual block, (3) the change within each Urban Growth Centre, and (4) the change in the entire "area of interest" for all twelve municipalities included in the project sample. To aid in visualizing these changes, the geographic data collected in this phase were also used to produced a full set of maps showing the distribution of surface parking across each UGC in both 2005/ 2006 and 2018 (see Appendix E).

The policy analysis phase of the project answered the second sub-question ("What policies are in place and how would these be characterized according to Barter's (2015) typology?") by categorizing relevant official plan policies and zoning regulations according to a number of keywords within the three policy "dimensions" provided by Barter (2015). The quantification presents some important opportunities for policy-makers and planning practitioners. Not only did the quantification of municipal policy positions, achieved by applying tier values to Barter's typology, facilitate the comparison of positions between different municipalities, but the process described in this chapter can also help individual municipalities identify which approach to parking policy reform is more likely to be successful, based on their current policy positions.

Lastly, the final analysis phase addressed the main research question ("What relationships might exist between policy positions and changes in surface parking?") in order to achieve the primary goal of this project of identifying possible points of connection between the results from the mapping and policy analysis phases, and thereby pointing out promising directions for future research to investigate. Descriptive statistics were used to produce qualitative characterizations of each municipality's policy position as well as characterizations of the nature of the change observed across its "area of interest." *K*-means cluster analysis was used to identify which municipalities had similar overall positions regarding parking policy and to investigate whether municipalities with similar positions also saw similar outcomes with respect to changes in surface parking area. Despite the small sample size used for this project, which limits what can be said conclusively about possible relationships, the results of the final analysis phase and of the project as a whole—all of which are presented in detail in the next chapter—do indeed point to some interesting possibilities that researchers may find fertile ground for future study.

Results

Both the mapping phase and the policy analysis phase of this project consisted of a data collection stage followed by an analysis stage (see Fig. 2 on p. 63). The results from the analysis portions of these two phases, which address the project's two research sub-questions, in turn provided the "raw material" for the final analysis phase, which focused on the main research question ("What sorts of relationship might exist between policy positions and changes in the amount of parking over time?"). The results of this project thus consist of the following, listed in the order in which they are presented in this chapter:

- Mapping phase results: (1) change in area devoted to surface parking between 2005/2006 and 2018 across the "area of interest" containing each Urban Growth Centre; (2) the distribution of net block-level changes observed for each area of interest; and (3) the change in area devoted to parking within exemption areas (areas where at least some land uses are completely exempt from minimum parking requirements).
- Policy analysis results: (1) tier values assigned to each municipality for each policy category/keyword; (2) positions along the three "axes" derived from Barter's (2015) typology (geographic, economic, and attitudinal), calculated by taking the weighted average of tier values for the categories under each axis; and (3) a three-dimensional plot of municipal positions in the "policy space" defined by the three axes.
- Final analysis results: (1) descriptive statistics, which were used to develop qualitative characterizations of municipal policy positions, along with the nature of the observed change in area devoted to surface parking; and (2) *k*-means cluster analysis, which was used to identify similarities between individual municipal policy

positions and, from there, to investigate whether municipalities holding similar positions also saw similar outcomes with respect to surface parking.

Mapping phase results

The initial results from the mapping phase of the project consist of twenty-four data feature layers (two for each sample municipality) which show the parking area added and removed between 2005/2006 and 2018 and the area used for parking at both points in time (i.e., the parking area that did not change over the study timeframe). The full set of maps can be found in Appendix E; as with Figure 4 (p. 77), the maps in Appendix E show the unchanged area in brown, the parking area added in green, and the parking area removed in magenta. (In other words, brown plus green is the parking area as observed in 2018, and brown plus magenta the area as observed in 2005/2006.)

The feature layers (which included attributes for each feature's total area and the area within the UGC) were exported from QGIS into Excel, where the areas of individual parking lot features at both points in time were tabulated. An area of zero at the appropriate point in time was assigned to any parking lot that had been completely added or removed over the period in question. The information exported into Excel also included measurements for the "overlapping" area (the area shown in brown in the Appendix E maps), which represents the area that was used for parking at both points in time, regardless of the "identity" of individual parking lots (see note 5 on p. 75).

Adjustments and corrections to initial results

Before final area calculations could be made, it was necessary to make some minor adjustments and corrections to the initial results. In general, such adjustments were made for one of three reasons:

Construction or redevelopment. Some parking lot features were situated on sites that either the earlier or later set of aerial images show undergoing construction or some form of redevelopment. These parking lots were excluded from the final calculations, as it was unclear from the available information how much surface parking had existed before (or how much will exist after) development or redevelopment.

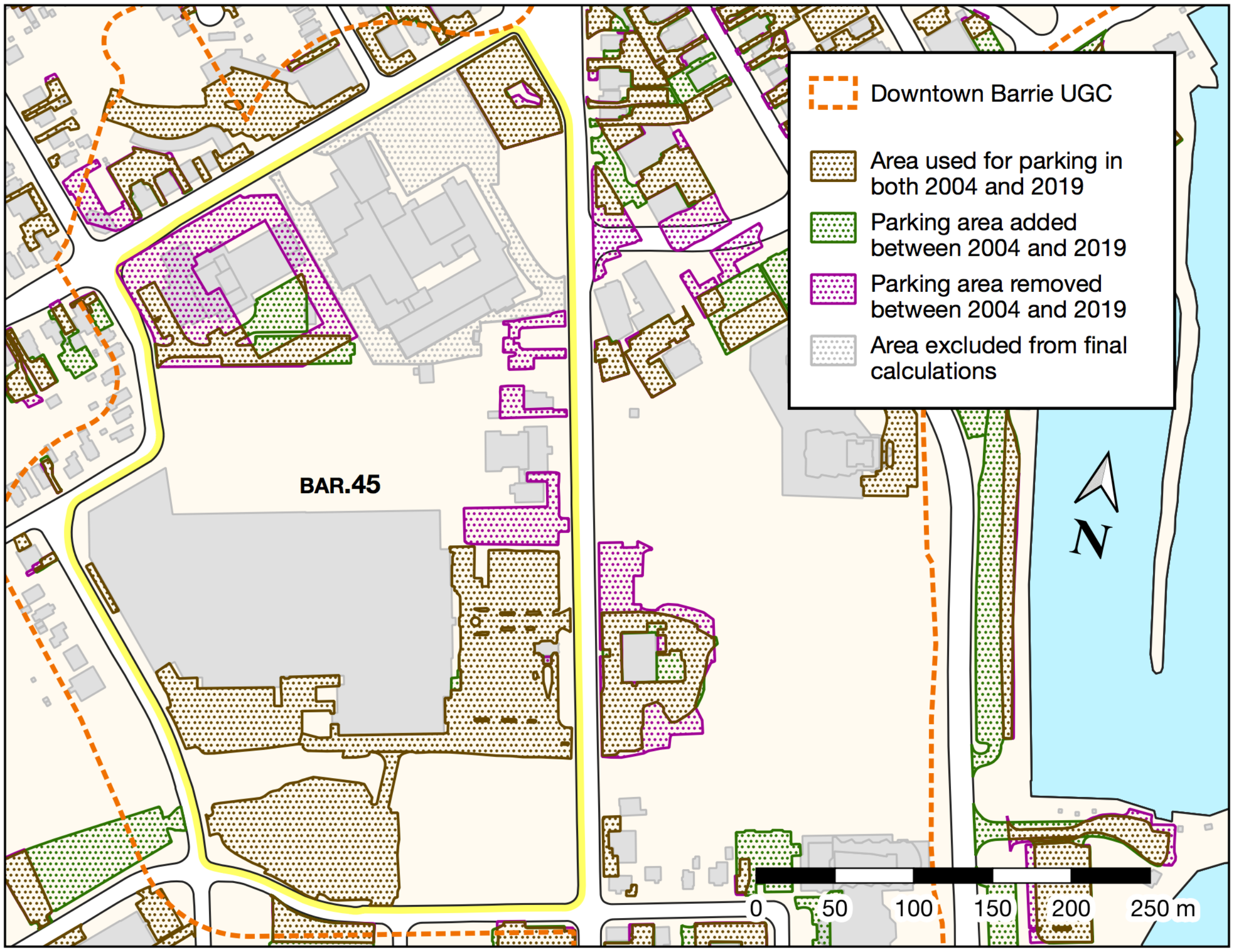
As an example, Figure 5 shows the changes observed on a block located in the Downtown Barrie UGC, designated BAR.45 (highlighted in yellow), according to the initial results.[9] Figure 6 (p. 107) presents aerial views of the northern portion of this block in 2004 (left; City of Barrie, 2004) and in 2019 (right; Google, 2020a). The removal of the large parking lot near the northerly corner of BAR.45 occurred in connection with the demolition of a former high school (Barrie Central Collegiate; the building that can be seen still standing in the more recent image is the former high school auditorium). According to the City's website, the intent is for the site to be occupied by a mixed-use development that will include 600 residential units in three high-rise buildings and a YMCA facility (City of Barrie, 2019a). However, the most recent aerial imagery (Fig. 6) clearly shows the site to be mostly vacant, and as of June 2020 the development application was still under review.

The situation surrounding the former Barrie Central Collegiate shows why adjustments needed to be made for sites that were shown undergoing development or redevelopment in either

[9] The discussion in this chapter will be making extensive use of the identification numbers that were assigned to individual blocks for this project, a guide to which can be found in Appendix C.

Figure 5

Changes in Surface Parking Area on Block BAR*.45, Downtown Barrie UGC*



set of images. On the one hand, it is clear from Figure 6 that the parking lot associated with the former high school has definitely been removed and replaced by an area that, just as clearly, is not intended to be used for parking. On the other hand, this removal is only temporary, and the intended redevelopment will include some parking—142 surface parking spaces, according to the Concept Site Plan submitted on June 11, 2019 (Martin Simmons Architects, 2019). However, we cannot at this point say how much surface area this parking will occupy. It was therefore decided that the most prudent course of action would be to simply "exclude" the high school

Figure 6

Aerial Views of North End of Block BAR.45, Downtown Barrie UGC, in 2004 (Left) and 2019 (Right)

Note. Image on left from City of Barrie Aerial Imagery REST Services, copyright by City of Barrie (City of Barrie, 2004). Image on right from *Google Earth Pro*, copyright 2020 by Google (Google, 2020a).

parking lot, as it existed in 2004, from the overall calculations, so that this particular site would have no bearing on the final results one way or the other.

Vacant but accessible lots. In some cases, areas that had formerly been used for parking were observed as being vacant according to the more recent imagery. As a rule, vacant lots that had been rendered inaccessible for parking purposes (by the installation of fencing, the placement of concrete blocks, or other such barriers) were not considered to be parking lots for the purposes of this project. However, closer inspection of some vacant lots revealed that they were still technically accessible, contrary to initial observations, in which cases it was necessary to correct the data collected to exclude them.

Figure 7 shows aerial views of a site located on the southwesterly corner of block STC.17 in the Downtown St. Catharines UGC, both in 2006 (top image; Niagara Region, 2018a) and in 2018 (bottom image; Google, 2020b). In 2006, this site featured a large parking lot, designated STC17.P12, associated with what appears to have been some sort of employment use. (STC17.P12 consists of the paved area to the south and east of the building; the photograph is oriented so that the top of the image is north, roughly speaking.) The property appears to have been abandoned in the 2018 image, which is why this parking lot was initially identified as having been removed. However, the bottom image in Figure 7 shows that, although portions of the property have been surrounded by fencing, the section in the middle remains accessible from the street and is therefore still technically available for parking purposes. (Moreover, the overall configuration of the site appears to be unchanged.) Because part of the site is vacant but still accessible, the decision was made to “exclude” this particular parking lot from the final calculations, effectively changing it from a removal to “no change,” as the most prudent course of action.

Figure 7

Aerial Views of Parking Lot STC17.P12, Downtown St. Catharines UGC, in 2006 (Top) and 2018 (Bottom)

Note. Top image from Niagara Navigator, copyright 2018 by Regional Municipality of Niagara (Niagara Region, 2018a). Bottom image from *Google Earth Pro*, copyright 2020 by Google (Google, 2020b).

Parking lots situated across municipal boundaries. Some parking lots observed in the area of interest surrounding the Uptown Waterloo UGC were located across the municipal boundary Waterloo shares with the City of Kitchener (see Map 5 for the Uptown Waterloo UGC in Appendix E on p. 319). In these cases, only the portions situated within the City of Waterloo proper were included in the final area calculations.

Full details regarding all of the adjustments and corrections made to the initial results, including their effects on the calculation of areas, can be found in Appendix H. The need to make such adjustments could indicate a drawback of relying upon aerial photographs as the primary data source for this portion of the study. The results have been supplemented by publicly available information on development applications and projects from municipal websites, but future research using a similar methodology might benefit from more specific information regarding the extent of surface parking associated with development or redevelopment projects in progress (or regarding parking that existed prior to the earliest available images).

Change in area devoted to surface parking lots

Table 11 presents the overall results from the mapping phase of the project (after the adjustments and corrections listed in Appendix H have been made). The results are organized into three categories: (1) all parking lots on all blocks within the area of interest for each municipality; (2) the full area of any parking lots located at least partially within each UGC; and (3) the area devoted to parking located within the UGC (including only portions within the UGC for parking lots that lie across the UGC boundary). The values for Cambridge and for Hamilton do not show any difference across these three categories because all of the blocks in their areas of interest are situated entirely within the boundaries of their respective UGCs.

Table 11

Change in Surface Parking Area between 2006[a] and 2018[b]

Municipality	All parking lots				Parking lots fully or partially within UGC				Parking area within UGC			
	Total area in 2006[a]	Total area in 2018[b]	Change in area	Change as % of 2006[a] area	Total area in 2006[a]	Total area in 2018[b]	Change in area	Change as % of 2006[a] area	Total area in 2006[a]	Total area in 2018[b]	Change in area	Change as % of 2006[a] area
Barrie	550,175	546,105	−4,070	−0.7	361,030	344,715	−16,315	−4.5	318,905	298,685	−20,220	−6.3
Brantford	264,860	271,775	+6,915	+2.6	257,845	264,815	+6,970	+2.7	255,965	262,765	+6,800	+2.7
Burlington	321,685	313,735	−7,950	−2.5	268,545	261,965	−6,580	−2.4	254,330	248,375	−5,955	−2.3
Cambridge	90,450	85,795	−4,655	−5.1	90,450	85,765	−4,655	−5.1	90,450	85,795	−4,655	−5.1
Guelph	236,705	230,465	−6,240	−2.6	229,590	223,540	−6,050	−2.6	227,065	219,275	−7,790	−3.4
Hamilton	354,175	340,645	−13,530	−3.8	354,175	340,645	−13,530	−3.8	354,175	340,645	−13,530	−3.8
Kitchener	264,970	226,860	−38,110	−14.4	263,015	224,385	−38,630	−14.7	261,735	222,790	−38,945	−14.9
Milton	348,280	408,895	+60,615	+17.4	328,040	388,320	+60,280	+18.4	326,435	386,770	+60,335	+18.5
Oshawa	235,360	306,250	+70,890	+30.1	232,240	303,155	+70,915	+30.5	229,710	266,735	+37,025	+16.1
Peterborough	250,025	249,530	−505	−0.2	242,545	241,140	−1,403	−0.6	238,805	237,385	−1,420	−0.6
St. Catharines	283,655	271,965	−11,690	−4.1	246,650	264,820	−11,830	−4.3	275,230	263,485	−11,745	−4.3
Waterloo	231,270	235,670	+4,400	+1.9	209,720	213,830	+4,110	+2.0	202,648	207,083	+4,435	+2.2

Note. All area measurements are given in square metres [m^2] and rounded to the nearest multiple of five.

[a] Aerial photographs for Barrie dated 2004; aerial photographs for Burlington, Hamilton, and Oshawa dated December 30, 2005; aerial photographs for Peterborough dated May 5, 2005. [b] Aerial photographs for Barrie, dated 2016, complemented by ground survey conducted in August 2019.

The results for the total area ("All parking lots" in Table 11) show that only four of the twelve municipalities saw increases to the amount of surface parking in and around their Urban Growth Centres over the period in question. The greatest increase took place in Oshawa, which saw an overall increase of 70,890 m^2 between December 2005 and May 2018, which represents an increase of 30.1% when compared to the area devoted to parking in 2005 (area measurements have all been rounded to the nearest multiple of five). Any time a change in area is expressed as a percentage, the point of reference is the surface parking area observed within the area in question according to the earlier set of aerial images (dates can be found in Table 2 on p. 70). Milton also saw a significant increase over a similar timeframe, from 348,280 m^2 in December 2005 to 408,895 m^2 in June 2018, an increase of 60,615 m^2 that represents 17.4% of the 2005 parking area. The other two municipalities where surface parking area increased over the period in question, Brantford and Waterloo, saw relatively modest amounts of parking area added, at 2.6% (an increase of 6,915 m^2) for Brantford and 1.9% (an increase of 4,400 m^2) for Waterloo. The greatest decrease observed took place in Kitchener, where the area devoted to surface parking in the area of interest was reduced by 14.4% between 2006 and 2018. The other seven municipalities all saw modest decreases, ranging from –4.1% for St Catharines to –0.2% for Peterborough. (This last value represents essentially no change, once any margin for error is taken into consideration.)

If we narrow our focus to consider parking lots lying either fully or partially within each UGC (the middle set of columns in Table 11), we find that the same four municipalities (Brantford, Milton, Oshawa, and Waterloo) saw increases in the area devoted to surface parking. In fact, the increases are slightly greater when expressed as percentages of the earlier parking area. Meanwhile, the greatest decrease was still observed in Kitchener, with a reduction of 14.7%

(38,630 m^2) in the area of the parking lots located fully or partially within the Downtown Kitchener UGC. The fact that this decrease is slightly greater than the value of 38,110 m^2 observed for all parking lots in Kitchener's area of interest means that the parking lots situated entirely outside the Downtown Kitchener UGC (but still within the area of interest) actually underwent a small *increase* in overall area over this timeframe. The remaining seven municipalities show a slightly wider range than that observed for the change in total area, from Cambridge at –5.1% to Peterborough at –0.6%. We find similar results again if we narrow our focus even further to consider just the area devoted to surface parking within the boundaries of each Urban Growth Centre. The same four municipalities saw increases in area, while the greatest decrease (–14.9%) is once again found in Kitchener, with a yet wider range of values for the other seven municipalities (from Barrie at –6.3% to Peterborough at –0.6%).

If we express these results as the percentage of each UGC's total area, as in Table 12, we encounter the eye-opening fact that, in 2018, eleven of the twelve municipalities in the project sample devoted something between one sixth and one quarter of their UGC area to surface parking. (The lone exception, Milton, actually exceeded the one-quarter mark, with 28.2% of its UGC given over to parking.) Guelph had the smallest percentage, with 18.3% of its UGC occupied by surface parking in 2018, followed by Barrie at 19.1%. The remaining nine all sit somewhere between 20% and 25%. Also noteworthy is the fact that, if we add up the surface parking located within all twelve UGCs, we find that the total amount actually increased by 0.43 hectares between 2005/2006 and 2018.

Table 12

Percentage of Urban Growth Centre (UGC) Area Used for Parking, 2006[a] and 2018[b]

Municipality	Area of UGC [ha]	Parking area within UGC, 2006[a] [ha]	Parking area within UGC, 2018[b] [ha]	Parking area within UGC as % of UGC area, 2006[a]	Parking area within UGC as % of UGC area, 2018[b]
Barrie	156.13	31.89	29.87	20.4	19.1
Brantford	131.89	25.60	26.28	19.4	19.9
Burlington	106.02	25.43	24.84	24.0	23.4
Cambridge	41.35	9.04	8.58	21.9	20.7
Guelph	119.97	22.71	21.93	18.9	18.3
Hamilton	159.00	35.42	34.06	22.3	21.4
Kitchener	110.16	26.17	22.28	23.8	20.2
Milton	137.26	32.64	38.68	23.8	28.2
Oshawa	106.54	22.97	26.67	21.6	25.0
Peterborough	98.36	23.88	23.74	24.3	24.1
St. Catharines	109.72	27.52	26.35	25.1	24.0
Waterloo	89.12	20.26	20.71	22.7	23.2
Totals	1,365.52	303.55	303.98	22.2	22.3

[a] Aerial photographs for Barrie dated 2004; aerial photographs for Burlington, Hamilton, Milton, and Oshawa dated December 30, 2005; aerial photographs for Peterborough dated May 5, 2005. [b] Aerial photographs for Barrie, dated 2016, complemented by ground survey conducted in August 2019.

Distribution of changes across each area of interest

The area measurements generated in QGIS for the mapping phase data were also used to calculate the net change on each individual block. By logical necessity, each block falls into one of three categories: (1) blocks on which the area devoted to surface parking saw a net increase between 2005/2006 and 2018; (2) blocks on which the area devoted to parking saw a net decrease; and (3) blocks that saw no overall net change one way or the other. Considering net change at the block level provides a helpful way of visualizing how changes in the area devoted to surface parking were distributed across each municipality's area of interest. This was done by determining the total "net block-level area" added within the area of interest, obtained by taking the sum of the net change on all blocks that saw net increases in parking area, as well as the total net block-level area removed, similarly obtained by taking the sum of the net change on the blocks that saw net decreases. Each block's share of the overall net block-level area (NBLA) added or removed was then expressed as a percentage of the appropriate total and represented using a circle whose size is proportional to that percentage.[10]

To illustrate, Figure 8 shows the resulting map for the Downtown Cambridge UGC (using green to indicate net increases and magenta for net decreases), with the corresponding numerical values listed in Table 13. (Cambridge has been chosen as an example because it has the fewest number of blocks out of the twelve municipalities.) Table 13 shows both the net block-level area (NBLA) added or removed on each block as well as that block's share of the appropriate total. As this table shows—and as can be seen from the size of the circles in Figure 8—the greatest share of NBLA removed took place on block CAM.18, which went from 3,915 m^2 of parking in 2006 to just 340 m^2 in 2018, a net decrease of 3,575 m^2 that represents 64.1% of the overall NBLA removed. (Again, the overall NBLA is simply the sum of the net area removed on the eleven blocks that saw net decreases between 2006 and 2018). Meanwhile, the greatest share of NBLA added took place on block CAM.22, a bit to the south of CAM.18, where the net addition of 350 m^2 of surface parking represents 37.9% of the overall NBLA added, a total of 920 m^2 across seven blocks. It is worth pointing out that the size of each circle is proportional to

[10] More precisely, the apparent size of each circle, using Flannery scaling, is directly proportional to the block's share of NBLA added or removed, expressed as a percentage of the appropriate total.

Figure 8

Distribution of Net Block-Level Changes in Downtown Cambridge UGC

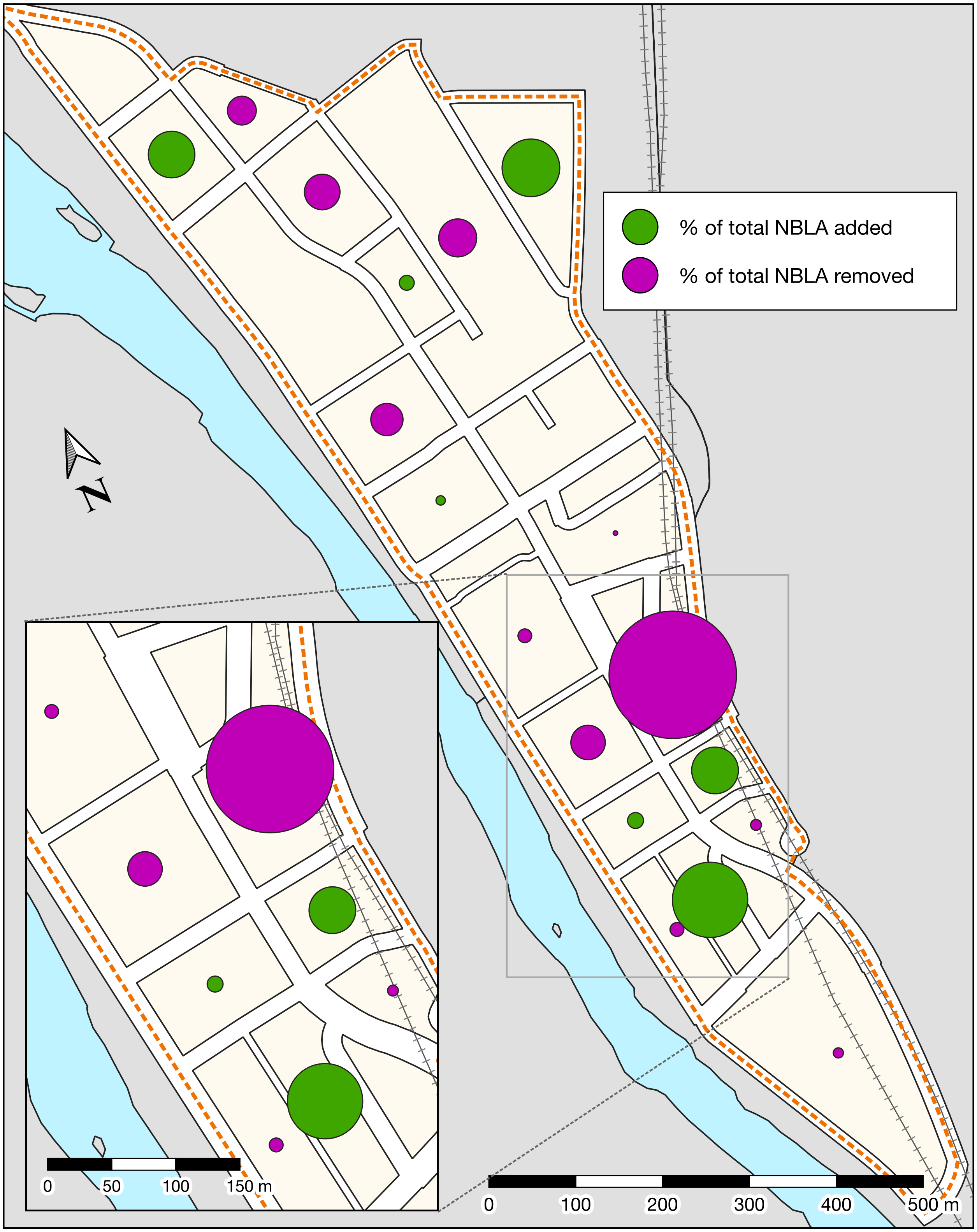


Table 13

Net Block-Level Change in Parking Area Between 2006 and 2018 in Downtown Cambridge UGC

Block ID	Total parking area on block in 2006 [m^2]	Total parking area on block in 2018 [m^2]	NBLA added [m^2]	% of total NBLA	NBLA removed [m^2]	% of total NBLA
CAM.01	2,390	2,390	--	--	--	--
CAM.02	3,930	4,080	+150	16.3	--	--
CAM.03	2,525	2,260	--	--	–265	4.7
CAM.04	11,680	11,680	--	--	--	--
CAM.05	5,765	5,445	--	--	–320	5.7
CAM.06	3,945	3,560	--	--	–380	6.8
CAM.07	1,565	1,585	+20	2.2	--	--
CAM.08	6,825	6,400	--	--	–425	7.7
CAM.09	5,380	5,600	+220	23.7	--	--
CAM.10	2,875	2,880	+10	1.0	--	--
CAM.11	2,595	2,595	--	--	--	--
CAM.12	0	0	--	--	--	--
CAM.13	7,930	7,920	--	--	–10	0.2
CAM.14	1,175	1,175	--	--	--	--
CAM.15	8,520	8,445	--	--	–70	1.3
CAM.16	4,815	4,455	--	--	–360	6.5
CAM.17	0	0	--	--	--	--
CAM.18	3,915	340	--	--	–3,575	64.1
CAM.19	1,720	1,745	+25	2.5	--	--
CAM.20	1,240	1,390	+150	16.4	--	--
CAM.21	2,405	2,330	--	--	–75	1.3
CAM.22	1,470	1,820	+350	37.9	--	--
CAM.23	2,085	2,085	--	--	--	--
CAM.24	150	100	--	--	–50	0.9
CAM.25	5,560	5,515	--	--	–40	0.8
Totals	90,450	85,795	+920	100.0	–5,575	100.0

Note. Area measurements have all been rounded to the nearest multiple of five. Totals may not add up exactly due to rounding.

the *percentage* of the total NBLA added or removed, and not to the area measurement itself, which is why CAM.22's circle is a little more than half the size of CAM.18's (37.9% versus 64.1%, and *not* 350 m^2 versus 3,575 m^2).

One thing worth noting with respect to the changes observed in the Downtown Cambridge UGC is the relatively small areas that are associated with large shares of the overall net block-level changes, particularly with respect to the NBLA added. The net increase of only 350 m^2 on CAM.22, for instance, represents over one third (37.9%) of the total NBLA added. The bulk of the increase on CAM.22 is associated with changes on the south end of the block, where a handful of smaller buildings and two parking lots (designated CAM22.P06 and CAM22.P07) were removed between 2006 and 2018 to accommodate the expansion of parking lot CAM22.P04. (This block can be found on Map 2 for Cambridge in Appendix E, on p. 281.) Meanwhile, the majority of the net decrease on CAM.18 was due to changes on one property, featuring a one- or two-storey building that in 2006 appears to have been used for commercial or employment purposes. By 2018, this property appears to fallen out of use, and the 3,130 m^2 previously used for parking (designated CAM18.P02) has been fenced off.

Because it was inaccessible for parking purposes in 2018, CAM18.P02 was included in the final calculations as a "legitimate" removal. More recent information, however, suggests that the property is once again in use (for commercial recreation purposes, according to information from Google Maps), with little to no discernible changes having been made to the extent of the previous parking lot. If, to reflect this fact, we were to categorize CAM18.P02 as "no change" instead of a removal, then the NBLA removed on its block changes to a net decrease of 445 m^2, which would be 18.2% of the new total NBLA removed of 2,445 m^2. Likewise, the overall change observed in the whole UGC between 2006 and 2018 would fall to –1,525 m^2, which is only –1.7% with respect to the 2006 area (instead of the original –5.1%).

Of course, CAM18.P02 was included in the final results because, as stated earlier, the aerial images from 2018 showed it as a “legitimate” removal, and to exclude it from the calculations or categorize it as “no change” would be inconsistent with the methodology used for mapping phase data collection in the other eleven areas of interest. However, this situation does raise an important caveat regarding Cambridge’s results: because the Downtown Cambridge UGC covers such a small area (about 41.4 hectares), and because no blocks outside the UGC were included in Cambridge’s area of interest, relatively small changes in area become “amplified” when expressed as percentages.

Maps showing the distribution of net block-level changes across all twelve areas of interest can be found in Appendix I. These maps have been included primarily to help visualize the overall change that occurred in each Urban Growth Centre (as opposed to the more finely focused parking maps found in Appendix E). While there do not appear to be any general overall patterns to the distribution of parking change, certain tendencies can be observed in some of the sample municipalities:

- *Guelph:* Blocks with greater net reductions in area tend to be located more centrally along a “spine” defined by the railway line passing through Downtown Guelph.
- *Kitchener:* A sizeable portion of the net block-level decreases in parking area can be found on the formerly industrial blocks situated along the railway at the northeastern end of the Downtown Kitchener UGC. Significant reductions also took place in the Civic District near the UGC’s east end.

- *Milton:* Most of the net block-level increases to parking area took place outside Downtown Milton proper, on the larger blocks located to the east and the south of the UGC.
- *Oshawa:* The largest net block-level decreases tend to be more centrally located with respect to the Downtown Oshawa UGC.
- *Peterborough:* A large share of the changes observed—both net block-level increases and decreases—took place on the blocks located along the Downtown Peterborough UGC's western boundary.
- *Waterloo:* Net block-level increases tend to be more peripherally located with respect to the Uptown Waterloo UGC, with net decreases occurring along a central "spine" provided by King and Caroline Streets and near the LRT line.

Blocks with greatest share of net block-level area added

Another benefit to considering net changes at the block level is that it allows us to quickly identify where significant changes occurred within each area of interest. One important observation to be made here is that, in each municipality, the majority of the net block-level area (NBLA) added and NBLA removed occurred on only a handful of blocks. This may not be entirely surprising, given the relatively short timeframe involved in this project, but it nonetheless raises a number of important points, which will be summarized here and taken up more extensively in the Discussion.

For all twelve municipalities, the majority of the NBLA added between 2005/2006 and 2018 is located on five or fewer blocks. Indeed, for five of the twelve, more than half of the total NBLA added can be found on a single block. In descending order (by percentage of total NBLA added on the block in question), these municipalities are Oshawa (72.0% on OSH.12), Waterloo

(67.4% on WAT.01), Milton (67.3% on MLN.30), Brantford (65.2% on BNF.68), and Guelph (61.1% on GUE.47). The net increase on block WAT.01 in Waterloo is mostly associated with high-rise residential development on the northern portion of the block (a net increase of 9,035 m^2) and with the construction of a hotel on the southern portion (a net increase of 6,210 m^2). For the other four (Brantford, Guelph, Milton, and Oshawa), the net increase is associated with the establishment of large retail centres or "power" centres, which combined to produce an increase of 117,220 m^2 in surface parking area. (Block BNF.68 in Brantford saw an additional 2,780 m^2 net increase from the construction of an office building on the southern half of the block.)

In the remaining seven municipalities, more than half of the overall NBLA added is found on more than one block (but still on five blocks or fewer). Most of the increases on the blocks with the greatest individual share are associated with just one or two development projects. Again, this may not be surprising, as the project's timeframe provided a relatively short period for development to take place, but it does speak to the importance of larger development projects when it comes to changes in the overall area devoted to surface parking.

This observation holds if we expand our focus to encompass the top three blocks (in terms of share of NBLA added) from the twelve municipalities in the project sample. Table 14 presents the land uses associated with the largest net increases in surface parking area on these blocks. (In the interests of saving space, this table has been limited to those land uses associated with net increases of more than 2,000 m^2.) The greatest net increase by far is associated with the four power centres discussed above. Public parking in six different municipalities accounts for the second largest net increase on the top three blocks (by NBLA added); parking associated with the GO regional transit stations in Barrie and Milton accounts for an additional net increase

Table 14

Land Uses and Associated Net Change in Parking Area on Blocks Ranking in Top Three According to Share of NBLA Added

Land use	Net change associated with use [m^2]	Municipalities where land use occurs on blocks in top three by share of NBLA added
Shopping/retail centre	+117,220	Brantford, Guelph, Milton, Oshawa
Public parking	+24,995	Barrie, Brantford, Burlington, Guelph, Oshawa, Waterloo
Regional transit station	+12,095	Barrie, Milton
High-rise residential	+11,570	Burlington, Hamilton, Waterloo
Office uses (general & medical/dental)	+7,115	Brantford, Hamilton, Kitchener, Milton, Waterloo
Parking lot (as primary use)	+6,580	Barrie, Peterborough, St. Catharines
Hotel	+6,210	Waterloo
Long-term care facility	+3,385	Milton
Police & emergency services	+2,545	Milton, Peterborough

Note. All area measurements rounded to the nearest multiple of five. Table only includes land uses where total net change on top three blocks ≥ +2,000 m^2.

of 12,095 m^2, divided almost evenly between the two—6,065 m^2 in Milton and 6,030 m^2 in Barrie. (These figures include public parking for transit users as well as parking areas for service vehicles.)

Blocks with greatest share of net block-level area removed

Net block-level decreases in parking area are a bit more spread out across the municipalities in the project sample, although eleven out of the twelve have five or fewer blocks that account for over 50% of the total NBLA removed. (The one exception is Hamilton, where it takes the top seven blocks, with a combined share of 52.3%, to eclipse the halfway mark.) Only two—Burlington and Cambridge—saw more than half of the total NBLA removed take place on a single block. Block CAM.18, which accounts for 64.1% of Cambridge's total NBLA removed, has already been discussed. Burlington's BRL.46 saw a net block-level decrease of 11,105 m^2, which represents 57.3% of the total NBLA removed. Almost all of the decrease on BRL.46 is associated with the expansion of Joseph Brant Hospital and the construction of the neighbouring McMaster Halton Family Health Centre. The hospital expansion occurred on lands previously occupied by surface parking, which was replaced with some smaller surface lots as well as a parking structure attached to the McMaster Centre, resulting in a decrease of 11,325 m^2. (An OPP station northwest of the hospital site accounts for a decrease of 15 m^2, offset by an increase of 235 m^2 associated with an employment use further to the south.)

If we once again expand our focus to include the top three blocks by share of NBLA removed in each municipality, we find a slightly greater variety of land uses than we saw associated with large net increases (see Table 15, which uses the same arbitrary cut-off point as Table 14 of 2,000 m^2). There are a few things to note when looking at Table 15. The first is that the land use associated with the greatest overall net decrease is, in fact, no use at all: between 2005/2006 and 2018, a combined total of 25,600 m^2 of parking (on the top three blocks by share of net block-level area removed) was replaced by vacant land—a figure that includes properties that appear to have been abandoned, but that does *not* include vacant lots that are still technically accessible for parking purposes. This is more than twice the net decrease of 12,475 m^2 (which ranks second in Table 15) associated with high-rise residential and mixed-use developments in Guelph, Hamilton, and Waterloo. It is striking that so much land in and around these Urban Growth Centres—land that presumably should be in high demand—is going unused.

Table 15

Land Uses and Associated Net Change in Parking Area on Blocks Ranking in Top Three According to Share of NBLA Removed

Land use	Net change associated with use [m^2]	Municipalities where land use occurs on blocks in top 3 by share of NBLA removed
Vacant land	−25,600	Barrie, Brantford, Burlington, Cambridge, Kitchener, Oshawa, Peterborough, St. Catharines
High-rise residential/mixed use	−12,475	**Guelph**, **Hamilton**, **Waterloo**
Hospital/health centre	−11,325	**Burlington**
Courthouse	−11,320	**Kitchener**
Office (general)	−9,215	Barrie, Guelph, **Kitchener**, Oshawa, St. Catharines, Waterloo
Arena	−8,465	Milton, Oshawa, St. Catharines
Commercial (general)	−8,315	Brantford, Guelph, Hamilton, Milton, Peterborough, St. Catharines
University	−7,485	Brantford, Kitchener, St. Catharines
Shopping centre	−6,070	Barrie, Burlington, Waterloo
Hotel	−4,205	**Hamilton**, **Oshawa**
Police & emergency services	−4,180	Barrie, Burlington
Mid-rise residential/mixed use	−3,010	Guelph, **Hamilton**, Milton
Public parking	−2,345	Barrie, Cambridge, Guelph, **Kitchener**
Employment uses (general)	−2,300	Kitchener
Performing arts centre	−2,230	St. Catharines
Library	−2,020	**Kitchener**

Note. All area measurements rounded to the nearest multiple of five. Table only includes land uses where total net change on top three blocks $\leq -2{,}000$ m^2. A municipality's name appearing in bold indicates that some surface parking associated with the use has been replaced by underground parking or structured parking.

A second observation to be made is that a number of the land uses listed in Table 15 also appear in Table 14. Indeed, four of the land uses associated with the five greatest net increases in Table 14—shopping centre, public parking, high-rise residential, and office uses—also appear somewhere in Table 15, where they combine for a decrease of 30,105 m^2 across nine municipalities. This suggests that the land use associated with the parking may not itself be the crucial factor, and that location and connections to other modes of travel—and other forms of parking—may play important roles. This brings us to the third important point, which is that the overall decreases in *surface* parking area listed in Table 15 have in some cases been offset by the establishment of other forms of parking. Municipalities where this has occurred appear in bold in the third column of the table. Of these, only Burlington represents the construction of a parking structure; the rest have all seen surface parking replaced with underground parking garages.

Changes in surface parking within exemption areas

Five of the twelve municipalities in the project sample define a specific area in their zoning by-laws in which at least some land uses are completely exempt from minimum parking requirements (MPRs). The five municipalities, along with the nature of their exemption areas, are as follows:

- Brantford: Three defined areas, consisting of a small central area (“Area 3”) within which all land uses are exempt from MPRs, surrounded by two larger areas within which all uses are permitted a 50% reduction (“Area 1”) or a 25% reduction (“Area 2”) in the minimum number of parking spaces required (City of Brantford, n.d., p. 6-20 [Sections 6.18.7.2–6.18.7.4]).

- Burlington: An area covering a sizeable portion of Downtown Burlington, within which all non-residential uses are exempt from normal parking requirements (City of Burlington, 2017a, p. 39 [Section 2.25.1]).[11]
- Cambridge: Three defined areas, one in each of the City's town centres (Galt City Centre, Hespeler Village, and Preston Town Centre), each consisting of a central area within which the provision of off-street parking and loading spaces is not required and a surrounding area within which the required number of spaces for non-residential uses is reduced by 25% and within which residential visitor parking does not need to be provided (City of Cambridge, 2012, p. 73 [Section 2.2.2.9]). The Galt City Centre exemption area is located within the Downtown Cambridge UGC.
- Oshawa: An extensive defined area covering a sizeable portion of the Downtown Oshawa UGC, within which parking requirements do not apply to "any building or structure" (City of Oshawa, 2019b, p. 39.11 [Section 39.10]).
- Peterborough: A defined area ("Area 1"), encompassing most of the Downtown Peterborough UGC, within which no parking spaces are required for the first four dwelling units "located on any lot in a commercial land use district" (City of Peterborough, 2019, Section 4.2.B(i)). The by-law also delineates a sub-area within Area 1 within which parking spaces are not required "in connection with any non-residential use of any property," so long as the use was permitted as of January 1, 1995, and is undertaken in a building that existed on that date; if however the building has been expanded since then, "the parking requirements provided in this by-law shall

[11] The specific regulation in the City of Burlington's zoning by-law is worded rather awkwardly: "Whenever a new development occurs or whenever an existing development is enlarged, extended or increased in capacity, in accordance with this By-law, off-street vehicle parking spaces shall be provided and maintained on the property and within the zone designation for all uses, except, within the 'Downtown Parking Exemption Area' shown on Diagram 1A, Subsection 2.25 shall only apply to residential uses" (City of Burlington, 2017a, p. 39).

apply to the expanded portion of such building" (City of Peterborough, 2019, Section 4.2.1).

Table 16 shows the changes that took place within these exemption areas between 2005/2006 and 2018 (for parking lots located partially within the exemption areas, only the portion within the area boundaries has been included), as well as the changes to parking lots located entirely outside the exemption area boundaries. One detail that immediately stands out is that the area devoted to surface parking within the boundaries of each exemption area decreased, regardless of the changes observed over the municipality's entire "area of interest."

Brantford has the smallest of the five exemption areas considered: its fully exempt Area 3 covers a little less than four blocks in Downtown Brantford (Fig. 9, on p. 129). Thus, while there was an almost 50% decrease in surface parking within this area between 2006 and 2018, this particular exemption area is too small for us to be able to say anything conclusively. This is the main reason why Table 16 includes the two areas with reduced minimum requirements: Area 1, which almost entirely surrounds Area 3 and in which parking requirements are reduced by 50%; and Area 2, which is divided into two separate portions, within each of which parking requirements are reduced by 25%. The area devoted to surface parking in Area 1 decreased by 2.8% between 2006 and 2018 (from 43,230 m^2 to 42,020 m^2, a decrease of 1,210 m^2), while Area 2 saw parking area decrease by a negligible amount (only 30 m^2, from 66,815 m^2 in 2006 to 66,785 m^2 in 2018). However, an interesting contrast emerges when we consider the two portions of Area 2 separately: the portion located north of downtown Brantford saw a decrease of 260 m^2, whereas the southern portion actually saw an increase of 230 m^2, most of it due to the expansion of the parking lot associated with the Brantford Farmers' Market. (The parking lot in question is located on the eastern end of block BNF.64, near the bottom right corner of Figure 9.

Table 16

Changes in Surface Parking Area Within, and Outside of, Exemption Areas, 2006[a]–2018

		Area used for surface parking within exemption area				Parking lots located entirely outside exemption area			
Municipality	Area of exemption area	Parking area in 2006[a]	Parking area in 2018	Change in parking area	Change as % of 2006 area	Parking area in 2006[a]	Parking area in 2018	Change in parking area	Change as % of 2006 area
Brantford (*Area 3 only*)	40,805	1,765	900	−865	−48.9	263,095	270,875	+7,780	+3.0
Brantford (*Areas 1–3*)[b]	516,505	111,815	109,705	−2,105	−1.9	104,985	105,510	+520	+0.5
Burlington	452,535	97,945	94,825	−3,120	−3.2	219,040	214,245	−4,795	−2.2
Cambridge	127,055	26,835	26,325	−510	−1.9	58,675	54,670	−4,010	−6.8
Oshawa	505,560	106,915	106,200	−715	−0.7	125,075	196,535	+71,460	+57.1
Peterborough (*Exempt Sub-area*)[c]	447,870	103,000	98,240	−4,760	−4.6	137,045	141,700	+4,655	+3.4

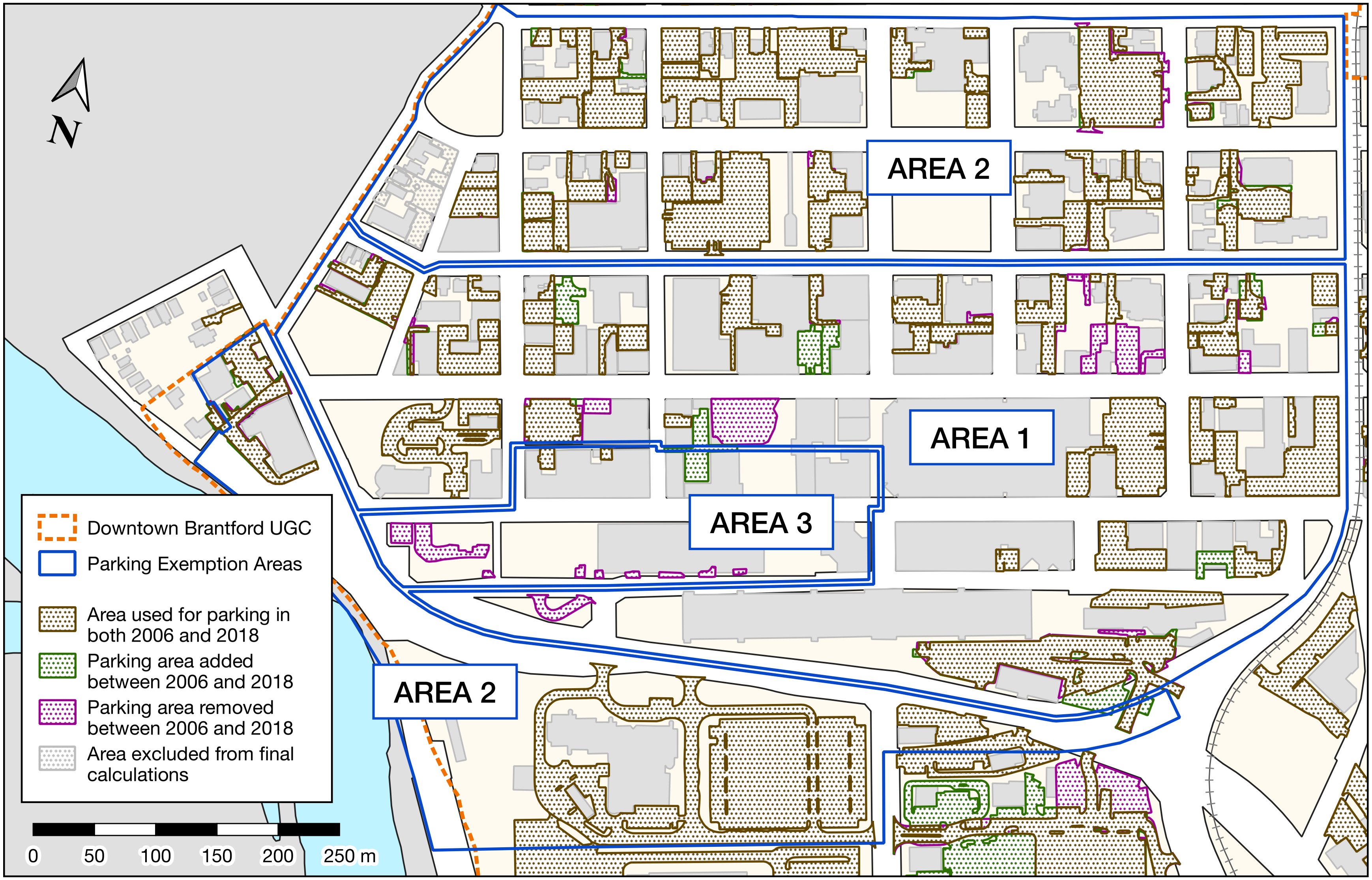
Note. All area measurements are given in square metres [m^2] and rounded to the nearest multiple of five.

[a] Aerial photographs for Burlington and Oshawa dated December 30, 2005; aerial photographs for Peterborough dated May 5, 2005. [b] Brantford's Area 3 grants a full exemption from parking requirements. Areas 1 and 2 permit a 50% reduction and a 25% reduction, respectively, in minimum parking requirements.

[c] Portion of "Area 1" ("Regional Centre/C.B.D. Area") within which non-residential uses are exempt from parking requirements, subject to certain restrictions.

Figure 9

Changes to Parking in Exemption Areas between 2006 and 2018, Downtown Brantford UGC



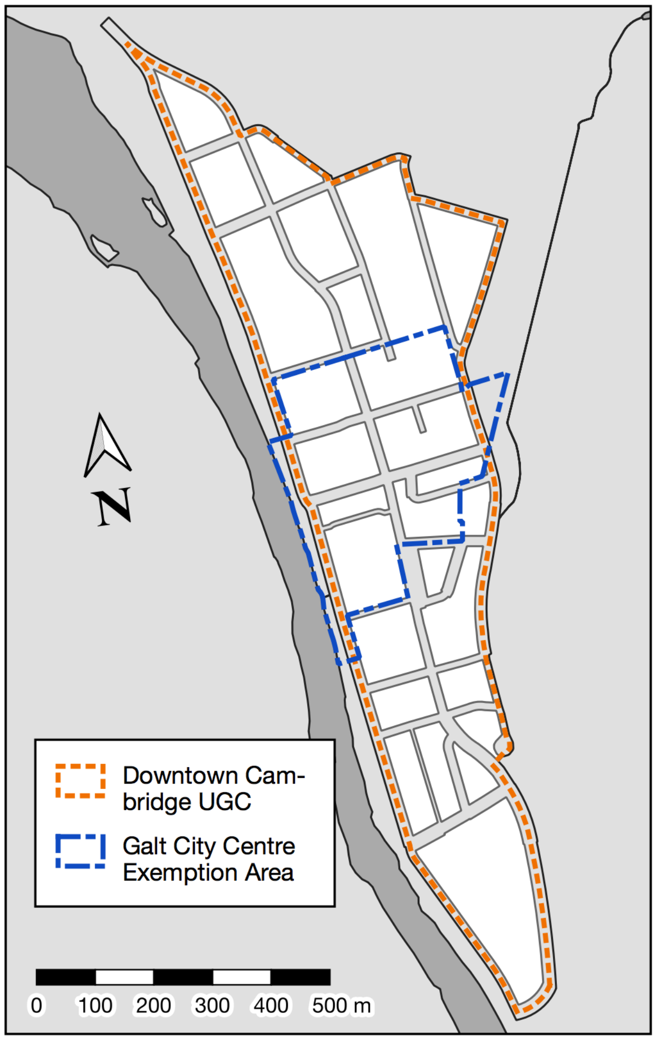
Interestingly, the bulk of this parking area is actually located within Area 1, with a small portion extending into the thin strip of Area 2 just to the south.) The southern portion of Area 2 also includes the northern tip of block BNF.68, the block that saw the greatest net increase. As Figure 9 shows, none of this increase took place within Area 2 itself; however, significant amounts of parking were added immediately to the south.

Similar to Brantford, the exemption area located within the Downtown Cambridge UGC (Fig. 10) consists of a smaller central area, within which land uses are fully exempt from parking requirements, surrounded by another area within which parking requirements are reduced. (This reduced requirement area covers most of the Downtown Cambridge UGC, except for small portions of blocks CAM.08 and CAM.09 at the northeastern corner, and actually extends well beyond the UGC to the west, north, and east.) The Galt City Centre exemption area, which covers five entire blocks within the UGC and portions of another two, saw a modest decrease in surface parking, just under two percent between 2006 and 2018. (This decrease does not include the small portion of the exemption area that extends outside the UGC to the east.) Cambridge's exemption area also represents the only instance of the five where the decrease that took place outside the exemption area was greater (in terms of percentages) than the decrease within the exemption area boundaries.

Burlington and Peterborough permit more limited exemptions within their respective areas—both exempt non-residential uses from parking requirements, as opposed to all land uses. (Peterborough's zoning by-law includes some additional provisos regarding the land use and building, as mentioned in the list above.) The area devoted to parking within Peterborough's exemption area (the shaded portion in Figure 11) decreased by 4.6% between 2005 and 2018, which contrasts somewhat with the negligible change (a decrease of just 0.2%) observed across

Figure 10

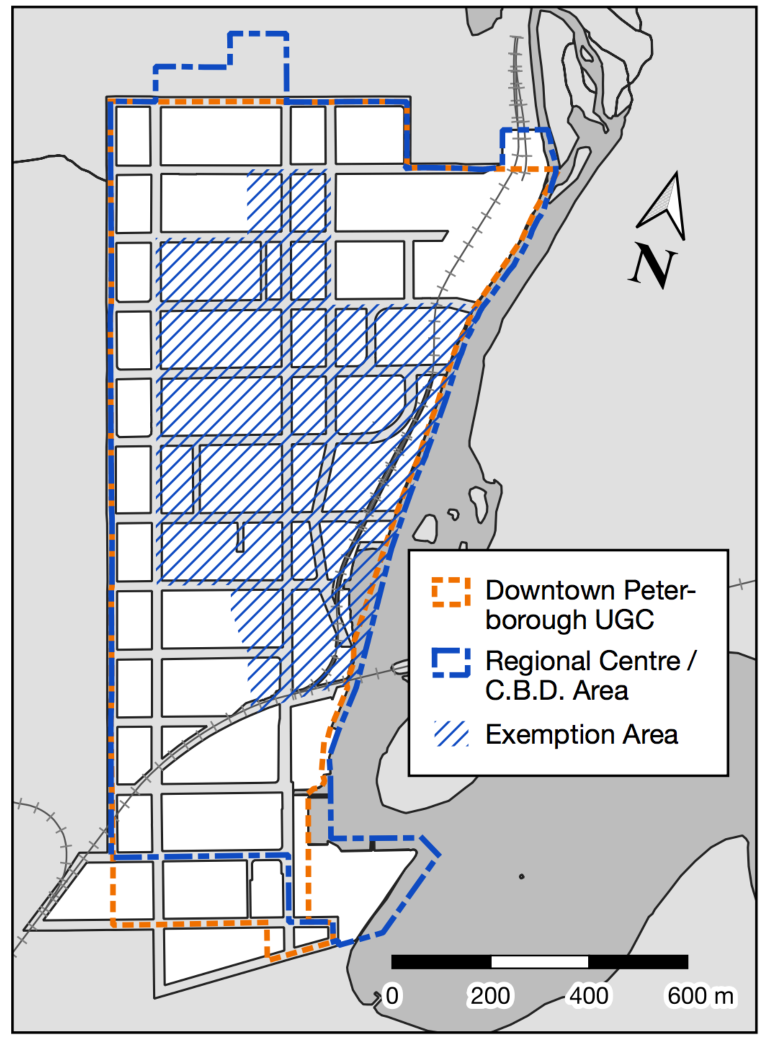
Galt City Centre Exemption Area (Cambridge)



Source: (City of Cambridge, 2012, p. 434 [Map Z4])

Figure 11

Downtown Peterborough Exemption Area



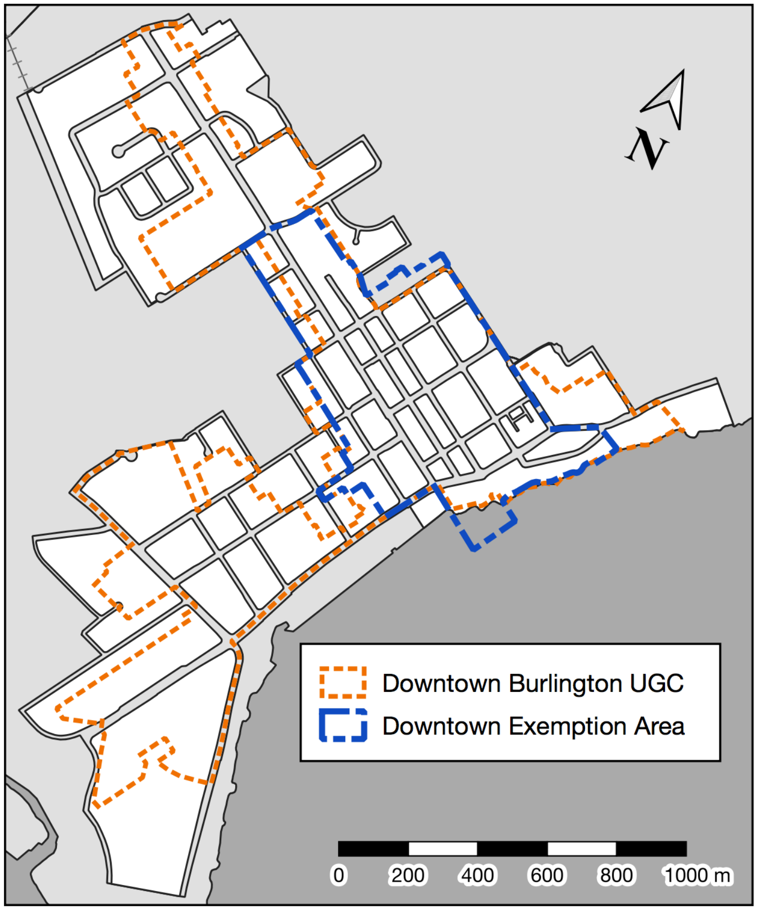
Source: (City of Peterborough, 2019, Schedule E(2)) the entire “area of interest.”[12] It is interesting to note that the five blocks that fall outside the larger “Area 1” (which permits a more limited exemption, with zero parking spaces being required for the first four dwelling units on a lot within a commercial land use designation), located at the southwest corner of the area of interest, saw an 8.5% increase between 2005 and 2018 (an increase of 1,370 m^2, from 16,040 m^2 to 17,405 m^2), which also contrasts starkly with the changes observed for Peterborough both overall and within the exemption area. As was the case with Brantford’s Area 3, however, these five blocks cover too small an area for us to be able to say anything conclusive. Meanwhile, Burlington’s Downtown Exemption Area (Fig. 12) saw a decrease of 3.2% between 2005 and 2018, slightly greater than the 2.5% decrease observed across Burlington’s entire area of interest.

Finally, Oshawa’s exemption area (Fig. 13)—which covers the greatest area of the five—presents us with perhaps the most dramatic contrast, when compared to the changes observed overall. Whereas the area devoted to surface parking across Oshawa’s entire area of interest increased dramatically, by just over 30%, between 2005 and 2018, the parking area within the exemption area actually saw a slight decrease of 0.7%. (By simple subtraction, this means that the parking lots located entirely outside this exemption area increased by an eye-opening 57.1% over the same timeframe, as shown in the right-hand columns in Table 16.) The dramatic contrast between the change in Oshawa’s exemption area and the change observed both overall and within the Downtown Oshawa UGC are perhaps the most suggestive when it comes to the possible effectiveness of exemption areas in reducing the amount of surface parking.

[12] The area devoted to surface parking within both the UGC and the boundaries of “Area 1” shown in Figure 11 decreased by just 0.8%, from 233,985 m^2 in 2005 to 232,120 m^2 in 2018. This larger area has been omitted from Table 16, both because it encompasses most of the Downtown Peterborough UGC and because the numbers presented here do not include the portion of “Area 1” that extends outside the UGC to the north.

Figure 12

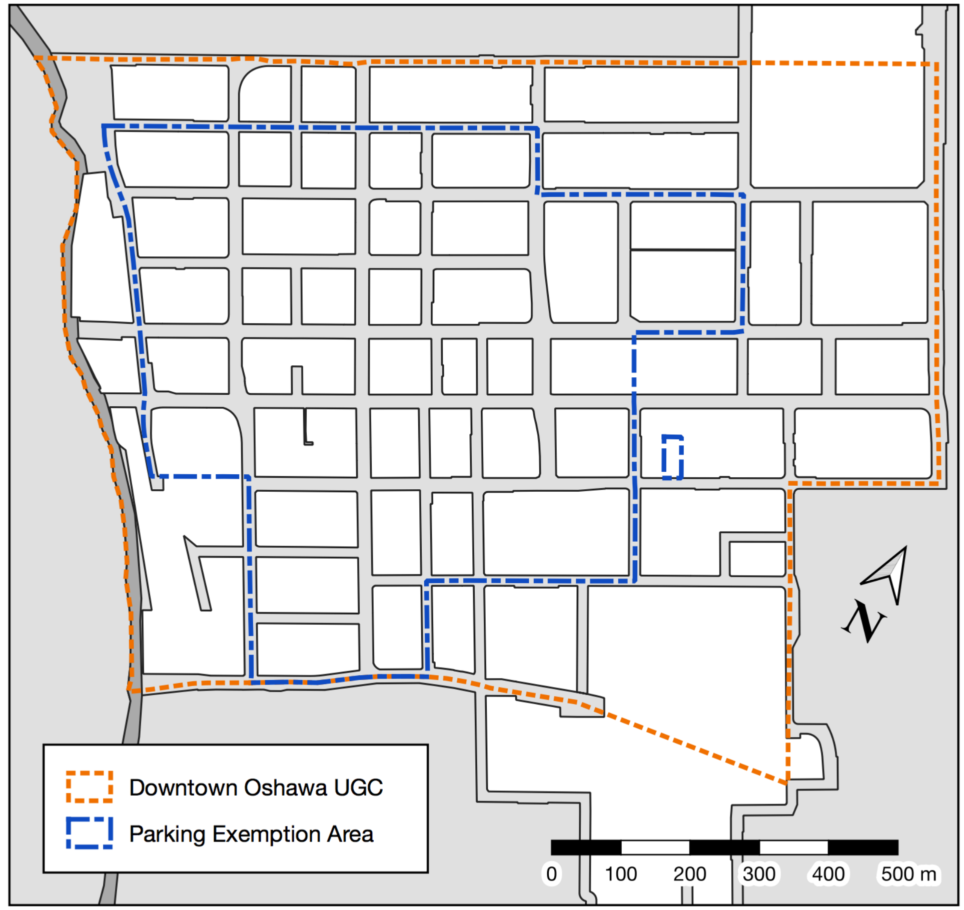
Downtown Burlington Exemption Area



Source: (City of Burlington, 2017a, p. 42 [Diagram 1A])

Figure 13

Downtown Oshawa Exemption Area



Source: (City of Oshawa, 2019b, Schedule "D")

Discussion points from mapping phase results

Our initial look at the results from the mapping phase of the project has raised a number of points that will be taken up again in the Discussion:

- In most of the sample municipalities, larger-scale development projects account for significant shares of both increases and decreases to surface parking area.
- Retail centres/"power centres" by far account for the greatest overall increases in surface parking area observed. Large net increases are also associated with public parking facilities, regional transit stations, and high-rise residential developments.
- Many of the land uses associated with the greatest net increases in surface parking area can also be found alongside the greatest net decreases, suggesting that land use on its own is not the sole factor dictating the area devoted to surface parking associated with a development.
- A significant portion of the parking area removed has been replaced by vacant lands and abandoned properties.
- A number of municipalities have seen decreases in surface parking occur alongside the establishment of other forms of parking, particularly underground parking.
- There is some evidence to suggest that establishing an exemption area may be an effective way of decreasing the amount of surface parking, at least within the boundaries of that area itself.

Policy analysis results

The policy analysis phase of the project involved the assignment of tier values to each municipality for various aspects of parking policy, based on the questions and tier descriptions presented in Tables 5, 7, and 9 (pp. 83–84, p. 88, and pp. 91–92, respectively). Tier values were then used to calculate each municipality's position along each of the three axes (geographic, economic, and attitudinal) derived from Barter's (2015) typology, with axial position calculated simply by taking the weighted average of the tier values for categories under that axis. Taken together, each municipality's axial positions provide three "coordinates" that were used to generate a three-dimensional plot of municipal policy positions.

This section focuses on the assignment of tier values for the various categories. Tier values provide not only the "inputs" for the calculation of overall policy positions, but also represent important characterizations of each municipality's "mindset" regarding diverse aspects of parking policy. The tier values and descriptions have also provided the basis for the qualitative characterizations presented in Table 21 (see p. 154). In some cases, it was considered appropriate to introduce finer gradations into the tier structure by using increments of 0.5. The following subsections provide an explanation of these situations, as well as a general rationale for various tier assignments. (The full comparison matrix can be found in Appendix F.)

Assignment of tier values: Geographic axis

Tiers for the categories under the geographic axis were assigned values so that a lower tier number represents a more site-focused mindset, with higher values moving towards more area management–oriented approaches. Table 17 summarizes the tier descriptions, with their associated values in parentheses, assigned for the categories along this axis. All twelve zoning by-laws contain a provision stating that the required parking spaces for any use shall be provided on the same lot as the use itself, and so all twelve have been assigned to tier 1 ("yes") for the "on-site parking" category.

Off-site parking. Barrie's is the only zoning by-law that does not contemplate the provision of required parking on a different site, which is why it has been given a tier value of 1.

Table 17

Tier Descriptions and Values: Geographic Axis

	Tier descriptions and values per municipality											
Category	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
On-site parking	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
Off-site parking	Not willing to permit (1)	May permit in some cases (4)	May permit on ltd. basis (2)	May permit in some cases (4)	May permit on smwt. ltd. basis (3)	May permit in some cases (4)	May permit in some cases (4)	May permit on smwt. ltd. basis (3)	May permit on ltd. basis (2)	May permit on ltd. basis (2)	May permit in many cases (5)	May permit in some cases (4)
Exemption area	Exmp'n for certain uses in area (2)	Exmp'n for all uses in area, red'n in surround-ing area (5)	Exmp'n for non-resid'l uses in area (3)	Exmp'n for all uses in area, red'n in surround-ing area (5)	Modified req'mts for central area (1.5)	Exmp'n for certain uses in area (2)	Modified req'mts for central area (1.5)	Exmp'n for certain uses in area (2)	Exemption for all uses in area (4)	Exmp'n for non-resid'l uses in area (3)	No exmp'n area defined (1)	Modified req'mts for central area (1.5)
Pk. for multiple uses	Standard approach (1)	Standard approach (1)	Std. app. w. some on-site sharing (3)	Standard approach (1)	Standard approach (1)	Std. appr. w. some ex-cept'ns (2)	Standard approach (1)	Standard approach (1)	Std. app. w. on-site shar. for home occ'ns (2.5)	Std. appr. w. some ex-cept'ns (2)	Does not contemplate (1)	Standard approach (1)
Shared pk.	Will con-sider on ltd. basis (2)	Will con-sider on smwt. ltd. basis (2.5)	Will con-sider (3)	Amenable (4)	Will con-sider (3)	Quite amenable (5)	Will con-sider on ltd. basis (2)	Amenable (4)	Does not contemplate (1)	Does not contemplate (1)	Quite amenable (5)	Will con-sider on smwt. ltd. basis (2.5)
Cash-in-lieu	Amenable in ltd. no. of cases (2)	Generally amenable, encourages in centre (5)	Generally amenable (4)	Generally amenable (4)	Generally amenable (4)	Generally amenable (4)	Generally amenable, encourages in centre (5)	Amenable in central area (3)	Does not contemplate (N/A)	Amenable in central area (3)	Generally amenable (4)	Generally amenable (4)
Public pk.	As altern've & as suppl. in centre (5)	As possible altern've (4)	As supplmt in central area (2)	As supplmt in general (1)	As supplmt in central area (2)	Does not contemplate (N/A)	As supplmt in general (1)	As supplmt in central area (2)	Does not contemplate (N/A)	As supplmt in general (1)	As possible altern've (4)	As possible altern've (4)
Community benefits	May use (5)	May use similar (4)	May use (5)	May use, but avoid adverse effects (2)	May use (5)	May use (5)	May use (5)	May use for non-surface parking (3)	Does not contemplate (1)	May use for non-surface parking (3)	May use (5)	Will not use, avoid adverse effects (1)
On-street pk.	Somewhat amenable (3)	Amenable in ltd. situ'ns (2)	Somewhat amenable (3)	Amenable in ltd. situ'ns (2)	Amenable in ltd. situ'ns (2)	Somewhat amenable (3)	Does not contemplate (N/A)	Amenable in ltd. situ'ns (2)	Not amenable (1)	Not amenable (1)	Does not contemplate (N/A)	Amenable in ltd. situ'ns (2)

At the other end of the spectrum, St. Catharines (on tier 5, "willing to permit in many cases") permits the parking required for any non-residential land use to be situated on another lot within 120 metres, so long as the off-site parking is not located within a residential zone (City of St. Catharines, 2013, p. 15 [Section 3.2.2]).

Exemption area. Although Guelph, Kitchener, and Waterloo do not define specific exemption areas, they have each been given a tier value of 1.5 because their zoning by-laws all apply lower minimum requirements within their downtowns (City of Guelph, 2019b [Section 6.3]; City of Kitchener, 2018b [Section 6.1.2(c)]; City of Waterloo, 2019)[13]. This is not quite the same as defining an exemption area, but it nonetheless indicates a different approach to parking within a specific area. Hamilton, which similarly provides a separate parking schedule for its Downtown zones and does not otherwise define an exemption area, has been assigned a tier value of 2 ("exemption for certain uses within area") instead of 1.5 because the minimum required number of parking spaces is zero for many land uses in Downtown Hamilton (City of Hamilton, 2019c [Section 5.6(a)]. Barrie, also assigned a tier value of 2, does not define an exemption area but does exempt certain uses from parking requirements within the central commercial area (City of Barrie, 2017, p. 4-13 [Section 4.6.3.1].

It is worth re-emphasizing here that the exemption areas defined in municipal zoning by-laws (i.e., in municipalities that were assigned to tier 3 or higher) all saw decreases in surface parking area within the exemption area boundaries between 2005/2006 and 2018.

Multiple uses on same site. The "standard approach" mentioned in the tier descriptions refers to the requirement that the total number of parking spaces on the site be equal to the sum of the number of spaces required for each individual use. Distinctions between tiers are based on

[13] Most of the Uptown Waterloo Urban Growth Centre falls within "Parking Area A" (City of Waterloo, 2019, Schedule 'A1'), which has lower minimum parking requirements than the other Parking Areas defined.

the range of possible exceptions to the standard approach; these exceptions do not deviate dramatically from the standard approach, which is why the highest tier value assigned for this category is 3 rather than 5. Hamilton and Peterborough, on tier 2 (“standard approach with some exceptions”), grant such exceptions in a limited set of circumstances.[14] Burlington, on tier 3 (“standard approach with some on-site sharing”), does not require additional parking for any home-based business (City of Burlington, 2017a, p. 41 [Table 1.2.6]), and also allows the parking spaces for non-residential uses in a mixed-use development to count towards the required visitor parking for the residential component (City of Burlington, 2015, p. 7 [Section 4.6.d]). Oshawa falls somewhere between these two approaches—its zoning by-law does not require additional parking for home occupations (City of Oshawa, 2019b, p. 5.5 [Section 5.3.11]), but the City does require the “functional separation of parking for residential and commercial components of mixed-use development” (City of Oshawa, 2019a, p. 2.2.9 [Policy no. 2.2.8.4.c])—and has therefore been assigned a tier value of 2.5.

Shared parking arrangements. Increments of 0.5 have been used in order to distinguish more finely between tier 2 (“will consider on a limited basis”) and tier 3 (“willing to consider”). Municipalities on tier 2 provide specific definitions for the “limited basis” on which they will consider shared arrangements.[15] The municipalities assigned to tier 3, on the other hand, are willing to explore opportunities for shared parking more broadly, though not quite at the city-

[14] Hamilton does not require additional parking for home occupations located in duplex or multiple dwellings (City of Hamilton, 2019b, p. 4-17 [Section 4.21.d. vi]). Peterborough requires less parking in Areas 2 and 3 (outside the downtown area) when more than four retail uses are situated on the same lot and applies reduced standards for residential uses in non-residential buildings within the city centre (City of Peterborough, 2019, section 4.2.B(i)).

[15] For Barrie, this basis is limited to community facilities within secondary plan areas (City of Barrie, 2018, p. 8-56 [Policy no. 8.6.11(b)(iv)]; p. 9-52 [Policy no. 9.6.11(b)(iv)]), whereas for Kitchener the basis comprises major transit station area plans and special policy areas (City of Kitchener, 2019, p. 3-12 [Policy no. 3.C.2.19(c)]; p. 15-17 [Policy no. 15.D.2.64(q)]; p. 15-20 [Policy no. 15.D.2.67(e)]).

wide level.[16] Brantford and Waterloo have each been assigned a tier value of 2.5, as their policies regarding shared parking[17] are not as narrow in scope as Barrie's or Kitchener's, nor are they quite as broad as Burlington's or Guelph's.

Cash in lieu of parking. The tier values for this category generally reflect the extent of the geographic area within which the municipality is willing to consider cash-in-lieu agreements. At the more restrictive end of the spectrum, Barrie (tier 2, "amenable in a limited number of cases") is willing to consider cash-in-lieu within its secondary plan areas (City of Barrie, 2018, pp. 8-50–8-51 [Policy no. 8.6.3.5(c)]; p. 9-46 [Policy no. 9.6.3.5(c)]) and in connection with development in institutional areas (City of Barrie, 2018, pp. 4-24–4-25 [Policy no. 4.5.2.3(b)]). In contrast, Kitchener (tier 5, "generally amenable, and encourages within central area") uses its Official Plan to establish that the City may consider cash-in-lieu in any situation where the zoning by-law requires a proponent to provide additional parking (City of Kitchener, 2019, p. 17-35 [Policy no. 17.E.18.2]).

Community benefits. An important distinction needs to be made between Cambridge on tier 2 ("may use, but avoid adverse effects") and Waterloo on tier 1 ("avoid adverse effects"). The provisions in Cambridge's Official Plan authorize the City to use bonusing to permit increased height or density of development where the increase may include "public parking over and above the regular requirements" (City of Cambridge, 2018, p. 201 [Policy no. 10.16.1.xi]),

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[16] Burlington's Official Plan, for instance, states that shared parking arrangements "may be considered" within mixed-use areas, with the possibility of reduced parking requirements where such arrangements are in place (City of Burlington, 2019b, p. 54 [Policy no. 5.2.2.j]). Guelph states in its Official Plan that the City "may develop zoning regulations for shared parking arrangements" (City of Guelph, 2018, p. 120 [Policy no. 5.11.7]), that its Downtown Parking Strategy will consider "existing and future opportunities for shared parking" within the city's central area (p. 267 [Policy no. 11.1.4.5.4.c]), and that it encourages shared parking arrangements within the Guelph Innovation District Secondary Plan area (p. 317 [Policy no. 11.2.4.10.1]).

[17] Brantford's Official Plan states the City will "consider" or "explore" shared parking in certain areas (City of Brantford, 2019, p. 19-40 [Policy no. 19.7.8.2]), while Waterloo's states that it "shall encourage" shared parking arrangements with specific land-use designations and in some special policy areas (City of Waterloo, 2020, p. 126 [Policy no. 7.7.2.5.e]; p. 291 [Policy no. 11.1.31.8.b]; pp. 297–298 [Policy no. 11.1.34.3]; p. 298 [Policy no. 11.1.35.3]).

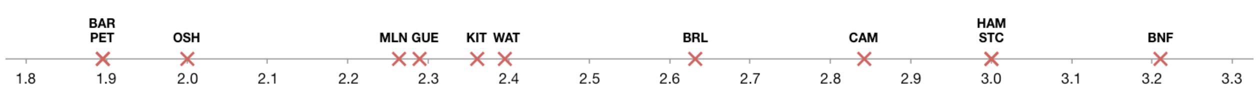
but also stipulate that, before any such increases are approved, the City will review the "suitability of the site … in terms of parking" (p. 201 [Policy no. 10.6.2.a]). In other words, it must be demonstrated that there will be no adverse effects on the surrounding area. Waterloo's Official Plan contains a similar policy regarding the suitability of the site (City of Waterloo, 2020, p. 396 [Policy no. 12.3.1.6.a]), but its provisions do not mention public parking as a possible community benefit, which is why it has been placed on the lower tier.

On-street parking. The municipalities assigned to tier 3 ("somewhat amenable") have policies either that mention on-street parking as a possible replacement for required on-site or surface parking (City of Barrie, 2018, p. 8-24 [Policy no. 8.4.4.5]; City of Hamilton, 2018a, p. E.3-11 [Policy no. E.3.8.18]) or that allow for the approval of "on-street parking ratios" through the development application process (City of Burlington, 2019a, p. 28 [Policy no. 3.2.2.j]).

Figure 14 shows the range of positions along the geographic axis, where a lower score represents a more site-focused policy mindset and where higher scores represent movement towards area management approaches. Brantford's high score, which places it furthest towards the area management end of the spectrum, is primarily due to the scope of its exemption areas and to its cash-in-lieu policies. Barrie and Peterborough find themselves at the opposite (site-focused) end of the spectrum for a variety of reasons, including policies regarding off-site

Figure 14

Municipal Policy Positions along Geographic Axis



parking, shared parking arrangements, and cash in lieu of parking, where both municipalities have tier values among the lowest out of the twelve.

Assignment of tier values: Economic axis

The scores along the economic axis have the narrowest range out of the three axes. In part this is because the treatment of parking as a market good is less likely to show up in policy documents like those considered here, especially zoning by-laws.[18] In general, lower tier values represent mindsets that are more likely to regard parking as a form of infrastructure, with higher tiers moving away from this position towards treating parking as a market good; Table 18 summarizes the tier descriptions and values assigned. The following paragraphs discuss tier assignment and explain instances where 0.5 increments have been used.

Infrastructure/municipal service. Municipalities were assigned to tier 1 ("clearly considers as infrastructure") if any of their policies expressly refer to parking as infrastructure or as a municipal service. Kitchener and St. Catharines have been assigned to tier 2 ("possibly considers as infrastructure") because, even though their documents lack any such explicit reference, the general thrust of their policies strongly suggests an infrastructural mindset. A number of municipalities were given a tier value of 1.5 ("likely considers as infrastructure") because parking is mentioned alongside other infrastructural elements, such as the road network, but is not itself expressly referred to as a form of infrastructure.

Municipal parking facilities. The tier values for this category generally reflect the strength of the language used regarding the provision of municipal facilities. The use of modal verbs such as "shall" or "will" was taken to indicate commitment (tier 1). St. Catharines has been

[18] The mere inclusion of minimum parking requirements within a zoning by-law implies a certain infrastructural view towards parking: in Barter's (2015) typology, the term "infrastructure" is used to refer to an item or system that is considered "something to be planned based on 'engineering' guidelines" (p. 139).

Table 18

Tier Descriptions and Values: Economic Axis

Category	Tier descriptions and values per municipality											
	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Infrastructure	Clearly considers as infrastr. (1)	Likely considers as infrastr. (1.5)	Clearly considers as infrastr. (1)	Likely considers as infrastr. (1.5)	Clearly considers as infrastr. (1)	Likely considers as infrastr. (1.5)	Possibly considers as infrastr. (2)	Clearly considers as infrastr. (1)	Likely considers as infrastr. (1.5)	Clearly considers as infrastr. (1)	Possibly considers as infrastr. (2)	Likely considers as infrastr. (1.5)
Municipal pk. facilities	Commits to playing active role (1)	Intends to play active role (1.5)	Commits to playing active role (1)	May play active role (2)	Commits to playing active role (1)	Intends to play active role (1.5)	Intends to play active role (1.5)	Commits to playing active role (1)	Does not contemplate (N/A)	Intends to play active role (1.5)	Vague intention of playing active role (2.5)	May play active role (2)
Pricing	Does not contemplate (N/A)	Does not contemplate (N/A)	Does not contemplate (N/A)	May use (3)	Does not contemplate (N/A)	Does not contemplate (N/A)	May consider (2)	Does not contemplate (N/A)	Does not contemplate (N/A)	Does not contemplate (N/A)	Does not contemplate (N/A)	May use (3)
Pedestr'n safety/ traffic calming	In limited number of places (3)	In limited number of places (3)	In some places (2)	Does not contemplate (N/A)	In some-what limited number of places (2.5)	In some places (2)	Generally (1)	In some places (2)	Will generally consider (1.5)	In some-what limited number of places (2.5)	Generally (1)	In limited number of places (3)
Comm. imprvmt. projects/areas	Yes, as general criterion (2)	Yes, for specific areas/uses (2.5)	Yes, as general criterion (2)	No (3)	Yes, with multiple criteria (1.5)	Yes, with multiple criteria (1.5)	No (3)	Yes & has established CIPs (1)	Yes & has established CIPs (1)	No (3)	Yes, for specific areas/uses (2.5)	Yes, with multiple criteria (1.5)
Commercial pk.	Does not contemplate (N/A)	Does not contemplate (N/A)	Does not contemplate (N/A)	Yes, may encourage (3)	Does not contemplate (N/A)	Does not contemplate (N/A)	Does not contemplate (N/A)	Does not contemplate (N/A)	Does not contemplate (N/A)	Does not contemplate (N/A)	Does not contemplate (N/A)	Yes, may encourage (3)

assigned a tier value of 2.5 (“vague intention of playing active role”) because the language it uses regarding this question makes its position somewhat unclear,[19] without reaching the level of tier 3 (“unlikely to play active role”).

Pricing. Only Cambridge, Kitchener, and Waterloo address pricing as an aspect of parking policy in the documents considered. Their positions were assigned tier values of either 2 (“may consider”) or 3 (“may use”), values chosen because charging an on-the-spot fee at least makes parking seem different from other forms of infrastructure (paid for through mechanisms like property tax or development charges).

Pedestrian safety. The tier values for this category generally represent the geographic range within which municipalities consider using on-street parking as a traffic-calming measure, from a narrow scope that focuses only on specific areas or developments to a broader, city-wide application. Increments of 0.5 have been used in this category to make finer distinctions between different positions along the continuum of possible scopes.

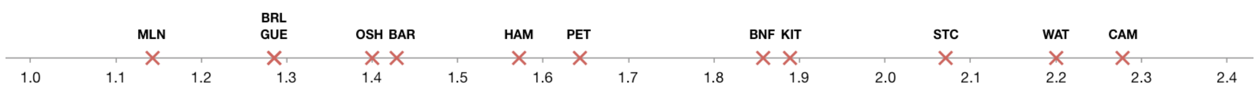
Community improvement projects/areas. The lists of criteria for designating CIP areas in Guelph’s, Hamilton’s, and Waterloo’s policy documents all feature multiple items that mention parking, hence their tier values of 1.5 (“yes, with multiple criteria).[20]

[19] St. Catharines’s only relevant policy for this category is from Section 11.3 (Downtown – General Policies) of its Official Plan (emphases added): “The City’s *existing municipal parking strategy for the Downtown should be reviewed with the purpose of* reducing or eliminating parking requirements for commercial and residential development, redevelopment and intensification, and *supporting public parking programs and facilities*” (City of St. Catharines, 2018, p. 58 [Policy no. 11.3(m)]).

[20] Guelph and Hamilton list both deteriorated/deficient parking facilities and a shortage of land for parking facilities as criteria (City of Guelph, 2018, p. 228 [Policy no. 10.3.2.b & Policy no. 10.3.2.h]; City of Hamilton, 2018b, p. F.1-16 [Policy no. F.1.15.2.i & Policy no. F.1.15.2.m]). Waterloo likewise includes “deteriorated or insufficient parking facilities” (City of Waterloo, 2020, p. 399 [Policy no. 12.3.2.3.h]) along with incompatible land uses “that disrupt the land use and/or lifestyle of the citizens of the area” due to factors such as parking (p. 399 [Policy no. 12.3.2.3.d]).

Figure 15

Municipal Policy Positions as Economic Axis



Commercial parking. Cambridge and Waterloo are the only municipalities whose documents mention commercial parking facilities in any capacity beyond simply as a permitted use, and are thus the only two that have been given tier values for this question.

Positions along the economic axis are represented in Figure 15, where lower values represent more "infrastructural" mindsets. One shortcoming of the values used for this axis, as compared to the other two axes, is that it is not as readily apparent what these scores are supposed to "mean." For instance, does possessing the highest score (2.28) really mean that Cambridge has the most market-oriented approach to parking out of the twelve sample municipalities? This point is addressed in more detail when the discussion turns to possible refinements to the typology and scoring system used (see pp. 184–185).

Assignment of tier values: Attitudinal axis

Tier values for the categories under the attitudinal axis generally correspond to the "amount" of parking each municipality thinks should be supplied. Lower values represent mindsets that consider lower amounts of parking as being necessary and that are more likely to take steps to limit, restrict, or even reduce the supply of parking. Increasing tier values represent mindsets that aim to provide parking more and more abundantly. Table 19 presents the tier descriptions and values assigned for the attitudinal axis.

Table 19

Tier Descriptions and Values: Attitudinal Axis

	Tier descriptions and values per municipality											
Category	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Parking supply	Satisfy demand, incr. supply as necessary (4)	Satisfy demand, incr. supply as necessary (4)	Satisfy demand, incr. supply as necessary (4)	Provide abundant supply (5)	Satisfy demand, incr. supply as necessary (4)	Match supply to demand (3)	Limit supply where possible (2)	Satisfy demand, incr. supply as necessary (4)	Match supply to demand (3)	Provide abundant supply (5)	Manage supply (2.5)	Satisfy demand, incr. supply as necessary (4)
Parking demand	Not contemplated (N/A)	Not contemplated (N/A)	Reduce demand (2)	Increase supply to satisfy (5)	Ensure sufficient supply (4)	Encourage reduced demand (2.5)	Reduce demand (2)	Avoid supply problems (4.5)	Ensure sufficient supply (4)	Ensure sufficient supply (4)	Encourage reduced demand (2.5)	Match supply to demand (3)
Reduced req'mts	On limited basis (4)	Willing to permit (2)	Willing to permit (2)	Willing to permit (2)	In some cases (3)	Reasonably willing (2.5)	Reasonably willing (2.5)	In some cases (3)	Not contemplated (N/A)	On very ltd. basis (4.5)	On limited basis (4)	In some cases (3)
Exemptions	In some cases (3)	Willing to consider (2)	Willing to consider (2)	Willing to consider (2)	Not contemplated (N/A)	Willing to consider (2)	In some cases (3)	In some cases (3)	Willing to consider (2)	Willing to consider (2)	On limited basis (4)	On limited basis (4)
Maximum stds.	For some uses/areas (2.5)	Does not apply (4)	For some uses/areas (2.5)	Does not apply (4)	May consider (3)	For some uses/areas (2.5)	May consider (3)	May consider (3)	Does not apply (4)	Does not apply (4)	For some uses in all areas (2)	For some uses/areas (2.5)
Adverse effects	Concerned (4)	Concerned (4)	Concerned (4)	Not very concerned (2)	Somewhat concerned (3)	Somewhat concerned (3)	Somewhat concerned (3)	Concerned (4)	Very concerned (5)	Not very concerned (2)	Not at all concerned (1)	Somewhat concerned (3)
Req'd pk. areas	Insistent (4)	Insistent (4)	Not very concerned (2)	Not very concerned (2)	Insistent (4)	Somewhat insistent (3)	Not concerned (1)	Quite insistent (5)	Not concerned (1)	Not concerned (1)	Not concerned (1)	Somewhat insistent (3)
"Adequate" pk.	Moderately insistent (3)	Insistent (4)	Insistent (4)	Not very concerned (2)	Insistent (4)	Insistent (4)	Not very concerned (2)	Quite insistent (5)	Quite insistent (5)	Quite insistent (5)	Insistent (4)	Moderately insistent (3)
Demand mgmt.	Considers (3)	Not contemplated (N/A)	Encourages and may require (1.5)	Considers (3)	Considers and may encourage (2.5)	Considers (3)	Encourages or may require (2)	Encourages or may require (2)	Considers (3)	Not contemplated (N/A)	Not contemplated (N/A)	Considers (3)
Rounding	Up or down (3.5)	Up or down (3.5)	Up or down (3.5)	Up (4)	Up or down (3.5)	Down (3)	Up or down (3.5)	Up (4)	Up or down (3.5)	Up (4)	Up or down (3.5)	Up (4)

Parking supply. A subtle distinction needs to be made between tier 3 ("match supply to demand") and tier 4 ("ensure demand can be satisfied"), which involves the attitude towards surplus parking. A tier-4 mindset indicates a more receptive attitude towards a parking surplus; this mindset is more willing to provide parking at a level that "overshoots" demand in order to ensure that any foreseeable level of demand can be satisfied. A tier-3 mindset suggests a more careful fine-tuning of the parking supply in order to avoid any significant surplus. St. Catharines has been given a tier value of 2.5 ("manage supply") because its policy positions involve steps towards managing the parking supply without going so far as to limit it (tier 2).

Parking demand. Hamilton and St. Catharines have both been assigned a tier value of 2.5 ("encourage reduced demand")—between tier 2 ("reduce demand", which involves taking concrete steps towards reducing demand rather than simply encouraging the reduction), and tier 3 ("match supply", which does not really seek to manage demand). Milton's tier value of 4.5 ("avoid supply problems") is based on the Town's Official Plan policy that the proponent of any major development or redevelopment project will be required to provide a study that presents the "implications" of said project for parking in the Central Business District and that proposes alternative solutions for any parking problems that might arise (Town of Milton, 2008, p. 150 [Policy no. 3.5.3.25.d]). While this position doesn't explicitly commit to increasing the existing supply, it nonetheless strongly suggests that the amount of parking will be increased if a project presents any sort of "problem" for parking in the CBD.

Reduced requirements. Tier value assignment for this category was determined by how likely it seems that the municipality will grant reductions in minimum parking requirements. Lower tiers are associated with stronger language, such as "shall be permitted," as opposed to "shall/may be considered" or "may be permitted." Again, Hamilton and Kitchener have each been given a tier value of 2.5 to distinguish their positions from both the more general willingness of municipalities like Burlington or Cambridge on tier 2 (“willing”) and the narrower scope outlined for municipalities such as Guelph or Milton on tier 3 (“in some cases”).

Exemption from parking requirements. The tier descriptions for this category focus on the central or downtown area simply because this is where exemption areas happen to exist in the sample municipalities. This category also considers uses that have a minimum parking requirement of zero spaces. The term “willing” (tier 2) generally means that most or all land uses within the central area are exempt from requirements. Burlington, which exempts non-residential uses in the central area, has been placed on tier 2 on the strength of its minimum requirement of zero spaces for home-based businesses, which applies more generally across the city.

Maximum standards. The possible responses to the question for maximum standards listed in Table 9 (see p. 91) include “expressly dismisses possibility” as tier 5, even though none of the municipalities considered reached this level. This was done in order to clarify the contrast between tier 5 and tier 4 (“does not apply maximum standards”), which is the “default” position assigned to municipalities that do not contemplate maximum standards in their policy documents.

Adverse effects. Tier assignment for this category takes into account the strength of the language used (“shall” versus “may”) and the document containing the policies in question (with zoning regulations being given more weight than official plan policies).[21]

[21] As an example, consider the contrast between, on the one hand, Policy no. 10.4.2.d in Cambridge’s Official Plan—that the extension or enlargement of a legal non-conforming use “may be permitted” provided that it “does not unduly aggravate an incompatible situation by reason of … parking” (City of Cambridge, 2018, p. 190)—and, on the other hand, the more direct wording in Oshawa’s Zoning By-law (City of Oshawa, 2019b), which stipulates that home occupations “shall not generate adverse effects such as that from … excessive traffic, [or] parking” (p. 5.5 [Section 5.3.10]) and that bed and breakfast establishments “shall not be established or operated in a manner which … generates adverse effects such as those from … parking” (p. 5.8 [Section 5.9.6]). This contrast helps explain why Cambridge has been placed on tier 2 (“not particularly concerned”) and Oshawa on tier 5 (“very concerned”).

Required parking areas. This category's tiers have also been assigned based on the strength of language and the scope of the policies that exist (i.e., what land uses or use categories are specified). The stipulation in Milton's zoning by-law, that all required parking spaces "*must* be unobstructed and available *exclusively* for parking purposes *at all times*" (Town of Milton, 2018a, p. 5-1 [Section 5.3]; emphases added), epitomizes the attitude represented by tier 5 ("quite insistent").

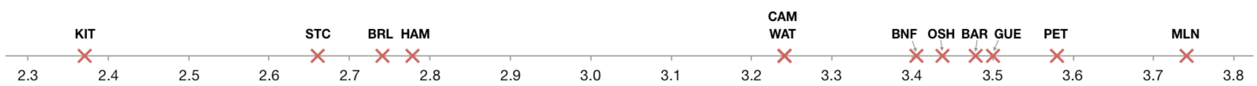
"Adequate" or "sufficient" parking. Tier assignment for this category was based on a number of factors: (1) on whether a general, "umbrella" policy exists requiring "adequate off-street parking" for all permitted uses or for all developments; (2) where such an "umbrella" policy does not exist, on the number of land use categories with respect to which "adequate parking" is required; and (3) on the strength of the language used (e.g., "required" versus "encouraged" or "considered"). The distinction made between the terms "sufficient" and "adequate" is similar to the one made between tiers 3 and 4 in the "parking supply" category.

Demand management. The policy position represented by tier 1 ("requires") was not actually observed in the sample documents; it has been included as a possible response in order distinguish between tier 2 ("encourages or may require," with "or" being exclusive) and tier 1.5 ("encourages *and* may require"), which is Burlington's position.

Rounding. The mindsets expressed by the two answers to the question of rounding were considered as representing attitudes towards surplus parking similar to those expressed by tiers 3 and 4 of the "parking supply" category, which is why the answers here have been given these same values. In colloquial terms, tier 4 ("round up") means "provide an extra parking space, just in case we need it," whereas tier 3 ("round down") means "don't worry about that one extra space, it'll be fine."

Figure 16

Municipal Policy Positions along Attitudinal Axis



Policy positions along the attitudinal axis are represented in Figure 16. Again, values along this axis generally represent the "amount" of parking each municipal mindset sees as being necessary or appropriate. Positions along this axis appear to be more "polarized" than they are for the other two axes, with a sizeable gap visible in the middle of Figure 16 (between Hamilton at 2.78 and Cambridge and Waterloo at 3.24).

Policy positions

Table 20 summarizes the tier values assigned for all three axes and presents each municipality's position along each axis. Axial positions were calculated by taking the weighted average of the tier values for that axis (weightings are shown in the second column of Table 20), excluding where necessary instances where a municipality's documents do not contemplate a particular category (indicated by "--" in Table 20). Taken together, the three axial positions provide us with a set of three "co-ordinates" that we can use to plot the municipality's overall positions within a three-dimensional "policy space." The resulting plot is shown in Figure 17, where the geographic axis has been assigned to the *x* axis, the economic to the *y* axis, and the attitudinal to the *z* axis.

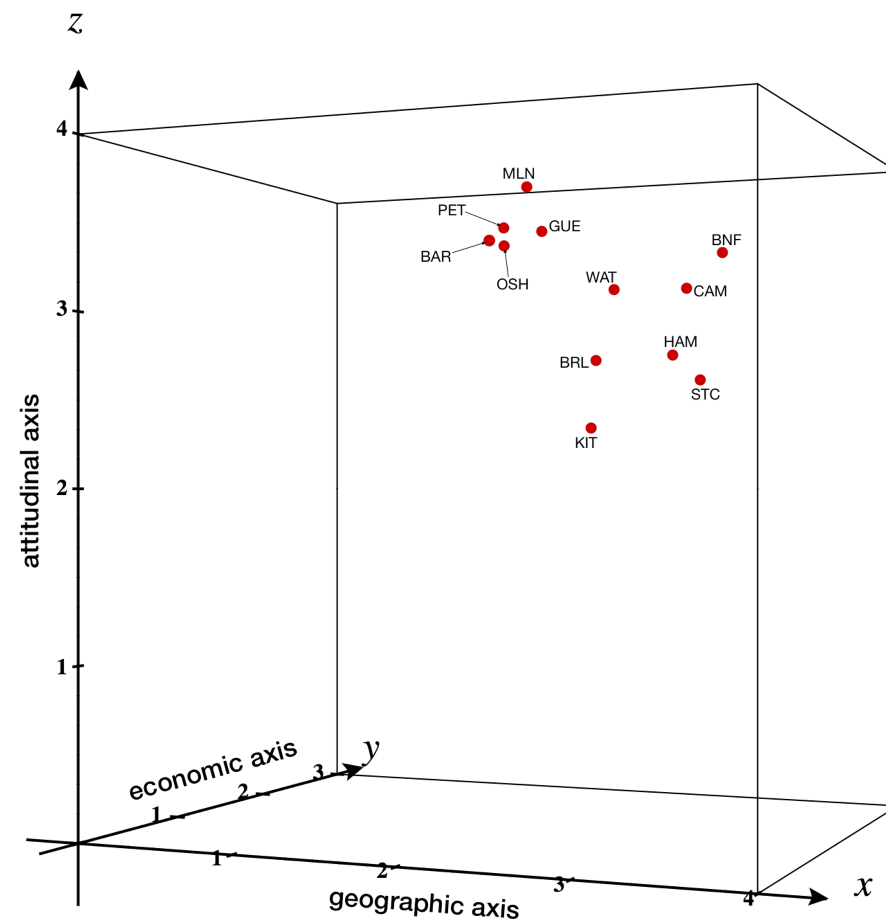
Table 20

Tier Values and Municipal Positions (Scores) along Each Axis

Category	*Wt.*	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
							Municipality						
Geographic axis													
On-site parking	*3*	1	1	1	1	1	1	1	1	1	1	1	1
Off-site parking	*3*	1	4	2	4	3	4	4	3	2	2	5	4
Exemption area	*3*	2	5	3	5	1.5	2	1.5	2	4	3	1	1.5
Pk. for multiple uses	*2*	1	1	3	1	1	2	1	1	2.5	2	1	1
Shared parking	*2*	2	2.5	3	4	3	5	2	4	1	1	5	2.5
Cash-in-lieu	*2*	2	5	4	4	4	4	5	3	--	3	4	4
Public parking	*2*	3	4	2	1	2	--	1	2	--	1	4	4
Community benefits	*1*	5	4	5	2	5	5	5	3	1	3	5	1
On-street parking	*1*	3	2	3	2	2	3	--	2	1	1	--	2
Score (weighted avg.)		**1.89**	**3.21**	**2.63**	**2.84**	**2.29**	**3.00**	**2.36**	**2.26**	**2.00**	**1.89**	**3.00**	**2.39**
Economic axis													
Infrastructure	*3*	1	1.5	1	1.5	1	1.5	2	1	1.5	1	2	1.5
Municipal facilities	*2*	1	1.5	1	2	1	1.5	1.5	1	--	1.5	2.5	2
Pricing	*2*	--	--	--	3	--	--	2	--	--	--	--	3
Pedestrian safety	*1*	3	3	2	--	2.5	2	1	2	1.5	2.5	1	3
CIPs	*1*	2	2.5	2	3	1.5	1.5	3	1	1	3	2.5	1.5
Commercial pk.	*1*	--	--	--	3	--	--	--	--	--	--	--	3
Score (weighted avg)		**1.43**	**1.86**	**1.29**	**2.28**	**1.29**	**1.57**	**1.89**	**1.14**	**1.40**	**1.64**	**2.07**	**2.20**
Attitudinal axis													
Parking supply	*4*	4	4	4	5	4	3	2	4	3	5	2.5	4
Parking demand	*4*	--	--	2	5	4	2.5	2	4.5	4	4	2.5	3
Reduced reqmts.	*3*	4	2	2	2	3	2.5	2.5	3	--	4.5	4	3
Exemption	*3*	3	2	2	2	--	2	3	3	2	2	4	4
Maximum stds.	*3*	2.5	4	2.5	4	3	2.5	3	3	4	4	2	2.5
Adverse effects	*3*	4	4	4	2	3	3	3	4	5	2	1	3
Req'd pk. areas	*2*	4	4	2	2	4	3	1	5	1	1	1	3
"Adequate" pk.	*2*	3	4	4	2	4	4	2	5	5	5	4	3
Demand mgmt.	*2*	3	--	1.5	3	2.5	3	2	2	3	--	--	3
Rounding	*1*	3.5	3.5	3.5	3.5	4	3	3.5	4	3.5	4	3.5	4
Score (weighted avg.)		**3.48**	**3.40**	**2.74**	**3.24**	**3.50**	**2.78**	**2.37**	**3.74**	**3.44**	**3.58**	**2.66**	**3.24**

Figure 17

Three-Dimensional Plot of Municipal Policy Positions



Note. Plotted using CalcPlot3D (Seeburger, 2018).

Discussion points from policy analysis results

Most of the discussion points regarding the results from the policy analysis phase of the project emerge once we have considered these results alongside the results from the mapping phase. However, three items are worth mentioning at this point:

- The values used along the economic axis (infrastructure vs. market good) are not as easily interpreted as those for the other two values. Refinements to the way this axis has been defined and organized could help make the results more meaningful.

- Municipal positions along the attitudinal axis (attitudes regarding parking supply) appear to be more polarized than positions along the other two axes.
- The numerical values obtained for each municipality's position along the three axes not only allow us to undertake the analysis performed in the final phase, but also provide a tool we can use to identify which of the different approaches to parking policy reform (Barter, 2015) are more likely to succeed, based current mindsets.

Final analysis results

The results presented so far, which address the project's two research "sub-questions," are valuable in and of themselves because of the exploratory nature of this research and the fact that the subject of parking in Canada's mid-size cities has received little attention to date. The purpose of the project's final phase was to look for possible points of connection between the results obtained from the two earlier phases in order to point out potentially fruitful directions for future research to investigate.

The final phase involved both qualitative and quantitative analysis, the results of which are presented here in the following order: (1) descriptive statistics, which were used to achieve qualitative characterizations of municipal parking positions and of the observed changes to surface parking area; and (2) *k*-means cluster analysis, which was used to find municipalities that had similar overall policy positions and to examine whether municipalities with similar positions also saw similar outcomes with respect to surface parking.

Descriptive statistics

Descriptive statistics were used to arrive at a qualitative characterization of each municipality's position on parking policy. This assessment was based on a holistic consideration of the tier values assigned for each category, with particular emphasis being placed on the descriptions associated with each tier (the "answers" to the question for each category). The characterization of policy positions was guided by the questions listed on p. 98 in the Methodology chapter, which relate to each municipality's amenability towards area-management strategies, its consistency in the treatment of parking as a form of infrastructure, its overall attitude regarding the parking supply and the demand for parking, and its level of concern regarding possible adverse effects of not providing enough parking.

Descriptive statistics were also used to characterize the nature of the change in surface parking area observed across each municipality's "area of interest," expressed as a percentage of the parking area that existed in 2005/2006. The following qualifiers were used to distinguish between different ranges of increases and decreases (again, all expressed as percentages of the 2005/2006 area):

- a *slight* increase or decrease indicates an increase/decrease of less than 1%;
- a *modest* increase/decrease indicates a change between 1% and 5%;
- an increase or decrease (without any qualifier) indicates a change between 5% and 10%; and
- a *significant* increase/decrease indicates a change of more than 10%.

Table 21 presents the qualitative characterizations of each municipality's policy position and of the change in surface parking area observed across its "area of interest." The twelve municipalities have been ranked from "most conventional" to "least conventional" in terms of overall parking policy, where "conventional" has the same meaning as it does in Barter's (2015) typology (see Fig. 1 on p. 32): an approach that emphasizes to provision of parking on each site, that regards parking as a form of infrastructure, and that considers parking as something that

Table 21

Descriptions of Municipal Policy Positions and Nature of Changes in Surface Parking Area Observed

Municipality	Description of policy position	Nature of change in parking area
Milton	Very site-focused, but open to some area management techniques in central area. Infrastructural mindset, commits to playing active role in provision of parking; has established CIP to address parking. Seeks to satisfy demand & avoid any problems with supply levels; quite concerned about adverse effects.	significant increase
Oshawa	Very site-focused, but has sizeable exemption area. Infrastructural mindset; has established CIP to address parking. Seeks to ensure sufficient supply for demand; generally concerned about adverse effects.	significant increase
Peterborough	Very site-focused, but open to some area management techniques. Infrastructural mindset, intends to play active role in provision of parking; criteria for designating CIP areas do not include parking. Seeks to ensure sufficient supply for demand; somewhat concerned about adverse effects.	slight decrease
Guelph	Site-focused, but open to some area management techniques. Infrastructural mindset, commits to playing active role in provision of parking; includes multiple parking-related criteria for designating CIP areas. Seeks to ensure sufficient supply for demand; generally concerned about adverse effects; open to demand management strategies.	modest decrease
Barrie	Site-focused, but open to some area management techniques in central area. Generally infrastructural mindset, commits to playing active role in provision of parking; includes parking as criterion for designating CIP areas. Seeks to satisfy demand; somewhat concerned about adverse effects; open to some alternative strategies.	slight decrease
Brantford	Amenable to some area management techniques; has small exemption area in downtown. Generally infrastructural mindset, intends to play active role in provision of parking; includes parking associated with specific land use categories as criterion for designating CIP areas. Seeks to satisfy demand; concerned about adverse effects.	modest increase

Municipality	Description of policy position	Nature of change in parking area
Cambridge	Amenable to some area management techniques; has small exemption area in downtown/UGC. Tends away from infrastructural mindset; may play active role in provision of parking; criteria for designating CIP areas do not include parking. Seeks to ensure that unmet demand is satisfied; not particularly concerned about adverse effects.	decrease
Waterloo	Amenable to some area management techniques. Tends away from infrastructural mindset, but includes multiple parking-related criteria for designating CIP areas. Seeks to satisfy demand; generaly concerned about providing too little.	modest increase
Burlington	Amenable to area management techniques; has sizeable downtown exemption area. Infrastructural mindset, commits to playing active role in provision of parking; includes parking as criterion for designating CIP areas. Seeks to satisfy demand but open to demand management strategies; somewhat concerned about adverse effects.	modest decrease
Hamilton	Amenable to area management techniques; exempts some uses from minimum requirements in downtown. Generally infrastructural mindset; includes multiple parking-related criteria for designating CIP areas. Amenable to approaches that will reduce demand, but still has reservations regarding adverse effects.	modest decrease
Kitchener	Amenable to some area management techniques, but tentative regarding exemptions & shared parking. Generally infrastructural mindset, intends to play active role in provision of parking; criteria for designating CIP areas do not include parking. Seeks to manage or limit supply where possible, is amenable to approaches that will reduce demand.	significant decrease
St. Catharines	Amenable to a number of area management techniques, but does not have exemption area. Tends away from infrastructural mindset; includes parking associated with specific land use categories as criterion for designating CIP areas. Amenable to managing supply & encouraging reduced demand, but reticent regarding reduced requirements & exemptions; somewhat concerned about providing "adequate" parking.	modest decrease

needs to be provided abundantly in order to satisfy peak levels of demand. The ranking presented in Table 21 is admittedly subjective, but it is nonetheless based on a consistent application of the guiding questions listed on p. 98.

The "nature of change" column in Table 21 shows that the general tendency is to move from greater increases to greater decreases as policy positions become less conventional: the two municipalities with the most conventional positions (Milton and Oshawa) are also the only two that saw significant increases in the overall area devoted to surface parking. However, there are a couple exceptions to this trend worth noting:

- Barrie, Guelph, and Peterborough are all ranked as having fairly conventional policy positions, yet each of these municipalities saw some sort of decrease in surface parking area (although the decrease for Peterborough overall was negligible). A more in-depth look at these particular cases could provide additional insight into factors beyond policy that can affect the amount of parking provided.
- The nature of the change observed in Cambridge contrasts with those observed in its immediate neighbours in Table 21, Brantford and Waterloo (both of which saw modest increases in surface parking area). This is most likely due to the small size of the Downtown Cambridge UGC and to the nature of the Galt City Centre parking exemption area; both of these are discussed in the next chapter (see pp. 177–178).

According to the axial values that have been used to establish positions for each municipality within three-dimensional "policy space," the conventional policy position described above would correspond to a position of (1 , 1 , 5): that is, a geographic score of 1 to reflect its site-focused approach, an economic score of 1 to reflect its infrastructural outlook, and an attitudinal score to reflect the mindset that parking needs to be provided abundantly. Using this idealized conventional position and the axial positions presented in Table 20, it is possible to calculate the "distance" within "policy space" of each municipal policy position from the idealized conventional position.[22] Doing so gives us a number representing each municipality's relative degree of "non-conventionality"—that is, greater values indicate greater distance from the conventional position on parking policy.

Table 22 presents the twelve sample municipalities ranked according to the scores thus obtained. In general, the ordering reflects the qualitative ranking presented in Table 21, though there are some important differences. Perhaps most notably, Table 22 ranks Brantford as being much less conventional as compared to Table 21. In large part, this is because Brantford received a high score along the geographic axis (see Figure 14 on p. 140), mostly due to its exemption

Table 22

Municipalities Ranked by "Non-conventionality" of Policy Positions

Rank	Municipality	"Non-conventionality" score	Rank	Municipality	"Non-conventionality" score
1	Milton	1.789	7	Burlington	2.801
2	Peterborough	1.797	8	Cambridge	2.850
3	Barrie	1.817	9	Brantford	2.858
4	Oshawa	1.898	10	Hamilton	3.044
5	Guelph	1.999	11	Kitchener	3.092
6	Waterloo	2.546	12	St. Catharines	3.259

Note. Each municipality's "non-conventionality score" is simply the Euclidean distance between its policy position and the idealized conventional point $(1, 1, 5)$. All values are dimensionless.

[22] This is simply a matter of taking the Euclidean distance between the two points using the Pythagorean theorem in three dimensions. The distance (s) between the policy position represented by the point (x, y, z)—where x is the municipality's position along the geographic axis, y its position along the economic axis, and z its position along the attitudinal axis—and the idealized conventional point $(1, 1, 5)$ is given by the equation:

$$s = \sqrt{[(x-1)^2 + (y-1)^2 + (z-1)^2]}$$

area and cash-in-lieu policies. However, the ranking in Table 21 takes the size of the exemption area into consideration, which the scores generated by the tier values do not. The discrepancies between the qualitative and quantitative rankings suggest that comparing the two might allow for further “calibration” of the methodology used in the policy analysis phase of the project, so that the quantitative results more closely reflect the qualitative characterizations achieved holistically and intuitively.

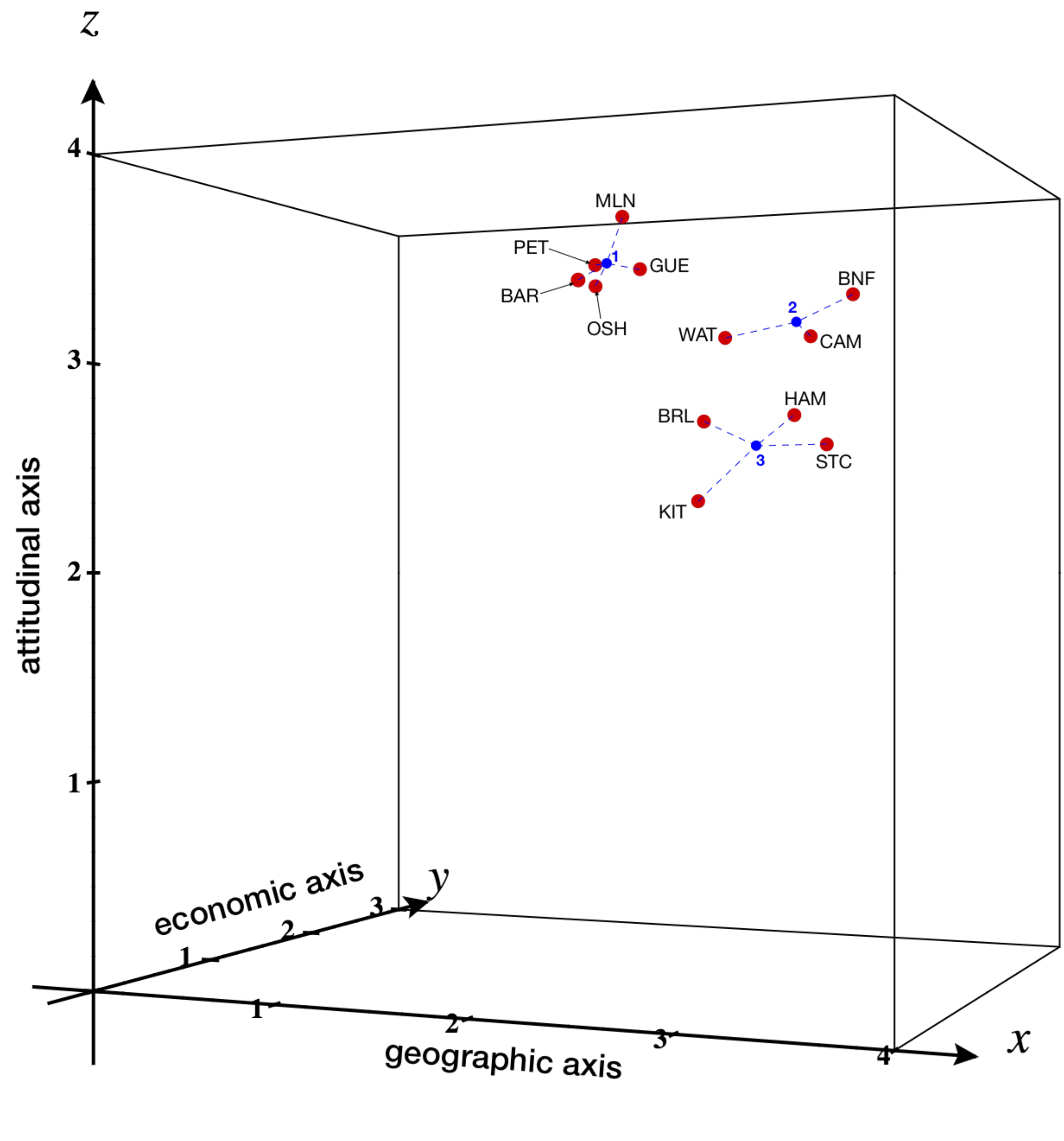
K-means cluster analysis

As described earlier (see Methodology, pp. 99–101), *k*-means cluster analysis involves a simple clustering algorithm that divides all data points into a user-defined number of clusters, each represented by a “prototype” (in this case, the mean values of the points in each cluster). This quantitative technique was used to examine whether municipalities with similar policy positions (as expressed by their positions along the geographic, economic, and attitudinal axes) also saw similar outcomes with regard to changes in the area devoted to surface parking within their areas of interest. The specific procedure used for this project (which among other things addresses the challenge of selecting initial points to use as cluster mean values) is outlined in Appendix G.

The best clustering achieved using this algorithm—that is, the clustering with the smallest sum-of-squares error (SSE)—is shown in Figure 18, with the mean value of each cluster represented by the three numbered blue points. The specific values for each cluster mean are presented in Table 23 (p. 160). Again, these mean values serve as “prototypes” that we can use to characterize the average policy position for each of the three clusters. Thus, we can say that, on average, Cluster 1 is the most site-focused and the most likely to consider parking as something

Figure 18

Three-Dimensional Plot of Policy Positions with Cluster Mean Values



Note. Plotted using CalcPlot3D (Seeburger, 2018).

Table 23

Position of Cluster Mean Values along Each Axis

	Axial position of cluster mean			
Cluster no.	Geog. (x)	Econ. (y)	Att. (z)	Municipalities in cluster
1	2.07	1.38	3.55	Barrie, Guelph, Milton, Oshawa, Peterborough
2	2.82	2.11	3.30	Brantford, Cambridge, Waterloo
3	2.75	1.70	2.64	Burlington, Hamilton, Kitchener, St. Catharines

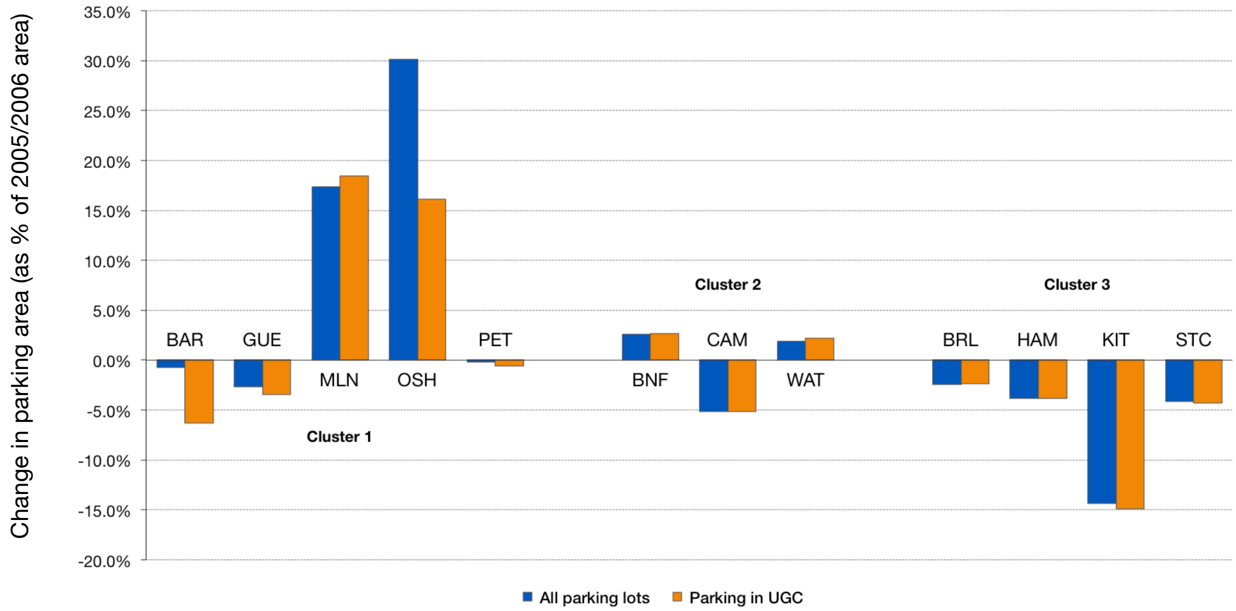
Note. All values dimensionless.

that should be provided abundantly; it is also the cluster with the most “infrastructural” mindset. Cluster 2, by contrast, is positioned further along the economic axis towards “parking as market good” than the other two clusters, and on average tends the most towards area management approaches. Cluster 3 has the lowest mean position of the three along the attitudinal (z) axis, meaning that on average these municipalities tend more towards approaches that seek to restrict or reduce the supply of parking; its position regarding area management is close to that of Cluster 2. (Incidentally, this clustering bears many similarities to the qualitative ranking, from most to least conventional, presented in Table 21.)

Some interesting possible patterns begin to emerge when we consider the changes in parking area that took place within each of the three clusters, as shown in Figure 19. (The corresponding numbers are the same as those shown in Table 11, on p. 111.) Cluster 1 contains the two municipalities with the greatest increases, Milton and Oshawa, while the other three in this cluster saw modest decreases over similar timeframes. In Cluster 2, Cambridge appears to be an outlier, as its 5% decrease contrasts markedly with the modest increases seen in Brantford and Waterloo. Finally, the four municipalities in Cluster 3—which has the lowest mean position on

Figure 19

Change in Surface Parking Area in Each Cluster



the attitudinal axis—all saw decreases of varying degrees over the period in question, including Kitchener, which saw the greatest decrease.

Four of the five municipalities in Cluster 1 (Guelph, Milton, Oshawa, and Peterborough) have official plans and zoning by-laws that both pre-date the Growth Plan coming into effect in 2006, with Barrie, whose Official Plan was approved in 2010 and whose current zoning by-law was passed in 2009, being the only exception. The policy positions within this cluster, then, may reflect older approaches to parking policy that, on average, are more site-focused and supply-oriented.[23] With respect to specific policy categories, one observation that stands out is that Milton and Oshawa, which saw the greatest increases in area devoted to surface parking, are also the only two municipalities in the sample that have established Community Improvement Plans

[23] Two other municipalities—Brantford in Cluster 2 and Burlington in Cluster 3—also have official plans and zoning by-laws that pre-date the Growth Plan. For dates, see Table 3 on page 78.

(CIPs) in order to address deficient parking.[24] This also happens to be the only characteristic that Milton and Oshawa share that the other three Cluster 1 municipalities do not. While we certainly cannot say that this has been the deciding factor in the different outcomes observed (the other three municipalities in Cluster 1 all saw modest decreases in parking area, also in contrast to Milton and Oshawa), it may be possible that the existence of these community improvement areas is indicative of general mindsets that are more concerned about the state and supply of parking. On average, Cluster 1 is the least amenable towards shared parking arrangements, with Barrie on tier 2 ("willing to consider on a limited basis") and both Oshawa and Peterborough on tier 1 ("does not contemplate shared parking"). (Guelph and Milton sit higher for this category, at tier 3 ("willing to consider") and tier 4 ("amenable"), respectively.) Cluster 1 was also the least amenable of the three towards cash-in-lieu and towards permitting the location of required parking on another site.

Cambridge stands out as the only municipality in Cluster 2 that saw a decrease in surface parking area over the study timeframe (–5.1%, as opposed to +2.6% for Brantford and +1.9% for Waterloo). Out of the three, Cambridge is the most amenable towards shared parking arrangements (tier 4, "amenable," versus tier values of 2.5 for the other two) and is also the least concerned about adverse effects, the provision of "adequate" parking, and the use of required parking areas exclusively for parking (Cambridge sits on tier 2, "not particularly concerned," for all three categories, whereas Waterloo is on tier 3 and Brantford on tier 4 across all three).

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[24] Milton's Old Milton Neighbourhood Community Improvement Area is located in "the historic core of Milton," according to the Town's Official Plan, and is described as possessing "a number of standard deficiencies in its older buildings, roadways, parking and landscaped areas" (Town of Milton, 2008, p. 119 [Policy no. 2.11.3.2]). Oshawa's Official Plan describes a couple noteworthy sub-areas within its larger Community Improvement Area: Sub-area C "includes a large portion of the Downtown Oshawa Urban Growth Centre" and requires improvements "to upgrade buildings requiring rehabilitation, deficient roads, deficient parking, and aesthetics" (City of Oshawa, 2019a, p. 4.3 [Policy no. 4.3.1]), while Sub-area E, just south of the UGC, appears to require similar improvements, with specific reference made to the need to "alleviate a lack of off-street parking in the Simcoe Street commercial area" (p. 4.4 [Policy no. 4.3.1]).

However, Cambridge also scores the highest out of the three when it comes to parking supply and to parking demand, sitting on tier 5 for both ("provide abundant supply" and "increase supply to satisfy demand").

The area devoted to surface parking in all four of the municipalities in Cluster 3 decreased between 2005/2006 and 2018, both overall and within their UGCs. Burlington, which saw the smallest decrease out of the four Cluster 3 municipalities, has the cluster's highest tier value for parking supply (4, "ensure demand will be satisfied, increase supply as necessary") as well as for adverse effects (4, "concerned"). Kitchener, which saw the greatest decrease by far, was the least concerned about providing "adequate" parking, with a tier value of 2 ("not particularly concerned") compared to values of 4 ("insistent") for the other three municipalities. Kitchener was also on the lowest tier of the four when it came to parking supply (2, "limit supply where possible"); St. Catharines, second lowest in this category at tier 2.5 ("manage supply"), also saw the second-greatest decrease in surface parking area. As for shared parking arrangements, Kitchener is somewhat of an outlier, with a cluster-low tier value of 2 ("willing to consider on a limited basis"). Burlington is on tier 3 ("willing to consider") for this category, while the other two both scored tier values of 5 ("quite amenable").

Again, the results of the qualitative characterization and ranking, on the one hand, and the results from the quantitative cluster analysis, on the other, complement each other quite well. Nonetheless, as we have already seen, the "non-conventionality" scores derived from the quantitative policy positions suggest that the methodology for assigning tier values might benefit from further calibration. Overall, there does appear to be a general tendency for municipalities with less conventional policy positions (the municipalities in Cluster 3, which are also the four "least conventional" in Table 21) to see greater decreases in surface parking area, though there are some important deviations from this general trend that merit further investigation.

Discussion points from final analysis phase

The results from the final analysis phase of the project have raised a few points that will be considered in the next chapter:

- The comparison of the project's quantitative results, which allow more precise comparisons between municipal policy positions, and the qualitative characterizations of those positions, which are more subjective but also more intuitive, present opportunities to "calibrate" the methodology used to obtain the quantitative results, particularly where category weightings are concerned.
- The fact that the two municipalities that saw the greatest increases in surface parking area in the project sample both have established CIPs to address the condition of parking facilities suggests that future research ought to investigate the possibility of such a relationship. It might also be possible that concerns about parking, expressed in this way, are indicative of a more general mindset among policy- and decision-makers.
- While there is a general tendency for municipalities with less conventional positions regarding parking policy to have seen greater decreases to surface parking area in their downtown areas, there are some important exceptions to this trend. Looking at these exceptions more closely could provide us with a better understanding of factors beyond policy that can affect the stock of surface parking. It may also be the case that some of these exceptions are the result of this project's focus on downtown areas.

Summary of results

Having taken an in-depth look at the results from all three project phases, we are now in a position to answer the research questions (two "sub-questions" and one main question) that guided this study:

How has the amount of off-street surface parking in downtown Urban Growth Centres changed since the Growth Plan first came into effect in 2006? For eight of the twelve municipalities in the project sample, the area devoted to surface parking decreased between 2005/2006 and 2018. Two municipalities—Milton and Oshawa—saw significant increases in and around their Urban Growth Centres, while the remaining two (Brantford and Waterloo) saw more modest increases. The results tend to be more pronounced when considering just the area devoted to parking within UGC boundaries—that is to say, the observed changes in area within the UGCs (expressed as a percentage of the earlier area) cover a greater range of values than the overall changes observed. It is also worth pointing out that, in 2018, most of the twelve municipalities devoted somewhere between 20% and 30% of their Urban Growth Centres to surface parking.

The majority of the changes observed, both net increases and net decreases, took place on just a handful of blocks (usually five or fewer for each municipality). Larger-scale developments, especially large retail/"power" centres, are the greatest contributing factor towards increases in surface parking area. A sizeable portion of the decreases in area observed can be traced to the conversion of surface parking lots into vacant lands. In addition, a reduction in the amount of surface parking does not necessarily equate to a reduction in the total amount of parking—witness those cases where surface parking lots have been replaced by other forms of parking, especially underground garages.

What parking policies do local municipalities have in place, and how would the mindsets represented by these policy positions be characterized according to Barter's (2015) typology? The twelve municipalities considered here occupy a variety of policy positions, which overall tend to fall into three clusters: one cluster, fairly well defined, with a more conventional mindset (i.e., one that is more site-focused and tends to encourage an abundant supply of parking), and two other clusters with mindsets that, to varying degrees, tend away from the conventional position towards area management approaches and towards promoting the provision of less parking. One point worth noting is that positions along the attitudinal axis appear to be more polarized than those along the other two axes.

What sorts of relationships exist between municipal policy positions and changes in the amount of parking over time? In general, there is a tendency for municipalities with less conventional mindsets to see greater decreases in the area devoted to surface parking within their downtowns. Similarly, the two municipalities that saw the greatest increases in surface parking area (Milton and Oshawa) both have policy positions that place them among the most conventional in the project sample. However, the other three municipalities with more conventional positions saw modest decreases in the amount of surface parking within their areas of interest. A more in-depth look at these cases might provide further insight on factors beyond policy that can affect the amount of parking provided; it might also help us understand how this project's focus on downtown areas has "skewed" the results towards finding greater decreases than might be observed on a city-wide level. There are also specific aspects of policy that deserve to be explored further, in particular the establishment of community improvement plans to address the condition of parking facilities, as well as the possible impact that designating an exemption area might have on the amount of surface parking provided. We might also consider looking more closely at policy statements that, while simple on the surface, express more deeply rooted mindsets among policy- and decision-makers.

In the next chapter, we will look at the implications these results have for researchers, planners, and policy-makers.

Discussion

The ultimate goal of the research undertaken for this project was not only to improve our understanding of parking in mid-size Canadian cities but also to identify directions for future research to explore. The closing paragraphs of the previous chapter have suggested some of these directions, and the final section of this chapter takes these up in more detail, along with the other discussion points from the final analysis phase. Before this, however, we need to consider the implications of the findings from the earlier project phases, as suggested by the discussion points summarized at the ends of their respective sections in the Results chapter.

The discussion points from the mapping phase focus on the reasons behind the most notable increases and decreases in surface parking area observed and on the changes that occurred within the parking exemption areas that some municipalities have established in their zoning by-laws. The most important point from the policy analysis phase concerns the opportunities presented by this project's methods for assessing and characterizing municipal policy positions. The discussion points from the final analysis phase feature the aforementioned directions for future research; this final section of the discussion also addresses some shortcomings of the overall project methodology and suggests some refinements for the process moving forward.

Observed changes in surface parking area

The first section of this chapter focuses on the discussion points that have emerged from the mapping phase results and from the changes observed across the twelve "areas of interest," addressing the following topics: (1) the significant impact larger-scale development projects can have on the amount of parking, (2) the role of surface parking in regional transit systems, (3) the replacement of surface parking with other forms and the concept of "parking intensification," (4) the conversion of downtown parking lots into vacant lands, and (5) the possible effectiveness of parking exemption areas.

Effects of larger-scale development projects

The distribution of net block-level changes (see Results, pp. 114 et seq.) reveals that, in all twelve municipalities in the project sample, changes to parking area on just a handful of blocks account for the majority of both net increases and net decreases observed within the area of interest. (This is particularly true for net block-level increases in area; net decreases are slightly more spread out across the various areas of interest.) Moreover, in most of the twelve municipalities there are one or two large development projects that account for a sizeable portion of the net area added between 2005/2006 and 2018, pointing towards the important effect that large development projects can have on the amount of parking in a given area. (This might seem obvious, but having larger-scale projects account for large shares of added surface parking area was not the only conceivable outcome, particularly in more traditional downtown areas with smaller blocks, where there will tend to be less space available for these types of sprawling development projects. In a longer timeframe, it is possible that an accumulation of smaller changes could "dilute" the effects of such larger projects, which by their nature will generally not happen as frequently.)

By far, the greatest net increases in surface parking area were associated with the development of large retail centres or "power" centres, which are generally composed of multiple retail outlets along with a large-format grocery store. (Technically, the development on block OSH.12, accounting for 72% of that municipality's net increase, is associated with a membership-based wholesale distributor, but for all practical purposes this is pretty much the same thing as a large grocery store.) These findings corroborate a number of earlier observations, especially those reported by Engel-Yan et al. (2007), who found that banks and large grocery stores in the Toronto region were likely to provide parking at levels well above those required by zoning (p. 106). Chatman (2013) has similarly remarked that the private automobile is "doubly attractive" for grocery shopping and similar trips, even in environments that are transit-oriented (pp. 27–28), while Ersoy et al. (2016) demonstrate that free parking at shopping centres almost always acts as a "loss leader" (p. 110). If the goal of policy is to reduce the supply of surface parking, then it would certainly appear to be the case that more restrictive policies will be needed before significant reductions take place at these types of locations (Engel Yan et al., 2007, p. 110).

It is important to keep in mind, however, that land use does not necessarily dictate outcomes when it comes to parking, and many of the land uses associated with the greatest net increases observed in this project (Table 14, p. 122) also occur in conjunction with significant net decreases (Table 15, p. 124). This category includes high-rise residential uses, general office uses, universities, and—most relevantly for the present discussion—shopping/retail centres. While shopping centres were responsible for major increases in surface parking in four municipalities, they were also associated with sizeable net decreases in Burlington and Waterloo.[1] Surface parking around the shopping mall located in the middle of Uptown Waterloo decreased by 4,380 m^2, with much of the removed parking area replaced by public space (Waterloo Public Square). In Burlington, the shopping centre in question is similarly situated more centrally within Downtown Burlington—and it is surely no coincidence that this shopping centre is located next to a parking structure. The fact that these large retail uses are associated

[1] Barrie is also listed next to "shopping/retail centre" in Table 15 because this land use is indeed associated with changes in surface parking on one of the blocks with the three highest shares of total NBLA removed. However, the change in parking area associated with this use on block BAR.45 was actually a small increase of 35 m^2.

with net decreases in surface parking area and are also found in denser, more central areas calls to mind Ersoy et al.'s (2016) finding that parking ceases to serve as a loss leader when traffic congestion becomes a significant factor.

This has important implications for planning practice, as it points to the possibility of introducing incremental parking reform at the individual development level, in circumstances where wider-reaching reform initiatives may not be possible. Because land use does not appear to be the sole determining factor dictating how the amount of parking must change in conjunction with development, there is an opportunity to pursue smaller-scale, site-specific changes aimed at decreasing the amount of land devoted to surface parking, especially in denser downtown environments. Such smaller-scale change could involve many of the options reviewed in the policy analysis portion of this project, including reduced minimum requirements (especially if the site can be easily accessed by transit or other modes), arrangements for shared parking between multiple uses on the same site or between neighbouring sites, and the provision of cash-in-lieu to finance smaller, more centralized parking facilities.

Surface parking at Milton's regional transit station

Considering the attention researchers have given to parking's influence on the travel behaviour of Canadian commuters, it is worth taking a quick look at the regional transit (GO Transit) station located towards the northeastern end of the Downtown Milton Urban Growth Centre. The expansion of surface parking associated with the Milton GO station resulted in the addition of just over 6,000 m^2 of parking.[2] (This expansion accounts for almost all of the net increase that took place on block MLN.29, which itself holds the second greatest share of Milton's

[2] Barrie saw a similar amount of parking added with its Allandale GO station—6,030 m^2 on block BAR.74—but the increases were distributed across a number of small parking areas. Incidentally, the Allandale station is located within a somewhat more densely developed area to the south of Downtown Barrie proper.

net block-level area added.) This number is somewhat misleading, though, as much of this expansion took place on lands that, in 2005, were used for parking but not associated with the GO station. (The property in question appears to have been associated with some sort of employment or office use; by 2018, the site has been completely taken over by GO parking.) All told, the parking facilities for the Milton GO station occupy a little more than 42,000 m^2, according to aerial images from 2018.

The changes observed around the Milton GO station, which is located outside the downtown area amid less dense commercial and employment uses, support the conclusions reached by Duncan (2010) regarding land use around BART (Bay Area Rapid Transit) stations in less dense areas of the San Francisco metro region. Duncan shows that, because parking facilities at these stations have such large "commuter catchment areas," replacing them with transit-oriented development does "not represent a practical strategy" in terms of ridership (p. 176)—although this does not preclude TOD from eventually becoming a practical possibility if more development is encouraged in the vicinity (Duncan, 2010, p. 176). The area surrounding Milton's GO station is zoned "Urban Growth Centre Mixed Use" (Town of Milton, 2018b), which permits a variety of residential and commercial uses, suggesting that there are policies in place for the area to eventually encourage more transit-supportive development. At the same time, the fact that new surface parking facilities measuring 42,125 m^2 have been installed since 2005 (along with another 43,805 m^2 of surface parking at the newly developed power centre on the neighbouring block), we can speculate with some confidence that the vicinity of the Milton GO station is unlikely to see compact, transit-oriented development at any point in the immediate future.

In their survey of commuters using regional transit in the Greater Toronto–Hamilton Area—which is almost certainly GO Transit—Rashedi et al. (2017) found that the introduction of parking fees at transit stations would very likely lead to "losing some regional transit users" (p. 11). The extensive tracts of parking at the Milton GO station, then, might very well be the result of fears on the transit agency's part that providing anything less than an over-abundance of free parking might lead to losing significant numbers of transit users (especially when we take into account deeply entrenched attitudes that see abundant parking as an absolute necessity for economic well-being). However, such extensive tracts of parking may not be necessary, despite what we see in the case of the Milton GO station: despite their findings about the effects of parking fees on ridership, Rashedi et al. suggest that commuters overall appear to be more sensitive to other trip characteristics, such as transit fare, egress time, and the cost of parking at work (pp. 11–12). If this is the case, then coordinated regional policy—involving, for example, parking fees at various locations, "cash-out" initiatives, and improved connections between facilities—could conceivably work together to decrease the amount of parking at park-and-ride stations without sacrificing ridership.

Parking intensification

As Agarwal and Collins (2016) have remarked, owning a car is "pervasive and usually unavoidable" in Canada's mid-size cities (p. 8), suggesting that it can be very difficult for residents to avoid some level of automobile dependence. With this in mind, it is important to note that decreased amounts of surface parking do not necessarily mean decreased amounts of parking overall: in this project, we have seen a number of instances where a decrease in surface parking has been accompanied by the establishment of other forms, primarily underground garages (see Table 15 on p. 124, where the names of municipalities where this has happened appear in bold). The replacement of surface parking with underground parking occurred most frequently in Kitchener and Hamilton, which both appear in bold multiple times in Table 15. This could very well indicate that land values in these two UGCs tend to be higher than in the others, thereby resulting in land being "invested more productively" (McCahill & Garrick, 2014, p. 40).

One concern regarding the replacement of surface parking with other forms is that this may not generally address the issue of automobile dependence. However, a few crucial points need to be made:

- Underground parking and structured parking require greater initial investments and involve greater operating and maintenance costs than surface parking lots do, which means that these alternative forms are much less likely to provide parking for free. Charging for these forms of parking in turn works as a form of demand management.
- Both structured parking and underground parking—particularly the latter—have a less detrimental effect on the quality of the urban environment than surface parking does.
- Parking structures and underground garages are able to provide more parking spaces per unit area than surface parking lots—indeed, that is the very reason they are constructed in the first place. As a result, these alternative forms of parking can support a greater number of surrounding uses and can be used to encourage drivers to park once and visit multiple locations (a likelihood enhanced by the fact that this parking is less likely to be free).

By supporting more parking in less area, the provision of more parking structures and underground garages represents an area-management strategy that we might call "parking intensification." These alternative forms also offer an intermediate step towards reduced automobile dependence, by providing terminal capacity while supporting higher densities, more walkable surroundings, and urban environments better able to support other modes of transportation. If the Province of Ontario is serious about the transportation goals set out in the Growth Plan, then it should strongly consider including some level of support for "parking intensification."

Vacant lots

According to much of the literature, land in city centres and downtown areas is in many cases too valuable to be used for surface parking, and the imposition of minimum parking requirements in these areas results in parking lots consuming land that could be used more densely and more productively (Brueckner & Franco, 2018; Marshall et al., 2008; McCahill & Garrick, 2014). If this is the case, then the results from this project raise an important question: why does Table 15 (p. 124) show that "vacant land" is the "use" associated with the greatest net decrease in parking area? (It is worth repeating that the figure reported in Table 15 does *not* include vacant lots and vacant areas that are still accessible for parking purposes.)

The conversion of parking to vacant land supports the argument that Blais (2010) makes, that the current property tax system disincentivizes the conversion of under-utilized land to more productive uses. In Ontario, she writes, the province offers "property tax rebates for vacant commercial and industrial buildings" and makes "vacant or excess industrial and commercial properties … eligible for tax reductions" (Blais, 2010, p. 105). The longer-term effects of such programs is to "remove an incentive to the use of these buildings and the development of vacant lands," which in turn detracts from the overall urban environment (Blais, 2010, p. 105). The areas of interest examined in this project show a number of cases where former commercial and industrial properties[3] have, from all appearances, fallen into disuse. One such instance, mentioned near the start of the Results chapter, is the parking lot designated STC17.P12 (see Fig. 7 on p. 109), which is associated with what may have been a distribution centre (an educated guess based primarily on the number of loading bays) but which appears to have been abandoned by 2018. (Because most of the former parking area is still accessible for parking purposes, this particular instance was classified as "no change"; see the discussion on p. 108.) Other examples of larger parking areas that have been converted into vacant lands include BAR58.P08 (a decrease of 10,615 m^2), which was likely associated with some sort of commercial use, and BNF62.P08 (a more modest decrease of 800 m^2), likely either a commercial or an employment use. Even Kitchener, where the installation of underground parking suggests that land values may be higher than elsewhere, is not immune to this phenomenon, as some of the formerly industrial lands along the rail tracks on block KIT.35 appear to be vacant or abandoned.

In a similar vein, Blais (2010) maintains that "distortions inherent in the property tax system" not only disincentivize the improvement of under-utilized properties but also often hinder the remediation of "brownfield" sites (p. 105). To address such situations, she argues in support of alternatives such as land value taxation (LVT), which shifts the basis of taxation from the assessment value of the property to the value of the land itself. In doing so, LVT encourages property improvements and denser development patterns, making it "considerably less attractive to hold land in an under-utilized state" (Blais, 2010, p. 187). Such alternatives, then, could support the more timely redevelopment of downtown surface parking lots that are no longer needed. They could also support the process of "parking intensification" described in the previous section.

[3] At least, these are considered the most likely land uses, based on the characteristics of the buildings and the overall layout of the sites in question.

Possible effectiveness of parking exemption areas

As shown in Table 16 (p. 128), five of the twelve municipalities in the project sample have been given tier values of 3 or higher for the "exemption area" category (geographic axis), meaning that their zoning by-laws all establish some sort of defined area within which at least some land uses are exempt from minimum parking requirements. (The municipalities with tier values of 2 or lower may exempt certain uses in certain areas, but do not define a parking exemption area *per se*; see p. 137 for details.) These five municipalities are Brantford, Burlington, Cambridge, Oshawa, and Peterborough; the nature of the exemptions permitted in these five areas are described on pp. 125–127.

As we saw in the Results section (see Table 16 on p. 128), the area devoted to surface parking within each of these exemption areas decreased between 2005/2006 and 2018 (regardless of the change observed across the municipality's entire area of interest). The most dramatic contrast was between Oshawa's exemption area (the largest of the five), whose admittedly modest decrease of 0.7% stands out starkly when considered alongside both the 30.1% increase observed across Oshawa's entire area of interest and the 16.1% increase observed within the boundaries of the Downtown Oshawa UGC. Oshawa's exemption area is located entirely within the downtown UGC; simple subtraction therefore shows us that the area devoted to parking within the UGC but outside the exemption area actually increased by 37,740 m^2, or 30.7%, between 2005 and 2018.[4]

Out of the five municipalities with exemption areas, Cambridge was the only one where the area devoted to surface parking outside the exemption area (but within the overall area of

[4] Using the values for parking area within the UGC given in Table 11 (p. 111)—from 229,710 m^2 in 2005 to 266,735 m^2 in 2018—and the values for the exemption area in Table 16 (p. 128)—from 106,915 m^2 in 2005 to 106,200 m^2 in 2018—yields a difference in area of 122,795 m^2 in 2005 and 160,535 m^2 in 2018 (as mentioned above, an increase of 37,740 m^2).

interest) underwent a greater decrease than that observed within the exemption area boundaries. However, we should re-emphasize here that the Galt City Centre exemption area is surrounded by a larger area within which parking requirements for non-residential uses are reduced by 25% (City of Cambridge, 2012, p. 73 [Section 2.2.2.9]), and that this "reduced requirement" area encompasses almost all of the remainder of the Downtown Cambridge UGC. It is also worth noting that the change that occurred outside Cambridge's exemption area includes the decrease of 3,130 m^2 that resulted from the removal of CAM18.P02 (see pp. 118–119 in the Results chapter for the discussion regarding this particular parking lot). The fact that almost all of the UGC is located either within the exemption area or within the wider reduced requirement area could help account for Cambridge's status an outlier in Cluster 2, whose other two municipalities saw modest increases in surface parking area between 2006 and 2018. Despite having a similar policy position, Cambridge saw a 5.1% decrease in parking area over the same timeframe. Based on the changes observed in these other two municipalities, we can hypothesize that, if we were to expand our focus to include the blocks surrounding the Galt City Centre parking policy area, much of which lies outside the Downtown Cambridge UGC, we would actually find a small increase in parking area between 2006 and 2018. At the very least, doing so would provide us with a better understanding of the impact Cambridge's exemption area may have had on the area devoted to parking in Galt City Centre.

While this sample of five exemption areas is not sufficiently large for us to make conclusive statements, the changes observed nonetheless strongly suggest the possibility that the establishment of a parking exemption area is associated with a decrease in the area devoted to surface parking within that area. The plausibility of such a connection is bolstered by the existing literature, most notably by Engel-Yan et al. (2007), whose survey in the Toronto region suggests that reduced parking requirements would prove to be a "successful strategy" for reducing the amount of parking associated with many commercial and office-related land uses. Developers in other jurisdictions have similarly shown a willingness to provide lesser amounts of parking than would normally be required (Li & Guo, 2014; Manville, 2013)—at least, once they come to understand that the existing supply of parking is already more than enough to meet demand (McCahill & Garrick, 2014, p. 35).

Even if we were to confirm an association between exemption areas and decreased amounts of parking, however, we cannot yet say anything about the direction of causality. The exemption areas considered in this project are all located in denser, more central urban areas, within which parking often "uses up land that could otherwise be invested more productively" (McCahill & Garrick, 2014, p. 40). In other words, it is quite possible that exemption areas are more likely to be established in areas where there has not been much demand for parking in the first place, or where the demand for parking is outweighed by competing demands for limited amounts of land. Even so, there would certainly appear to be some willingness to provide less parking in such areas, which the establishment of an exemption area simply allows to manifest itself.

At the same time, the increases in surface parking area observed outside some of these exemption areas support comments made by other researchers regarding the importance of an appropriately broad geographic scope when it comes to parking policy. Yan et al. (2019), for instance, have found that the primary response to a change in policy (in the context of their study, at least) was to change parking location (p. 48), despite the sensitivity some drivers demonstrate to egress time. Similarly, Young and Miles (2015) point to the decentralizing effects of restrictive policies in Melbourne's CBD, while McCahill and Garrick (2010) observe that different approaches to parking policy in Cambridge (Massachusetts) and Hartford have greatly influenced the spatial distribution of parking in those two cities (p. 128). As Marsden (2006) has noted, restrictive policies in the central city can be undermined by more relaxed parking standard in outlying areas, meaning that parking problems will simply “migrate” (p. 456). Indeed, the increases seen just beyond the exemption area’s borders in places like Brantford, Oshawa, or Peterborough suggest that such migrations may not involve much distance at all.

Different approaches to parking policy reform

The intent of Barter’s (2015) typology, he writes, was to highlight and clarify the “distinct dimensions” of parking policy reform that exist (p. 151). The Literature Review has outlined the three major reform thrusts identified by Barter: (1) “right-sizing” approaches, which generally involve adjustments to attitudes regarding the appropriate or necessary amount of parking to supply; (2) area management approaches, which move away from the traditional site-focused paradigm; and (3) market-based approaches, which involve a shift towards viewing parking as a “real-estate-based service” (Barter, 2015, p. 139) rather than as a form of infrastructure.[5] In addition to these three, Barter points out that his typology presents possibilities for reform or alternative approaches that have received little attention in the past, such as supply-oriented but market-based approaches, “in which any boosting of supply would need to be [done] by market-friendly tools,” or approaches that involve “more thorough deregulation, privatization, and ‘free market’ parking” (Barter, 2015, p. 154). Parking policy, in other words, is not a monolithic entity, and policy reform need not—and will not—look the same in different places at different times.

[5] See pp. 34–35 in the Literature Review for further details on these three approaches.

The methodology developed for this project for assessing and characterizing municipal policy positions, both qualitatively and quantitatively, thus represents an important tool to help policy-makers identify which approaches to parking policy reform are more likely to succeed based on their municipality's current overall mindset. As Barter (2015) emphasizes, some approaches to reform are more radical than others, involving more dramatic changes in outlook with respect to the various dimensions of his typology. On top of this, the literature on parking policy frequently remarks upon the entrenchment of minimum parking requirements and widely held concerns about a perceived link between abundant parking and economic well-being (Barter, 2010; Marsden, 2006; Willson & Roberts, 2011). Despite the general lack of evidence to support such fears (Marsden, 2006), it is highly probable that downward adjustments to attitudes about parking supply will require significant investments of time and energy. Thus, municipalities occupying more traditional site-focused and supply-oriented positions will likely find it more advisable to adopt "right-sizing" reforms (which focus on the attitudinal axis) before attempting anything more ambitious involving the geographic or economic dimensions of parking. The polarization observed along the attitudinal axis in the policy positions examined in this project similarly suggests that opinions regarding the "right" level of supply may be more sharply divided than those regarding other aspects of parking policy.

With respect to this project in particular, the five municipalities in the project sample that find themselves occupying the more conventional positions in Cluster 1 would be more likely to achieve successful reform by pursuing modest changes targeted at addressing the mindset that parking needs to be provided abundantly. These changes could involve shifting policies towards being more amenable to reduced minimum requirements and exemptions from requirements, or steps taken towards demand management; beyond policy, such changes would also be more likely to succeed if coupled with public awareness and education regarding the existing surplus of parking and the benefits of more efficiently managing the supply and demand.

Indeed, considering the persistence of the "Suburban New World" policy mindset (Barter, 2015, p. 146) and the fact that automobile parking tends to be "expected but unnoticed" (Taylor & van Bemmel-Misrachi, 2017, p. 287), it is quite possible that some municipalities may not even realize just how conventional their overall policy position regarding parking actually is. In many cases, applying the methodology presented here could prove a valuable and eye-opening exercise for policy-makers and municipal planners. Meanwhile, those municipalities that already find themselves with lower "scores" along the attitudinal axis are better positioned to explore alternatives oriented towards area management or market-based strategies, such as increased opportunities for shared parking arrangements, more aggressive promotion of cash-in-lieu, or even demand-based pricing for on-street parking, as well as more restrictive approaches to supply.

Directions for future research

We have already seen that the results from this project strongly suggest that parking exemption areas deserve more attention from both researchers and policy-makers. A number of other aspects of policy similarly represent potentially fruitful avenues of inquiry for future investigators. There are also opportunities to refine the methodology used for this project and to expand its scope to consider other situations and municipalities. This section will focus on these possibilities by looking at three categories:

- refinements to the typology and methods used for the analysis of parking policy;
- extensions of the methodology employed in this project; and
- new parking-related topics that merit further exploration.

Refinements to typology and to project methods

Some of the methods used in this project were novel, having been specifically developed for this exploratory research; thus, there remain a number of opportunities to refine these processes (particularly when it comes to the policy analysis phase). This section describes these refinements while also addressing some of the shortcomings that have imposed limitations on what we can say based on the project results.

Mapping phase. During data collection for the mapping phase, it was necessary to make a distinction between parking lots and driveways (see the discussion in the Methodology chapter, at the end of the mapping phase data collection section, pp. 73–74, as well as the more detailed treatment of the topic in Appendix D). This distinction was motivated both by a recognition of the functional difference between the two and by the interests of expediency, since including residential driveways would have significantly increased the time required to complete data collection for the project's mapping phase. Nonetheless, changes to driveways often involve changes to the stock of residential surface parking, and a more thorough version of this study should do away with the distinction in order to arrive at a more complete picture. This project also focused on off-street parking, again for the sake of expediency but also because zoning regulations primarily apply to off-street facilities. However, considering the important role that on-street parking can play in downtown areas and as an area management technique, future studies using a similar methodology should consider the question of including on-street parking spaces.

The discussion of the adjustments and corrections made to the initial results of the mapping phase (see pp. 105–110) alluded to some of the shortcomings of relying primarily on aerial photography as a data source. One important challenge during this phase was presented by construction and redevelopment projects; information from other sources, such as site plans, could prove especially helpful in determining the amount of parking that existed on a given site before redevelopment on that site took place or in estimating the amount that will likely exist once development is complete.

Policy analysis phase. The most significant factor affecting the findings from the policy analysis phase involves the dates of some of the policy documents used. A good number of the twelve sample municipalities had an official plan or a zoning by-law (or both) that were adopted or enacted after the Growth Plan had already come into effect. The policy analysis results therefore rely upon the assumption that policy positions have remained consistent as the municipalities in question have replaced their earlier documents. In order to arrive at a fair characterization of positions covering the entire period of interest, it would be necessary to obtain copies of earlier official plans and zoning by-laws for these municipalities to determine whether any important changes in policy position or mindsets had occurred. There are also other important documents that likely express municipal mindsets regarding parking policy and that could influence on-the-ground changes in surface parking. The policy analysis portions of future studies should consider a broader selection of such documents, including Transportation Master Plans, parking strategies, and other relevant by-laws.

One notable omission that needs to be addressed is the absence of specific minimum parking requirements from the categories under the attitudinal axis—in other words, how many parking spaces do different zoning by-laws require for various land uses? The main reason for this omission is the surprising level of difficulty involved in arriving at a consistent basis of comparison for minimum requirements across even such a small sample of municipalities. Different zoning by-laws include a variety of different land uses and use categories, with some listing a number of distinct, specific uses and others relying more upon general categories. Even when multiple by-laws do include the same specific use, the parking requirement for that use will not necessarily be based upon the same criterion (e.g., gross floor area versus permitted capacity). Furthermore, focusing too much attention on this one specific aspect at too fine a level of detail presented a risk of getting too "deep into the weeds" and of overemphasizing this particular element.

As for refinements, one area to address is the somewhat subjective judgment involved in assigning tier values for some policy categories. In a few cases, tier values may have been assigned based more on relative positions among the twelve sample municipalities, rather than representing more absolute positions along a spectrum of possibilities (with perhaps the most prominent example being the off-site parking category, under the geographic axis). Further experience with this method of analysis using policies from a wider range of municipalities, along with steps taken to standardize tier values across categories, would help refine the procedure and make this sort of policy analysis more rigorous and systematic. Achieving a more systematically consistent method for assigning tier values would also allow for the triangulation of results by having different researchers use the same rubric to independently assess municipal policy positions. Triangulating the results in such a way would enhance the validity of the findings from future research projects using this methodology.

The presentation of results for the assignment of tiers along the economic axis raised the issue of how to interpret these values (see p. 144)—should a higher value really be interpreted as a municipality adopting a more "market-oriented" approach to parking? One possible refinement to the system would be to have this axis incorporate the sort of design and aesthetic considerations that Shoup (2005) recommends when he raises the question of quantity versus quality in parking regulation.[6] The reconfigured "economic" axis would then be renamed the "planning" axis (or, alternatively, the "regulatory" axis) with values now representing the "amount" of planning or regulation that a given mindset sees as being necessary when it comes to parking. These considerations are in keeping with Barter's (2015) treatment of this dimension of parking policy: his typology uses the term "infrastructure" to refer to "a range of goods and services with economic characteristics (market failures) that prompt them to be provided or heavily regulated by government, so that they are non-market goods" (p. 139).

Under this new configuration, the lowest possible value along the "planning" axis would represent the complete deregulation of parking, whereas higher values would indicate more attention being paid to regulations that address not only pricing, but also design, integration with the built environment, and on-site location (that is to say, location as regulated through setbacks and positioning on a given property, rather than location within the larger surrounding area, which would remain under the purview of the geographic axis). This reconfiguration would also encapsulate the spirit of Shoup's (2005) maxim, "Let the prices do the planning" (p. 471).

Final analysis phase. The presentation of the results from the final analysis phase in the previous chapter suggested that we might consider using the qualitative characterizations of policy positions, and the subsequent ranking of municipalities based on the "conventionality" of their policies, to calibrate the quantitative methods used during the policy analysis . This calibration might include a reconsideration of some of the categories used (one example being the "exemption area" category, which didn't take into account the size or geographic extent of a municipality's exemption area) and of the weightings used for some categories in the calculation

[6] Shoup (2005) suggests that planners should focus less on the number of parking spaces and more on aesthetic concerns, like improved architectural and landscape design for parking facilities, or on ensuring that parking regulations do not undermine other important aspects of urban design, such as the conservation and re-use of older buildings.

of axial positions. Making these sorts of adjustments could help achieve better agreement between the quantitative results (which allow for more precise assessments and comparisons of policy positions) and the more intuitive understanding represented by the qualitative characterizations of municipal policy. (This "recalibration" would need to take place after the refinements to the "economic" or "planning" axis, discussed above, have taken place.)

Extensions of project methodology

This research project, to the best of my knowledge, is the first one to adopt a broader perspective on parking policy in mid-size Canadian cities and the first to consider overall policy positions alongside observable changes to the supply of surface parking. Our understanding of the subject would be enhanced by extending the methodology used for this project (1) to a greater portion of the area surrounding the twelve Urban Growth Centres in the project sample; (2) to the areas in and around other Urban Growth Centres established in the Growth Plan (which are generally not located in traditional downtown areas); and (3) to the downtown areas of Canadian municipalities not included in the Growth Plan, both in Ontario and in other provinces.

Municipalities included in the project sample. A logical first step in extending the application of this project's methodology, which could also help refine the processes used, would be to investigate changes to the amount of surface parking within a greater area surrounding each Urban Growth Centre in the project sample. This project involved a fairly narrow geographic focus, mostly because of time constraints. The limitations imposed by this narrow focus are particularly evident in the case of Downtown Cambridge, where important questions about the possible influence of the Galt City Centre exemption area on the stock of surface parking have gone unresolved.

Understanding how changes in parking area are distributed across a wider area is particularly important, considering what others have said about the need to adopt a sufficiently broad scope and a more regional perspective when it comes to parking policy (Marsden, 2006; McCahill & Garrick, 2010; Young & Miles, 2015). Given what the literature tells us, we would be justified in expecting to see increases in the amount of surface parking outside the city centre, even in municipalities that saw decreases within their UGCs. To take one example, there is a dramatic difference between the decrease in surface parking area observed within the Downtown Barrie UGC (−6.3% with respect to parking area in the UGC in 2004), on the one hand, and the changes observed over Barrie's entire area of interest (–0.74% relative to overall parking area in 2004).[7] Using the results presented in Table 11 (p. 111), simple subtraction tells us that parking lots situated entirely outside the Downtown Barrie UGC actually increased in area, by 12,245 m^2 (or 6.5% of the 2004 area), between 2004 and 2019. This increase essentially "cancels out" much of the decrease that took place within the Urban Growth Centre itself.

Urban Growth Centres not included in the project sample. The Growth Plan defines thirteen additional Urban Growth Centres, most of them located outside of traditional downtown areas,[8] that were not included in this study. Thus, it seems logical to extend the project methodology to include these remaining UGCs. This would help us understand the nature of changes in surface parking area in these municipalities, and would provide an opportunity to see whether the general trend of municipalities with less conventional parking policy positions seeing greater decreases in surface parking area holds true for a larger sample. This, in turn,

[7] Unlike most of the other UGCs considered here, the boundaries of the Downtown Barrie UGC tend not to follow the street network, which means that only small portions of many of Barrie's 88 blocks fall within the UGC boundaries. As a result, more area outside the UGC itself was included for Barrie than for any of the other eleven municipalities: 207 hectares (which includes some "background" area, most of it roads), roughly 1.3 times the size of the 156-hectare Downtown Barrie UGC itself.
[8] The lone exception is the Downtown Toronto Urban Growth Centre.

would help us establish which categories or aspects of policy are more likely to be related to the supply of surface parking, as well as providing an opportunity to investigate whether the stock of surface parking outside downtown areas has changed in significantly different ways.

Other municipalities in Ontario and elsewhere in Canada. The Growth Plan applies to only a subset of Ontario's municipalities, and the research described in this report has had little to say about other cities and towns both in and outside of the province. Of course, we cannot look at changes within a defined Urban Growth Centre for those municipalities not included in the Growth Plan. Nevertheless, it might still be enlightening to investigate changes to the supply of surface parking in and around other cities' downtown areas, especially alongside an analysis of their policy positions based on the methodology used for this project. This could provide us with a potentially useful "control" group to compare against the "treatment" represented by the Growth Plan's intensification policies and targets. It would also enhance our understanding of surface parking and parking policy in Canada's mid-size cities, a subject where there remains much that we can learn.

New parking-related topics

The results from this project suggest a number of ways in which we might enhance our understanding of the relationships between parking policy and changes in surface parking area. This includes both specific strategies and policies that merit more in-depth exploration, as well as more general approaches that will help us better understand and appreciate the mindsets that inform parking policy decisions.

One specific policy instrument that deserves further investigation is the establishment of parking exemption areas. As we have already seen, the five exemption areas found in the project sample all saw some sort of decrease in the area devoted to surface parking, regardless of the change that took place in the municipality's area of interest more generally. Although a sample of five is too small to allow us to make any conclusive statements, and although we cannot, at this point, say anything about the direction of causality, the findings from this project regarding exemption area nonetheless raise some interesting questions to be taken up by future researchers, among them, How many mid-size Canadian cities have established such exemption areas? Does the observed decrease in parking area hold across a larger sample? Are exemption areas the reason for the decrease, or are such areas established in places where the demand for surface parking is already low?

Another specific aspect of parking policy that deserves further study is the designation of community improvement project areas with the purpose of addressing the condition of parking facilities. This project found that the two municipalities that experienced the greatest overall increases in surface parking area (Milton and Oshawa) were also the only two that had active Community Improvement Plans to address parking during the time period in question. Again, this is too small a sample for us to make conclusive statements, but it is worth assembling a larger sample of municipalities with such CIPs to investigate any possible relationship with the supply of parking. This observation also raises interesting questions about more general mindsets: do the mindsets that motivate the designation of such CIPs accurately reflect on-the-ground conditions? More broadly, what conditions or circumstances motivate the designation of such projects and areas?

Staying within the project sample for now, it is also interesting to note that some municipalities have one policy category that appears "anomalous," considered alongside the other categories and the municipality's overall policy position. For instance, Oshawa has defined a sizeable exemption area, even though its policies are otherwise very site-focused; in contrast, neither Kitchener nor St. Catharines have established an exemption area, despite the fact that both are quite amenable to other area management strategies and approaches. Exploring the motivations and mindsets behind such apparent “anomalies” might prove fruitful in helping us understand how municipalities make decisions regarding parking policy. We have also identified Barrie, Guelph, and Peterborough as outliers, in that they all maintain fairly conventional positions regarding parking policy and yet all saw decreases—albeit small ones—in the amount of surface parking within their areas of interest. Are these decreases simply a side effect of this project’s focus on central and downtown areas? Or might a closer look at these specific cases help us understand factors besides policy that affect the supply of surface parking?

Taking a broader perspective on parking policy, the emphasis that Barter’s (2015) typology puts on mindsets suggests that paying more attention to this dimension of decision-making, the attitudes and assumptions that, consciously or not, underlie parking policy decisions. For example, the terms “adequate” and “sufficient” parking appear quite often in the various policy documents considered in this project, and appear to indirectly express concerns about the parking supply. What do municipal planners and policy-makers consider to be “adequate” or “sufficient” parking? How do they define these terms? (*Do* they define these terms?) More generally, we likely have much to gain from looking more closely at the mindsets that inform an overall willingness, or reluctance, to pursue different approaches to parking policy (e.g., site-focused versus area management strategies, policies that would limit or even reduce supply) on the part of municipal planners and decision-makers, perhaps by engaging a sufficient sample of respondents. Another important question would be the (perceived) evidence base behind concerns that prevent municipalities from pursuing more ambitious policy reform agendas.

Finally, although this project has focused on the area devoted to surface parking, it will be necessary for future research to consider other possible measurable outcomes; our understanding of the effects of parking policy on the built environment and of the role played by automobile parking within the transportation system will need to take into account other ways in which parking policy decisions might be expressed or reflected in the make-up of cities. For instance, we might consider looking at the level of pedestrian activity in a given area, which could indicate more of an area management approach being taken, or an area's "walkability score" (or the results of a similar assessment). We might also consider the amount of development relative to the amount of surface parking as a measurement of "parking intensification," since higher values for something like "gross floor area per square metre of parking" would suggest that each individual parking space is serving a greater share of the surrounding development.

The main reason to look for other possible indicators is to take into account the important relationship between parking and travel behaviour. As McCahill et al. (2016) have noted, the provision of parking is a "primary leading factor" in the decision to drive (p. 162), and a number of other studies have confirmed the link between the parking supply and travel by private automobile (McCahill & Garrick, 2012; Weinberger, 2012). Moreover, the effects of policies like "cash-out" are more likely to be expressed in indicators related to travel behaviour (Shoup, 2005, p. 262) than in changes to the amount of parking, at least in the shorter term.

Summary: Implications for researchers and for practitioners

As this chapter has shown, the project results have many implications for researchers as well as for practicing planners and policy-makers. The important points to take away from this project and its results consist of the following:

- **Exemption areas.** The possible effectiveness of parking exemption areas deserves attention both from researchers and from planning practitioners. As we have seen, there is some evidence to suggest that establishing such an area in or near city's downtown core might help produce the provision of less surface parking within that area (although care should be taken to prevent the "migration" of parking problems). While we cannot ascertain the direction of causality, there does appear to be a willingness to provide less parking in such areas. As for researchers, the topic should be investigated further, both to establish whether there is indeed a connection between exemption areas and decreased amounts of surface parking and, if so, whether it is possible to determine the direction of causality. One possible approach would be to look at specific developments that took place within exemption areas and compare the number of parking spaces provided with the number that would normally have been required of that land use according to the zoning by-law.
- **Other research topics.** The previous section has suggested a number of avenues for future research to pursue. These include specific aspects of parking policy which may be important factors in the amount of surface parking provided, such as community improvement plans and policies expressing concerns about adverse effects and the provision of "adequate" parking. The latter topic connects to more general questions regarding the mindsets that motivate decisions to pursue, or not to pursue, different approaches to parking policy and to policy reform. Research using both qualitative and quantitative methods would help us enhance our understanding of surface parking and the various dimensions of parking policy in Canada's mid-size cities.

- **Smaller-scale reform.** Considering that the greatest increases observed in the project sample were associated with larger-scale development projects, it is important for municipal planners to consider the possibility of pursuing more incremental, smaller-scale parking reform at the site-specific level in circumstances where broader initiatives may not be possible. This is especially true in cases where a development project already requires an amendment to the zoning by-law. Absent such opportunities, it is still possible to pursue public awareness and education campaigns regarding the benefits (and debunking the perceived dangers) of more efficient managing the parking supply, especially within the downtown.
- **Assessing policy positions.** The methodology presented in this report for assessing and characterizing municipal policy positions represents a valuable diagnostic tool for municipal planners and policy-makers. Achieving a better overall understanding of current mindsets and positions on parking policy will help identify the reform approaches that are most likely to succeed when choosing from the various different options for reform that are available. This diagnostic tool can also help municipalities identify specific aspects of policy which might be addressed, and may even alert municipal officials to the fact that their positions regarding parking are much more conventional than they might have thought.
- **Vacant lots.** The conversion of parking lots into significant amounts of vacant land, as witnessed in the project results, lends credence to Blais's (2010) argument and suggests that current policies incentivize the under-utilization of downtown lots. It also points to the possibility that land value may be less of a factor in the downtown areas of mid-size cities in Canada than it would be in the country's largest metro

regions. This means that policy and financial instruments that might be unintentionally hindering the improvement of vacant lots need to be identified and evaluated, in order to effectively address the situations generated by the sorts of "perverse subsidies" Blais (2010) has called our attention to.

- **Vitality of downtown areas.** It is reasonably well established at this point that downtown areas need to be friendly to pedestrian travel, and to retain their unique attributes in order to flourish. This means that downtowns are particularly susceptible to the detrimental effects of a surfeit of surface parking. At the same time, we need to recognize that a certain level of automobile dependence will persist in Canada's mid-size cities, within the foreseeable future, at least. In order to maintain the economic and social vitality of their downtown areas, planners and policy-makers need to address public attitudes and assumptions regarding automobile parking, to recognize the role that on-street parking can play in supporting a pedestrian-friendly environment, and to promote more "intensified" forms of parking. At the same time, policy-makers at higher levels of government need to seriously consider providing support for "parking intensification" in order to achieve policy objectives regarding reduced automobile dependence and increased densities in Urban Growth Centres. We are at a point where we need to create and pursue viable opportunities for parking policy reform, for the health of our cities.

Conclusion

The research presented in this report was undertaken in order to explore the ways in which municipal parking policy might be related to changes in the amount of surface parking in the downtown areas of mid-size Canadian cities. The specific focus for this project was on the downtown Urban Growth Centres (as defined in the Province of Ontario's "Growth Plan for the Greater Golden Horseshoe") of twelve municipalities located in the Greater Toronto–Hamilton Area. Achieving the project's primary goal required (1) an assessment of the changes in surface parking area that have taken place in these downtown UGCs since 2006 (when the "Growth Plan" came into effect) and (2) an examination of policy documents in order to characterize municipal positions with respect to automobile parking. The former was addressed by inspecting aerial photographs of the twelve sample municipalities, while the latter involved content analysis of the same municipalities' official plans and zoning by-laws according to three "dimensions" of parking policy derived from Barter (2015). Qualitative and quantitative techniques were used to analyze the two sets of results produced by these processes, in order to address the primary purpose of the project.

Four of the twelve municipalities in the project sample saw increases in the area devoted to surface parking in and around their Urban Growth Centres (UGCs)—two of them by significant amounts. One municipality saw its surface parking area decrease by a significant amount, while the remaining seven saw relatively modest decreases (one very close to zero). As for parking policy, five municipalities, including the two that experienced significant increases in surface parking area, occupy positions that can be characterized as more conventional within the North American context—that is, their policy mindsets are more focused on providing parking on each individual site and regard parking as something that needs to be provided abundantly. The others in the sample occupy positions that depart from the more traditional mindset to varying degrees, away from a site-focused mindset towards a more area-oriented approach and towards attitudes that regard less parking as being necessary. In general, there appears to be a trend wherein municipalities that have less conventional policy positions are more likely to see greater decreases to the amount of surface parking in and around their downtown areas—though there are also important exceptions to this trend that deserve to be examined more closely. There is also evidence to suggest that the existence of an area within which development is exempt from parking requirements may be connected to decreased amounts of surface parking, at least within the exemption area itself.

It is important both for practicing planners and for researchers to take up the possibility that such exemption areas might be an effective way to encourage the provision of less parking. As noted in the summary that concludes the previous chapter, this project has also suggested a number of other avenues for future research to explore, including specific policies related to parking as well as the more general question of mindsets, attitudes, and assumptions about parking in Canada's mid-size cities. This project has contributed to the literature on automobile parking and parking policy by enhancing our understanding of how much surface parking exists in the downtown areas of twelve mid-size cities in southwestern Ontario, by providing some insights into how this stock of surface parking might relate to municipal policy positions, and by emphasizing the need to address parking's role in helping or hindering the overall vitality of our downtown areas. The methodology used to assess municipal policy positions both qualitative and quantitatively also represents an important diagnostic tool to help municipal planners and policy-makers understand their current policy mindsets and, armed with this knowledge, to pursue approaches to policy reform that will be more likely to succeed. Even if wide-reaching reform is for some reason not possible, there are still opportunities to implement more modest reforms at the individual development level.

One important—and eye-opening—finding from this project has to do with the proportion of surface parking area to the total area in each of the twelve sample Urban Growth Centres: all twelve have devoted somewhere between 18 and 30 percent of their UGCs to surface parking, according to aerial images from 2018. Taken together, the twelve sample UGCs provided 303.98 hectares of surface parking within a combined total of 1,365.52 hectares—that is, 22.3% of these UGCs' total area has been given over to surface parking. In fact, the area devoted to surface parking within the UGC boundaries, taken as a whole, actually underwent a small increase of about 4,335 m^2 (0.43 ha) between 2005/2006 and 2018. This finding has important implications when we consider what has been said about the "durability of past preferences" expressed in the built environment (Storper & Manville, 2006, p. 1267).[1] The stock of surface parking often represents an element of the urban landscape that is "relatively inflexible" (McCahill & Garrick, 2014, p. 36). This, according to McCahill and Garrick (2014), is one reason why it is so important for cities to find alternatives to the imposition of minimum requirements for on-site parking.

The previous chapter closed by emphasizing the need to re-think the role of automobile parking in the downtowns of Canada's mid-size cities, emphasizing the importance of pursuing strategies oriented towards area management of parking facilities as well as the need to adjust current attitudes and assumptions about the amount of parking that "needs" to be provided. Some of the municipalities in the project sample have taken steps towards reform, either by defining exemption areas or by establishing lower standards (or minimum requirements of zero) for their

[1] See pp. 5–6 in the Introduction.

downtown areas. Nevertheless, the results from this project—including the 22.3% share of the twelve combined UGCs that has been claimed by surface parking—indicate that there is still much that can be done. In particular, municipal planners and policy-makers need to consider implementing strategies that are more area-oriented, including the “intensification” of parking facilities, so that downtowns and urban centres can retain the unique qualities and more compact, pedestrian-friendly environments that are vital for their well-being. As it stands, the continuing practice of imposing minimum on-site parking requirements will ultimately lead to the paving over of what could have been urban paradises.

The Canadian Institute of Planners defines “planning” as “the scientific, aesthetic, and orderly disposition of land, resources, facilities, and services with a view to securing the physical, economic, and social efficiency, health and well-being of urban and rural communities” (CIP/ICU, 2020). Yet the proliferation of surface parking seen across the Urban Growth Centres in the project sample (even those where the overall surface parking area decreased) suggests that the status quo has not produced an “orderly disposition” of land and facilities when it comes to parking. Minimum parking requirements implemented at the site level may have seemed logical when first introduced, but observations from this project suggest that parking has an insatiable appetite for land. Surface lots cover over the entire rear yards of dwellings converted to other uses, paving over lawns and gardens; parking extends itself to consume entire city blocks, stretching tendrils of asphalt into the smallest cracks and cavities around and between buildings. Parking policies and requirements have produced a supply capable of meeting any realistic level of demand, and, in many cases, levels well beyond.

In addition to promoting private automobile use and ownership, excess surface parking undermines objectives related to environmental sustainability; reduces the amount of green space available, which has implications for drainage and urban heat-island effects; and makes the urban landscape less hospitable to pedestrians and less able to achieve transit-supportive densities. The ad hoc, piecemeal approach of the twentieth century has excelled in achieving a vast and abundant supply of parking, but a much different approach will be necessary if our cities and our downtown centres are to become what we say we want them to be. In order to achieve orderly and efficient patterns of urban development, planners and policy-makers will need to pay attention to the overall supply of parking (all forms of it, but especially surface parking), and will need to devote much more time and energy to managing both demand and parking supply. Achieving a more equitable, more diverse, and more active public realm will require open-mindedness and a willingness to explore the most effective and appropriate options.

All of this will require all of us to approach these challenges with a very different mindset. It will require convincing politicians and decision-makers that parking shortages are not some looming economic disaster, and are certainly not the imminent threat they have been made out to be. It will require clear communication with citizens who have been conditioned by decades of policy to expect certain levels of automobile accessibility. It will require transit service, not lip service, with more substantial support for alternative modes of transportation and, as an intermediate step, for alternative, more efficient forms of parking itself. It will require more collaboration between property owners and local governments, in order to arrive at agreements that serve both the individual and the public good, and it will require long-term thinking and creative solutions that are much more sensitive to the local context.

It will, in short, require planning.

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Appendices

Appendix

Appendix A

Delineation of Urban Growth Centres: Sources and Adjustments Made to GIS Features

Municipality	Policy document source	Adjustments made to data feature
Barrie	Zoning By-law (2009-141), Appendix C	Feature layer downloaded directly from municipal Open Data portal
Brantford	Zoning By-law (160-90), Schedule M[a]	Based on combination of street centrelines, parcel fabric, and zoning districts
Burlington	Official Plan, Schedules D & E	Based on combination of street centrelines and zoning boundaries
Cambridge	Official Plan, Map 3	Based on street centrelines
Guelph	Official Plan, Schedule C	Based on combination of parcel fabric and street centrelines
Hamilton	Urban Hamilton Official Plan, Map B.6.1-1	Based on street centrelines
Kitchener	Official Plan, Map 4	Feature layer downloaded directly from municipal Open Data portal
Milton	Zoning By-law (016-2014), Schedule D	Based on feature layer from Land Information Ontario (Ontario MMAH, 2017), with small adjustments based on street centrelines, hydrological features, and property boundaries (approximated from aerial photographs in Google Earth Pro)
Oshawa	Zoning By-law (60-94), Schedule I	Based primarily on street centrelines and linear extensions thereof (where necessary), as well as on hydrological features (Oshawa Creek)
Peterborough	Official Plan, Schedule A-1[b]	Based on street centrelines, parcel fabric, and hydrological features (Otonabee River)

Municipality	Policy document source	Adjustments made to data feature
St. Catharines	Official Plan, Schedule D	Based on street centrelines; some slight adjustments made along southerly border to match policy document source
Waterloo	Official Plan, Schedule B2	Based on street centrelines and on property boundaries (approximated from aerial photographs in Google Earth Pro)

[a] Boundary more precisely shown in Municipal Comprehensive Review – Part 1 report, Figure 6 (City of Brantford, 2018, p. 87). [b] References also made to figures in Report to Council No. PLPD18-005, which show boundary against unlabelled street network (Humble, 2018, p. 22; p. 26).

Appendix B

Urban Growth Centre Blocks Not Bounded on All Sides by Streets

The identification codes listed in the "Block ID" column refer to the numbering system shown in Appendix C.

Block ID	Comments on block boundary
Barrie (BAR)	
BAR.63	bounded along westerly edge by railway
BAR.86	bounded along southerly edge by Kempenfelt Bay (Lake Simcoe) and along westerly edge by extension of northeasterly edge of Bayfield Street road segment polygon
BAR.87	bounded along northeasterly edge by extension of northeasterly edge of Bayfield Street road segment polygon, along easterly edge by Kempenfelt Bay (Lake Simcoe), and along southerly edge by extension of southerly edge of Tiffin Street road segment polygon
BAR.88	bounded at northwesterly corner by extension of southerly edge of Tiffin Street road segment polygon, along northerly edge by Kempenfelt Bay (Lake Simcoe), and at northeasterly corner by approximate property boundary between Nos. 20 and 24 White Oaks Road (estimated based upon aerial photographs)
Brantford (BNF)	
BNF.02	bounded on northerly edge by railway parcel
BNF.03	bounded on northerly edge by railway parcel
BNF.04	bounded on northerly edge by railway parcel
BNF.05	bounded on northerly and easterly edges by railway parcel
BNF.49	bounded on southwest side by SC Johnson Trail; block feature based on parcel fabric
BNF.67	bounded on westerly and southerly edges by SC Johnson Trail and Dike Trail, respectively

Block ID	Comments on block boundary
BNF.71	bounded on westerly and northerly edges by SC Johnson Trail and Dike Trail, respectively
BNF.72	bounded along southerly edge by parcel of land occupied by portion of Veterans Memorial Parkway
Burlington (BRL)	
BRL.01	bounded at westerly corner along walking trail joining westerly terminus of Grahams Lane with Stephenson Drive, along southwesterly edge by hydro right-of-way (approximated from aerial photographs), and at southerly corner by extension of southeasterly limit of Ghent Avenue (approximated from aerial photographs)
BRL.02	bounded along northeasterly edge by zoning boundary
BRL.04	bounded along northeasterly edge by zoning boundary
BRL.05	bounded at southerly corner by extension of northwesterly edge of Olga Drive (approximated from aerial photographs)
BRL.22	bounded along portion of southerly edge by line between Regina Drive and Bellview Crescent corresponding to approximate property boundary between Nos. 1185 and 1187 Bellview Crescent
BRL.23	bounded along middle portion of northwesterly edge by cul-de-sac and walking trail joining Maple Crossing Boulevard to westerly terminus of Caroline Street
BRL.30	bounded along westerly edge at southwesterly corner by extension of southeasterly edge of Bellview Street
BRL.45	bounded along northwesterly edge by portion of Waterfront Trail joining Martha Street to Harris Crescent
BRL.46	bounded along southerly edge by driveway between Nos. 1135 and 1141 Lakeshore Road
BRL.47	bounded along southwesterly edge by extension of northerly limit of Locust Street (approximated from aerial photographs), along southeasterly edge by Lake Ontario, and along northeasterly edge by approximate property boundary between Nos. 2196 and 2210 Lakeshore Road
Cambridge (CAM)	
CAM.24	bounded at southerly corner by sidewalk (approximate) joining southerly terminus of Wellington Street South to Ainslie Street South and corresponding with boundary of Urban Growth Centre

Block ID	Comments on block boundary
Guelph (GUE)	
GUE.01	northerly boundary based on southerly bank of Speed River according to hydrology feature layer; northeasterly boundary, corresponding to southeasterly bank of Speed River, and boundary at northwesterly corner both based on parcel fabric feature layer
GUE.02	northerly boundary, corresponding to southerly bank of Speed River, based on parcel fabric feature layer
GUE.44	boundaries along Speed River based on parcel fabric feature layer
GUE.45	boundaries along Speed River based on parcel fabric feature layer
GUE.46	boundaries along Speed River based on parcel fabric feature layer
GUE.47	boundaries along Speed River based on parcel fabric feature layer
GUE.48	northwesterly and northeasterly boundaries based on parcel fabric feature layer: northwesterly boundary corresponds to railway parcel; northeasterly boundary corresponds to extension of Huron Street
GUE.49	boundary with block GUE.50 based on boundaries of railway parcel from parcel fabric feature layer
GUE.50	boundary with block GUE.49 based on boundaries of railway parcel from parcel fabric feature layer
GUE.51	northwesterly boundary, corresponding to railway parcel, based on parcel fabric feature layer
GUE.54	southerly boundary, corresponding to railway parcel, based on parcel fabric feature layer
GUE.55	northerly boundary, corresponding to railway parcel, and westerly boundary, corresponding to easterly bank of Speed River, based on parcel fabric feature layer
GUE.57	boundaries along Speed River based on parcel fabric feature layer
GUE.59	boundaries along Speed River based on parcel fabric feature layer
Hamilton (HAM)	
	(all blocks delineated based on road network)

Block ID	Comments on block boundary
Kitchener	
KIT.02	portion of northeasterly boundary corresponds to line segment joining termini of Ahrens Street West located north and south of railway line
KIT.08	boundary at northerly corner based on extension of Breithaupt Street centreline
KIT.35	westerly boundary based on railway line
Milton (MLN)	
MLN.01	northwesterly boundary based on railway (approximated from aerial photographs); boundary between MLN.01 and MLN.03 based on culvert (approximated from aerial photographs)
MLN.03	northwesterly boundary based on railway (approximated from aerial photographs); boundary between MLN.01 and MLN.03 based on culvert (approximated from aerial photographs); boundary at northeasterly corner based on extension of southerly limit of Court Street North
MLN.04	northwesterly boundary based on railway
MLN.05	southeasterly boundary based on railway
MLN.06	boundary with MLN.07 based on railway overpass (approximated from aerial photographs)
MLN.07	boundary with MLN.06 based on railway overpass (approximated from aerial photographs)
MLN.08	boundary extending northeasterly from westerly corner based on sidewalk connecting Wilson Drive at Lorne Scots Drive with Frobisher Boulevard; boundary at northerly corner based on sidewalk connecting Bishops Court with Thompson Road North
MLN.09	southwesterly boundary corresponds to Hugh Lane
MLN.23	southeasterly boundary based on extension of northwesterly limit of Wakefield Drive
MLN.24	southeasterly boundary based on extension of northwesterly limit of Wakefield Drive
MLN.26	northeasterly and southeasterly boundaries based on sidewalk extending northeasterly from Ontario Street South south of Allendale Long Term Care Facility and extending southeasterly from intersection of Childs Drive and Nipissing Road (approximated from aerial photographs)

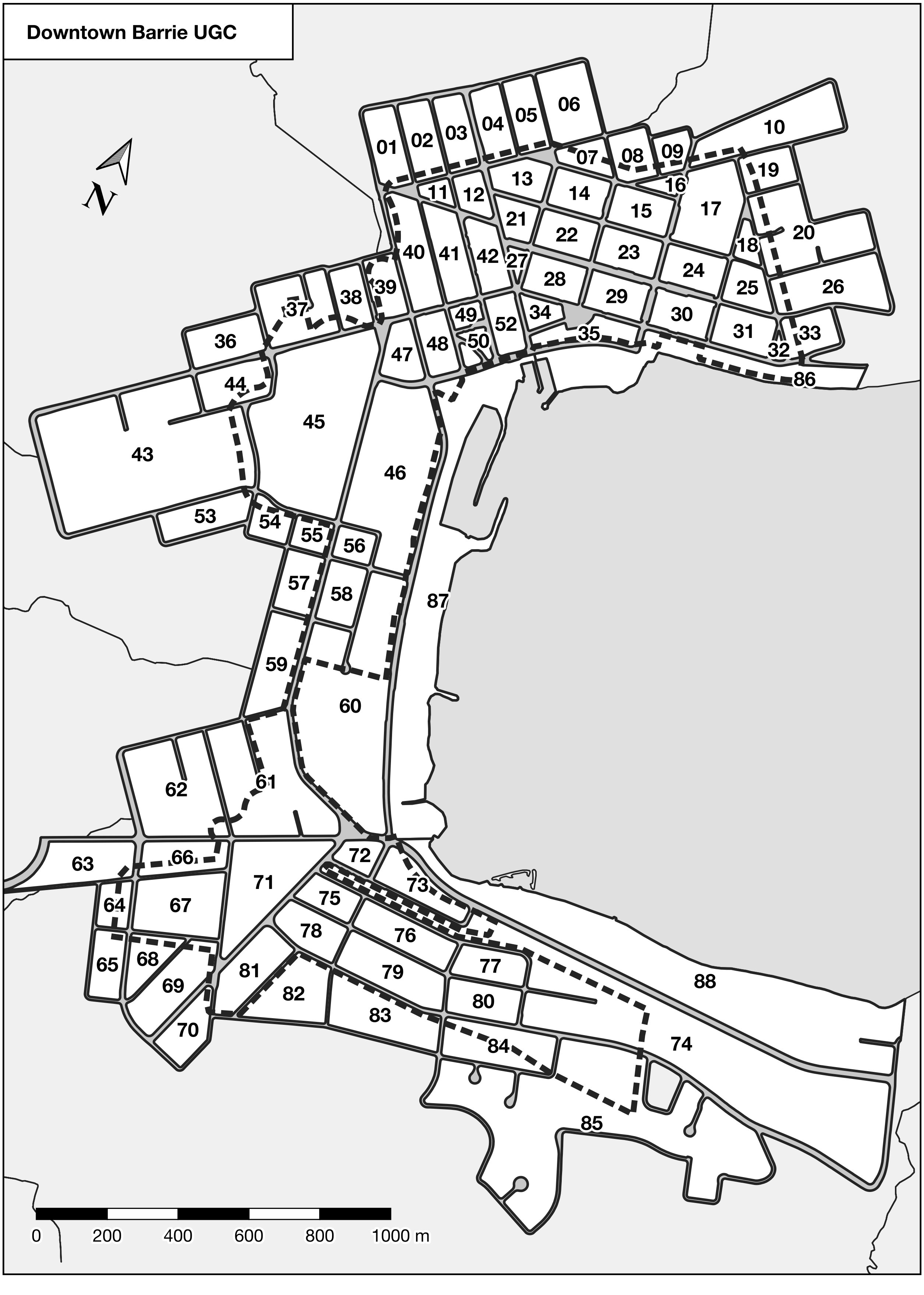
Block ID	Comments on block boundary
MLN.27	boundary with MLN.29 based on railway (approximated from aerial photographs)
MLN.29	boundary with MLN.27 based on railway (approximated from aerial photographs)
MLN.31	northeasterly boundary corresponds to unnamed creek according to hydrology feature layer
MLN.33	northeasterly boundary corresponds to unnamed creek according to hydrology feature layer
MLN.34	northeasterly boundary corresponds to unnamed creek according to hydrology feature layer; southeasterly boundary based on railway (approximated from aerial photographs)
Oshawa (OSH)	
OSH.13	northerly boundary, corresponding to unnamed path located in Valleyview Gardens, and westerly boundary, corresponding to Oshawa Creek, based on parcel fabric feature layer
OSH.28	westerly boundary based on Joseph Kolodzie Oshawa Creek Bike Path
OSH.37	westerly boundary based on Joseph Kolodzie Oshawa Creek Bike Path
OSH.55	portion of boundary along easterly edge based on extension of Drew Street centreline
Peterborough (PET)	
PET.08	easterly boundary, corresponding to westerly bank of Otonabee River, based on parcel fabric feature layer
PET.18	easterly boundary, corresponding to westerly bank of Otonabee River, based on parcel fabric feature layer
PET.27	easterly boundary based on railway parcel from parcel fabric feature layer
PET.28	easterly boundary, corresponding to westerly bank of Otonabee River, based on parcel fabric feature layer; westerly boundary based on railway parcel from parcel fabric feature layer
PET.32	easterly boundary based on railway parcel from parcel fabric feature layer
PET.33	northern portion of westerly boundary (boundary with PET.32) based on railway parcel from parcel fabric feature layer; easterly boundary, corresponding to westerly bank of Otonabee River, based on parcel fabric feature layer
PET.37	boundary along southwesterly corner based on railway parcel from parcel fabric feature layer

Block ID	Comments on block boundary
PET.38	boundary along southwesterly corner based on railway parcel from parcel fabric feature layer
PET.39	southwesterly boundary based on railway parcel from parcel fabric feature layer
PET.40	northerly boundary based on railway parcel from parcel fabric feature layer
PET.41	northerly boundary based on railway parcel from parcel fabric feature layer; easterly boundary, corresponding to westerly bank of Otonabee River, based on parcel fabric feature layer
PET.44	westerly boundary based on railway parcel from parcel fabric feature layer
PET.47	northerly and easterly boundaries, corresponding to westerly bank of Otonabee River, based on parcel fabric feature layer
St. Catharines (STC)	
	(all blocks delineated based on road network)
Waterloo (WAT)	
WAT.02	northerly boundary at northwesterly corner based on boundary of Urban Growth Centre feature layer; remainder of northerly boundary based on southerly shoreline of Silver Lake according to hydrology feature layer; boundary with WAT.08 based on unnamed pathway that meets Caroline Street North just north of Dupont Street West (approximated from aerial photographs)
WAT.08	westerly boundary extending southward from westerly corner based on line drawn from approximate southerly limit of Young Street West at its terminus to northerly point located on the easterly shoreline of Silver Lake, according to hydrology feature layer; remainder of westerly boundary based on easterly shoreline of Silver Lake according to hydrology layer; boundary with WAT.02 based on unnamed pathway that meets Caroline Street North just north of Dupont Street West (approximated from aerial photographs)
WAT.31	portion of northerly boundary near northeasterly corner based on extension of Young Street; easterly boundary based on Laurel Creek according to hydrology feature layer
WAT.52	boundary with WAT.53 based on line drawn between William Street East at Spur Line Trail and terminus of Willow Street
WAT.53	boundary with WAT.52 based on line drawn between William Street East at Spur Line Trail and terminus of Willow Street

Appendix C

Maps Showing Numbering System Used for Urban Growth Centre Blocks

Note: The thick dotted black line on each map represents the Urban Growth Centre boundary.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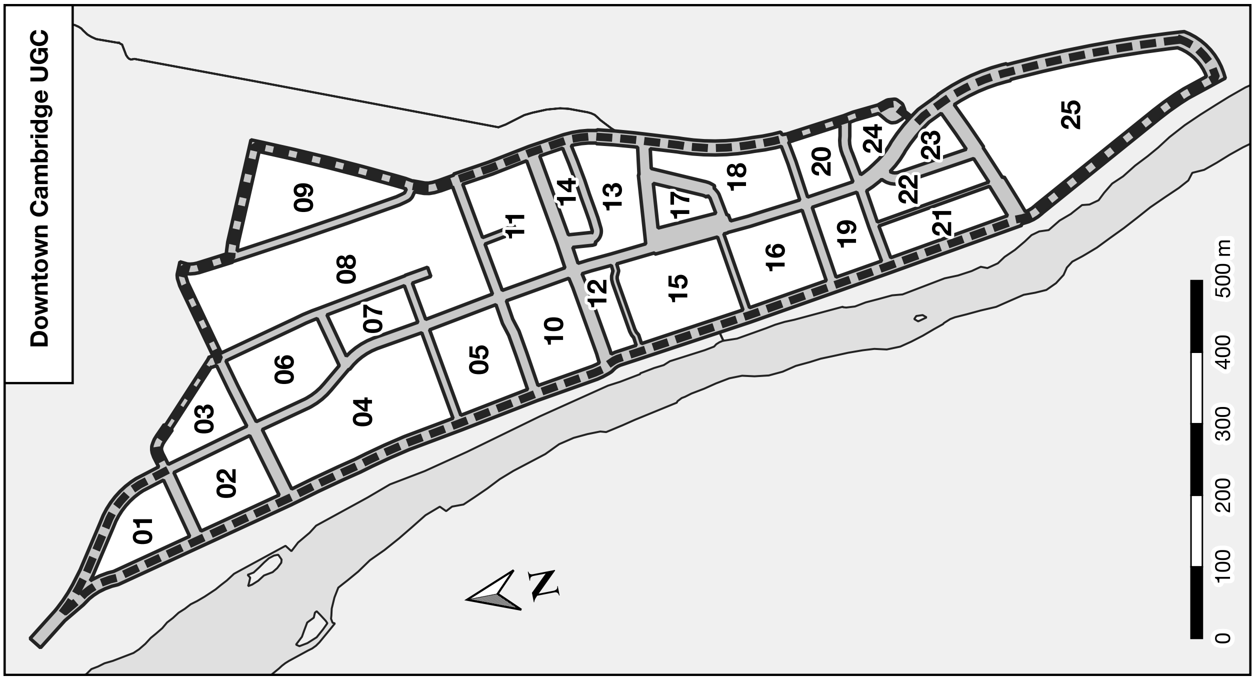
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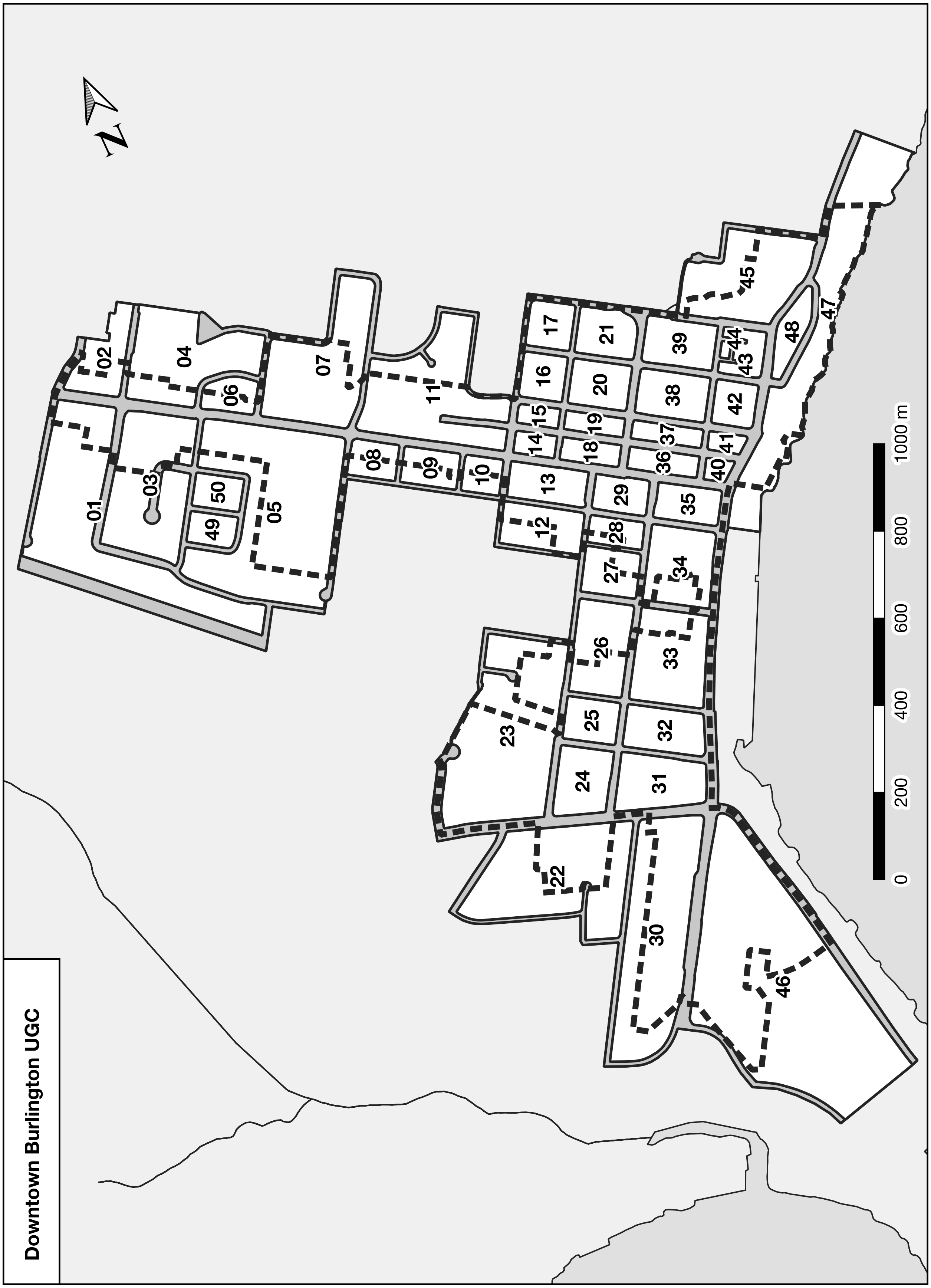
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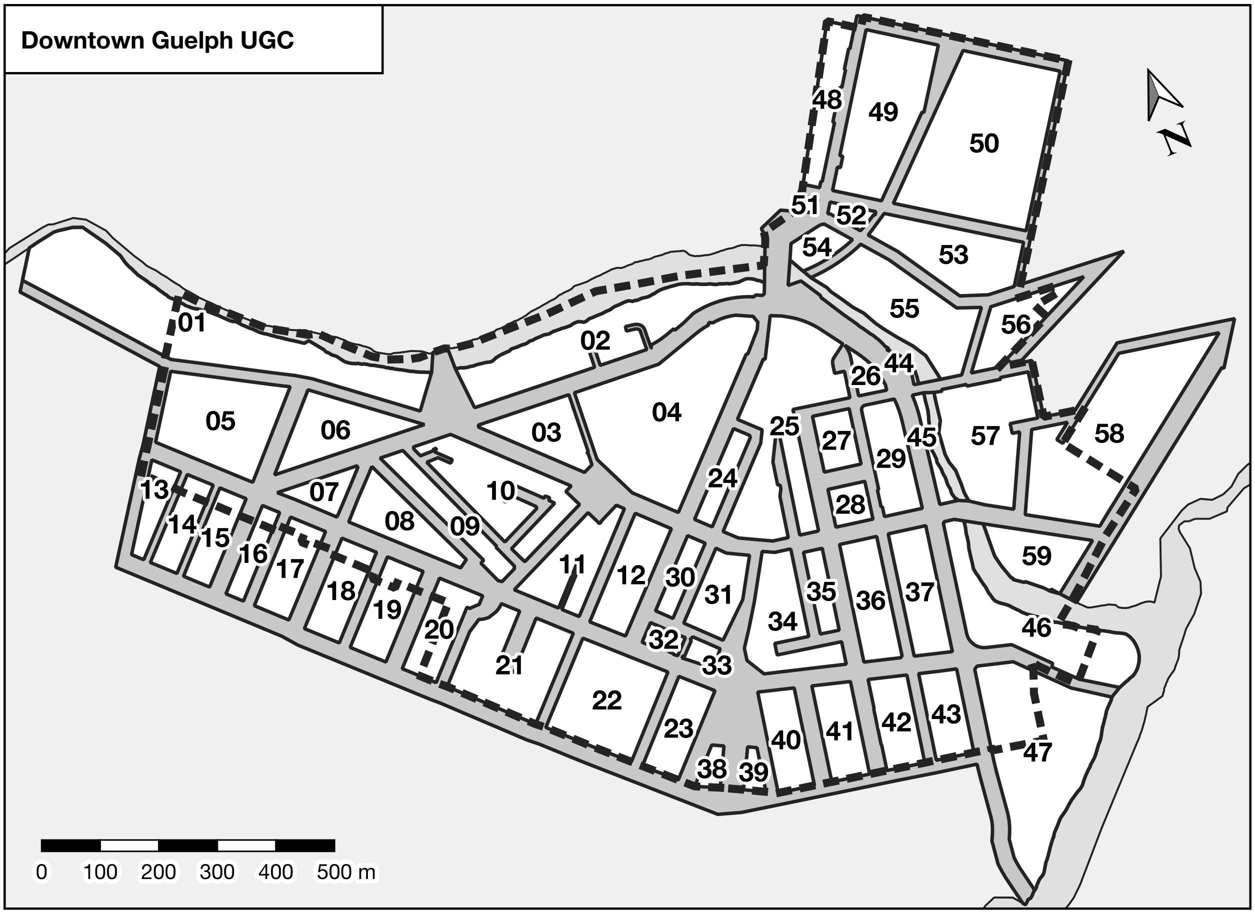
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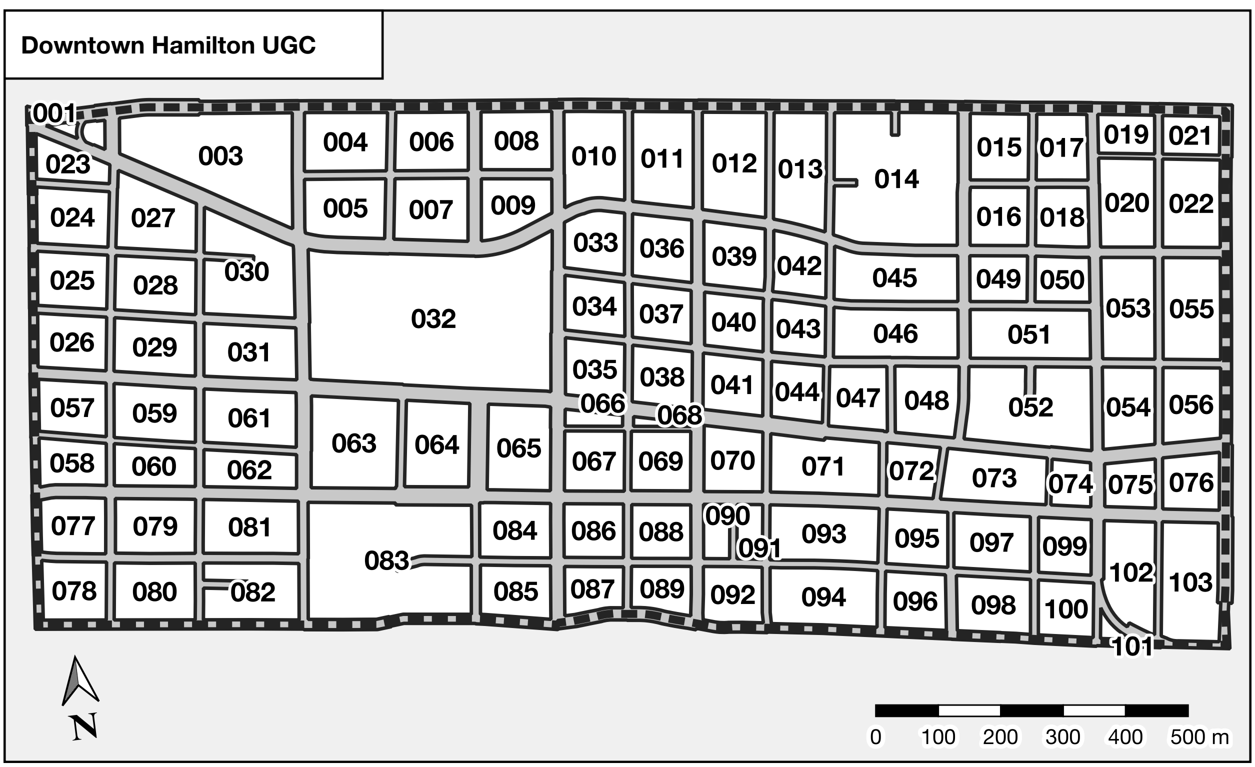
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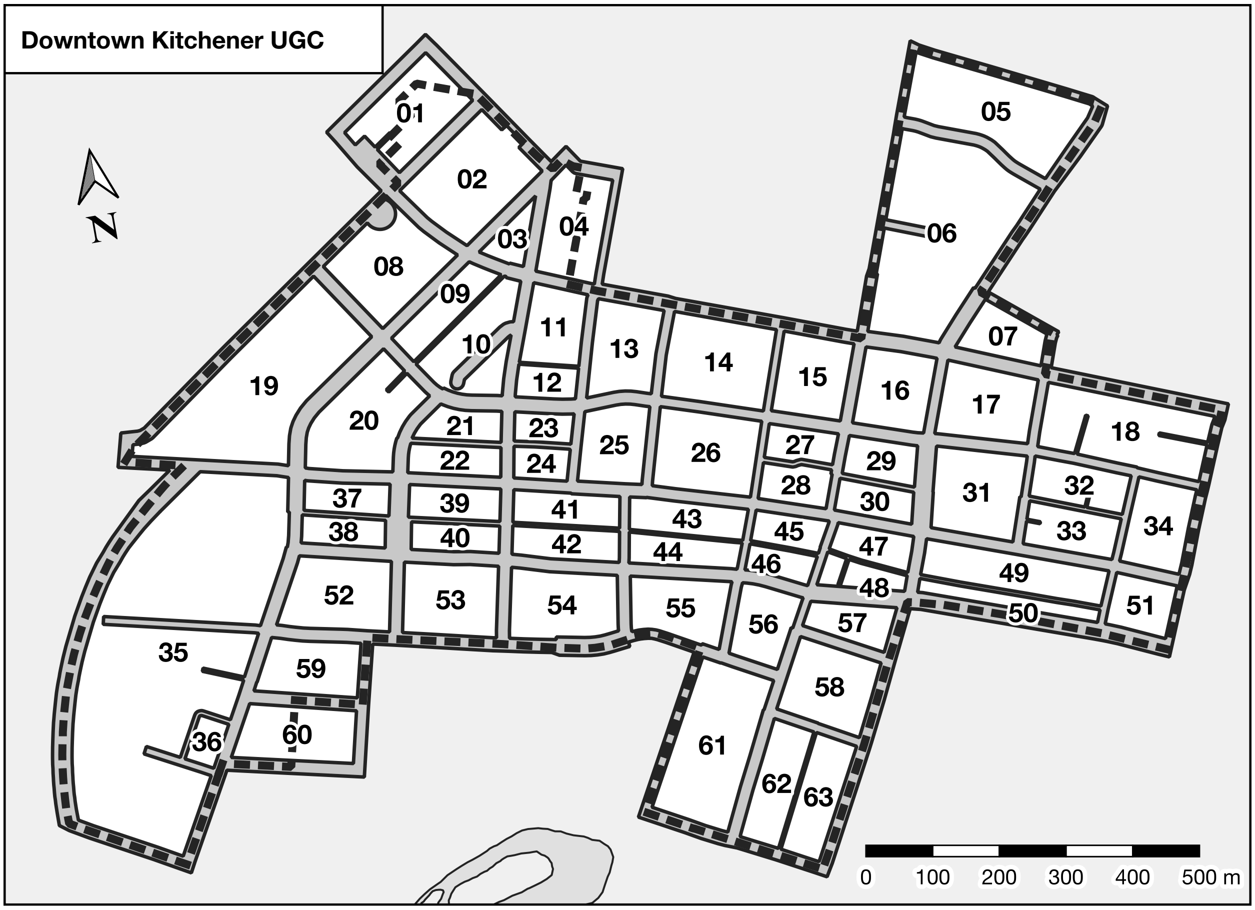
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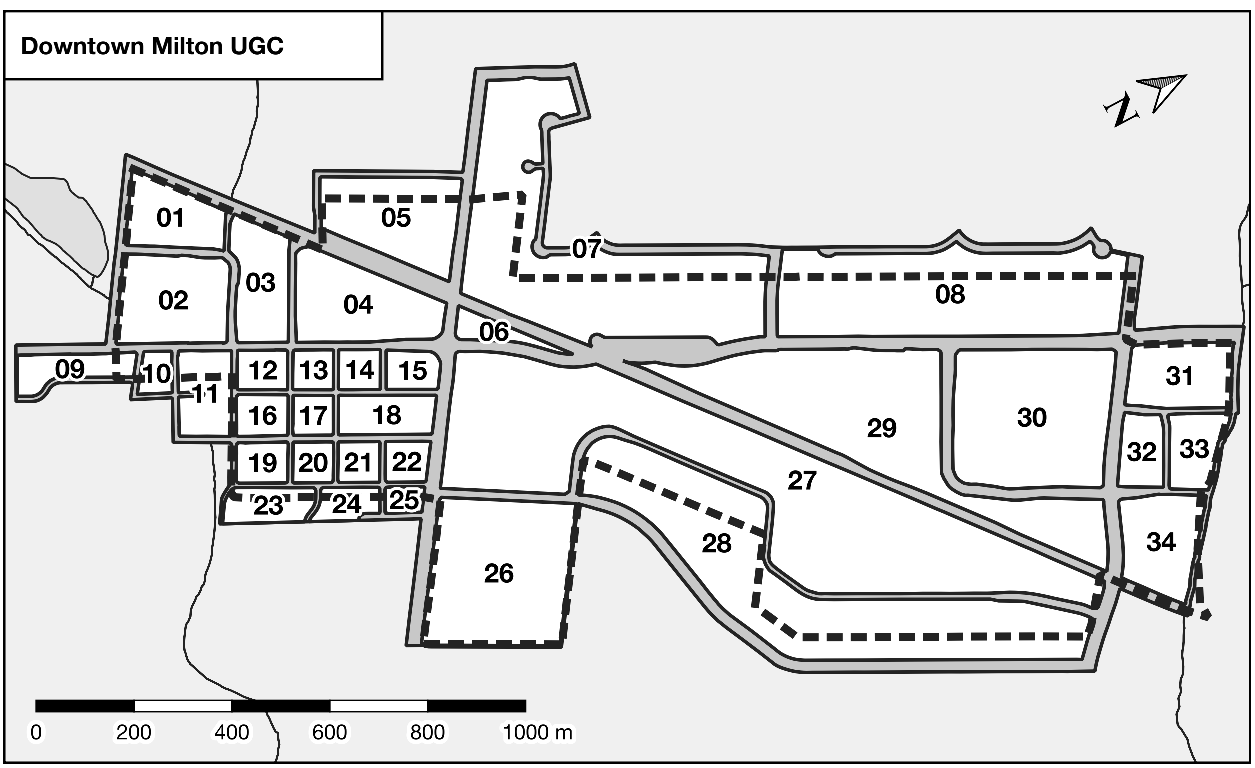
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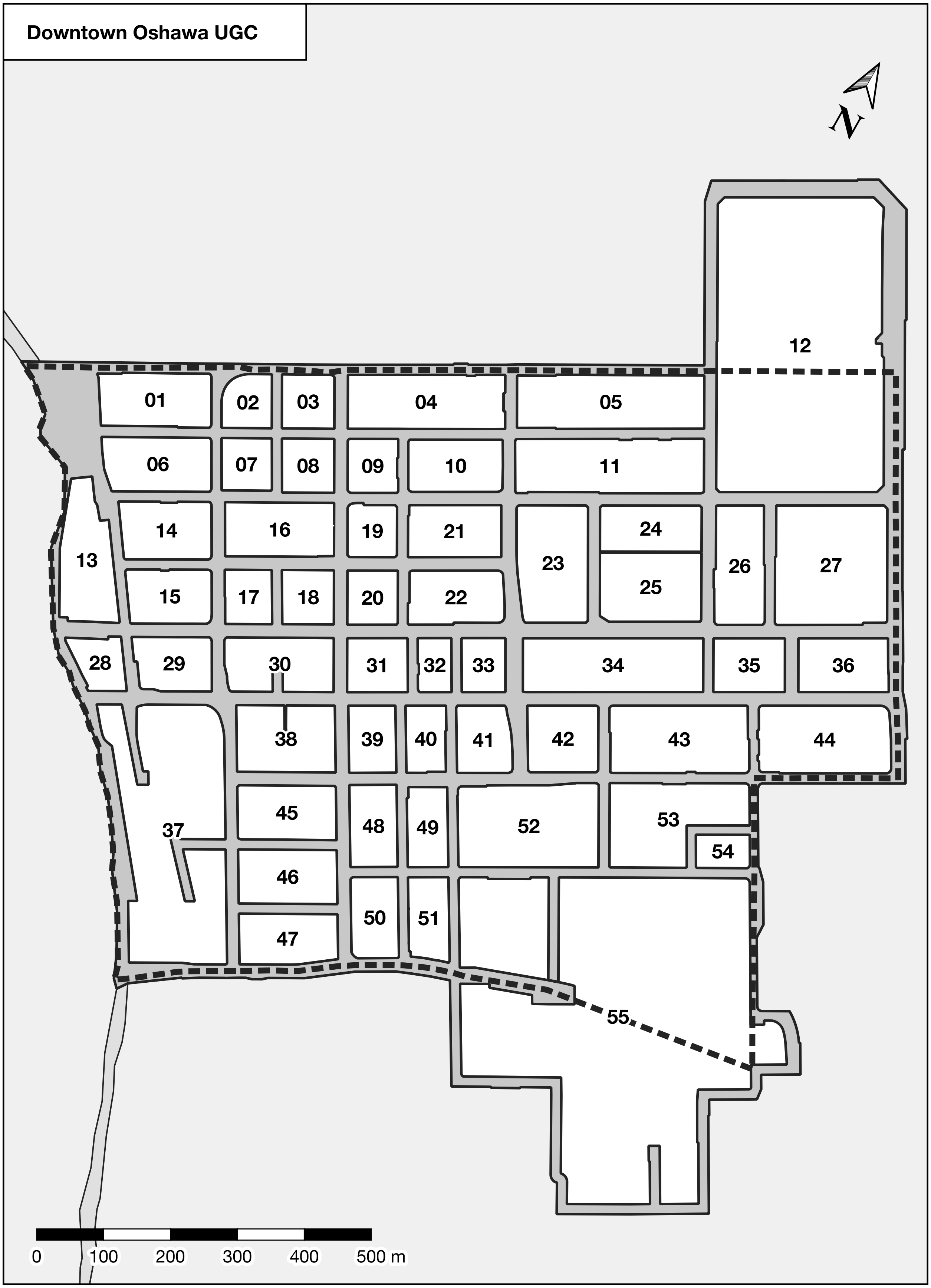

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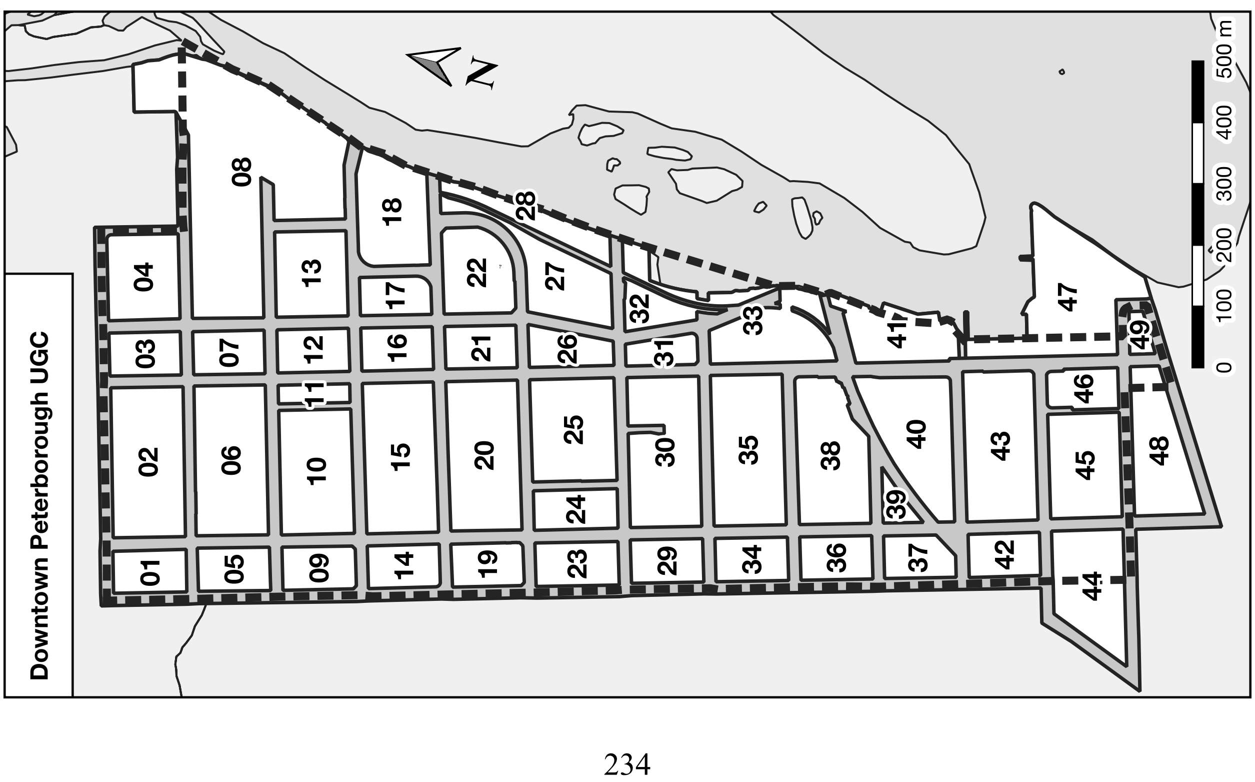
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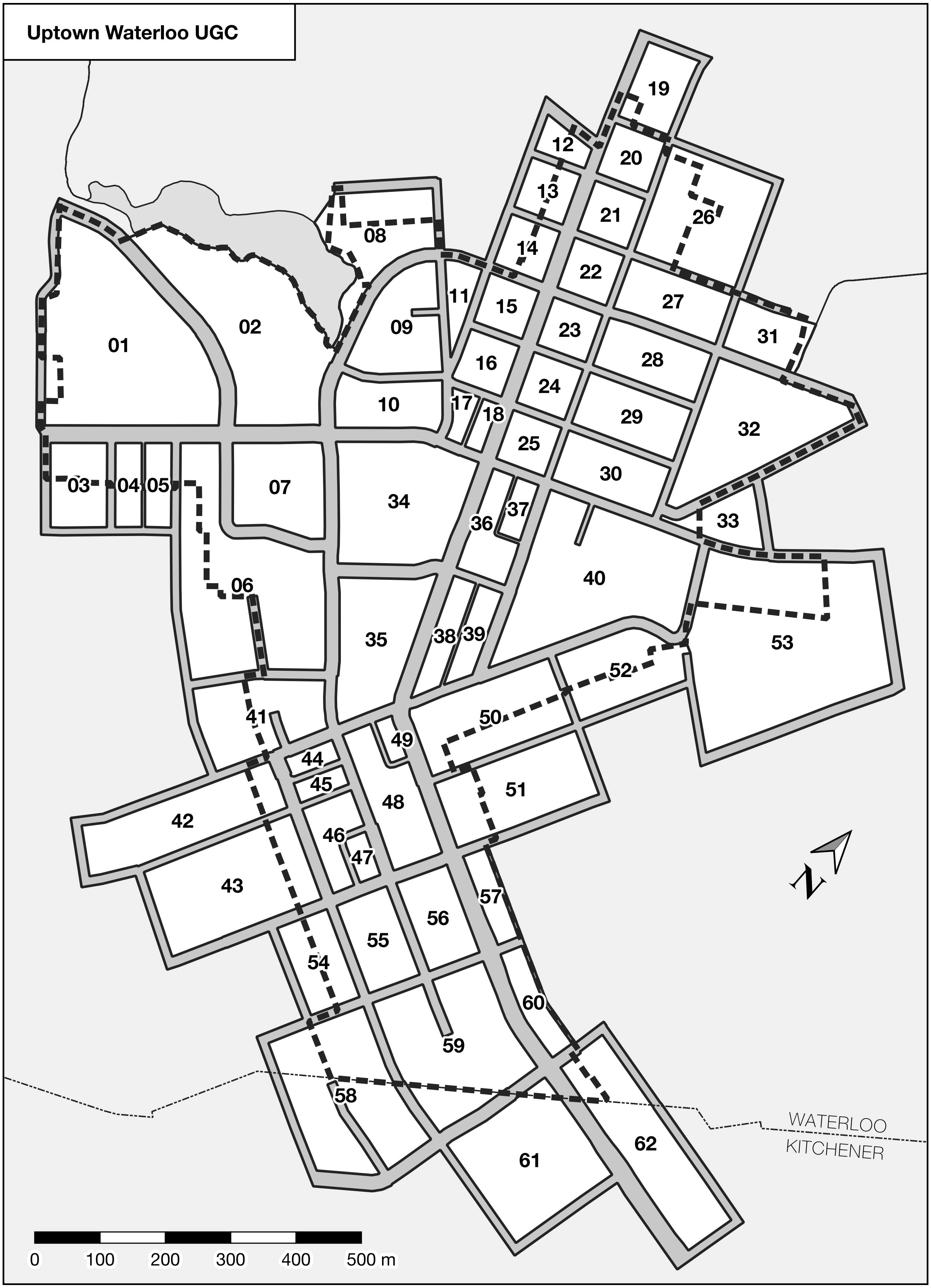

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Appendix D

What Is a Parking Lot?

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What Is a Parking Lot?

As has been mentioned in the Metholdogy chapter (see pp. 73–74), an important question arose during the data collection portion of the project's mapping phase: what exactly is a parking lot? The need to establish a clear definition for what would be considered a parking lot became apparent early on in the data collection for the mapping phase. This definition needed to be established in such a way that it could be applied consistently across the twelve sample municipalities. While on the surface the question of what a parking lot is (and what it is not) seems relatively straightforward, it turns out that deciding whether or not to classify a particular area as a parking lot for the purposes of this project required some surprisingly subtle distinctions to be made. This appendix describes and explains the decision-making processes that were used to achieve precise definitions for the terms presented on pp. 73 and 74.

Zoning by-law definitions

It seems reasonable to begin with the definitions provided in the zoning by-laws from the twelve sample municipalities. Eleven of these by-laws include a definition for the term "parking lot" or for "parking area," the lone exception being the City of Peterborough's Zoning By-Law (2019). The eleven relevant definitions generally employ a sort of circular logic: the City of Barrie's Zoning By-Law (2017), for instance, defines a "Parking Area" as "any parking aisle and parking space which may be located in a building or structure" (p. 3-21). For further elucidation, we are told that a "Parking Aisle" is "an area of land which abuts and provides direct vehicular access to 1 or more parking spaces," while a "Parking Space" is "a portion of a building or lot for use for the parking of a vehicle and/or recreational vehicle" (City of Barrie, 2017, p. 3-21).[1] All of these definitions rely upon a tacit but mutually agreed-upon understanding of what the act of parking entails. The City of Barrie's Zoning By-Law has been cited as an example, but it is certainly not unique in this regard—indeed, all of the zoning by-law definitions considered here feature the term "parking" in some way. It would seem, then, that zoning by-laws tend to define parking using the standard established (under slightly different circumstances) by Potter Stewart, former Justice on the United States Supreme Court—namely, "I know it when I see it" (*Jacobellis v. Ohio*, 1964, p. 197).

Arriving at a suitable definition for the act of parking, however, proves to be something of a challenge. It may seem obvious that parking is simply the act of leaving a vehicle unattended while it is not in operation, but this definition begins to unravel with even minimal prodding. Is a car sitting in a salvage yard or abandoned at the side of the road "parked"? Is it parked if is sitting, inoperative, on a hoist as it undergoes repair?[2] Of course, we are ultimately interested in defining the area where the act of parking takes place, so perhaps, for now, we can define parking as the "temporary storage of a non-operational vehicle" (so long as we understand "non-operational" to mean "not currently in operation" as opposed to "not capable of being operated"). Can we thus define a parking lot as "an area whose primary intended use is the temporary storage of non-operational vehicles"? This may seem satisfactory, but, once again, we prod. An area used for the storage of vehicles could just as easily refer to a salvage yard or to an impound

[1] Barrie's Zoning By-Law (2017) also defines the term "Parking Lot" as "a building, structure and/or lot, used for the parking of vehicles for gain or profit" (p. 3-21), or what we would more likely refer to in everyday terms as a commercial parking lot.

[2] Some might point out that the presence of the repair technician means that the car being repaired is not "unattended." We might thus amend the definition to specify, "unattended by the driver"—or, given that the car is not running and thus not technically being driven, "unattended by the owner." But what if someone other than the legal owner has parked the car? What if it is a rental? We might amend our definition once more: "unattended by the individual who currently has use of it." But what about "unattended"—does being attended mean that a car is no longer parked? Is it therefore impossible for someone to wait inside a parked vehicle? (And so on, and so on….)

lot, or to the outdoor display area at an automobile dealership—or, for that matter, to the dealership's showroom, since we have not specified that this area must be outdoors. Each of these stretches the definition of "parking" beyond what most would likely consider reasonable bounds. Once again, we might amend our definition by specifying that a vehicle is only "parked" while its operator (or the person who currently has use of it) is on the premises, perhaps as a resident or a visitor, or as a customer, or an employee, and so on. Even this emendation, however, runs into difficulties when we consider park-and-ride at transit stations, the entire purpose of which is to allow the operator to *leave* the premises for an extended period of time. For that matter, we may well ask, what period of time qualifies as "temporary"? An hour? Eight hours? Twenty-four? But what then of park-and-fly services at airports, where vehicles may be parked for days or even weeks at a time?[3]

Suffice it to say, arriving at a satisfactory definition that can be consistently applied in order to determine what should and should not qualify as a parking lot is a formidable challenge, and the urge to shrug and simply say, "I know it when I see it," is strong—which is perhaps why our zoning by-laws have avoided the issue, relying instead upon the tacit assumption that the definition is understood and need not be set out in formal terms. The most important features of the eleven relevant definitions—five for "parking lot" (Burlington, Cambridge, Hamilton, Kitchener, and Oshawa), four for "parking area" (Brantford, Guelph, Milton, and St. Catharines), and one each for "parking space" and "parking facility" (Barrie and Waterloo, respectively)—are summarized and categorized in Table D–1. (The elements listed in the "Qualifiers" column of the table most likely serve to stipulate where zoning provisions regarding parking lots do and do not apply.) The majority of these definitions use the function of a parking lot or parking area as

[3] The reader is thanked for their indulgence for this brief foray into the author's thought processes, and may rest assured that future opportunities for similar explorations shall be avoided as much as possible.

Table D–1

Components Included in Zoning By-law Definitions of Parking Lots and Parking Areas

Municipality	Function	Timeframe	Number of spaces	Qualifiers
Barrie[a]	Parking of vehicle or recreational vehicle			
Brantford[b]	Parking of three or more motor vehicles			Includes parking spaces, traffic aisles, and driveways
Burlington[c]	Temporary parking of five or more motor vehicles	Daily or overnight		Does not include occupant parking spaces in driveways of individual dwelling units
Cambridge[c]	Temporary parking or storage of motor vehicles in the open air	Temporary		
Guelph[b]				Includes parking aisles and parking spaces. Does not include any part of a street
Hamilton[c]			Contains five or more parking spots	
Kitchener[c]			Contains four or more parking spots	
Milton[b]	Temporary parking of two or more vehicles	Temporary		Includes loading spaces, parking spaces, and parking aisles. Does not include storage of impounded, wrecked, or otherwise inoperable vehicles
Oshawa[c]	Temporary storing or parking of licensed vehicles	Temporary		
St. Catharines[b]	Temporary parking of vehicles	Temporary		Includes drive aisles. Does not include outdoor storage
Waterloo[d]	Temporary parking of motor vehicles	For a period not to exceed twenty-four successive hours		Includes structured parking and surface parking

[a] From definition of "parking space" (City of Barrie, 2017). [b] From definition of "parking area" (City of Brantford, n.d.; City of Guelph, 2019a; Town of Milton, 2018a; City of St. Catharines, 2013). [c] From definition of "parking lot" (City of Burlington, 2017b; City of Cambridge, 2012; City of Hamilton, 2019a; City of Kitchener, 2018a; City of Oshawa, 2019b). [d] From definition of "parking facility" (City of Waterloo, 2019).

the primary defining attribute, which, as we have already seen, relies upon an understanding of what "parking" is. Burlington's and Waterloo's are the only definitions that specify a timeframe beyond "temporary." Both Kitchener and Hamilton define a parking lot simply as an area that contains a given number of parking spaces; their respective definitions of "parking space" provide more detail but still assume that the meaning of the term "parking" (or "parked") is sufficiently understood. Hamilton defines a parking space as "an unobstructed space that is designed to be used for the temporary parking of a motor vehicle for other than the purpose of sale or display" (City of Hamilton, 2019a, p. 3-34), which is essentially the same as the functional definitions presented in Table 7. In Kitchener's Zoning By-Law, a parking space is defined as "an area on which a motor vehicle may be parked and which has access directly or by way of an aisle or ramp, to a public lane or to a street without the necessity of moving any other motor vehicle" (City of Kitchener, 2018a, p. 10).

The general consensus that emerges from these definitions is that a parking lot is an off-street facility, usually at grade or in the open air, that is meant to be used on a temporary basis for the storage of multiple vehicles. Interestingly, there is little agreement regarding the specific number of vehicles: Hamilton sets the minimum number at five, Kitchener at four; for Milton, two will suffice. A few of the by-law definitions are careful to separate parking for residential and for non-residential purposes. Burlington, for instance, states that its definition "shall not include occupant parking spaces in the driveway of individual dwelling units" (City of Burlington, 2017b, p. 19), while Milton, in both its 2003 zoning by-law as well as its later by-law from 2014, which replaced the 2003 by-law for the Town's urban areas, specifies that the definition of "parking area" "shall include residential uses containing four or more dwelling units" (Town of Milton, 2018a, p. 3-20; Town of Milton, 2019, p. 3-23).[4] Presumably, such distinctions are made in order to exempt residential driveways, which are meant to accommodate only a very small number of vehicles, from the broader provisions that apply to larger parking lots.

Parking lots and driveways

Overall, then, the zoning by-laws considered here have provided us with an adequate definition for a parking lot in functional terms (namely, as an area that serves for the storage of multiple vehicles on a temporary basis). The focus of this project was on all off-street surface parking, including parking for residential uses, even where only one or two units may be present. However, there are important functional differences between parking lots on the one hand and driveways on the other, differences that need to be addressed so that we can refine our definitions and express them in morphological terms appropriate for the specific nature of the data collection process used in this project.

The functional difference can be summarized as follows: a parking lot is primarily intended to be used for *storage*, whereas the purpose of a driveway is to provide *access*. Even though driveways can serve as space for the off-street parking of multiple vehicles, this is often done in a tandem fashion, so that vehicles are not each individually accessible at all times—if one vehicle is parked behind another, then it must be moved before the vehicle in front of it is able to leave. The "boundary" between what is a driveway and what is a parking lot is therefore not entirely clear, and a thorough examination of *all* surface parking would include each and every driveway. However, it was simply not possible to do so for this project because of the

[4] As there are no substantive differences between these two by-laws' provisions with respect to parking, reference will generally be made to the older by-law (Town of Milton, 2018a), which was enacted in 2003.

prohibitive amount of time this would have required; it was therefore necessary to articulate a consistent basis upon which parking lots and driveways would be distinguished from one another. The functional distinction referred to at the start of this paragraph provided a useful starting point.

Ultimately, the decision was made to include any parking area that could accommodate more than one vehicle and that could be considered "more" than a driveway. (The terms "parking area" and "parking lot" will be used interchangeably from hereon in.) This distinction—that a parking lot is somehow "more" than a driveway—is nebulous, but it served as a useful starting point to develop more formal definitions for the two terms. As it stands, however, this definition possesses the same deficiency as those already considered—it relies upon a tacit understanding of what constitutes a driveway and what can be considered "more" in some way—and thus has not particularly helped us in advancing our understanding.[5] However, it is worth reiterating that a driveway's purpose is to provide access—in other words, its principal function is to allow for vehicle *movement*. In a parking lot, vehicles need to be able to move in order to access individual parking spaces; the construction of a parking lot makes such movement possible while retaining the lot's primary role as a space for the storage of stationary vehicles. Moreover, while it is possible to park on a driveway, doing so does not guarantee that the vehicle will be readily accessible (as in the case of tandem parking). While some zoning by-laws do expressly permit tandem parking arrangements, it seems reasonable to state that, in order for an area to count as a

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[5] The zoning by-laws considered here generally agree that a driveway connects a parking area or a garage to the street, and is used in order to access an individual parking space or the parking area itself. For example, an "access driveway" is defined in Cambridge's Zoning By-law as "the area between the traveled portion of a roadway and a parking lot used by motor vehicles for access to and from the parking lot, but does not include an aisle" (City of Cambridge, 2012, p. 1). Similarly, Milton defines a driveway as the "portion of a lot used to provide vehicular access from a street to a parking space or to an off-street parking or loading area located on the same lot" (Town of Milton, 2018a, p. 3-8). Some zoning by-laws distinguish between residential and non-residential driveways.

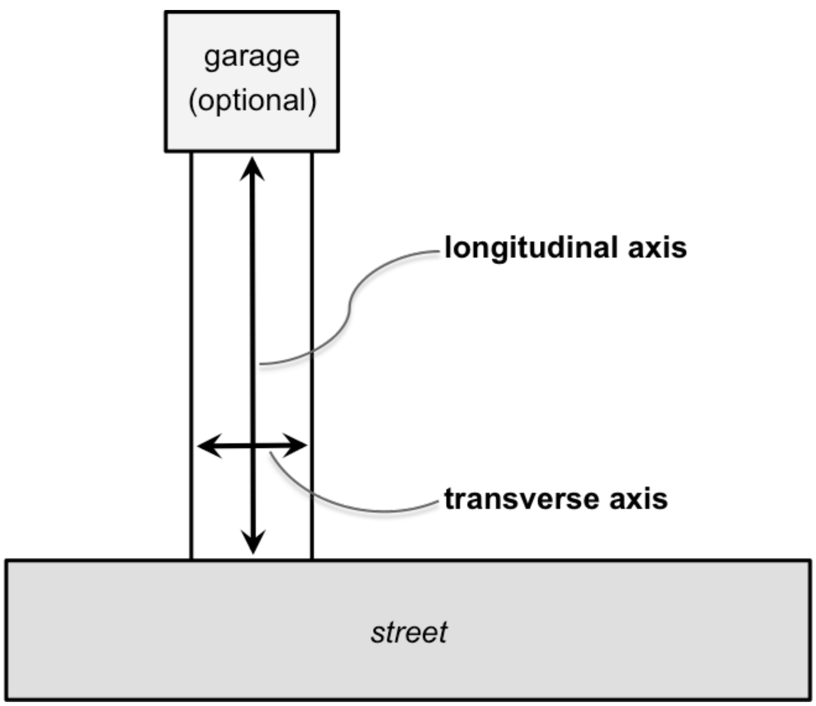
parking lot for the purposes of this project, each individual vehicle should generally be accessible at all times without disturbing other vehicles.

Formal definitions

Using the foregoing observations as a guide, it is now possible to articulate a reasonable formal definition for the term "driveway": *A driveway is a surfaced area, intended for motorized vehicles and not situated on a right-of-way, whose physical construction allows for vehicular motion only along a single longitudinal axis (as clearly discernible from a transverse axis)*. The two "axes" referred to in this definition are illustrated in Figure D–1. A driveway's longitudinal axis may provide passage for a single vehicle between the street and a garage, but this is not a

Figure D–1

Diagram Showing Driveway with Longitudinal and Transverse Axes Labelled



requirement; in other words, a driveway can exist without a garage. In most cases, the longitudinal axis is perpendicular to the street, though again this is not an absolute requirement: it is possible for a driveway's entrance or exit to intersect the street at an oblique angle, and the longitudinal axis need not be perfectly rectilinear (in other words, a driveway can be curved). The salient feature is that the transverse axis, which by definition is perpendicular to the direction of vehicular motion, is not wide enough to provide passage for more than a single vehicle.

With the definition for a driveway in hand, we can now proceed to define a parking lot along the same lines. Like a driveway, a parking lot is a surfaced area intended for motorized vehicles and not situated on a right-of-way. Unlike a driveway, however, a parking lot's construction permits vehicular movement along multiple "axes." This design feature permits stationary vehicles to be stored when they are not in operation, while at the same time allowing vehicles stored in this manner to be accessible on an individual basis.

These two formal definitions, while derived from observations regarding the important functional difference between a driveway (access) and a parking lot (storage), have nonetheless been expressed in morphological terms. Indeed, morphology provides the most appropriate terms for this project, as the data collection portion of the mapping phase primarily relied upon visual inspection of aerial images. Although any definition will likely remain imperfect in some regard, it was possible to apply the definitions discussed here consistently throughout the mapping phase of this project.

Examples from sample municipalities

The following examples, taken from the twelve municipalities included in the project sample, will help illustrate the morphological differences between what were considered parking lots and what were considered driveways. (To clarify, an area being "considered" or "counted as" a parking lot means that it was included as a feature on the data layers created during the mapping phase.)

Figure D–2 shows a parking lot situated in front of and between two detached dwellings within the Uptown Waterloo Urban Growth Centre. (The label in the top left corner of the image on the bottom shows the unique identification code given to this particular feature: Waterloo, Block 51, Parking Lot Number 5.) It should be readily apparent how the extent of the paved area makes this particular example "more than a driveway," and therefore a parking lot. In terms of our more formal definitions, the construction of the parking area in Figure D–2 provides a longitudinal axis perpendicular to the street and running between the two buildings. What makes this "more than a driveway" is the fact that multiple directions of motion are clearly possible: one can travel along the longitudinal axis alone, as the car on the left has done, or along a path that involves movement along both axes, as is the case with the car parked to the side, in front of the smaller dwelling on the right.

To illustrate the distinction further, Figure D–3 (p. 248) shows a driveway next to a parking area, located within the Downtown Milton UGC, as seen from street level and from above. (The visible seam where the surfacing material changes marks the boundary between the two.) The juxtaposition shows the contrast between the driveway on the left, which is only wide enough to allow passage for a single vehicle, and the parking area on the right, whose construction will require the driver of the car parked in front of the dwelling to manoeuvre along both axes in order to reach the street.

Directly below this, Figure D–4 shows how the presence of a garage does not necessarily indicate the existence of a driveway: the parking area in Figure D–4 is wider than both garages

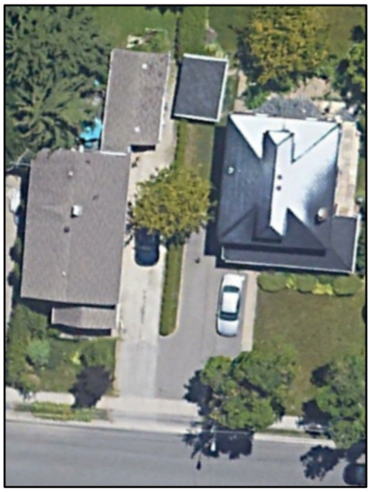
Figure D–2

Parking Area in Front of and Between Two Detached Dwellings, Uptown Waterloo UGC: Aerial View (Top) and Street-level View (Bottom)

Note. From *Google Earth Pro*. Copyright 2020 by Google (Google, 2020c, 2020d).

Figure D–3

Driveway Next to Parking Area, Downtown Milton UGC: Aerial View (Left) and Street-level View (Right)



Note. From *Google Earth Pro*. Copyright 2020 by Google (Google, 2020e, 2020f).

Figure D–4

Parking Area in Front of Duplex Dwelling with Garages, Downtown Oshawa UGC: Aerial View (Left) and Street-level View (Right)

Note. From *Google Earth Pro*. Copyright 2020 by Google (Google, 2020g, 2020h).

Figure D–5

Curved Parking Area in Front of Apartment Building, Downtown Hamilton UGC: Aerial View (Top) and Street-level View (Bottom)

Note. From *Google Earth Pro*. Copyright 2020 by Google (Google, 2020i, 2020j).

combined and clearly allows for multiple vehicles to be parked side by side. This also serves to illustrate that the longitudinal axis does not need to be longer than the transverse axis. In this particular case, the longitudinal axis is not much greater than the length of a single vehicle, whereas the transverse axis spans the width of the property. Nonetheless, the longitudinal axis is still defined by the principal axis intended for vehicle movement. In cases such as this one, it is the possibility of movement along the transverse axis that qualifies the area as a parking lot.

Figure D–5 (p. 249), showing a curved "driveway" in front of an apartment building in the Downtown Hamilton UGC, provides one final example of the difference between a driveway and a parking lot.[6] Here, the longitudinal axis is curved, with vehicles able to enter at one end and exit from the other; the transverse axis (perpendicular to the direction of vehicle movement) is much shorter by comparison. Nonetheless, this was still considered a parking lot, as the transverse axis is wide enough to permit the passage of more than one vehicle—a fact that can be clearly seen from the vehicles parked along the curb in front of the building.

Contiguous surfaces

These morphological definitions provided a consistent basis on which distinctions could be made between parking lots and driveways. However, there were many cases where both a parking lot and a driveway providing access from the street were incorporated into the same feature. In these cases, the pertinent question was whether or not the driveway should be included as part of the parking lot. The decision was made that, once a given area had been identified as a parking lot, then the total parking area included the entire paved (or otherwise surfaced) area contiguous with the parking lot, including any portions that might be considered

[6] From hereon in, the use of quotation marks around the term "driveway" indicates that the area being referred to was counted as a parking lot, and that the term "driveway" is being used according to the common understanding of the term—namely, as a long narrow strip intended for the passage of vehicles that may or may not serve as a parking area—rather than according to the more technical definition established for this project.

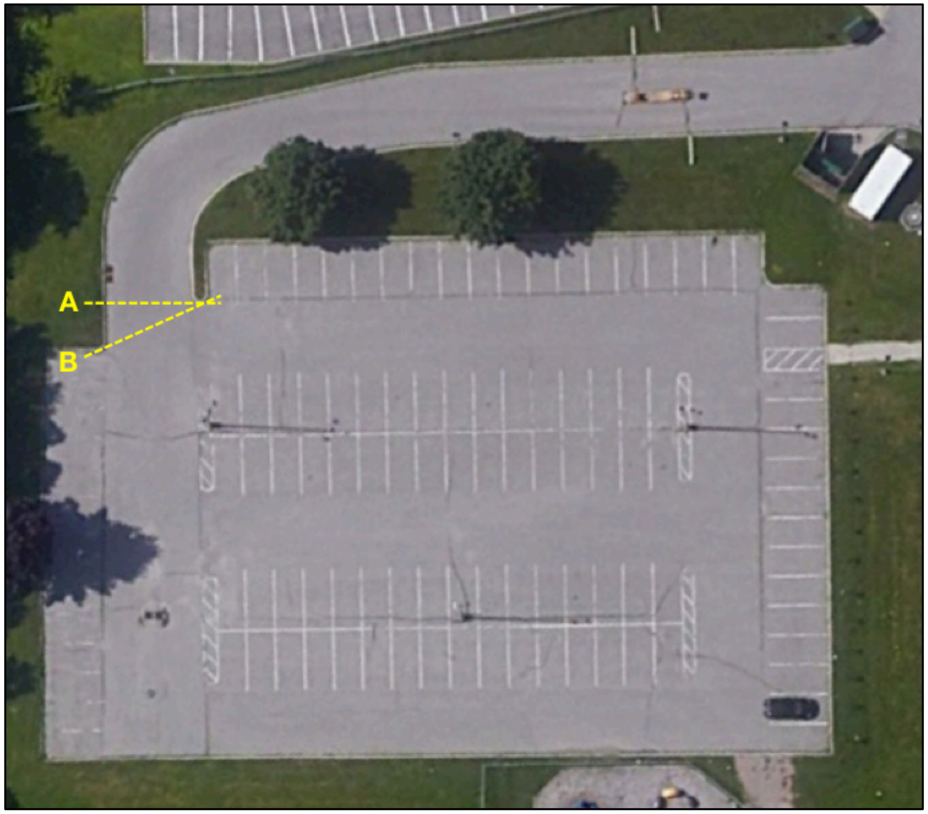
"driveways" on their own, up until the surfaced area meets the street (or the sidewalk, if it was clearly discernible).

Figures D–6 and D–7 illustrate why this decision was necessary. Figure D–6 shows a parking lot (located within the Downtown Oshawa Urban Growth Centre) that has a long, curved driveway leading out to the street, partway along which is a traffic island with entrance and exit gates. While we may feel Justice Stewart's confidence that we know a parking lot and a driveway when we see them and can easily distinguish between the two, even this simple example shows that any distinction would require an arbitrary decision: where does the driveway "end" and the parking lot "begin"? At the point where the "mouth" of the driveway opens to the parking lot? But then, should the line be drawn horizontally, as with line "A" in Figure D–6, or diagonally, as with line "B"? And what of the gates—should we not instead consider these as marking the entrance and exit? Then should the demarcation line be drawn at the middle of the traffic island, or at one of its two ends?

Figure D–7 (in which the perimeter of the parking lot has been highlighted in yellow to compensate for the low brightness level in the photograph) complicates this question further, as here we have a driveway with two "indentations," each of which supplies two parking spaces. Should this therefore be considered three parking lots, two small and one larger, all joined by a single driveway? Once again, where should the line between the larger parking area and the driveway be drawn? As these and other such questions suggest, the simplest way to avoid this kind of arbitrary decision-making was to include the entire contiguous surfaced area as one single parking lot. Moreover, this decision is consistent with the definitions in zoning by-laws that state the parking lots and parking areas include drive aisles, loading spaces, and driveways.

Figure D–6

Parking Lot with Long Driveway, Downtown Oshawa UGC



Note. From *Google Earth Pro*. Copyright 2020 by Google (Google, 2020k).

Figure D–7

Parking Lot with Long Driveway Featuring Parking "Indentations," Downtown Burlington UGC

Note. From *Google Earth Pro*. Copyright 2020 by Google (Google, 2020*l*).

Special cases encountered during data collection

Even with the distinction between what would be considered a "parking lot" or a "driveway" expressed in strict morphological terms, there were still certain cases that presented challenges. This section explains how these cases were classified based on the definitions that have already been established.

"Side-by-side" and "double-width" driveways

Two particular configurations were frequently observed across the twelve areas of interest in the project sample. The first configuration, which will be referred to as "side-by-side driveways," consists of two driveways directly adjacent to one another, each associated with a separate unit (and usually on separate parcels of land), that are contiguous along their entire length, without any intervening surface or barrier (such as a grass median or a fence). The second configuration is the "double-width driveway," whose defining characteristic is the presence of a double garage.

As the name suggests, side-by-side driveways were considered driveways for the purposes of this project—it was assumed that the intent of this configuration is to provide two separate lanes of motion (two driveways), each for the sole use of the unit with which it is associated. This implies that vehicle movement is intended to take place only along the longitudinal axis of each driveway and not along the transverse, despite the contiguity of surfaces. An example of this configuration is shown in Figure D–8, where the intended separation is emphasized by the use of different roofing materials on the two sides of the shared garage at the end of the driveways.

Double-width driveways were similarly considered to be driveways rather than parking lots, but only when a double garage was present. In these cases, the presence of a double garage

Figure D–8

Side-by-side Driveways Located between Two Detached Dwellings, Downtown Barrie UGC: Aerial View (Left) and Street-level View (Right)

Note. From *Google Earth Pro*. Copyright 2020 by Google (Google, 2020m, 2020n).

was seen as implying the existence of two separate lanes for vehicular movement, each with its own transverse axis equal to the width of a single vehicle. (Double garages may have two separate doors or one single, double-width garage door.) Regarded in this fashion, double-width driveways are similar to side-by-side driveways, in that their design implies two separate lanes of motion, each intended for the passage of a single vehicle between the street and the garage. Because a driveway's primary purpose is to provide access, the presence of a double garage is what indicates the intent of the double-width design: each lane of motion along the driveway provides access to a single vehicle berth within the garage. Cases where a double-width "driveway" led to only a single garage, or where there was no garage at all, were deemed to represent parking areas: without a double garage requiring two separate lanes of movement for full access, there was no clear reason to exclude the possibility of vehicular motion along both the longitudinal and the transverse axes.

The two contrasting cases are illustrated in Figures D–9 and D–10 (p. 256), which present examples located on neighbouring properties within the Downtown Milton Urban Growth Centre. Figure D–9 shows a driveway with a double garage; the vehicle parked in front of one of the garage doors helps to illustrate the intent of the design. The area shown in Figure D–10 has a very similar width, but, without a garage to indicate lanes of passage, this was deemed to be a parking area. Figure D–11 (p. 257) shows an important variation on this particular theme, with a double garage whose "driveway" begins at the street with a single lane that widens to double width partway between the street and the garage. While this might at first seem like a driveway, consistent application of our definitions in fact requires us to consider this a parking lot, because the narrow entrance from the street requires one vehicle to move along both axes in order to access the berth on the right-hand side of the garage, as illustrated in Figure D–12 (p. 257).

Conversions between driveways and parking lots

Although the definitions for the terms "driveway" and "parking lot" were applied consistently across all twelve Urban Growth Centres, it is necessary to acknowledge that there were some cases in which a driveway was indeed "counted" as a parking lot and thus included in the data collection. However, this occurred only in one of two strictly defined cases: either the driveway in question had been expanded into a parking lot between the points in time at which the earlier and later aerial photographs had been taken (as in Fig. D–13, p. 258), or, conversely, a parking lot had been reduced to a driveway over the intervening period (as in Fig. D–14, p. 258). In these cases, the area that would normally have been considered a driveway was counted as a

Figure D–9

Double-width Driveway with Double Garage, Downtown Milton UGC

Note. From *Google Earth Pro*. Copyright 2020 by Google (Google, 2020o).

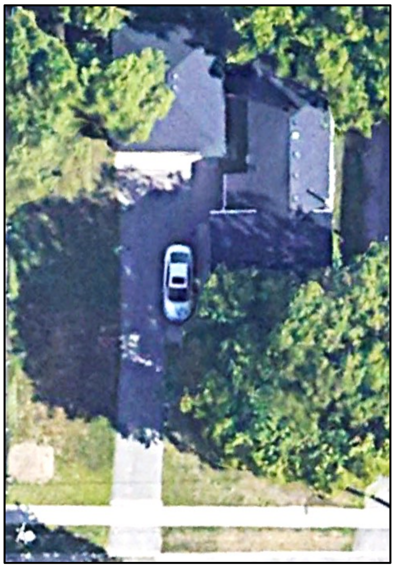
Figure D–10

Double-width Parking Area (No Garage), Downtown Milton UGC

Note. From *Google Earth Pro*. Copyright 2020 by Google (Google, 2020p).

Figure D–11

Parking Area with Double Garage, Downtown Barrie UGC: Aerial View (Left) and Street-level View (Right).



Note. From *Google Earth Pro*. Copyright 2020 by Google (Google, 2020q, 2020r).

Figure D–12

Illustration of Motion Along Both Axes for Parking Area with Double Garage

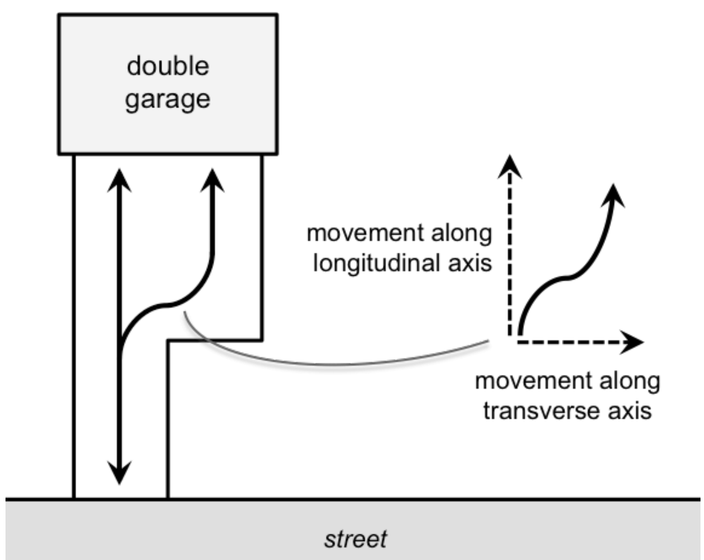


Figure D–13

Driveway Expanded to Parking Lot, Downtown Peterborough UGC: Aerial Photograph Showing Driveway in 2005 (Middle) and Parking Lot in 2018 (Right)

Note. Aerial photographs from City of Peterborough Historical Imagery (City of Peterborough, 2020a, 2020b).

Figure D–14

Parking Lot Reduced to Driveway, St. Catharines UGC: Aerial Photograph Showing Parking Lot in 2006 (Middle) and Driveway in 2018 (Right)

Note. Aerial photographs from Niagara Navigator. Copyright 2018 by Regional Municipality of Niagara (Niagara Region, 2018b, 2018c).

parking area in order to make a fair comparison between the earlier and later situations—that is, in order for the comparison to more accurately reflect the actual change in parking area.

In both Figure D–13 and in Figure D–14, the image on the left-hand side shows the relevant features from the data layers in QGIS. The green area in Figure D–13 represents the parking area that was added between 2005 and 2018, with the brown area representing the area that did not change over that period. Without the addition of the parking lot behind the dwelling, this brown area would have been considered a driveway—and, as such, would not have been included as a feature on the data layer. In Figure D–14, the parking lot behind and in front of the dwelling, represented in pink, was removed between 2006 and 2018 and replaced by landscaping, leaving only the driveway, represented in brown (the area which remained unchanged over the same timeframe). As a driveway, this area would have been excluded from the feature layer had it not earlier been part of a parking lot.

"Non-parking" uses

During the mapping portion of the project, certain land uses that were automobile-related but considered "non-parking uses" were also recorded. In addition to the aforementioned side-by-side and double-width driveways, such uses included impound yards, fuelling and service stations, outdoor display areas at automobile dealerships, and outdoor vehicle storage areas at rental establishments and transportation terminals or depots. In most cases, the area devoted to any given "non-parking use" did not appear to undergo significant change between the earlier and later aerial photographs. In some places, vacant lots were converted into parking lots, or vice versa, between the earlier and later photographs; vacant lots that were inaccessible due to the installation of fencing or the placement of concrete blocks were not considered to be parking lots.

Summary of important terminology

This appendix has been included in order to provide a full explanation and justification for important decisions that were made during data collection for the project's mapping phase. To summarize, for the purposes of this project:

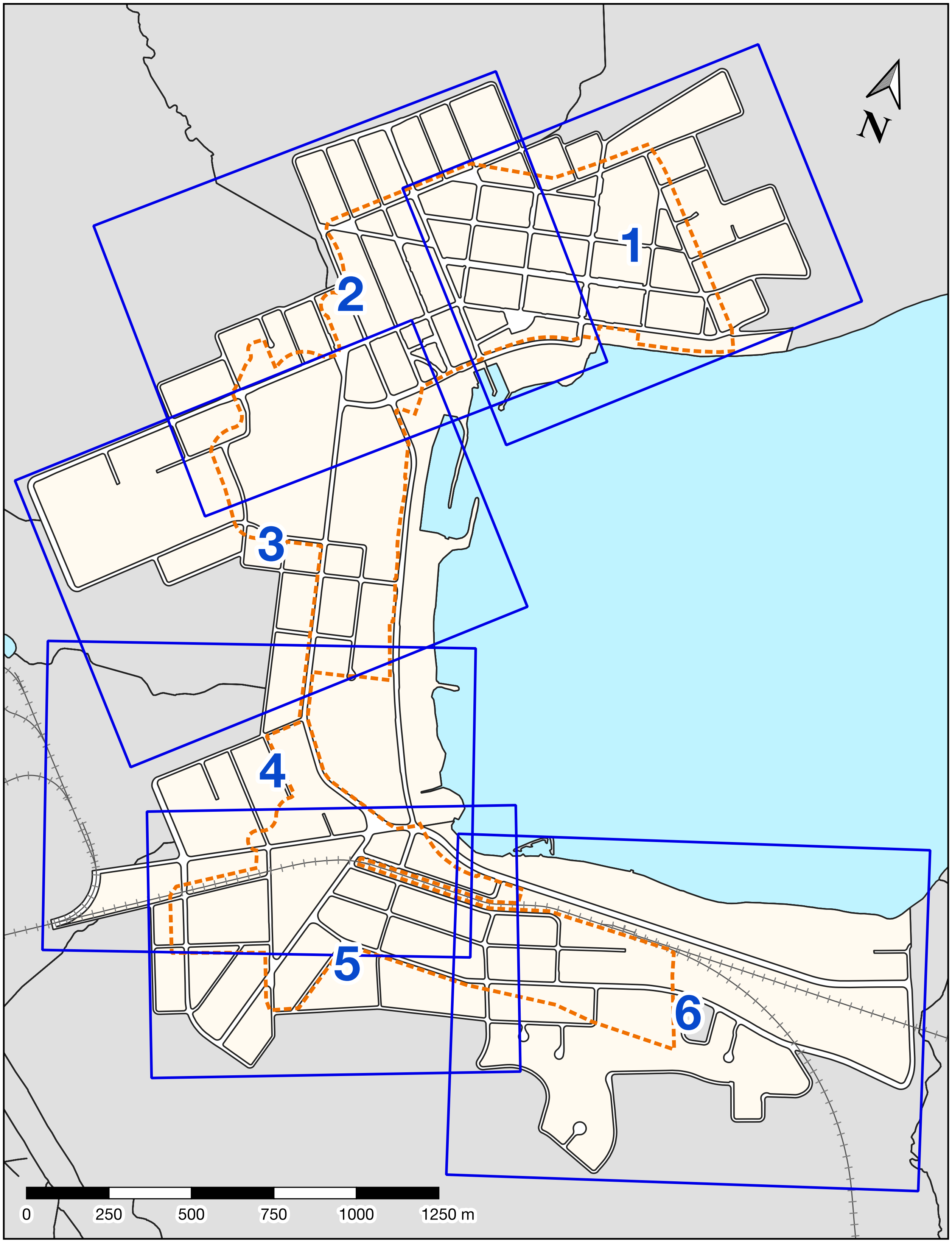
- A *parking lot* (or *parking area*) is defined as a surfaced area, intended for motorized vehicles and not situated on a right-of-way, whose physical construction permits vehicular movement along multiple "axes" (i.e., in multiple directions). (A parking lot's primary function is to provide space for vehicle storage.)
- A *driveway* is defined as a surfaced area, intended for motorized vehicles and not situated on a right-of-way, whose physical construction allows for vehicular motion only along a single axis (in other words, back-and-forth in a single direction). Driveways, whose primary function is to provide access, were not considered to be parking lots.
- The appearance of quotation marks around the word "driveway" indicates that the term is being used to refer to an area that, in everyday parlance, would be called a driveway (i.e., a long, narrow strip intended for vehicles) but that was considered a parking lot for the purposes of this project.
- An area being "considered" or "counted as" a parking lot means that the area in question was included as a feature on the data layers created during the mapping phase of this project.
- Once an area had been identified as a parking lot, the total parking area was deemed to include the entire paved or otherwise surfaced area contiguous with the portion used for parking, including any portions that on their own would be considered

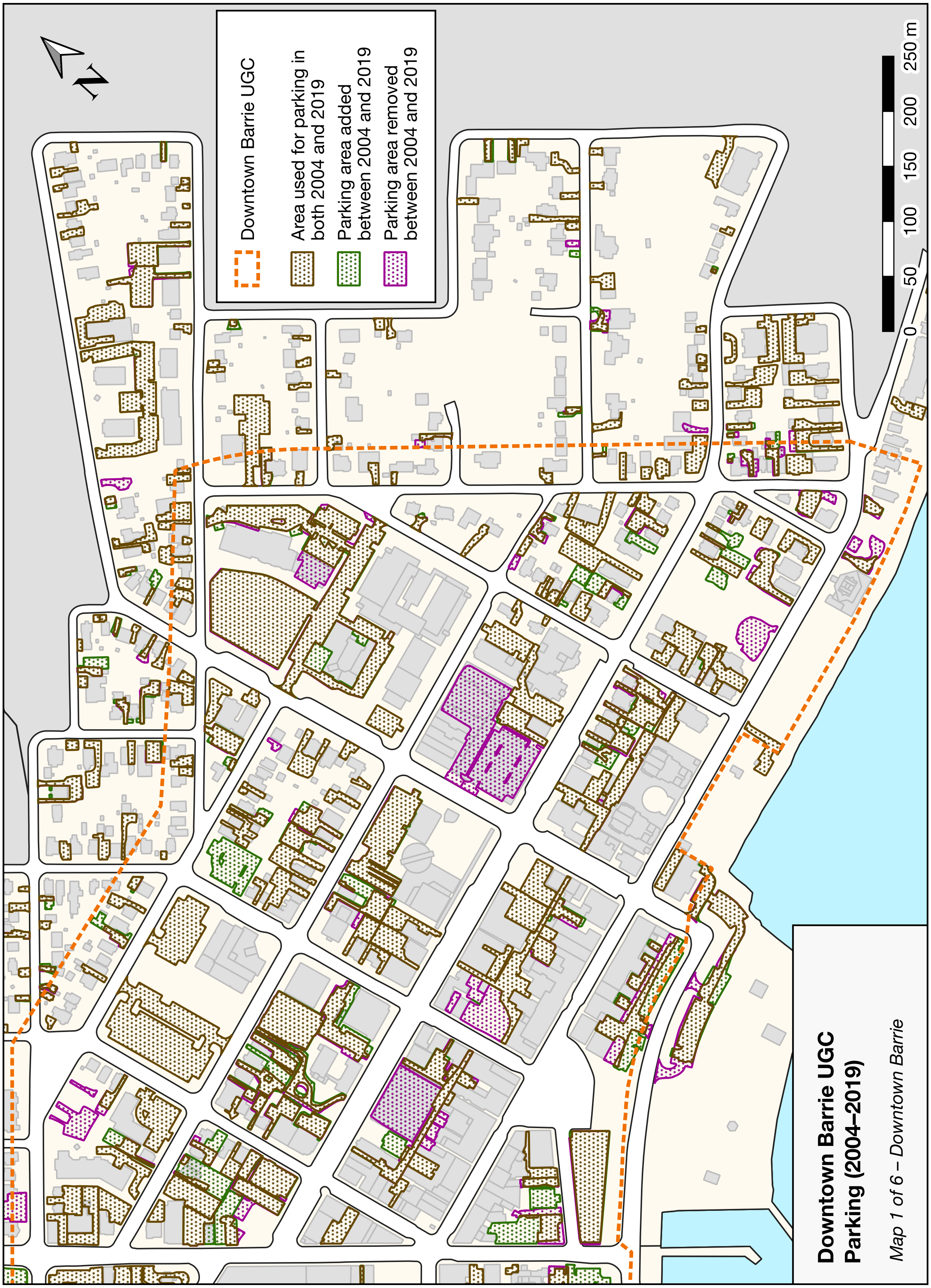
driveways, up until the surfaced area meets the street (or the sidewalk, where clearly discernible).

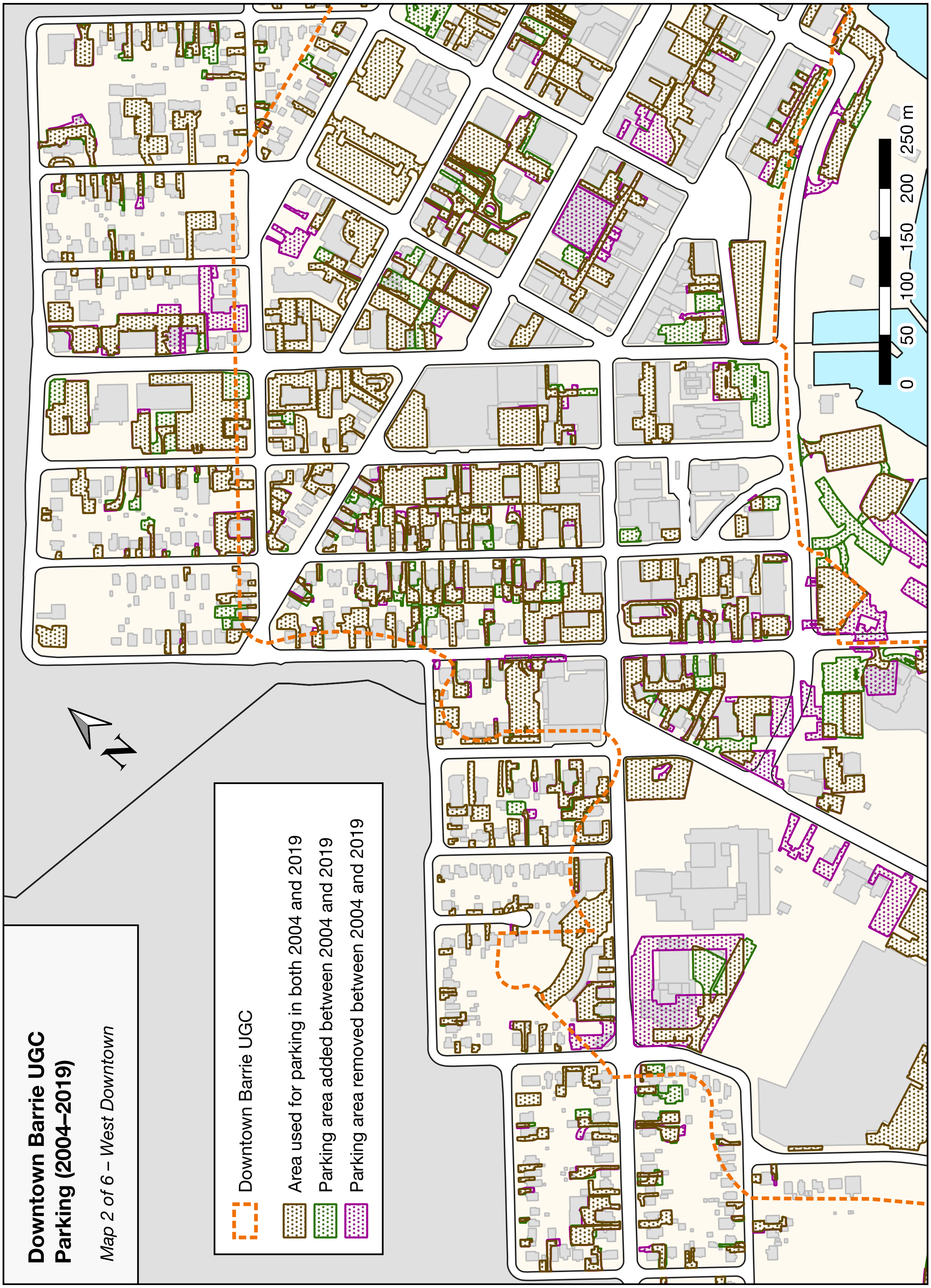
- *"Side-by-side" driveways*—which consist of two driveways directly adjacent to one another, each associated with a separate unit, that are contiguous along their entire length without any intervening surface or barrier—were not considered to be parking lots.
- *"Double-width" driveways*—which consist of two separate lanes for vehicle movement on one contiguous surface, where each lane provides access to a single vehicle berth within a double garage—were not considered to be parking lots. However, without a double garage requiring two separate lanes to access each berth, such an area was considered to be a parking lot.
- Some driveways were included as features on the final data layers, but *only* if (1) the earlier set of aerial images indicated that the area in question had previously been a parking lot, or (2) the later set of images indicated that what had previously been a driveway had since been expanded into a parking lot.

Appendix E

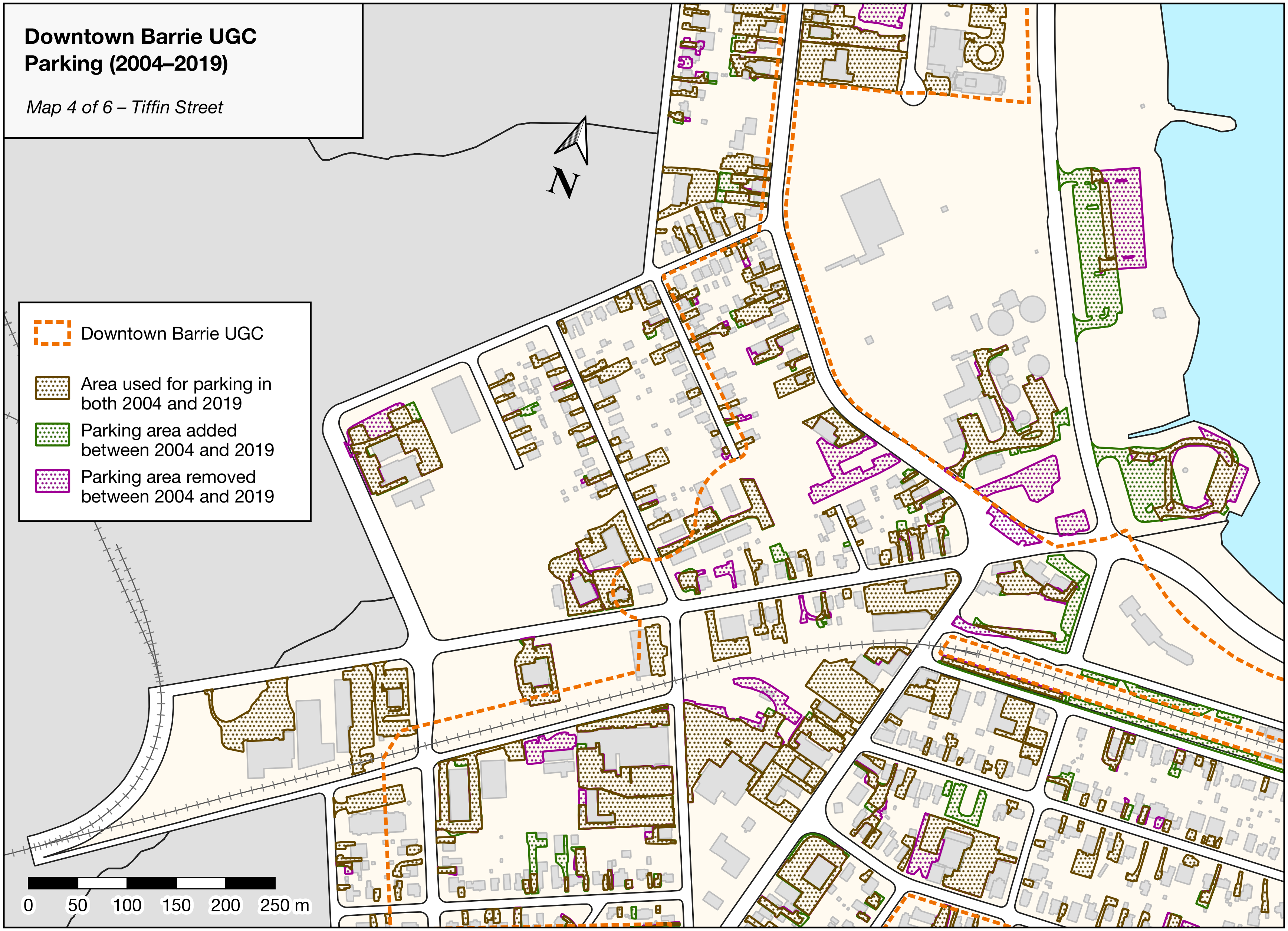
Maps Showing Changes in Area Devoted to Surface Parking


1
2
3
4
5
6
N
0
250
500
750
1000
1250 m

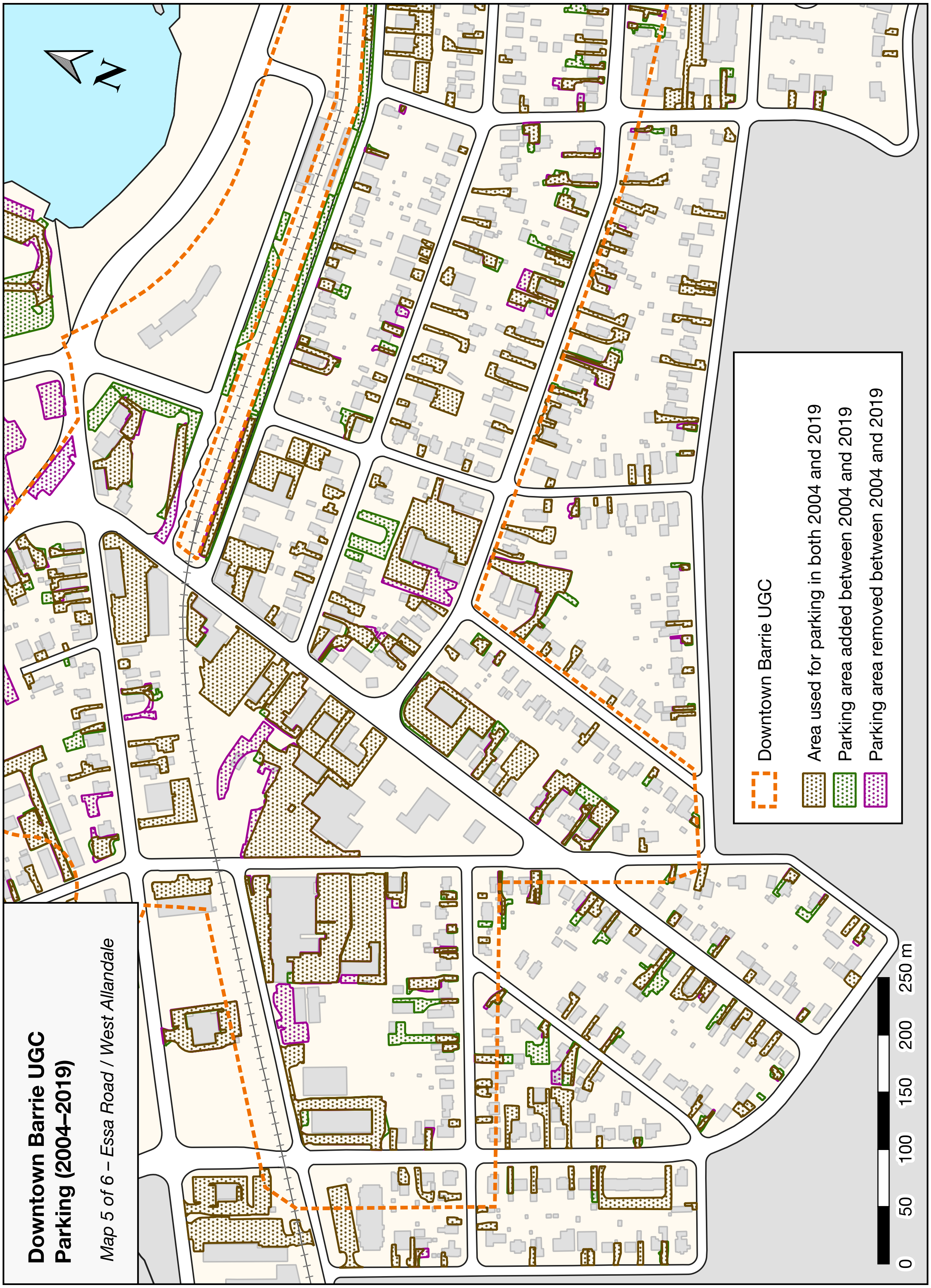

N
Downtown Barrie UGC
Area used for parking in both 2004 and 2019
Parking area added between 2004 and 2019
Parking area removed between 2004 and 2019
0
50
100
150
200
250 m
Downtown Barrie UGC Parking (2004–2019)
Map 1 of 6 – Downtown Barrie


Downtown Barrie UGC Parking (2004–2019)
Map 2 of 6 – West Downtown
Downtown Barrie UGC
Area used for parking in both 2004 and 2019
Parking area added between 2004 and 2019
Parking area removed between 2004 and 2019
N
0 50 100 150 200 250 m


Downtown Barrie UGC
Area used for parking in both 2004 and 2019
Parking area added between 2004 and 2019
Parking area removed between 2004 and 2019
Area excluded from final calculations
Downtown Barrie UGC
Parking (2004–2019)
Map 3 of 6 – West Lakeshore
N
0
50
100
150
200
250 m



Downtown Barrie UGC
Parking (2004–2019)
Map 4 of 6 – Tiffin Street
N
Downtown Barrie UGC
Area used for parking in both 2004 and 2019
Parking area added between 2004 and 2019
Parking area removed between 2004 and 2019
0
50
100
150
200
250 m


Downtown Barrie UGC
Parking (2004–2019)
Map 5 of 6 – Essa Road / West Allandale
N
Downtown Barrie UGC
Area used for parking in both 2004 and 2019
Parking area added between 2004 and 2019
Parking area removed between 2004 and 2019
0
50
100
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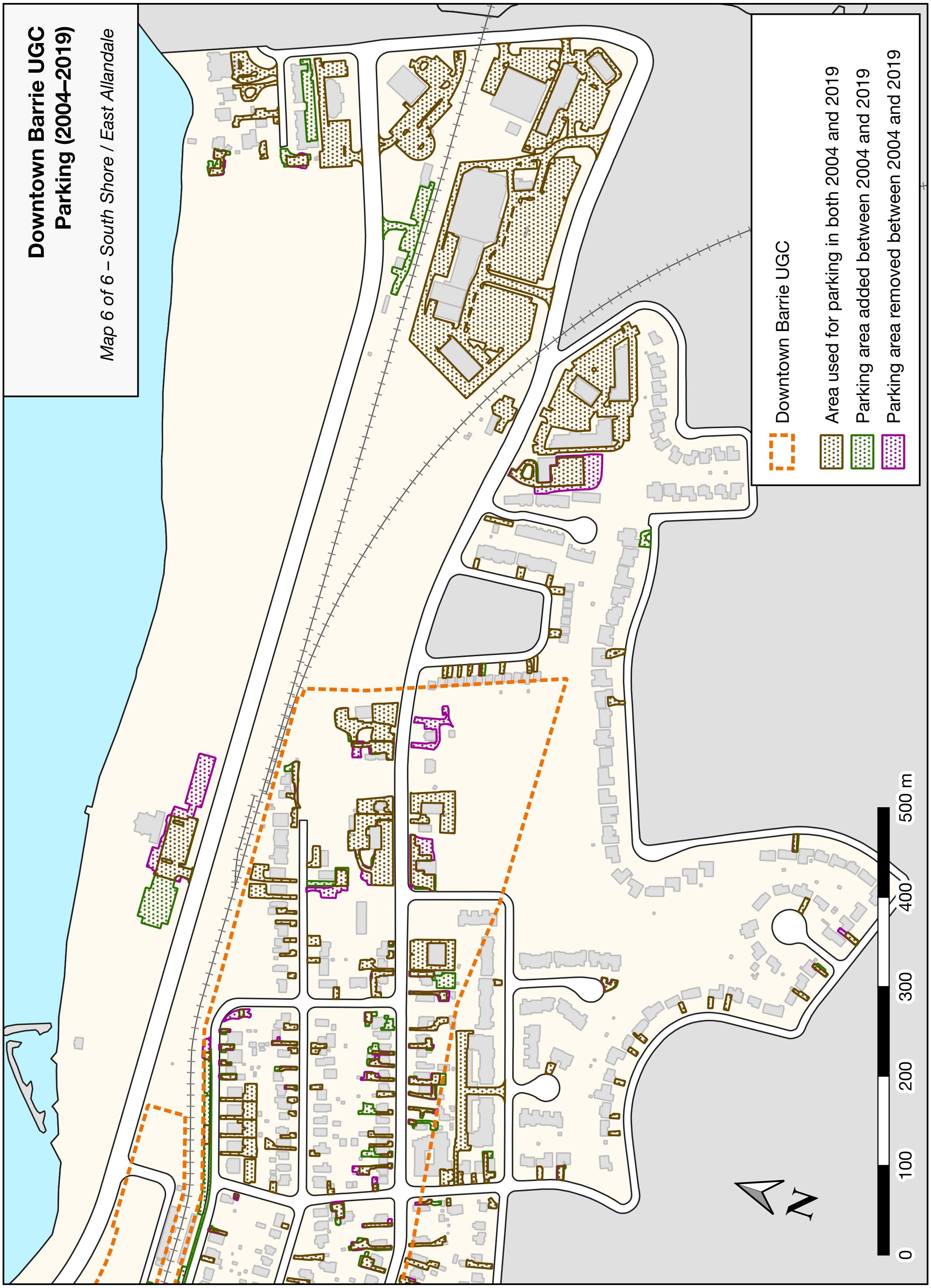
200
250 m



Downtown Barrie UGC
Parking (2004–2019)
Map 6 of 6 – South Shore / East Allandale
Downtown Barrie UGC
Area used for parking in both 2004 and 2019
Parking area added between 2004 and 2019
Parking area removed between 2004 and 2019
N
0
100
200
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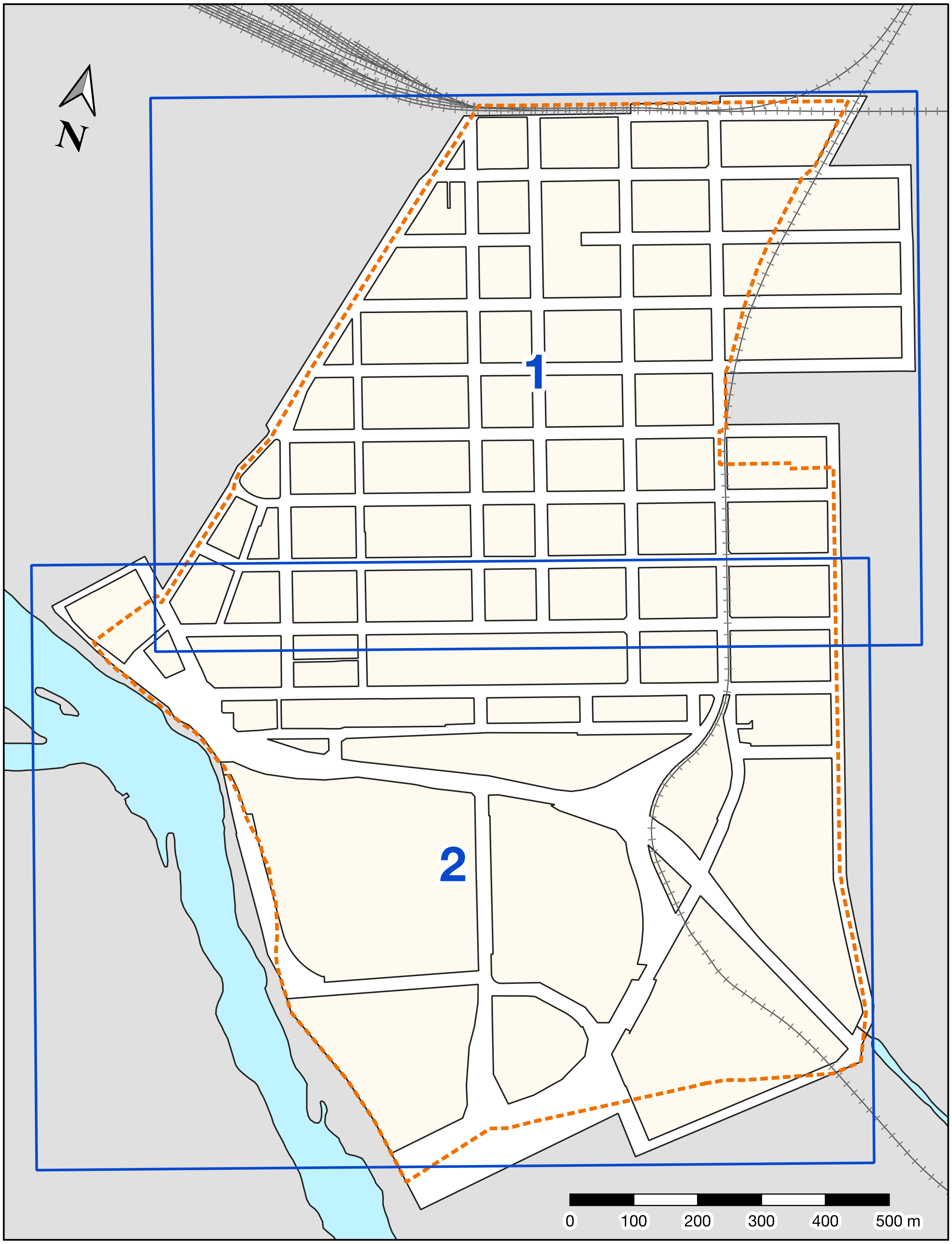
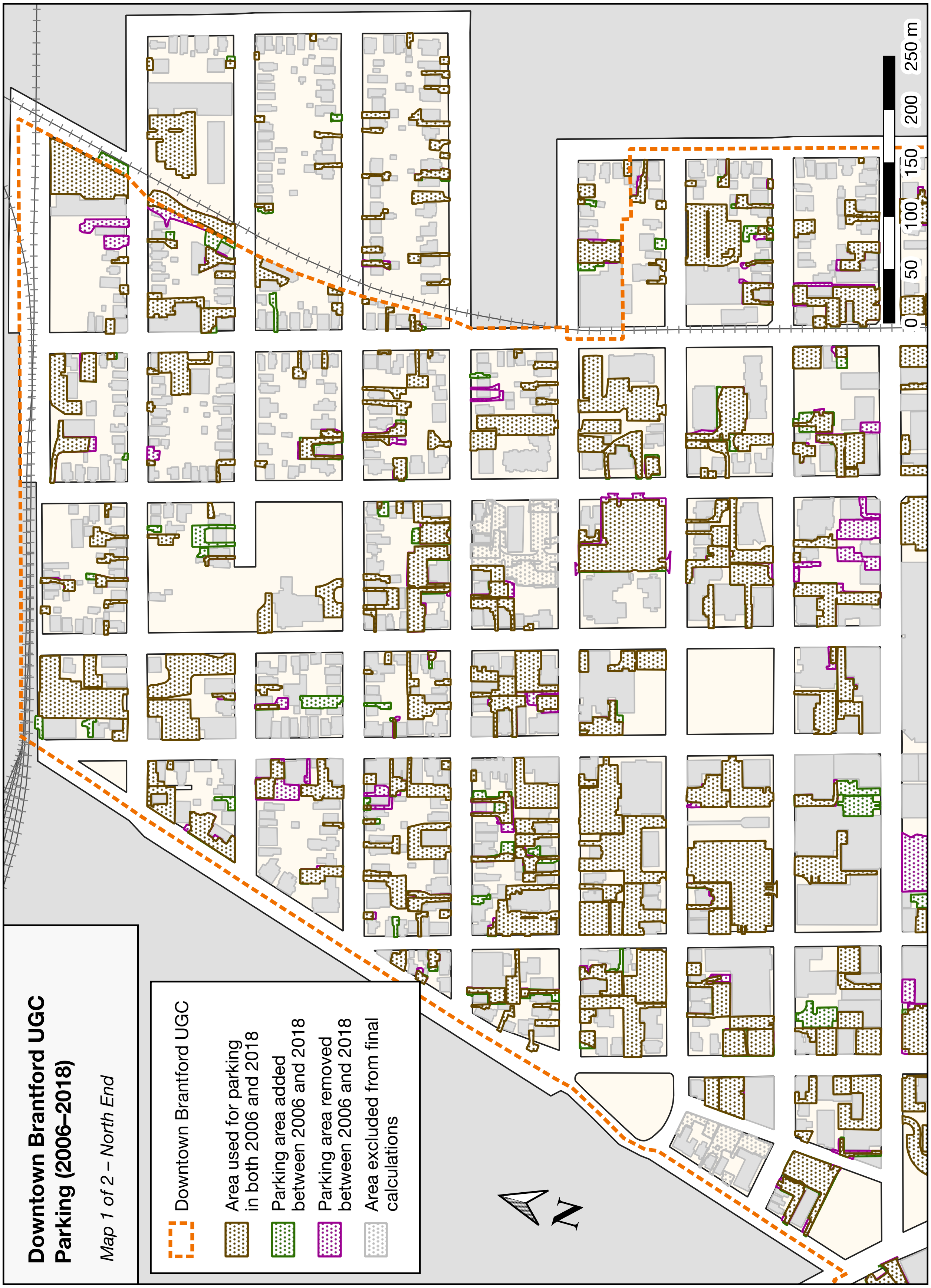
500 m

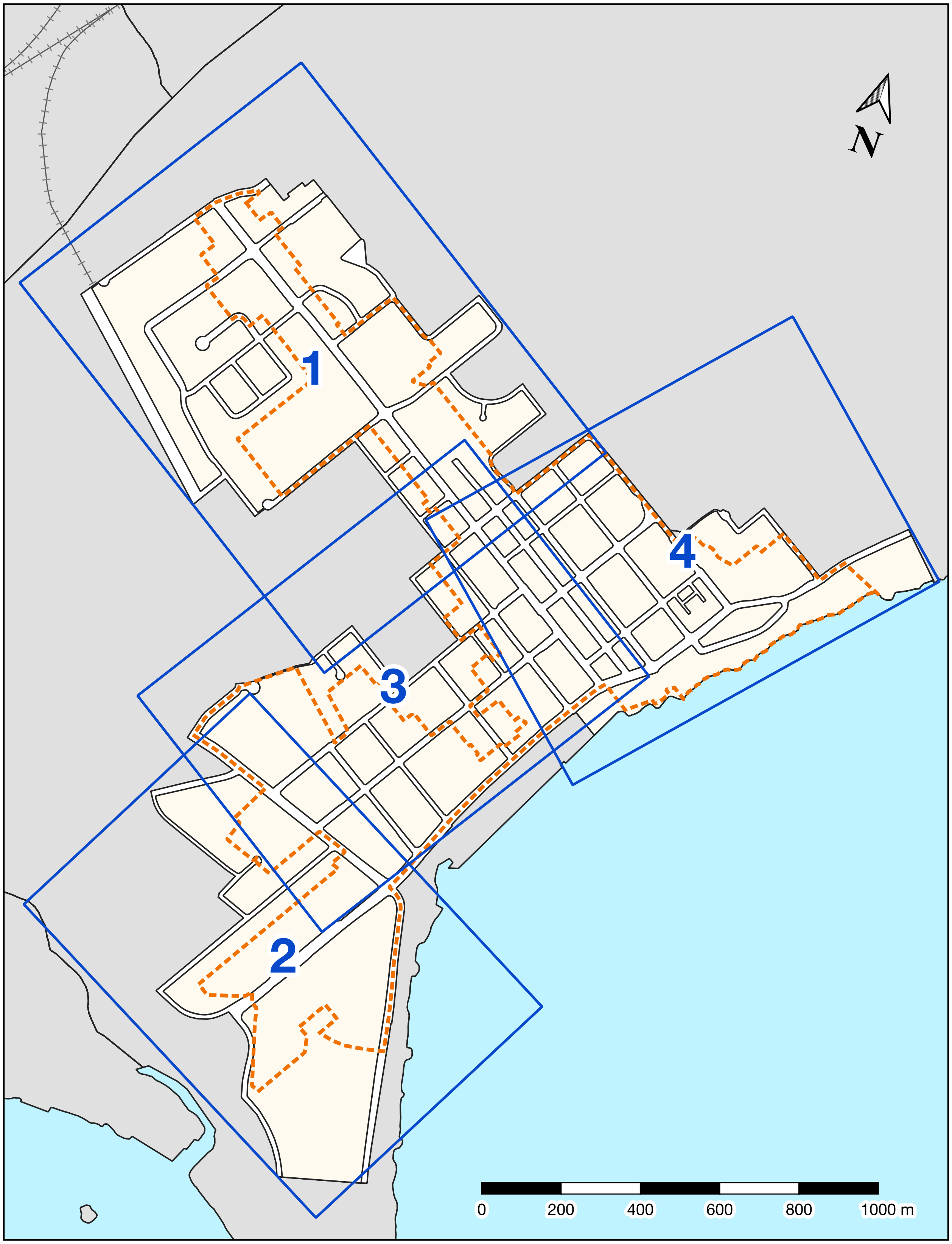
Parking Maps – Downtown Brantford UGC

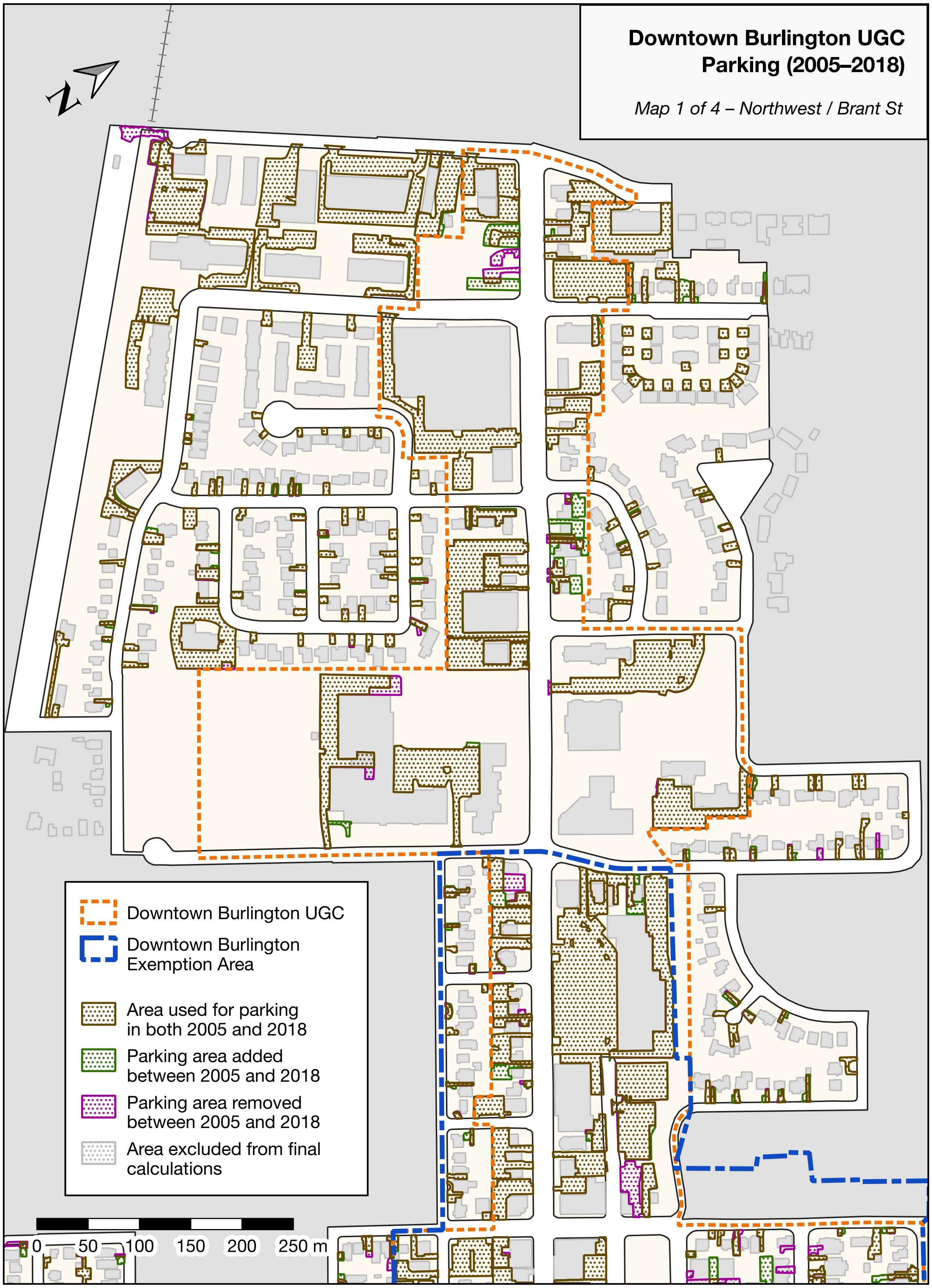



Downtown Brantford UGC
Parking (2006–2018)
Map 1 of 2 – North End
Downtown Brantford UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
Area excluded from final calculations
N
0 50 100 150 200 250 m


Downtown Brantford UGC
Parking (2006–2018)
Map 2 of 2 – South End
Downtown Brantford UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
N
0 50 100 150 200 250 m

Parking Maps – Downtown Burlington UGC




Downtown Burlington UGC
Parking (2005–2018)
Map 1 of 4 – Northwest / Brant St
N
Downtown Burlington UGC
Downtown Burlington Exemption Area
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
Area excluded from final calculations
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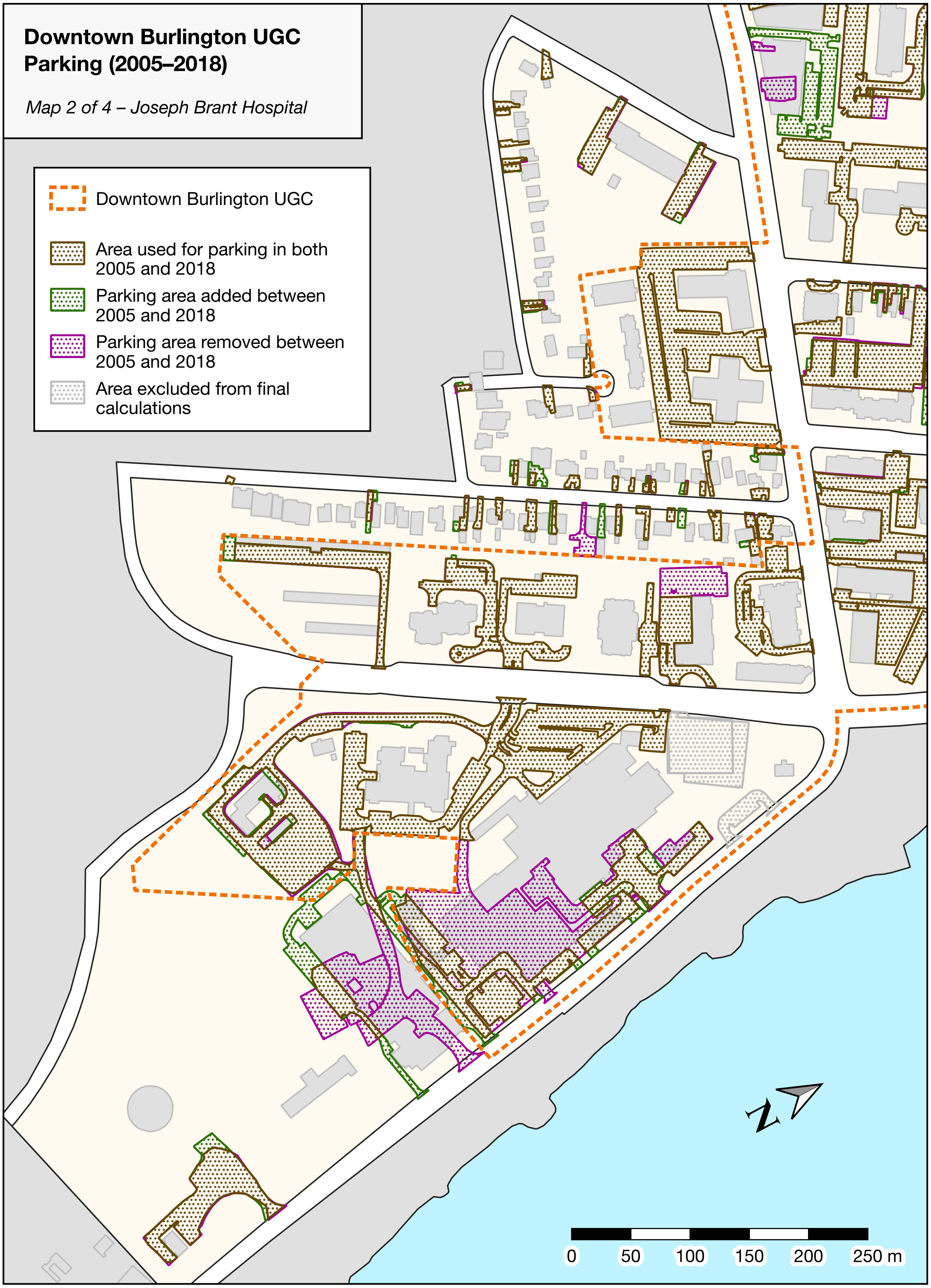
Downtown Burlington UGC
Parking (2005–2018)
Map 2 of 4 – Joseph Brant Hospital
Downtown Burlington UGC
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
Area excluded from final calculations
N
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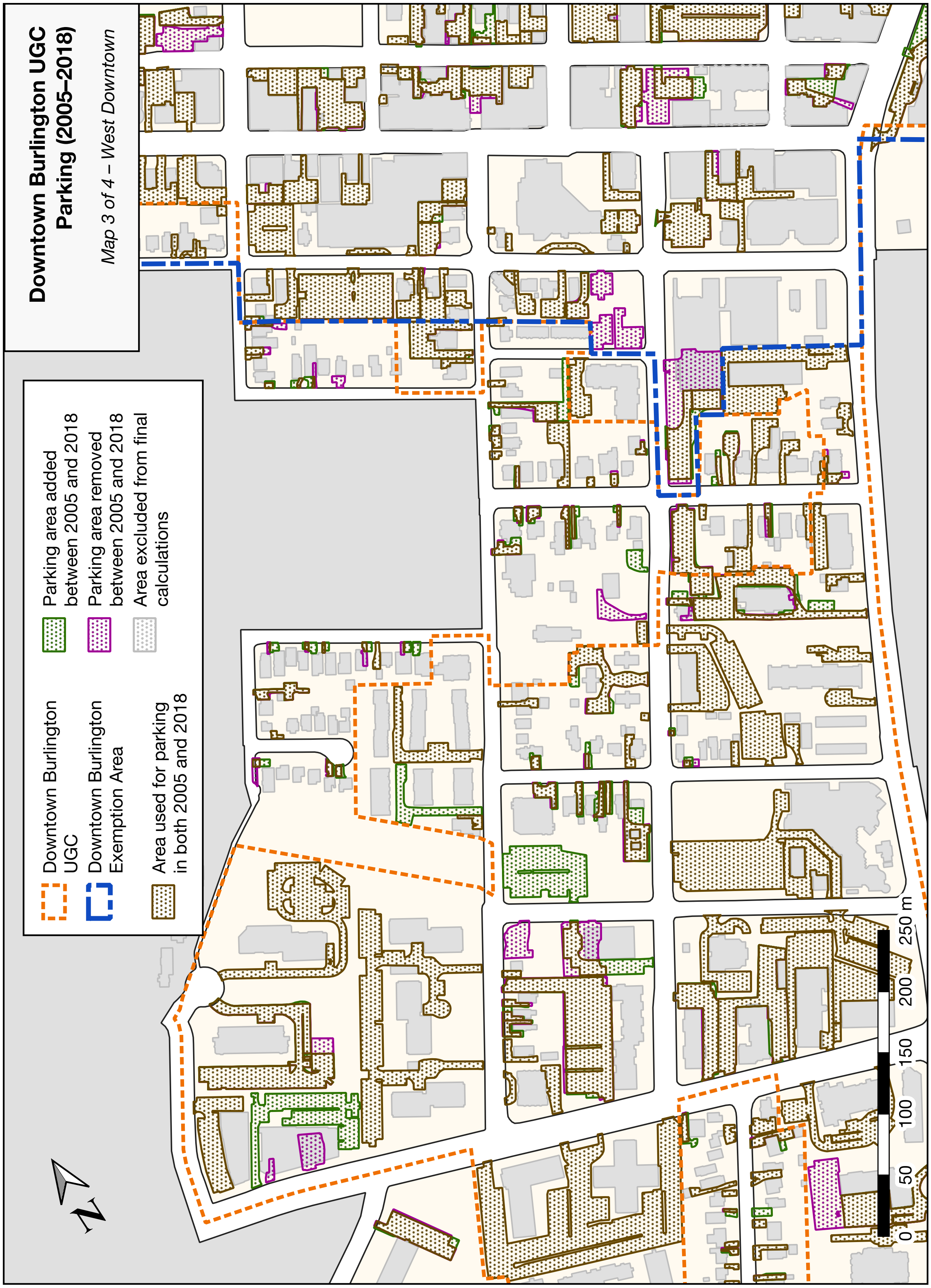
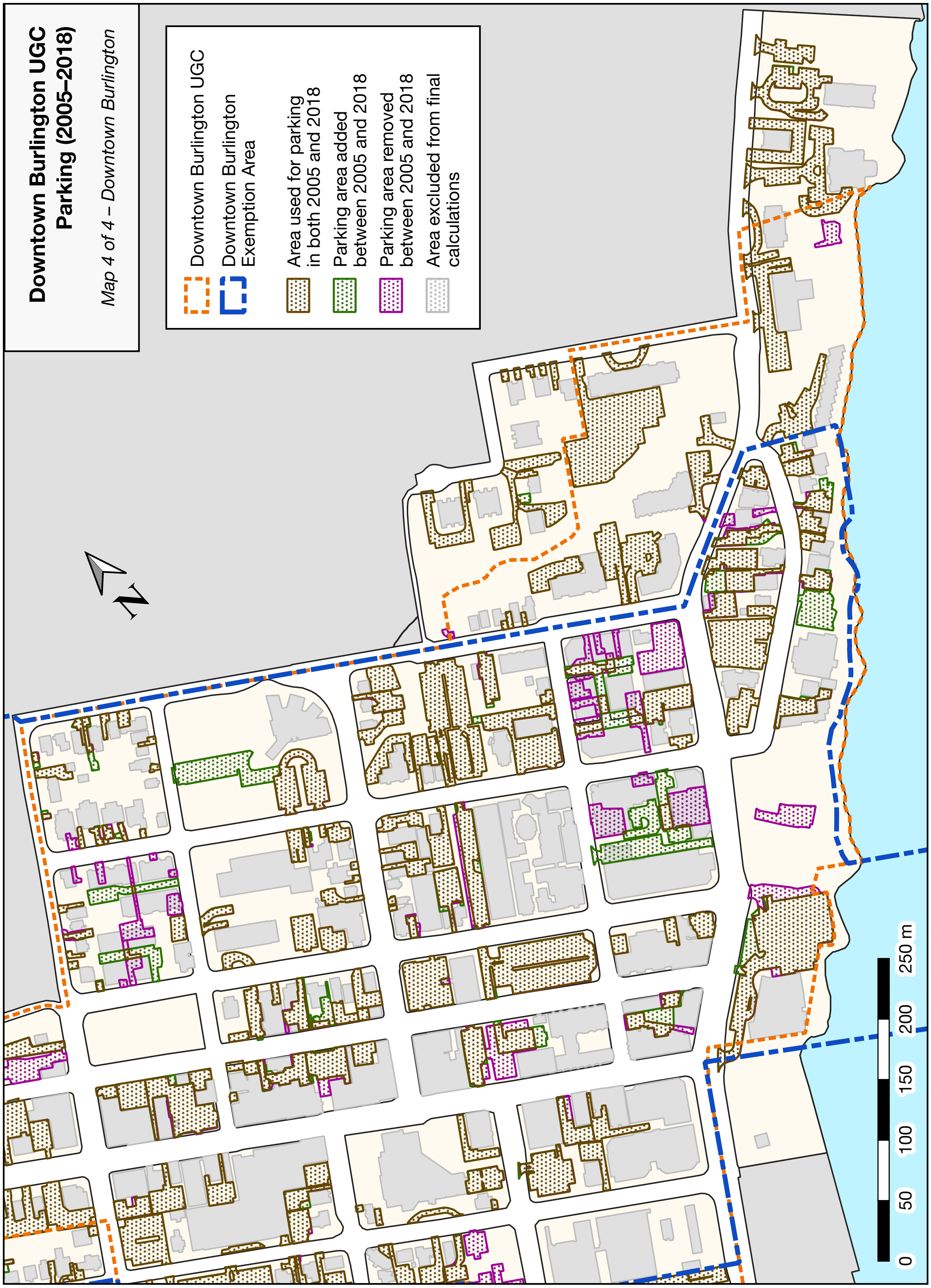
250 m



Downtown Burlington UGC Parking (2005–2018)
Map 3 of 4 – West Downtown
Downtown Burlington UGC
Downtown Burlington Exemption Area
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
Area excluded from final calculations
N
0 50 100 150 200 250 m


Downtown Burlington UGC
Parking (2005–2018)
Map 4 of 4 – Downtown Burlington
Downtown Burlington UGC
Downtown Burlington Exemption Area
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
Area excluded from final calculations
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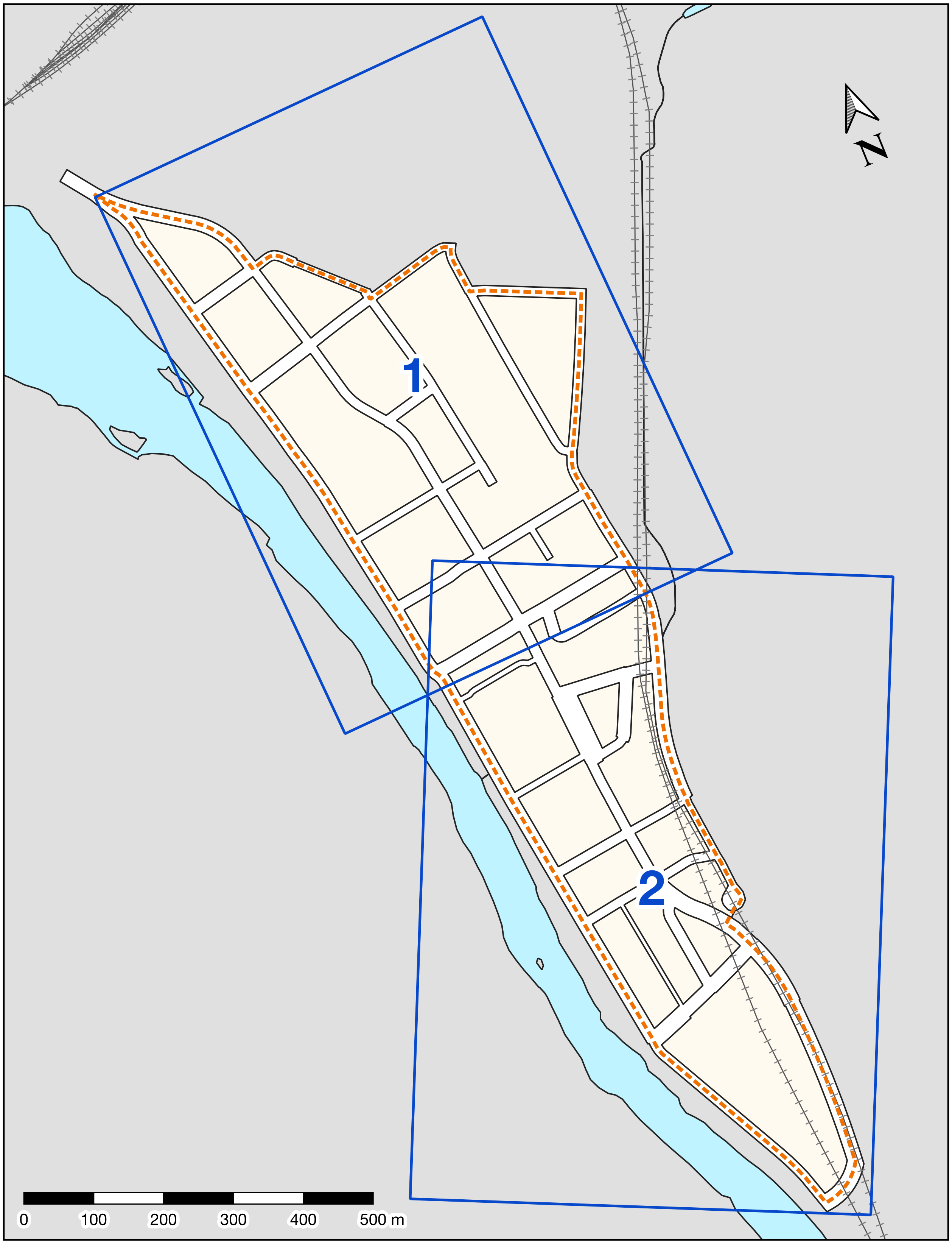
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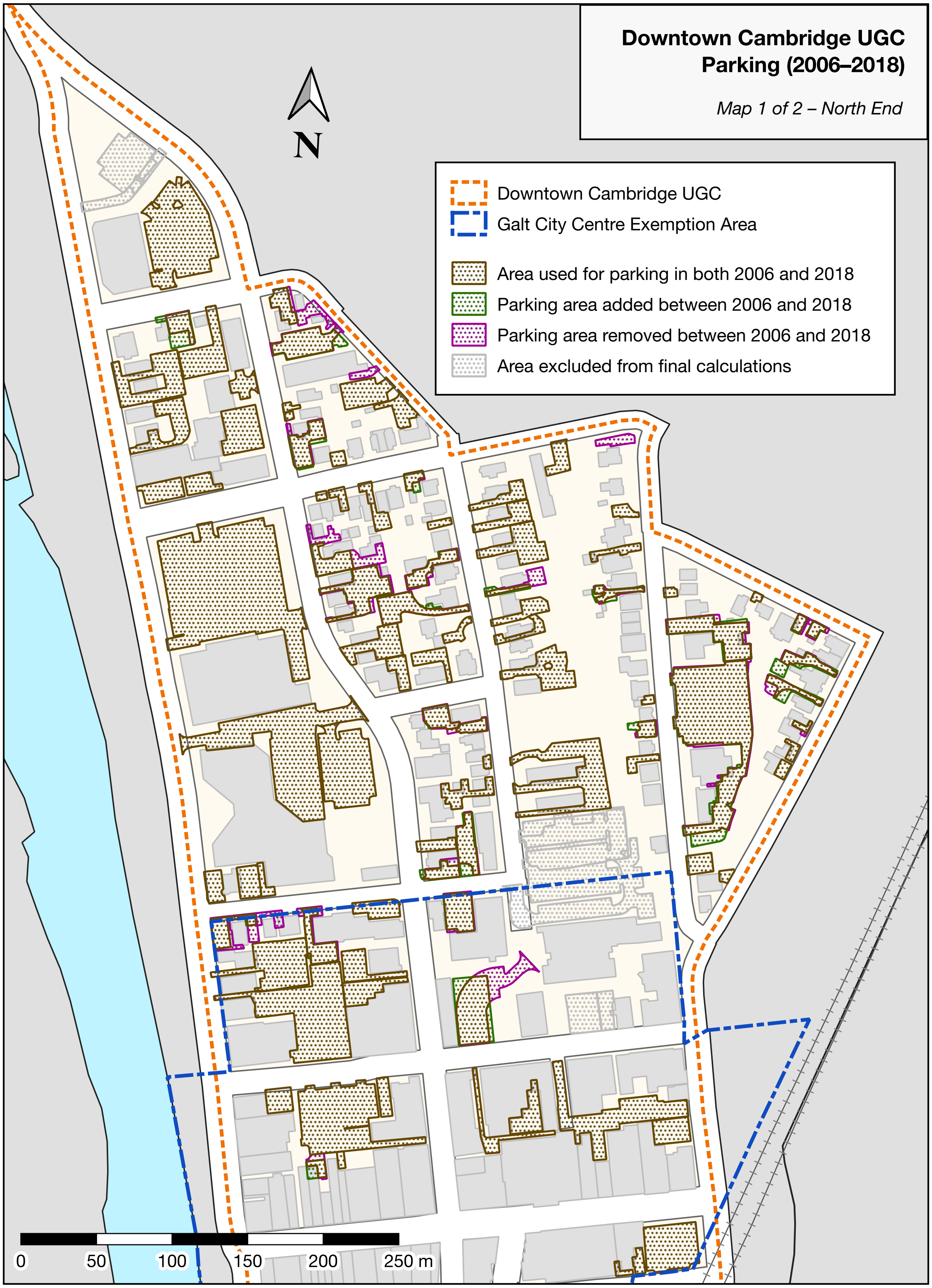
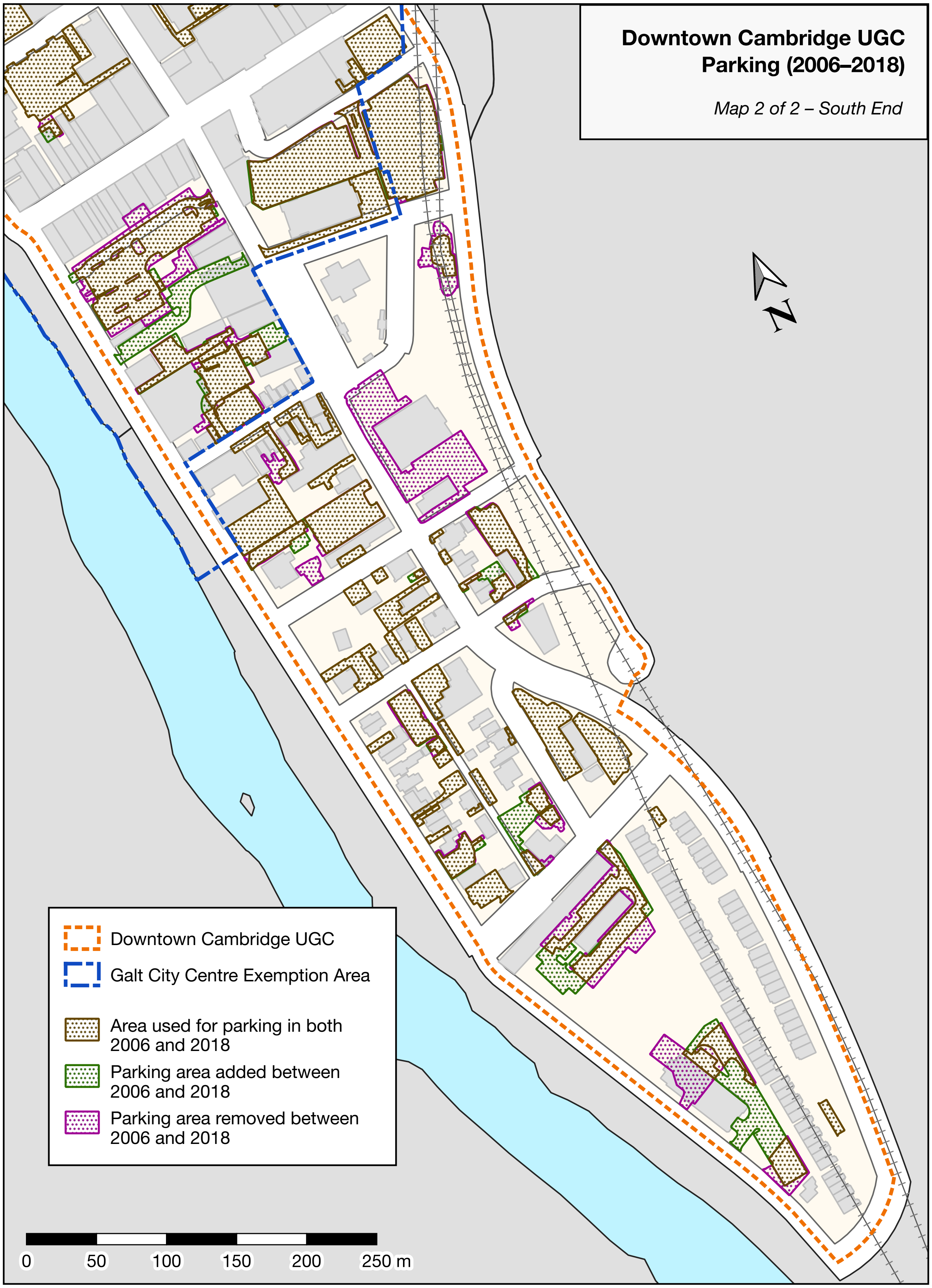
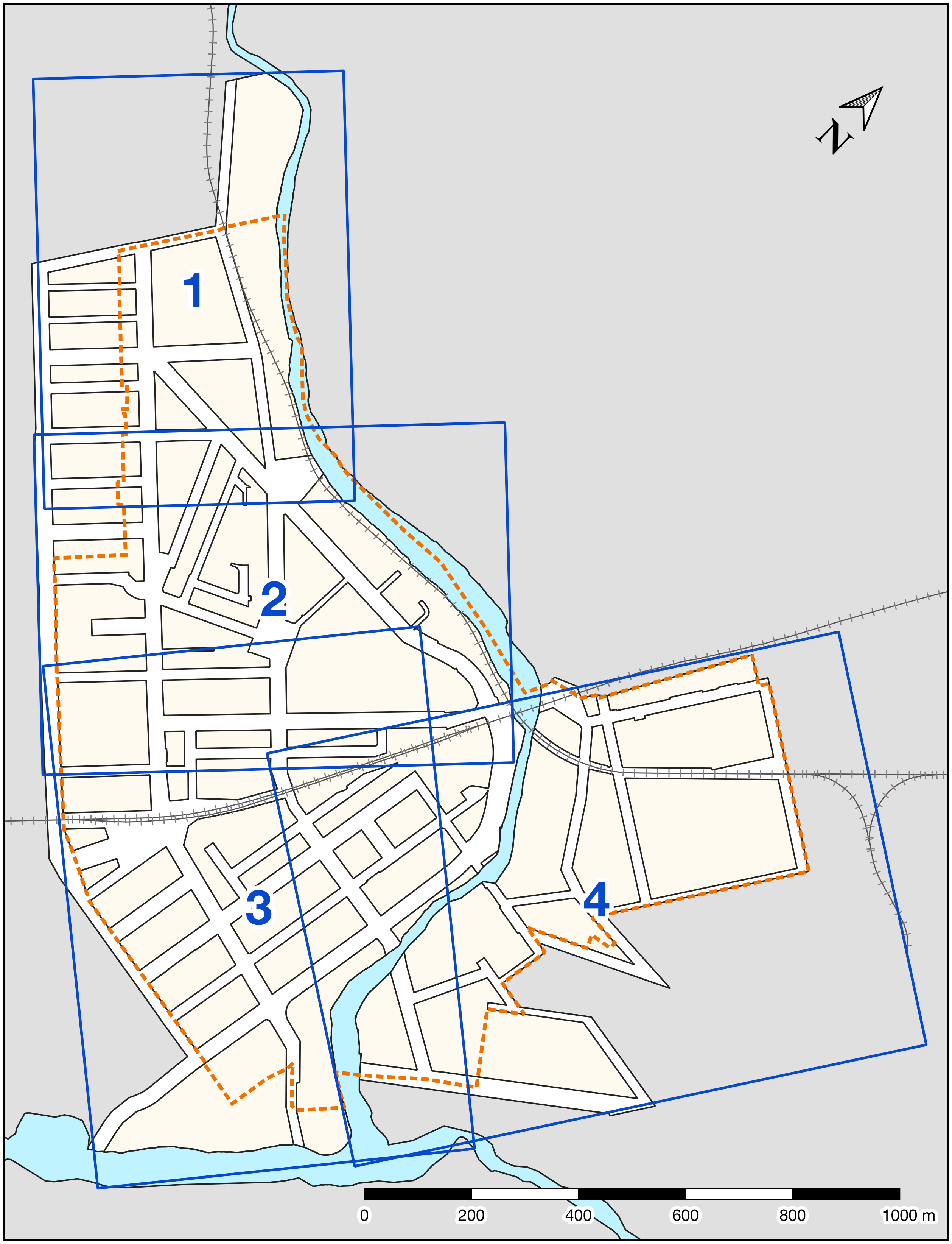


Downtown Cambridge UGC
Parking (2006–2018)
Map 1 of 2 – North End
N
Downtown Cambridge UGC
Galt City Centre Exemption Area
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
Area excluded from final calculations
0
50
100
150
200
250 m


Downtown Cambridge UGC
Parking (2006–2018)
Map 2 of 2 – South End
N
Downtown Cambridge UGC
Galt City Centre Exemption Area
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
0
50
100
150
200
250 m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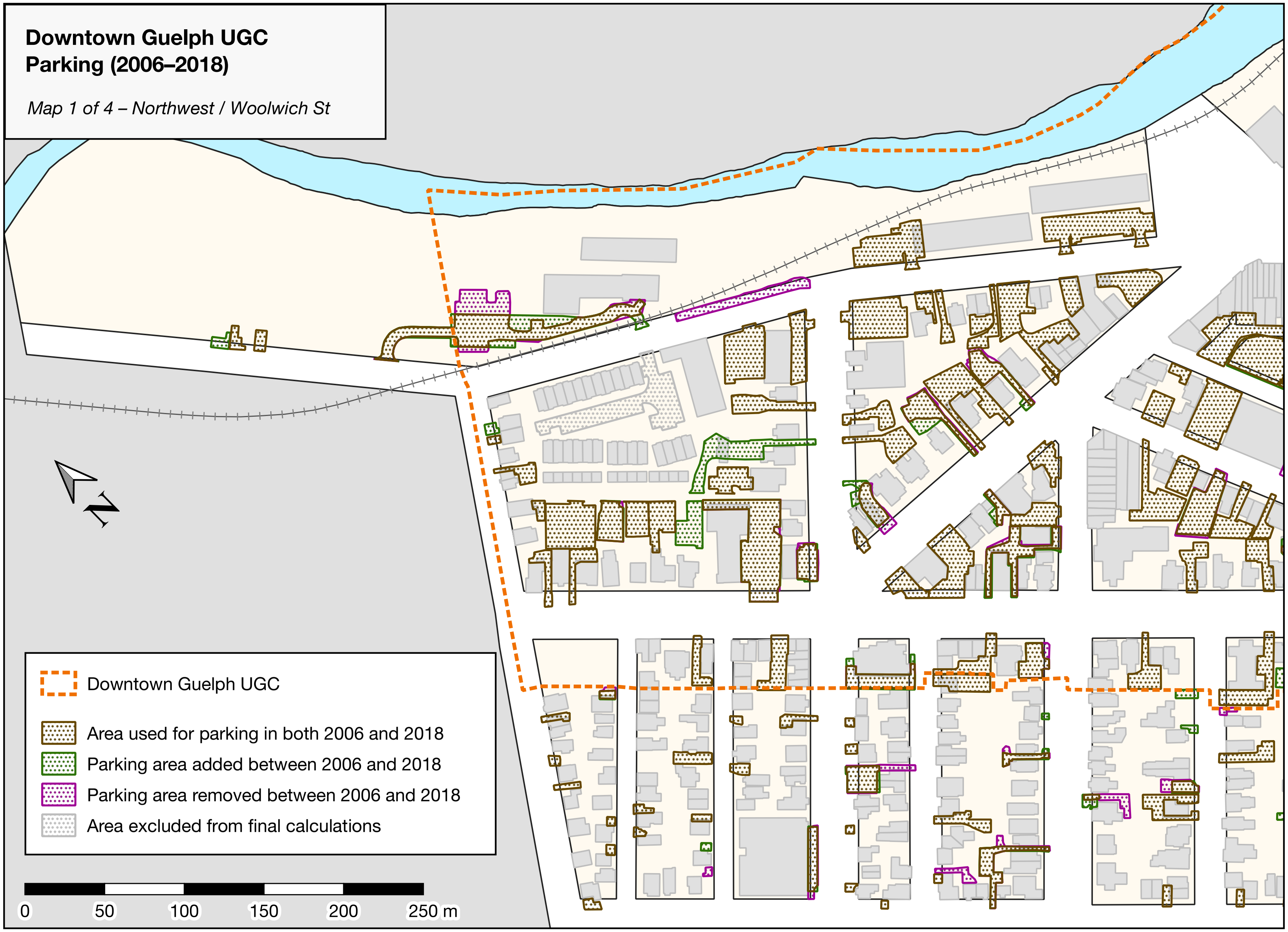
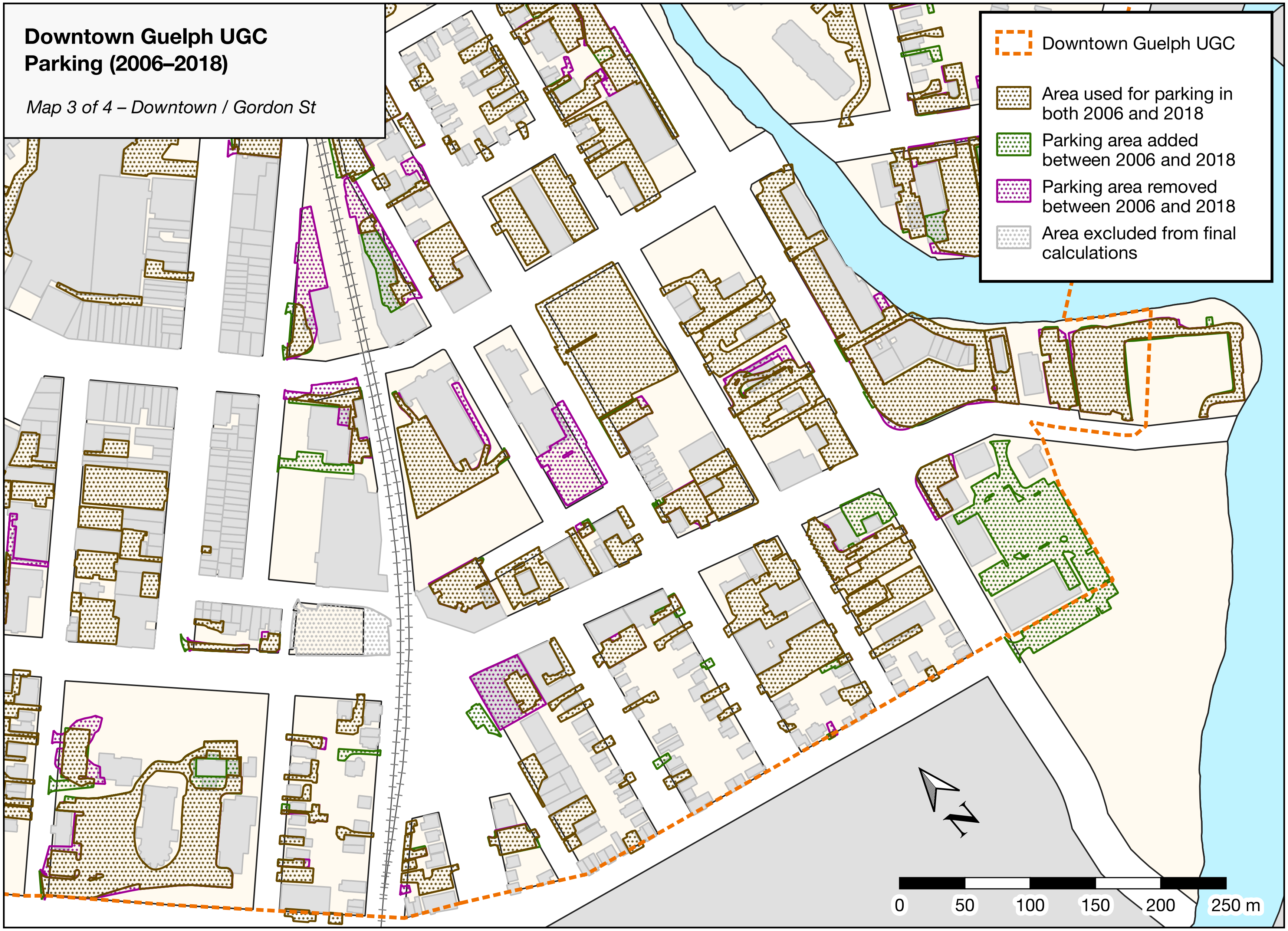
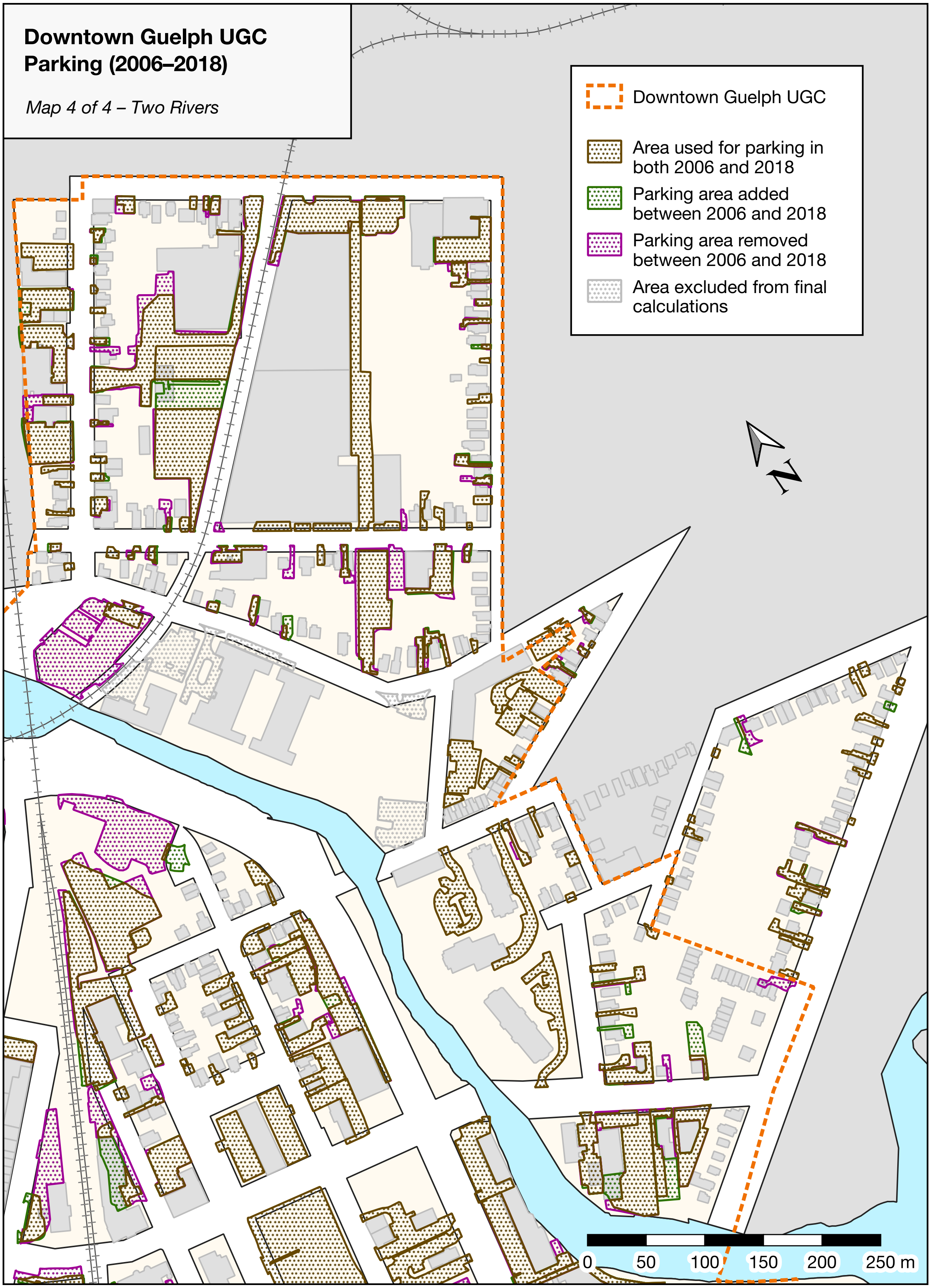
1000 m

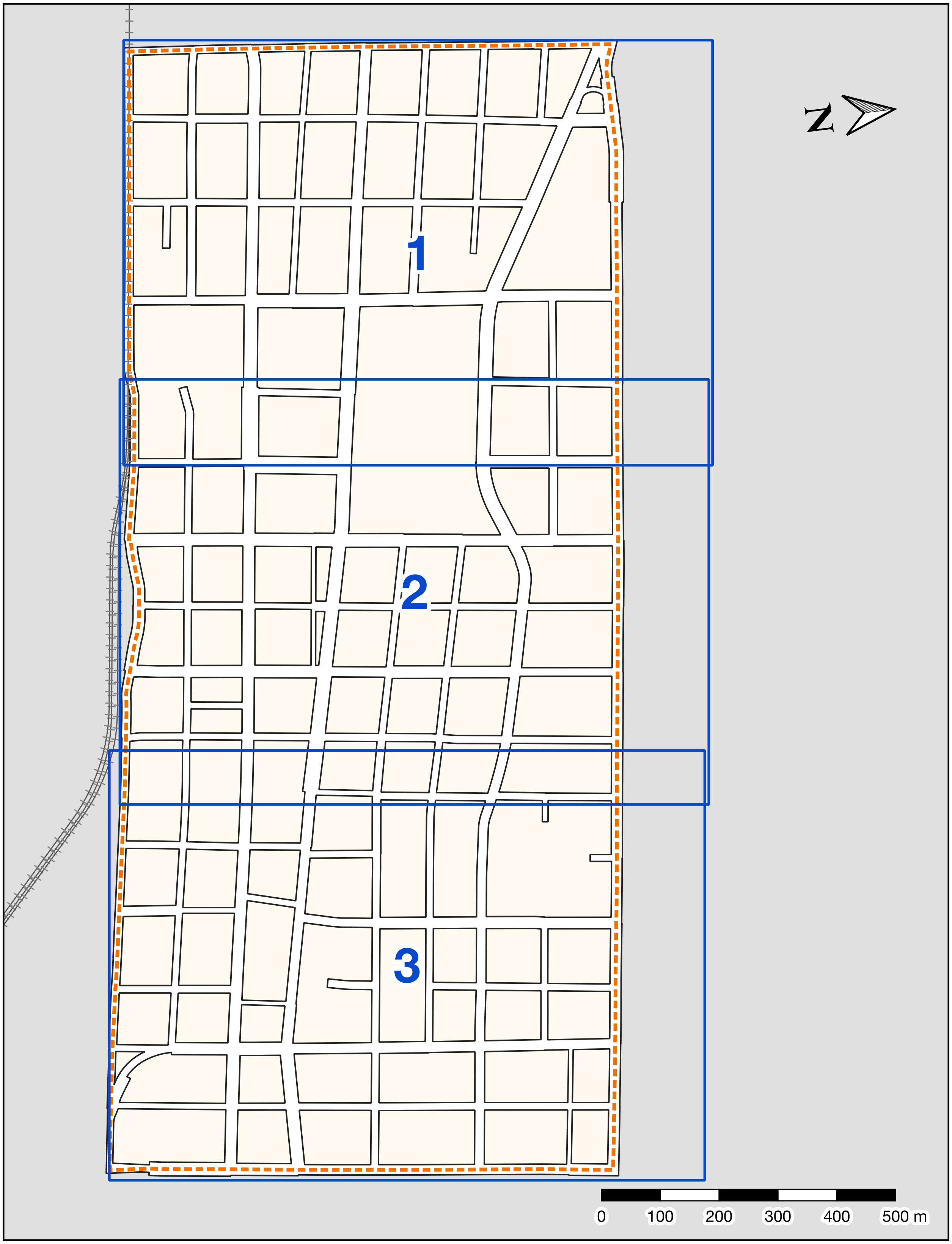


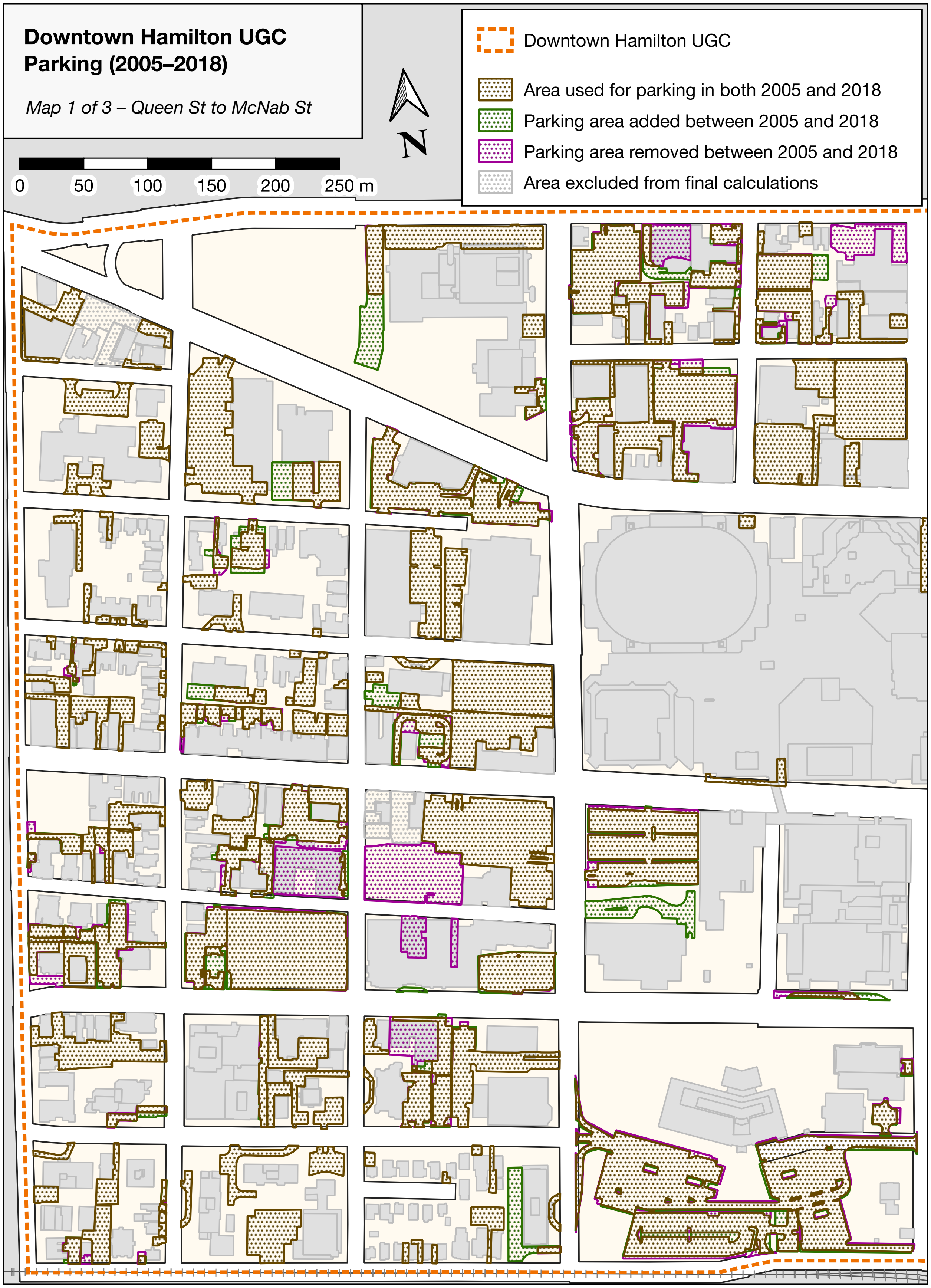
Downtown Guelph UGC
Parking (2006–2018)
Map 1 of 4 – Northwest / Woolwich St
N
Downtown Guelph UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
Area excluded from final calculations
0
50
100
150
200
250 m

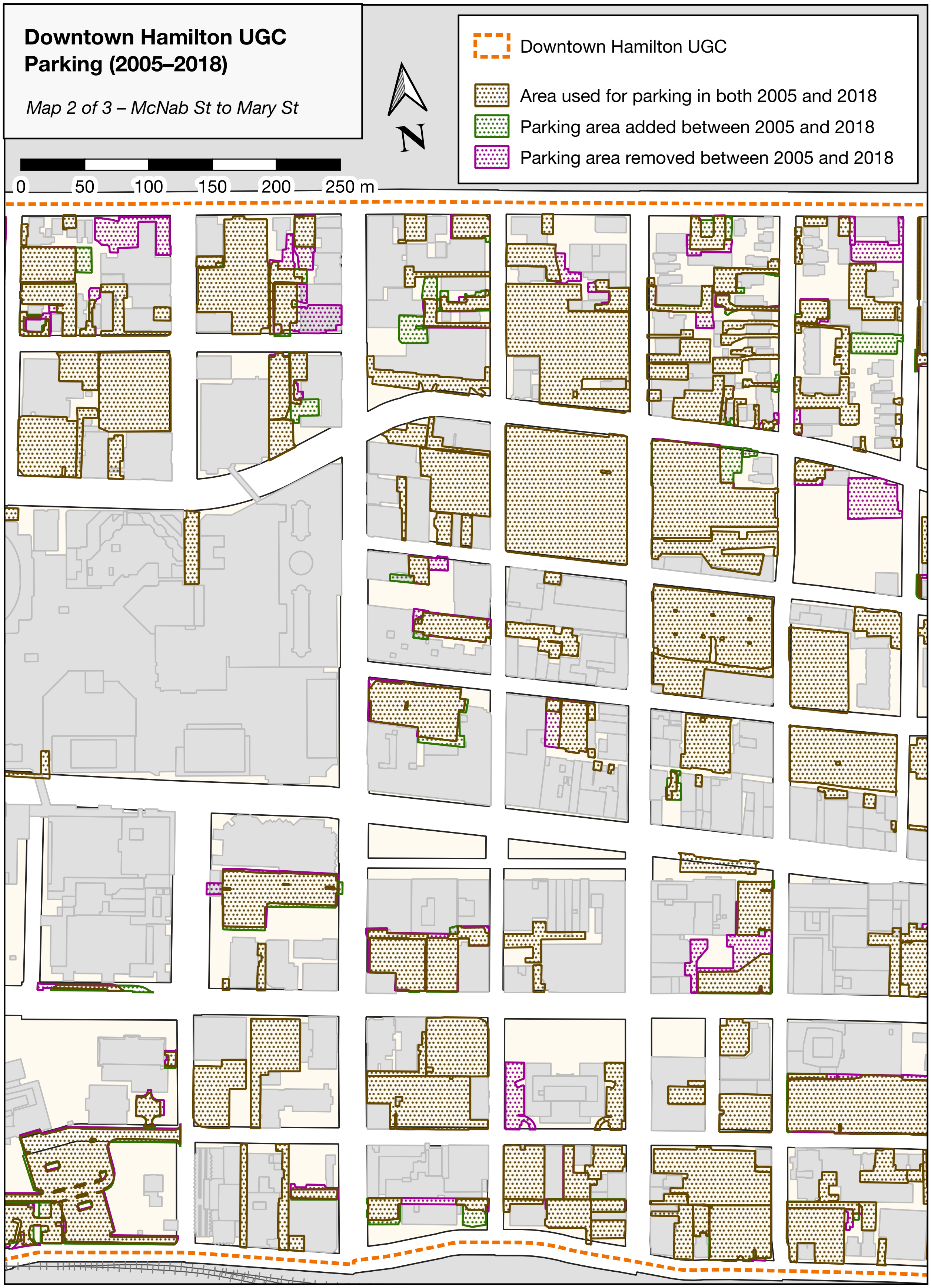
Downtown Guelph UGC Parking (2006–2018)
Map 2 of 4 – Downtown Guelph
Downtown Guelph UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
N
0
50
100
150
200
250 m


Downtown Guelph UGC
Parking (2006–2018)
Map 3 of 4 – Downtown / Gordon St
Downtown Guelph UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
Area excluded from final calculations
N
0
50
100
150
200
250 m

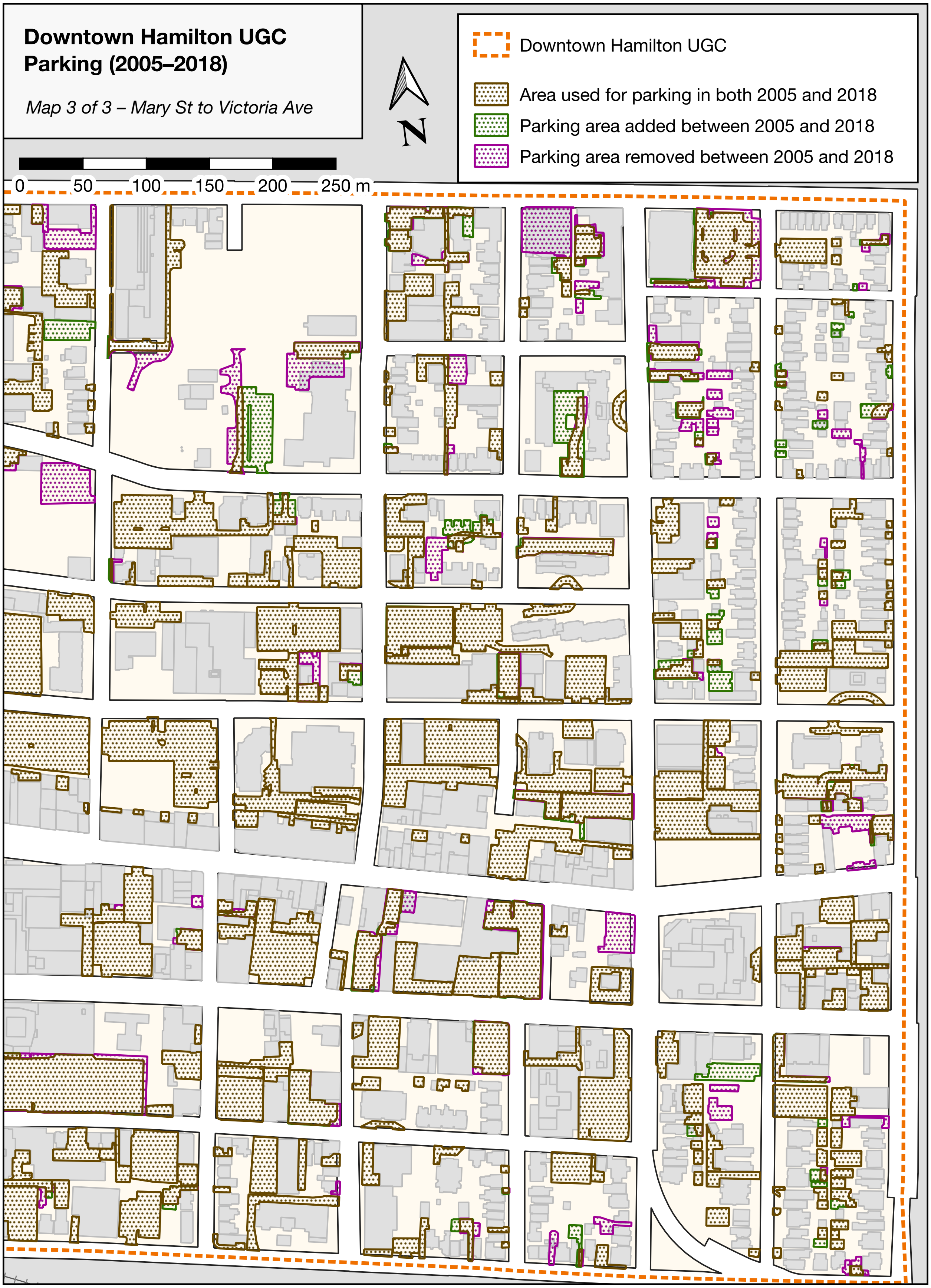

Downtown Guelph UGC
Parking (2006–2018)
Map 4 of 4 – Two Rivers
Downtown Guelph UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
Area excluded from final calculations
N
0
50
100
150
200
250 m

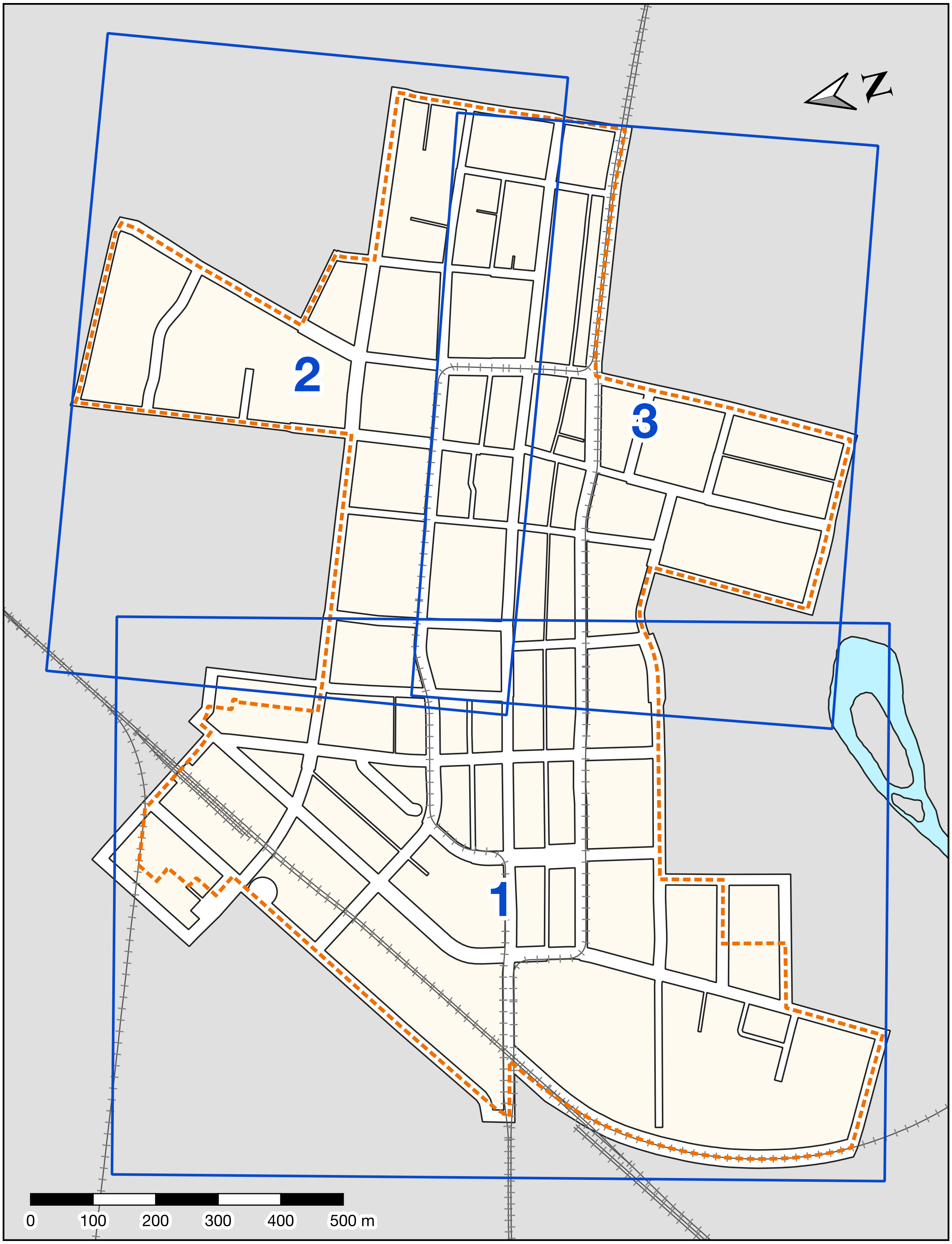

1
2
3
N
0
100
200
300
400
500 m

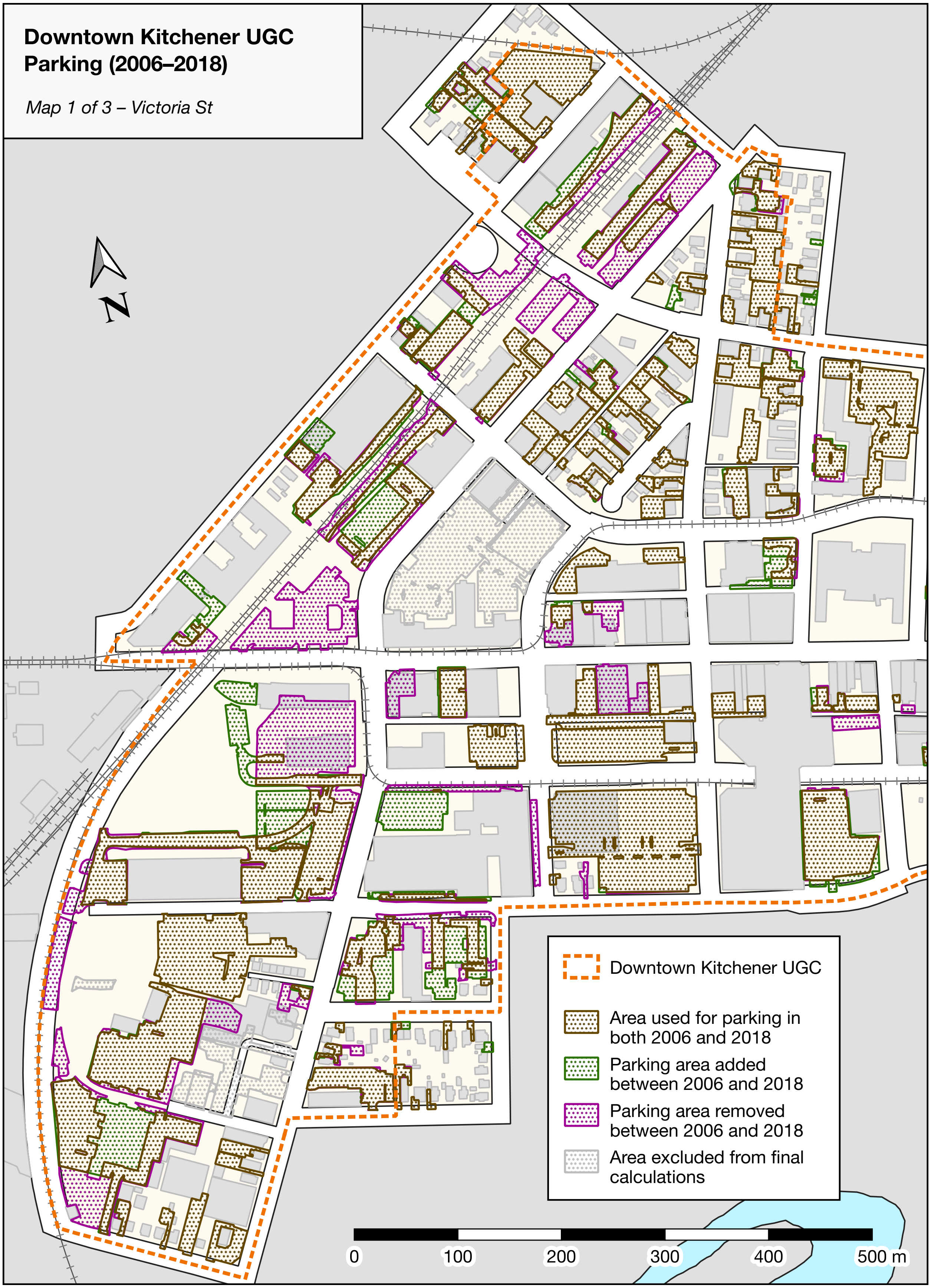

Downtown Hamilton UGC
Parking (2005–2018)
Map 1 of 3 – Queen St to McNab St
N
0 50 100 150 200 250 m
Downtown Hamilton UGC
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
Area excluded from final calculations

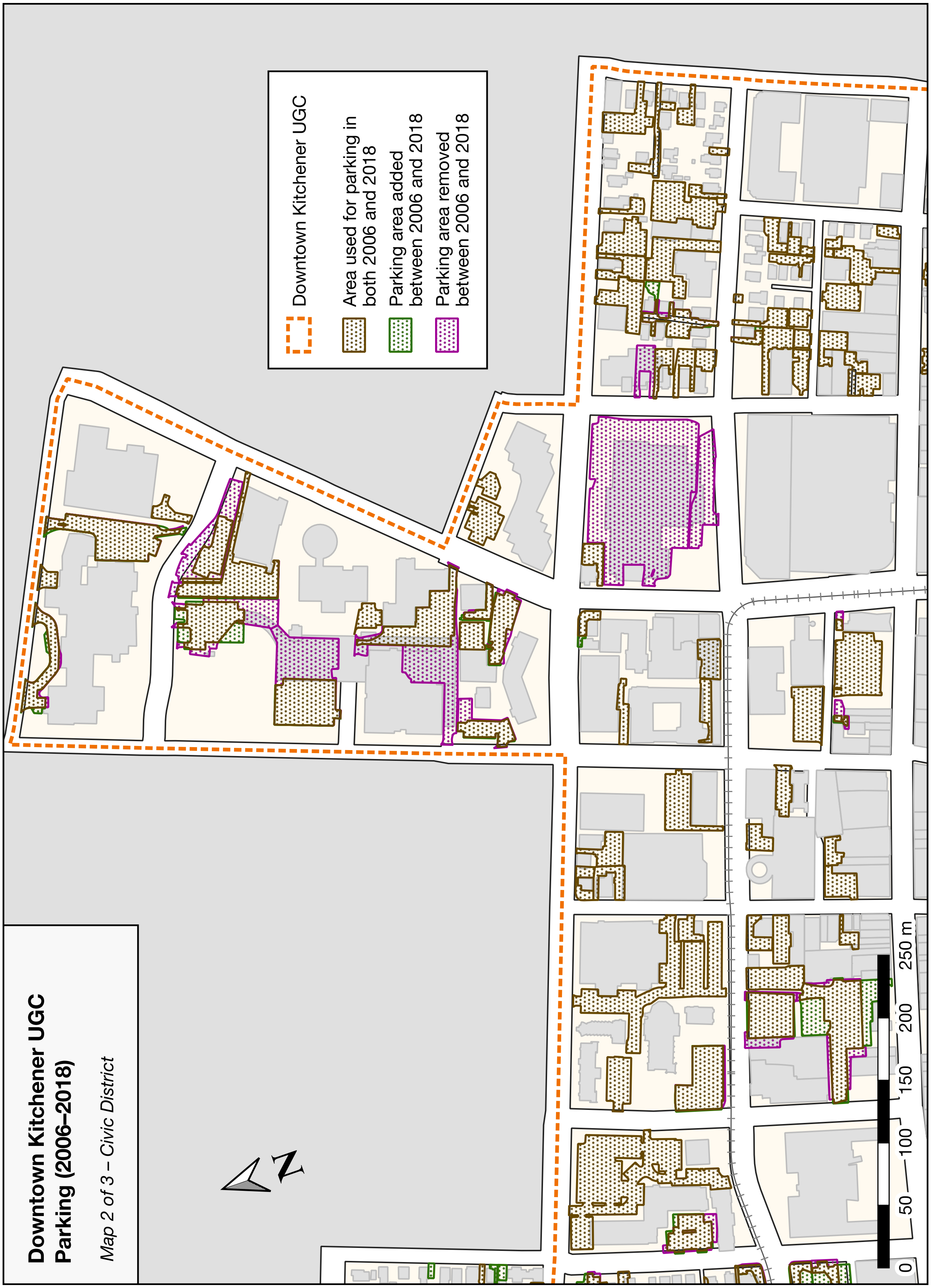


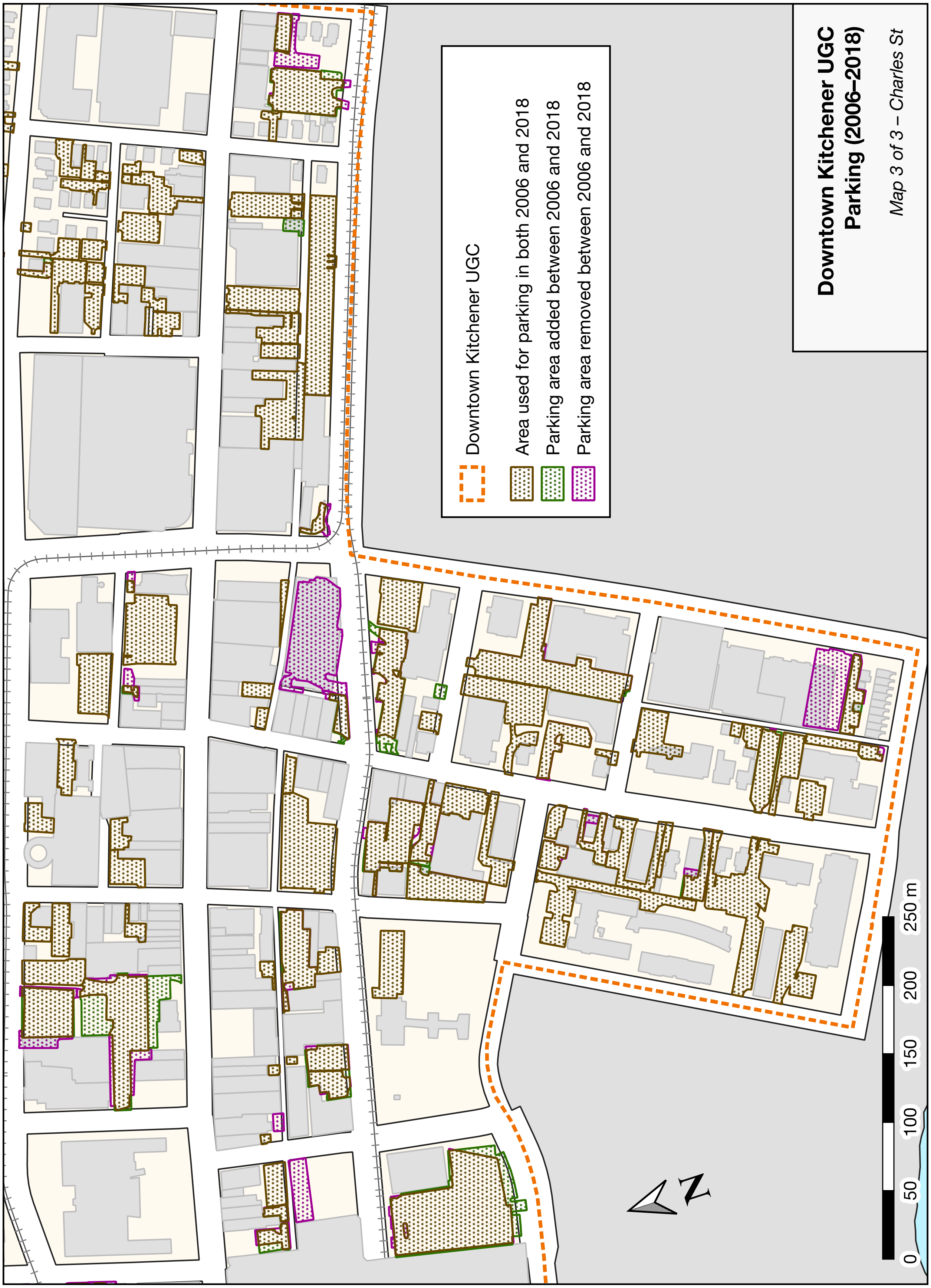
Downtown Hamilton UGC
Parking (2005–2018)
Map 2 of 3 – McNab St to Mary St
N
0
50
100
150
200
250 m
Downtown Hamilton UGC
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018

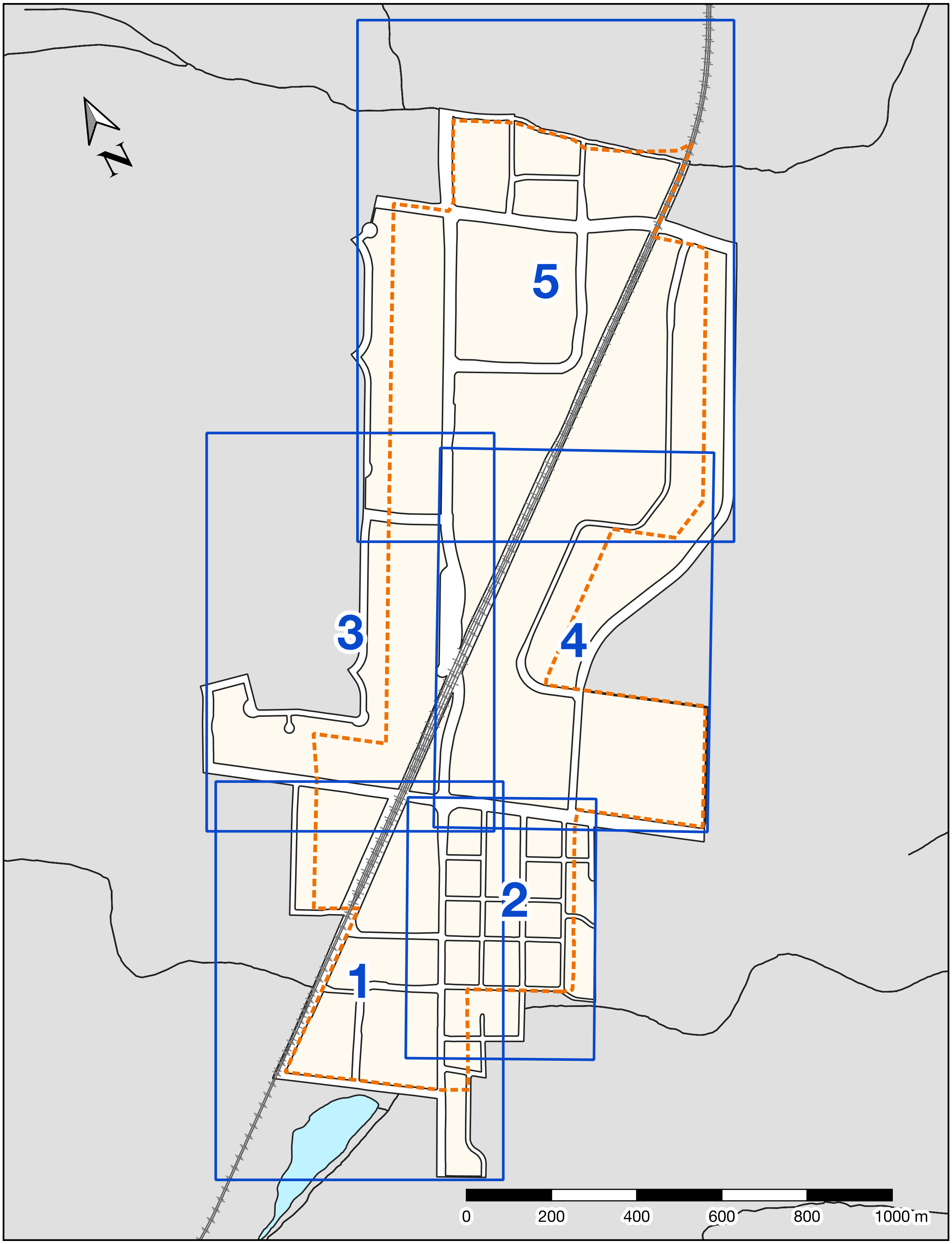

Downtown Hamilton UGC
Parking (2005–2018)
Map 3 of 3 – Mary St to Victoria Ave
N
0
50
100
150
200
250 m
Downtown Hamilton UGC
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018

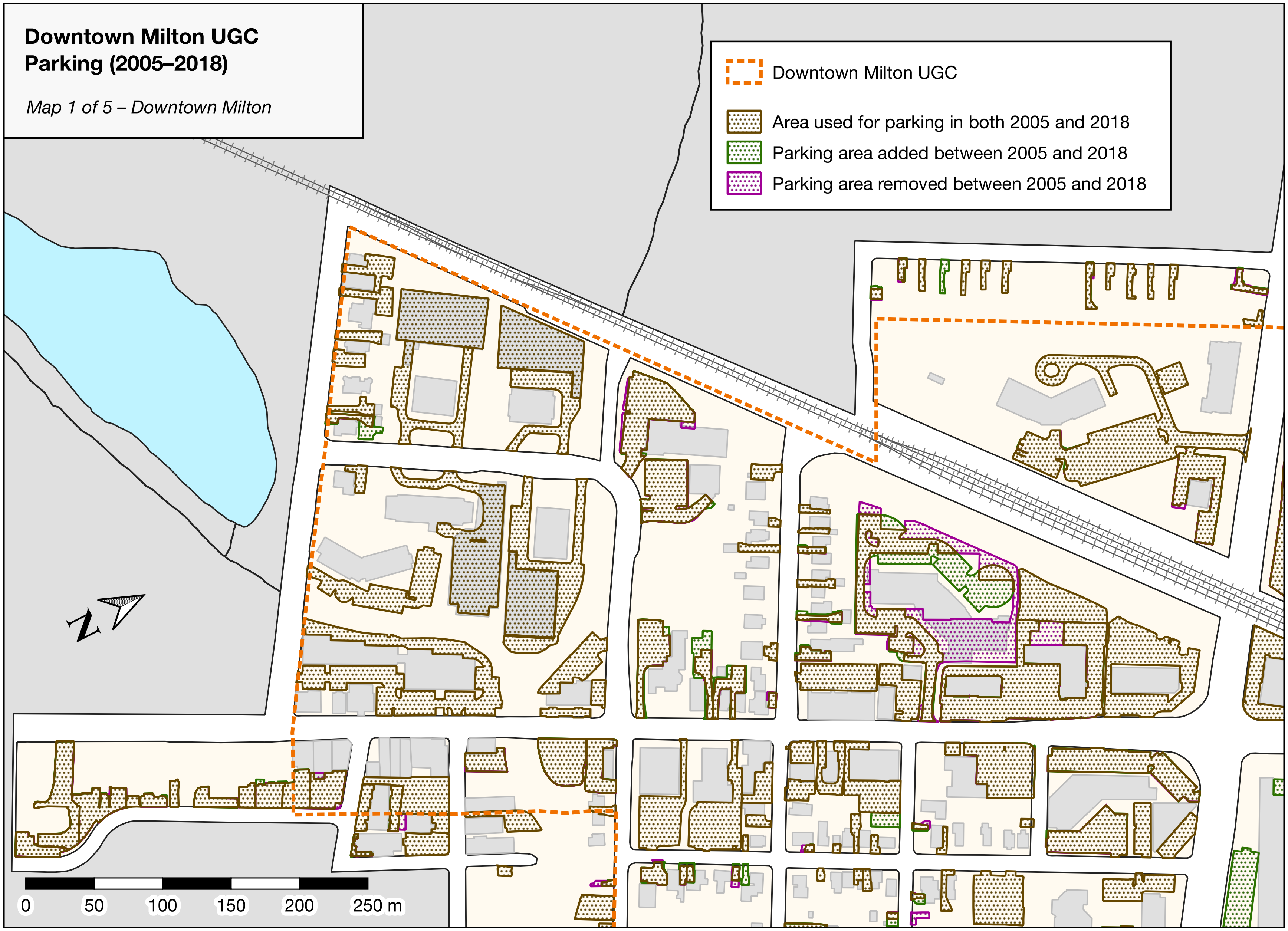

2
3
1
N
0
100
200
300
400
500 m


Downtown Kitchener UGC
Parking (2006–2018)
Map 1 of 3 – Victoria St
N
Downtown Kitchener UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
Area excluded from final calculations
0
100
200
300
400
500 m

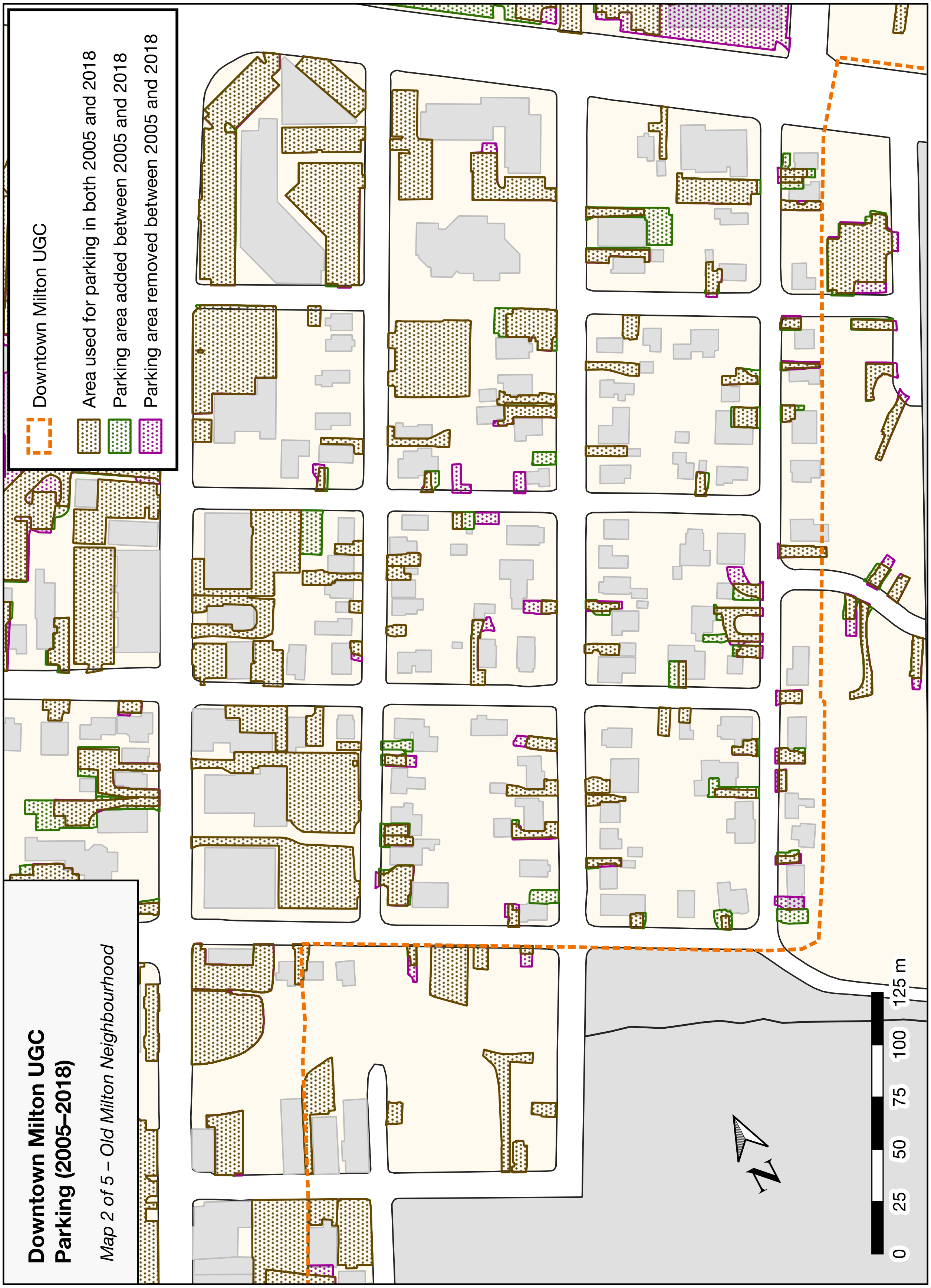

Downtown Kitchener UGC
Parking (2006–2018)
Map 2 of 3 – Civic District
N
Downtown Kitchener UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
0
50
100
150
200
250 m


Downtown Kitchener UGC
Parking (2006–2018)
Map 3 of 3 – Charles St
Downtown Kitchener UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
N
0
50
100
150
200
250 m

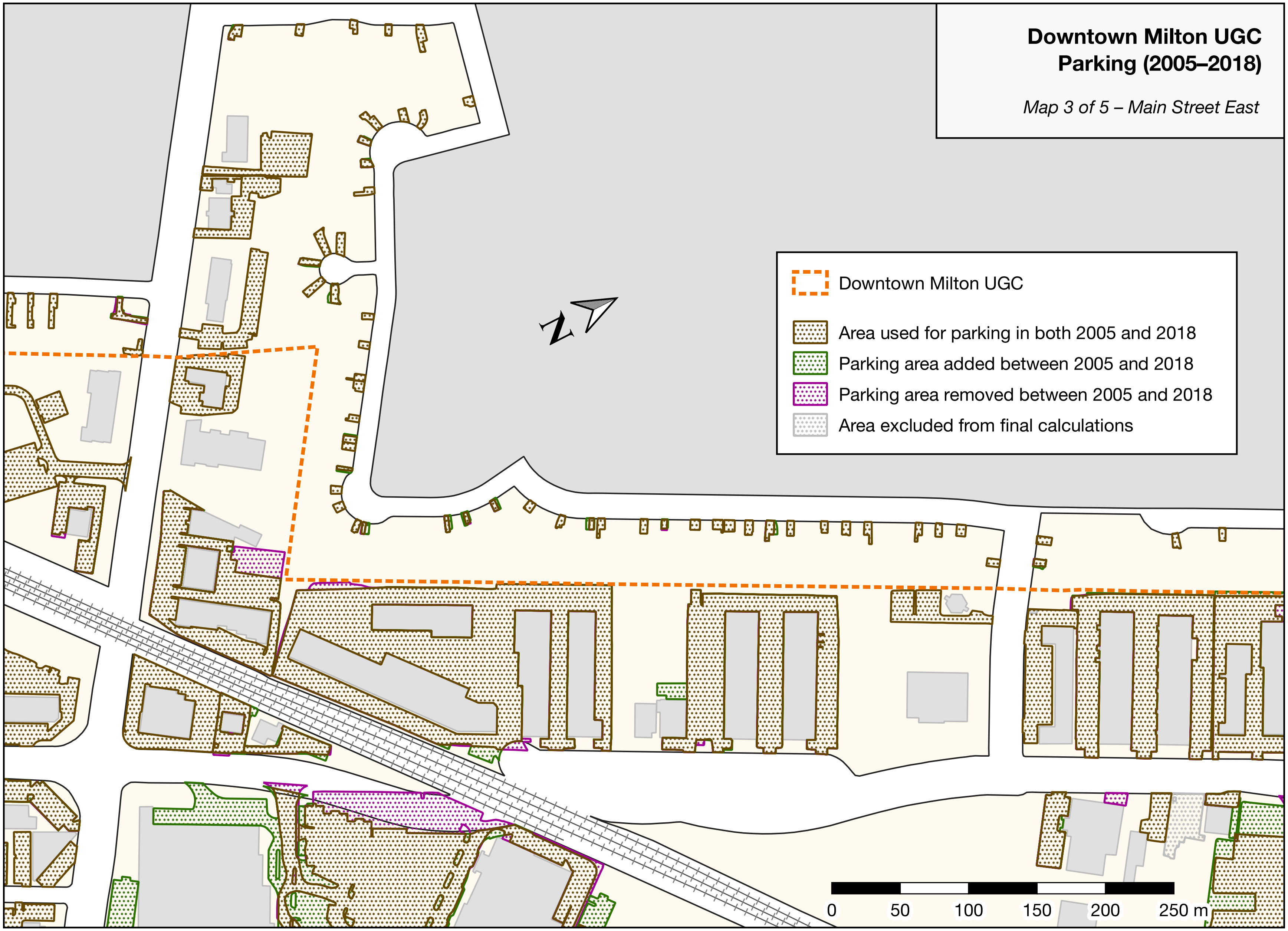

N
5
3
4
2
1
0
200
400
600
800
1000 m

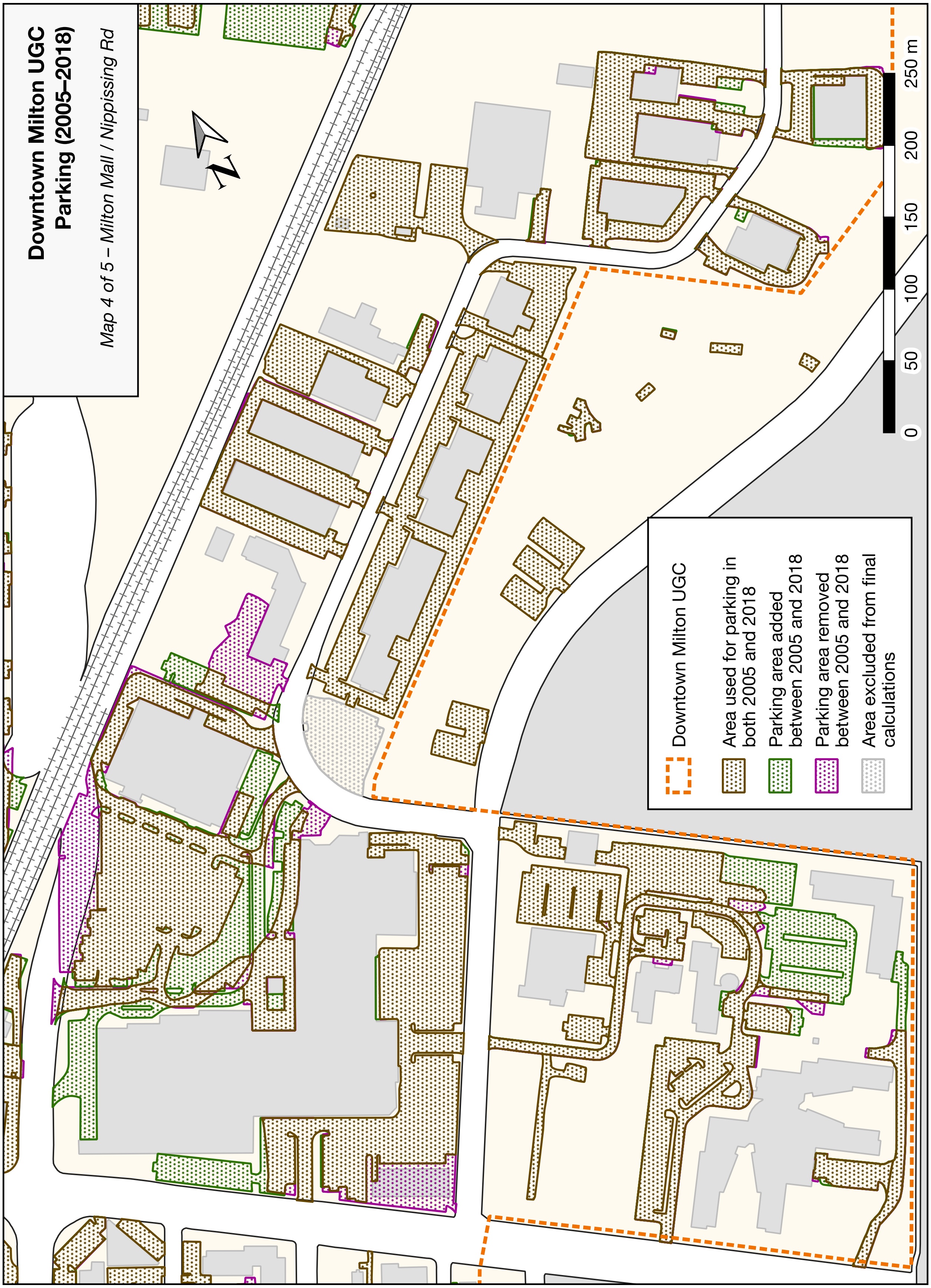


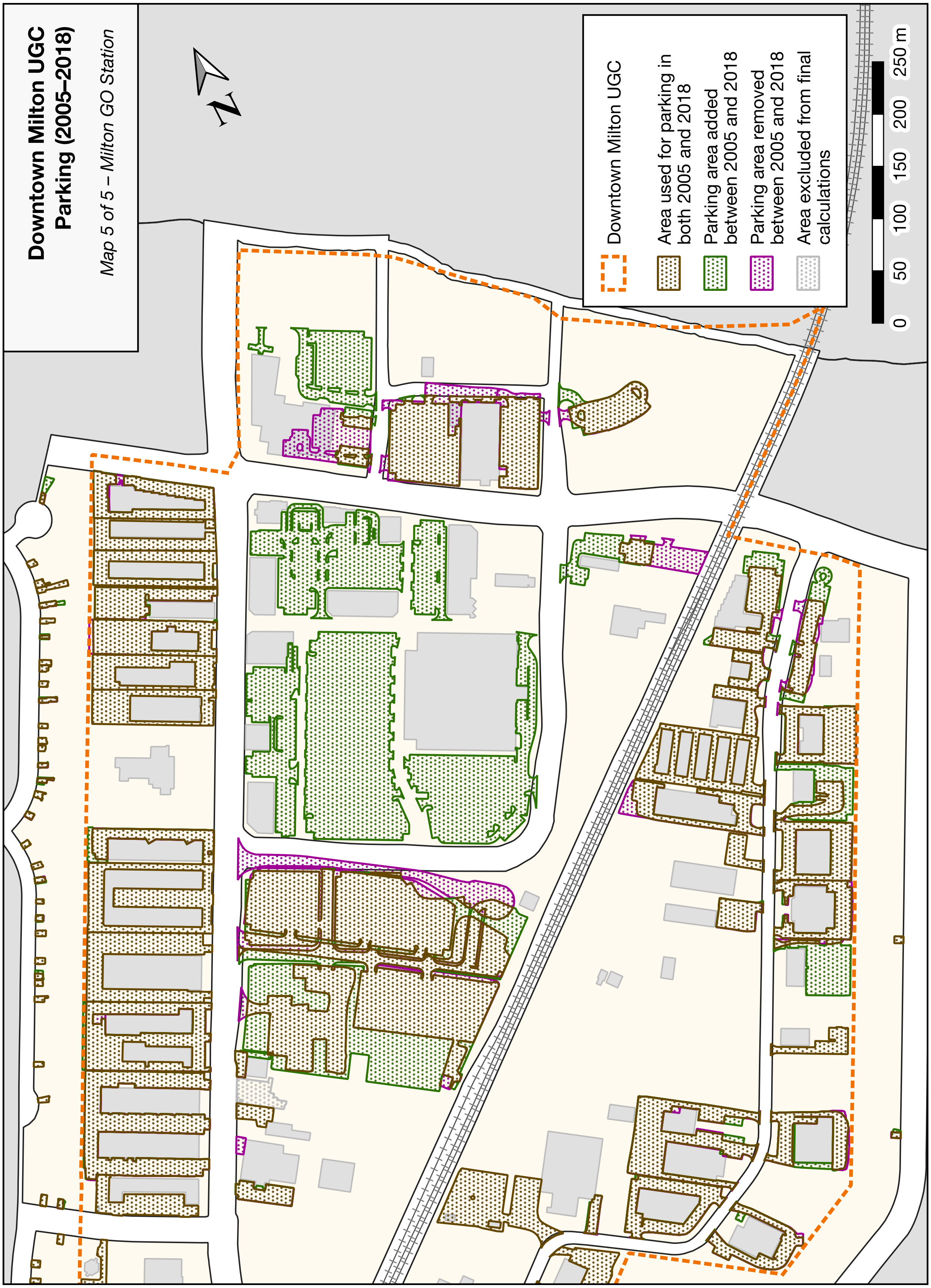
Downtown Milton UGC
Parking (2005–2018)
Map 1 of 5 – Downtown Milton
Downtown Milton UGC
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
N
0
50
100
150
200
250 m



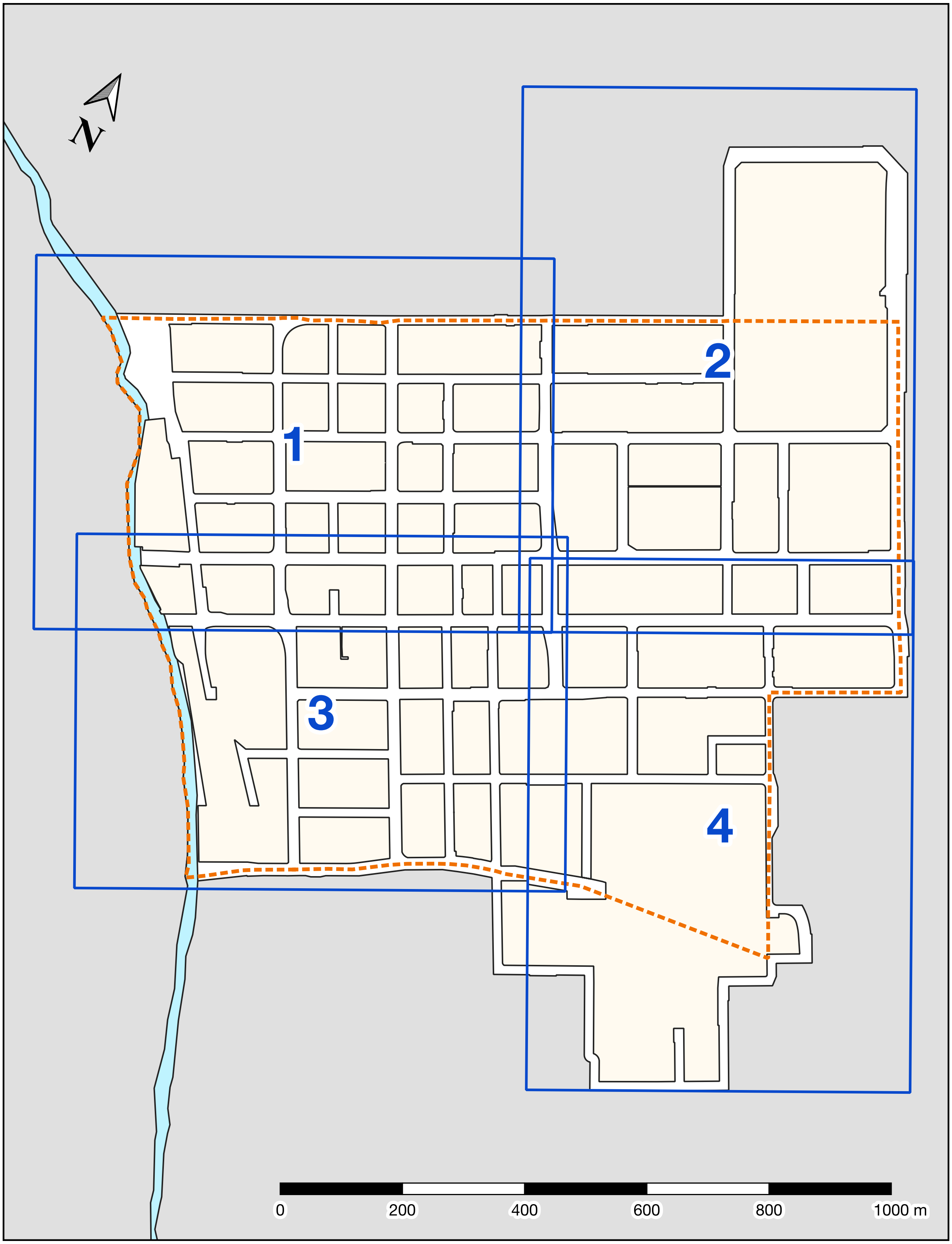
Downtown Milton UGC
Parking (2005–2018)
Map 2 of 5 – Old Milton Neighbourhood
Downtown Milton UGC
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
N
0
25
50
75
100
125 m

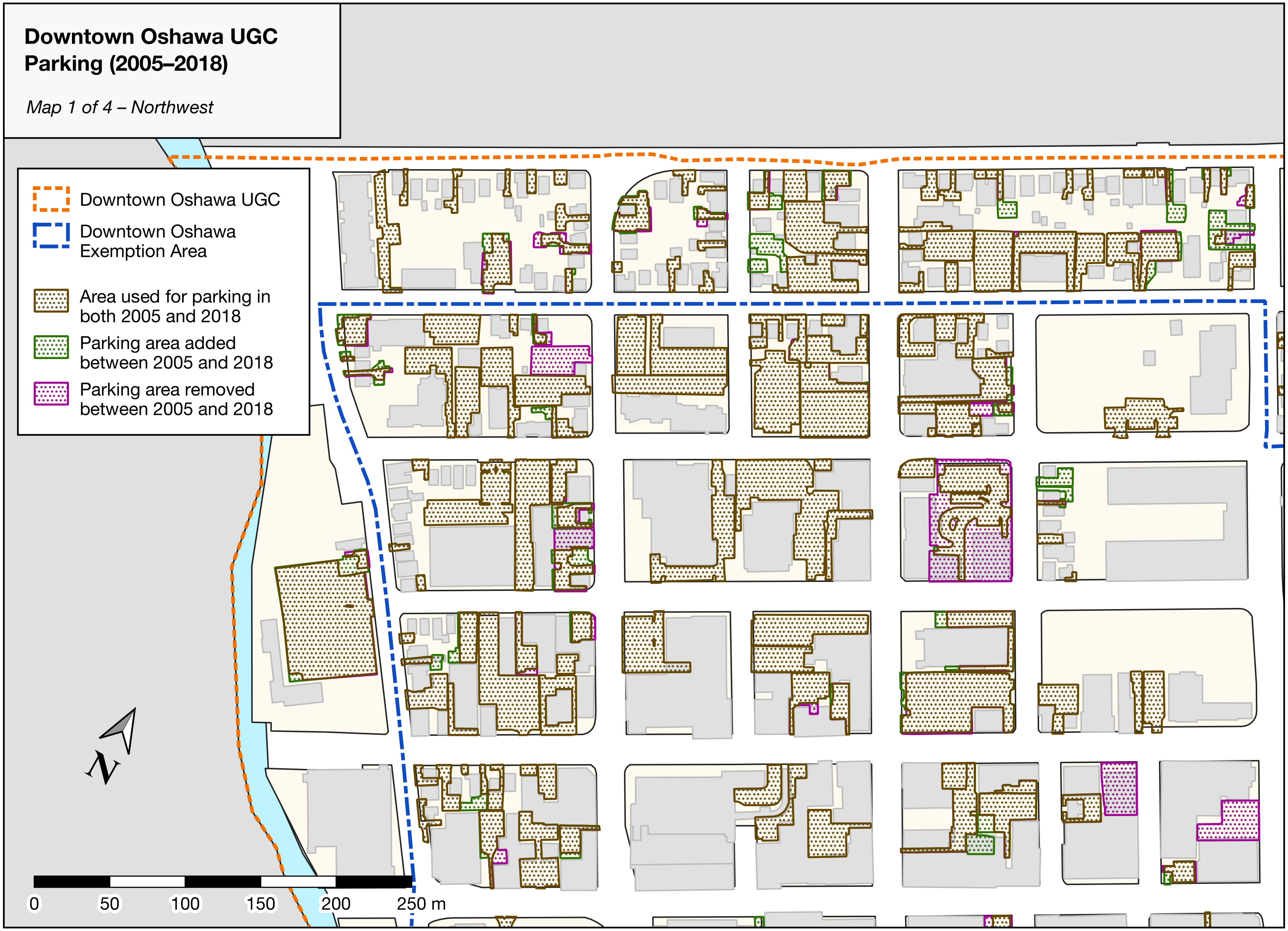

Downtown Milton UGC
Parking (2005–2018)
Map 3 of 5 – Main Street East
Downtown Milton UGC
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
Area excluded from final calculations
N
0
50
100
150
200
250 m


Downtown Milton UGC
Parking (2005–2018)
Map 4 of 5 – Milton Mall / Nippissing Rd
N
Downtown Milton UGC
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
Area excluded from final calculations
0
50
100
150
200
250 m

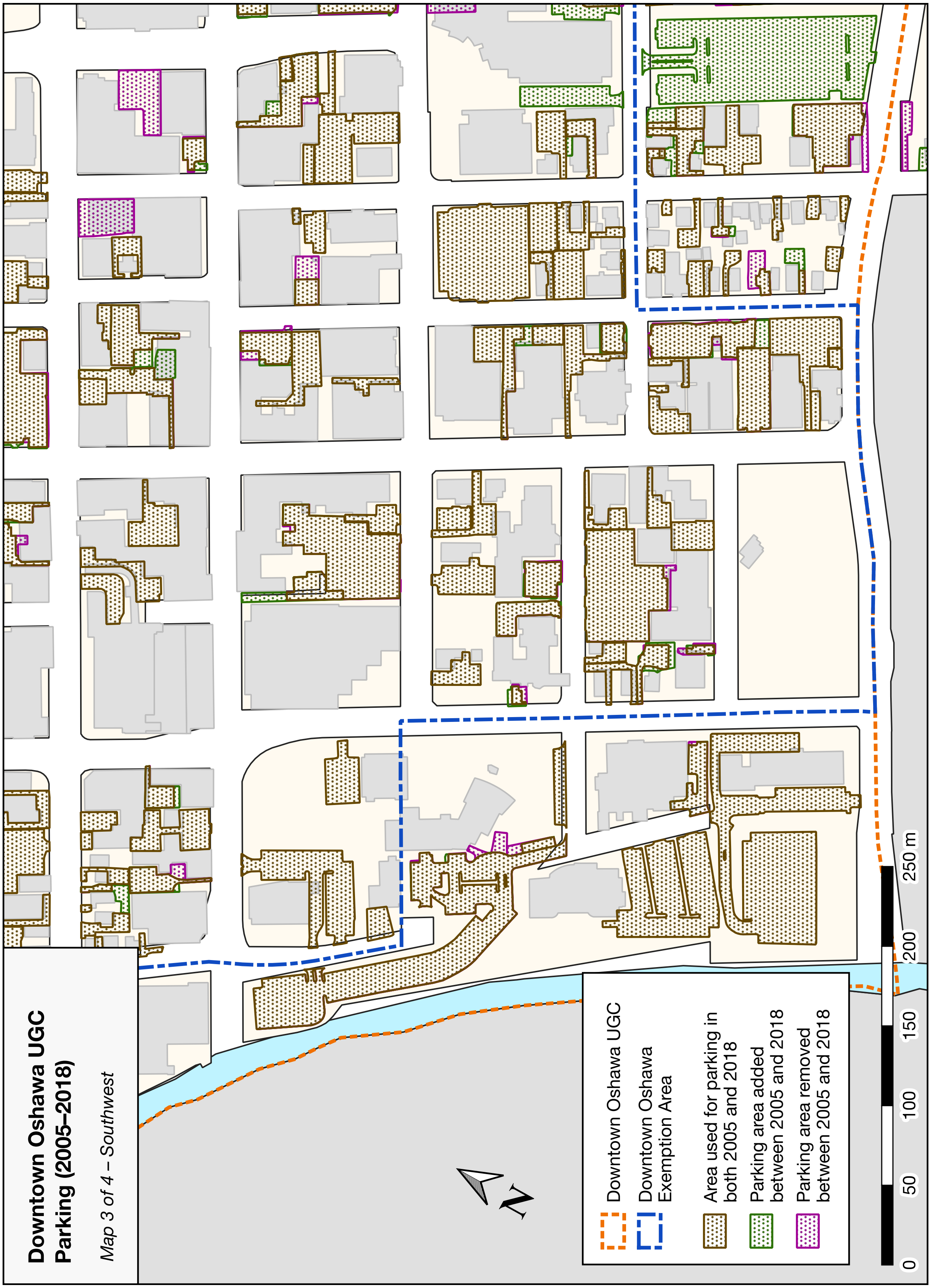

Downtown Milton UGC
Parking (2005–2018)
Map 5 of 5 – Milton GO Station
N
Downtown Milton UGC
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
Area excluded from final calculations
0
50
100
150
200
250 m

Parking Maps – Downtown Oshawa UGC

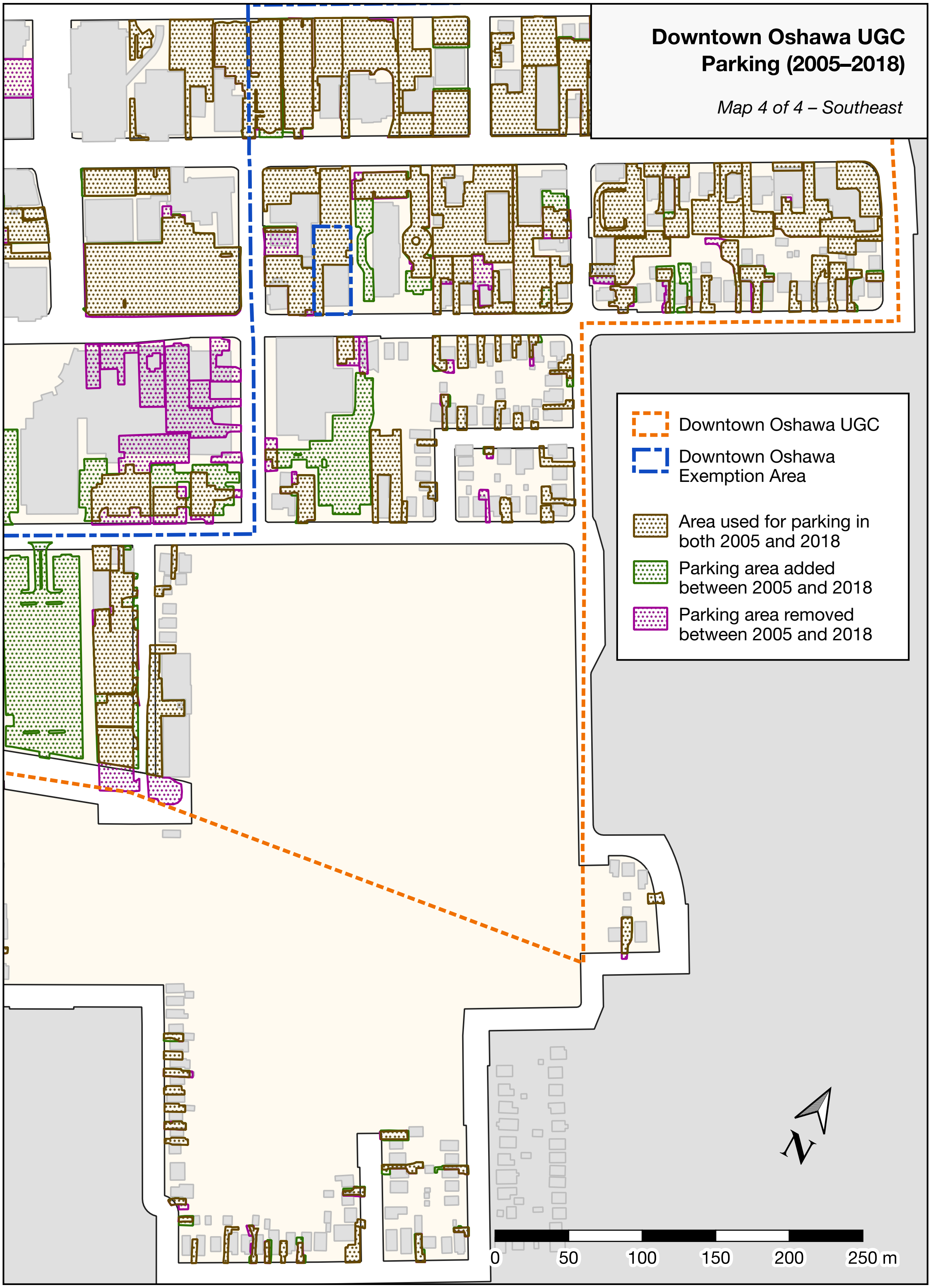


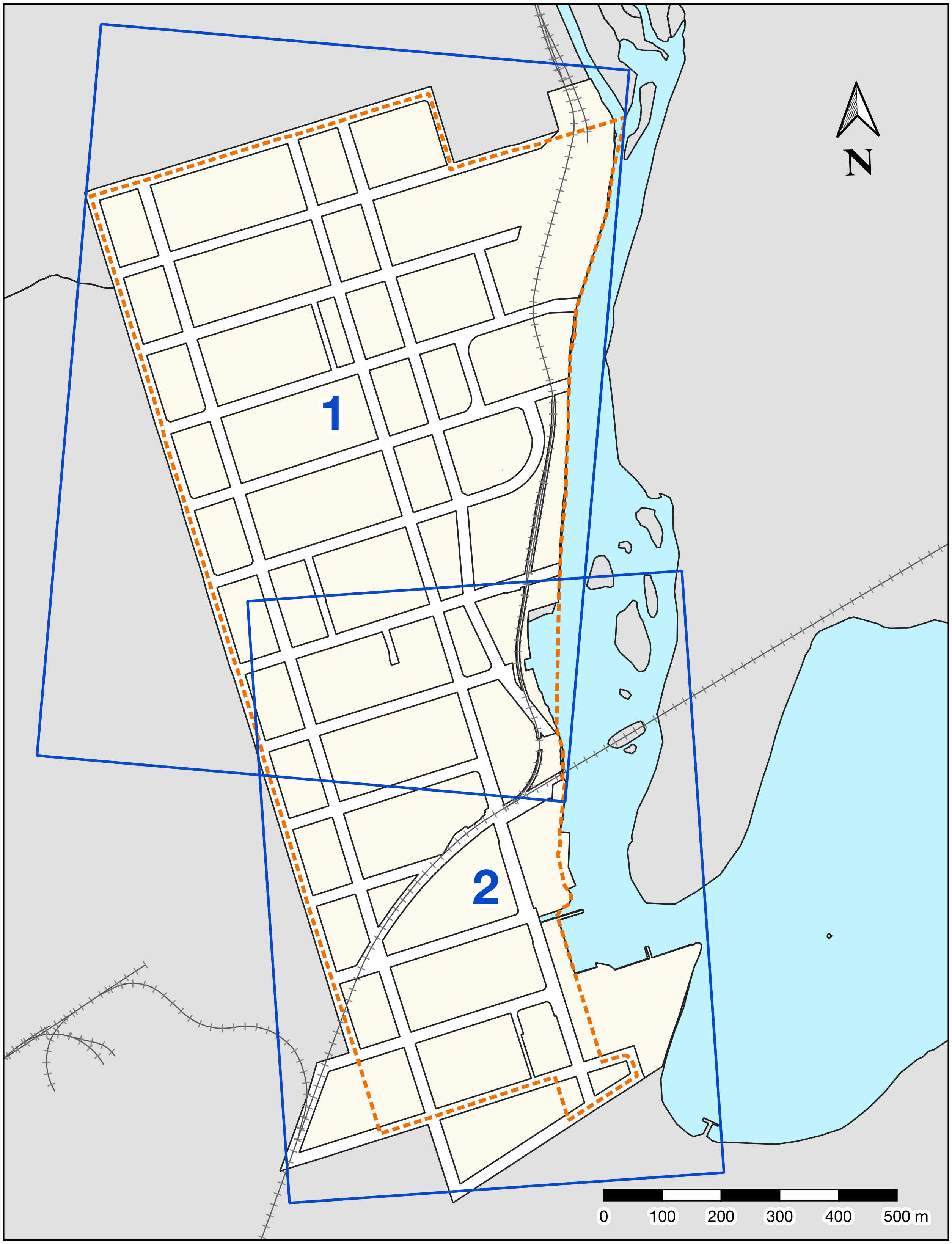

Downtown Oshawa UGC
Parking (2005–2018)
Map 1 of 4 – Northwest
Downtown Oshawa UGC
Downtown Oshawa Exemption Area
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
N
0
50
100
150
200
250 m

Downtown Oshawa UGC
Parking (2005–2018)
Map 2 of 4 – Northeast
Downtown Oshawa UGC
Downtown Oshawa Exemption Area
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
N
0
50
100
150
200
250 m

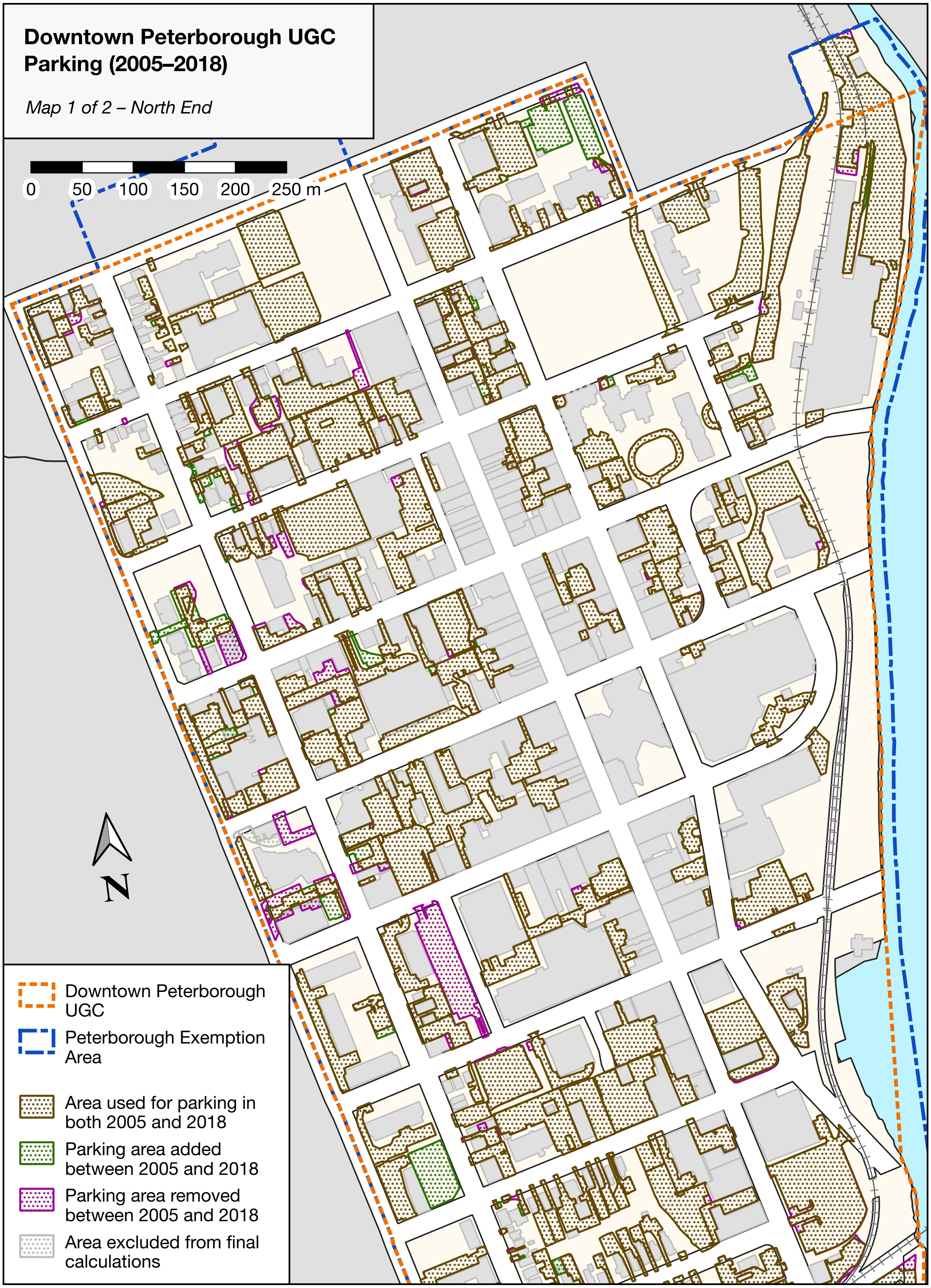


Downtown Oshawa UGC
Parking (2005–2018)
Map 3 of 4 – Southwest
N
Downtown Oshawa UGC
Downtown Oshawa Exemption Area
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
0
50
100
150
200
250 m

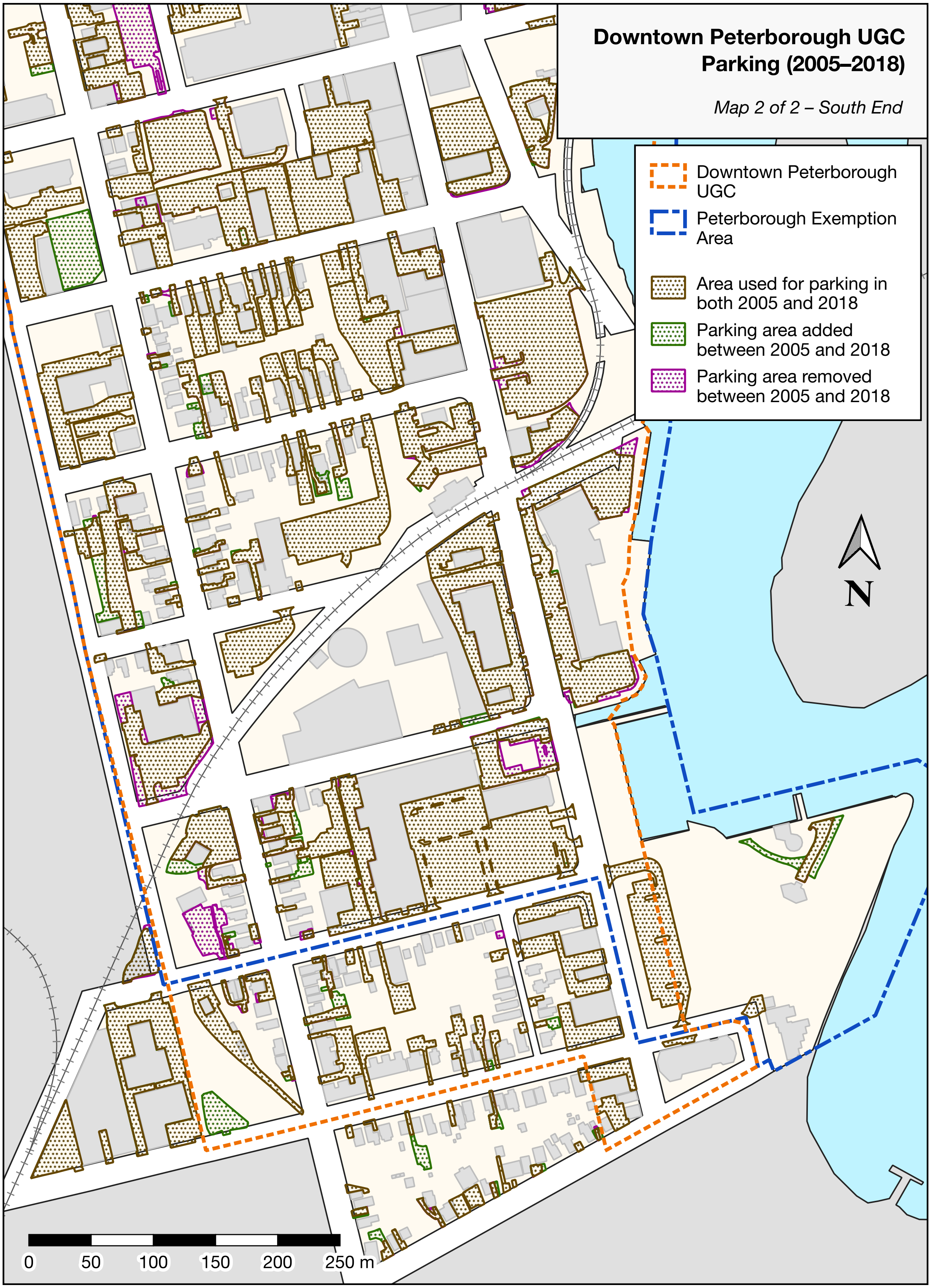

Downtown Oshawa UGC
Parking (2005–2018)
Map 4 of 4 – Southeast
Downtown Oshawa UGC
Downtown Oshawa Exemption Area
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
N
0
50
100
150
200
250 m

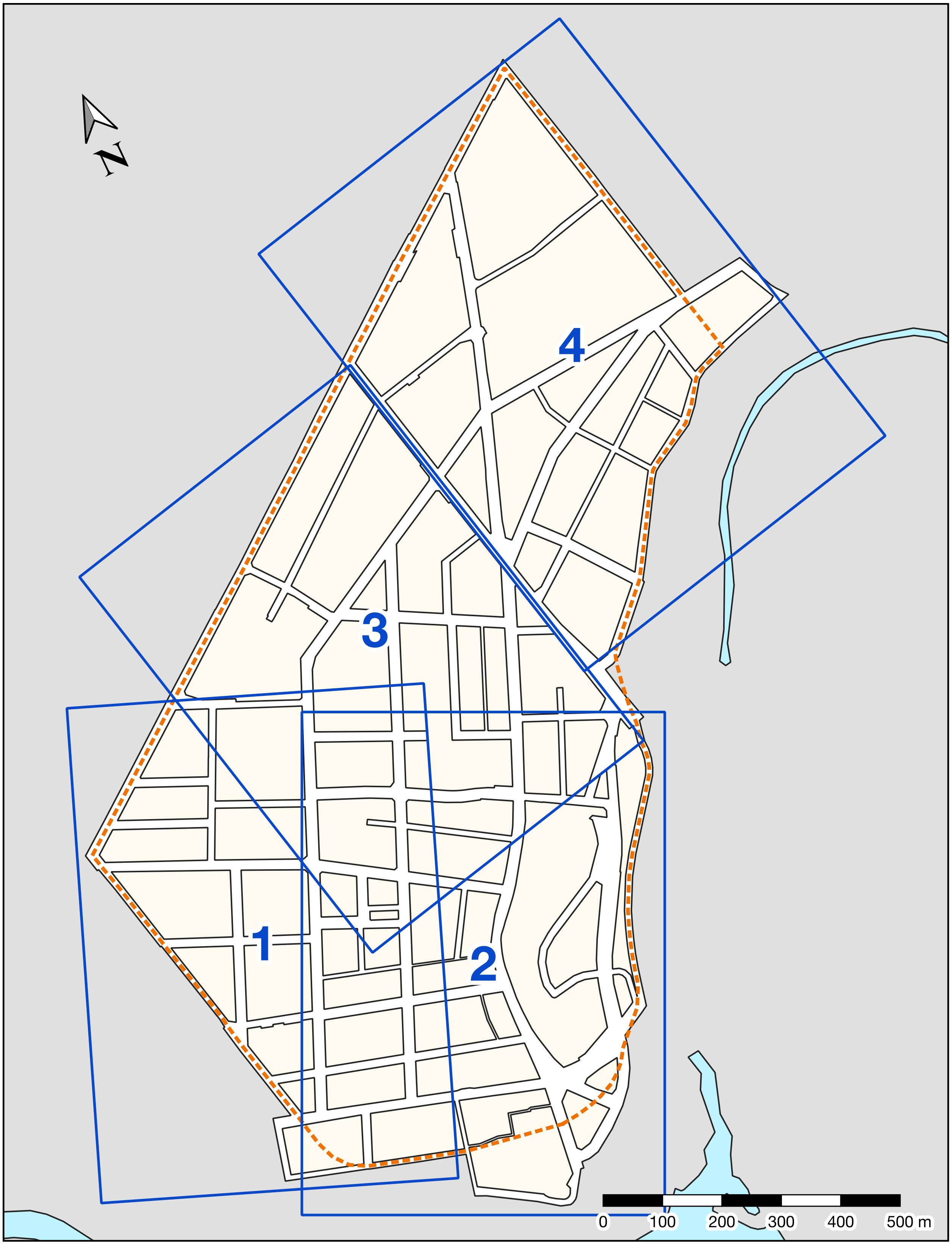


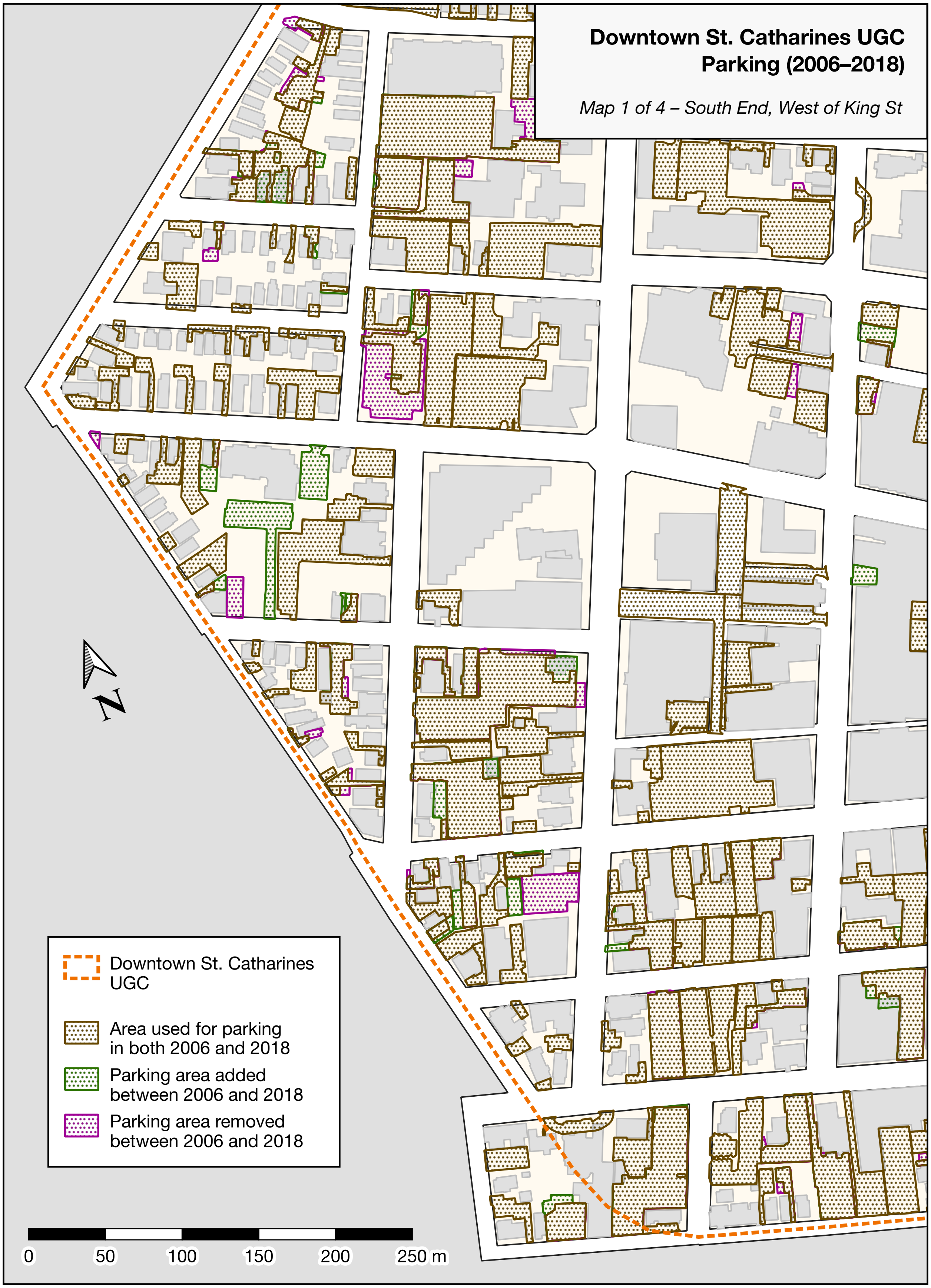
1
2
N
0
100
200
300
400
500 m



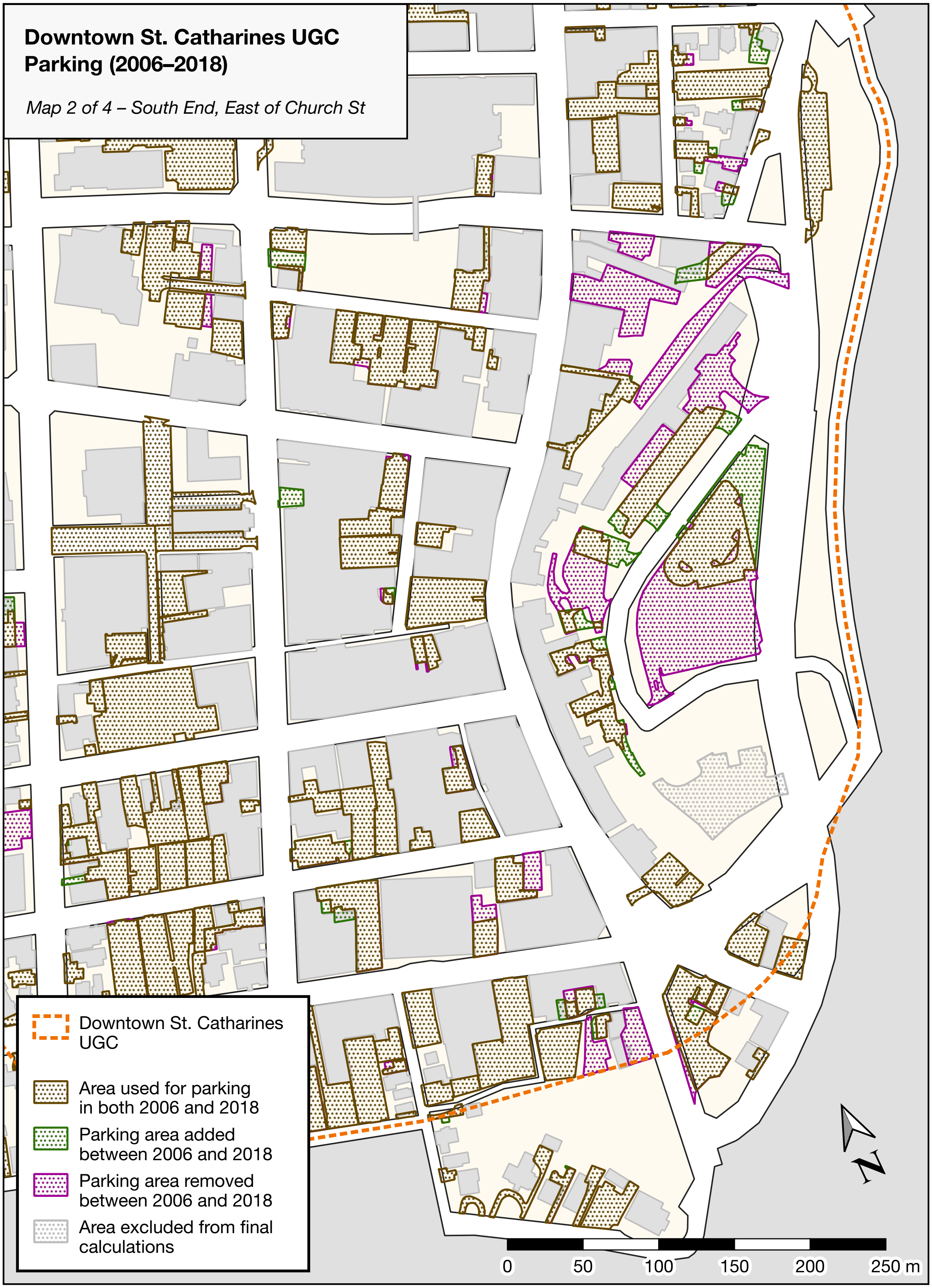
Downtown Peterborough UGC Parking (2005–2018)
Map 1 of 2 – North End
0
50
100
150
200
250 m
N
Downtown Peterborough UGC
Peterborough Exemption Area
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
Area excluded from final calculations


Downtown Peterborough UGC Parking (2005–2018)
Map 2 of 2 – South End
Downtown Peterborough UGC
Peterborough Exemption Area
Area used for parking in both 2005 and 2018
Parking area added between 2005 and 2018
Parking area removed between 2005 and 2018
N
0
50
100
150
200
250 m

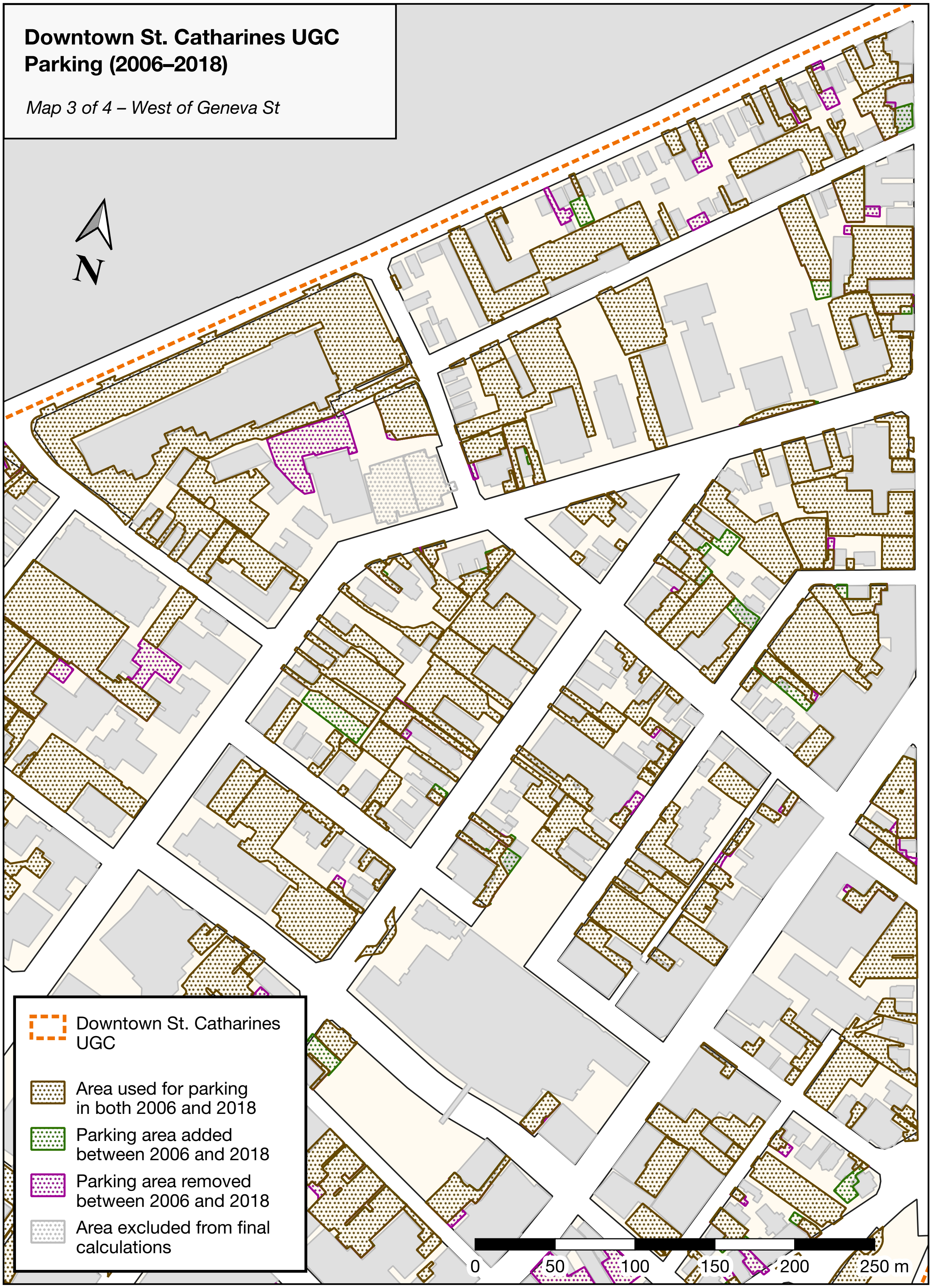

N
1
2
3
4
0
100
200
300
400
500 m

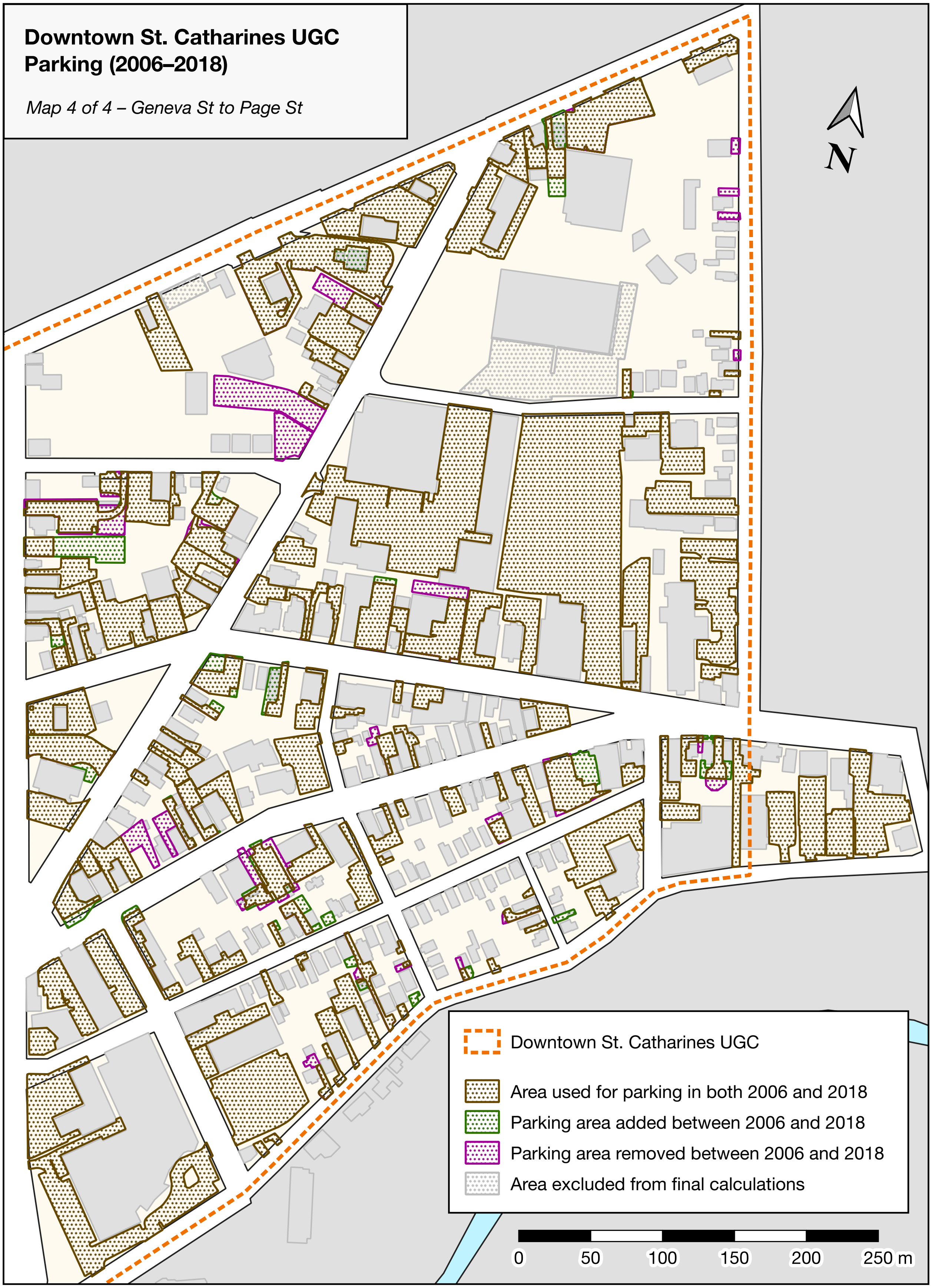


Downtown St. Catharines UGC
Parking (2006–2018)
Map 1 of 4 – South End, West of King St
N
Downtown St. Catharines UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
0
50
100
150
200
250 m

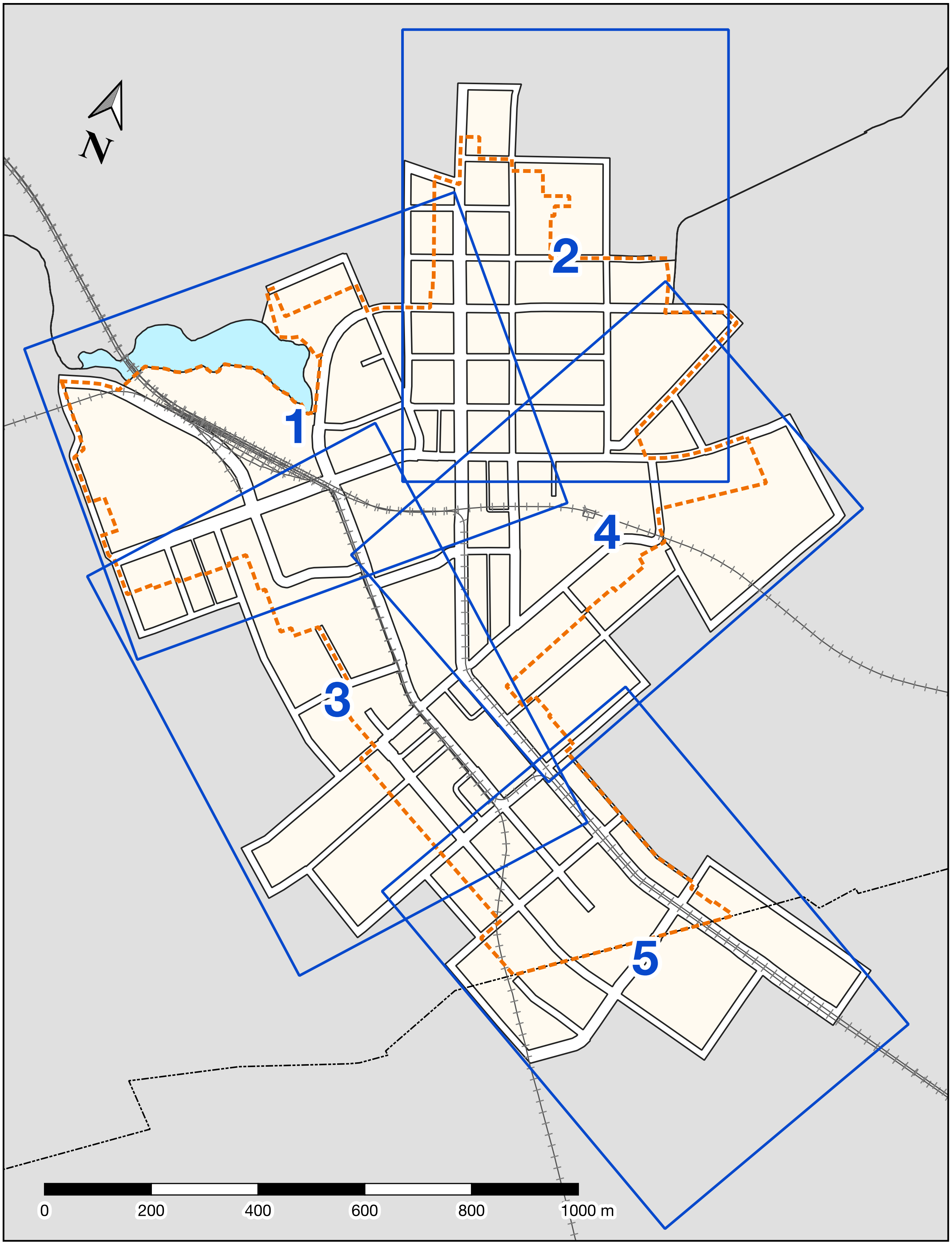


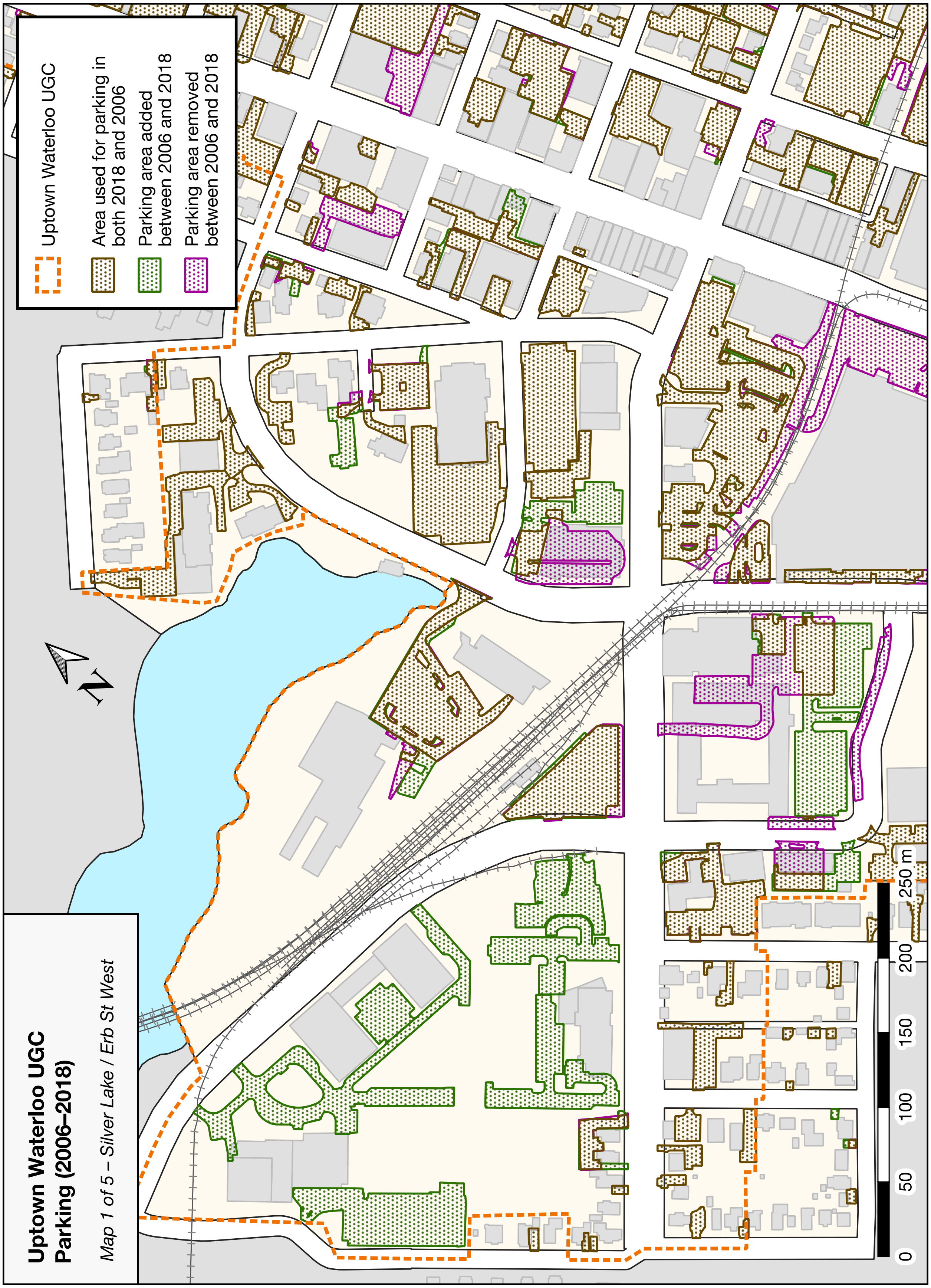
Downtown St. Catharines UGC
Parking (2006–2018)
Map 2 of 4 – South End, East of Church St
Downtown St. Catharines UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
Area excluded from final calculations
N
0
50
100
150
200
250 m


Downtown St. Catharines UGC
Parking (2006–2018)
Map 3 of 4 – West of Geneva St
N
Downtown St. Catharines UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
Area excluded from final calculations
0
50
100
150
200
250 m



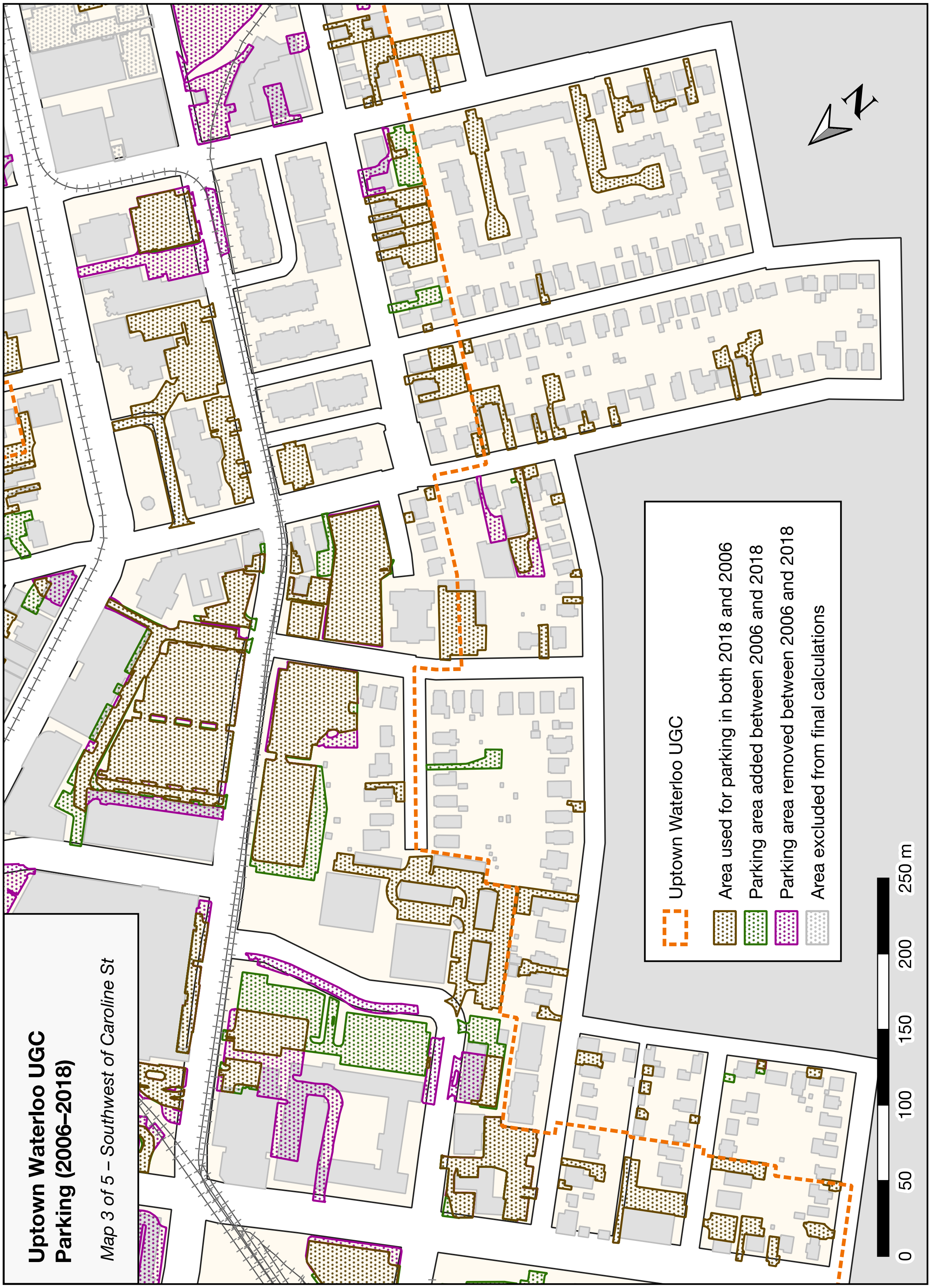
Downtown St. Catharines UGC
Parking (2006–2018)
Map 4 of 4 – Geneva St to Page St
N
Downtown St. Catharines UGC
Area used for parking in both 2006 and 2018
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
Area excluded from final calculations
0
50
100
150
200
250 m

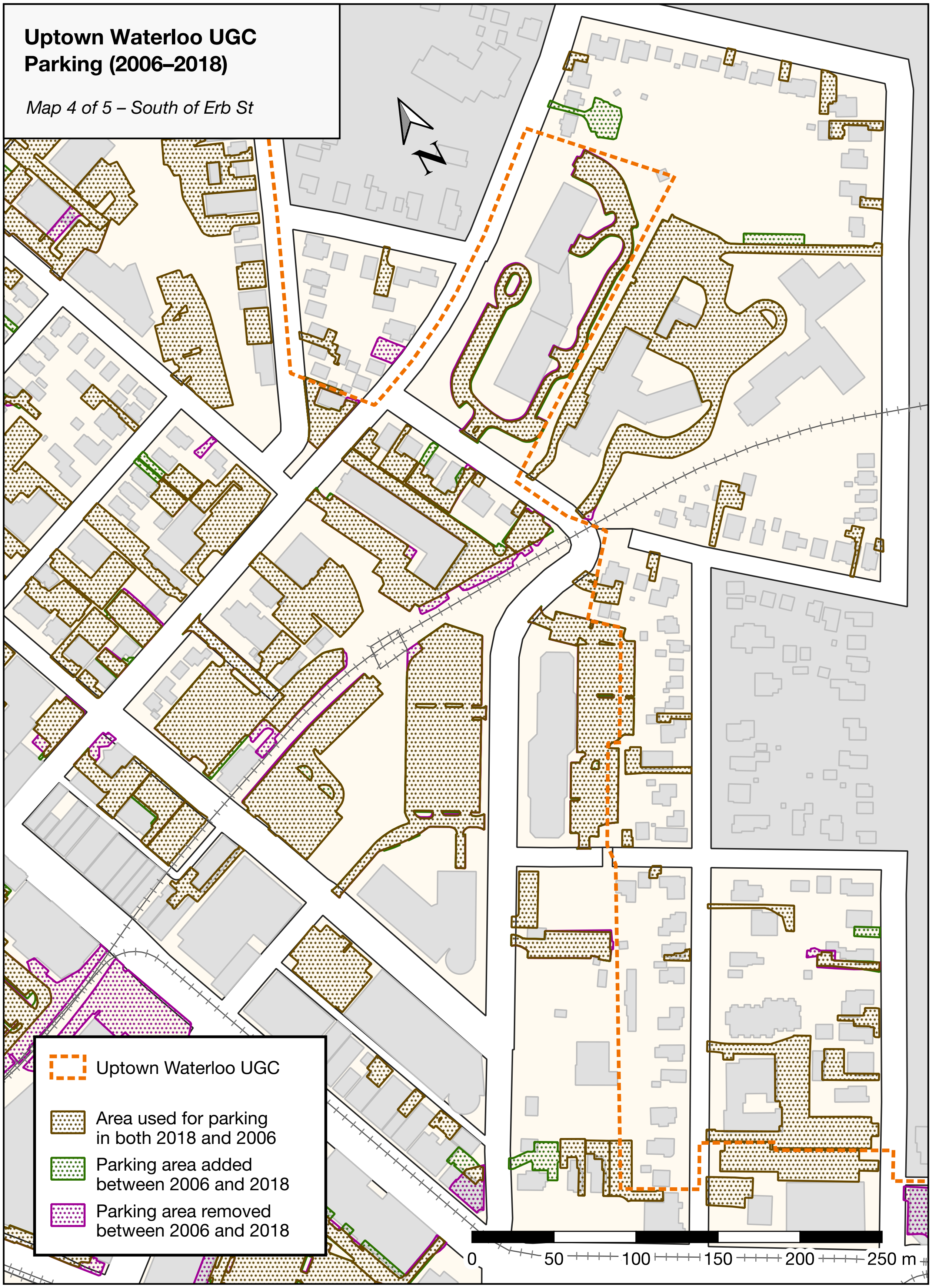

N
1
2
3
4
5
0
200
400
600
800
1000 m

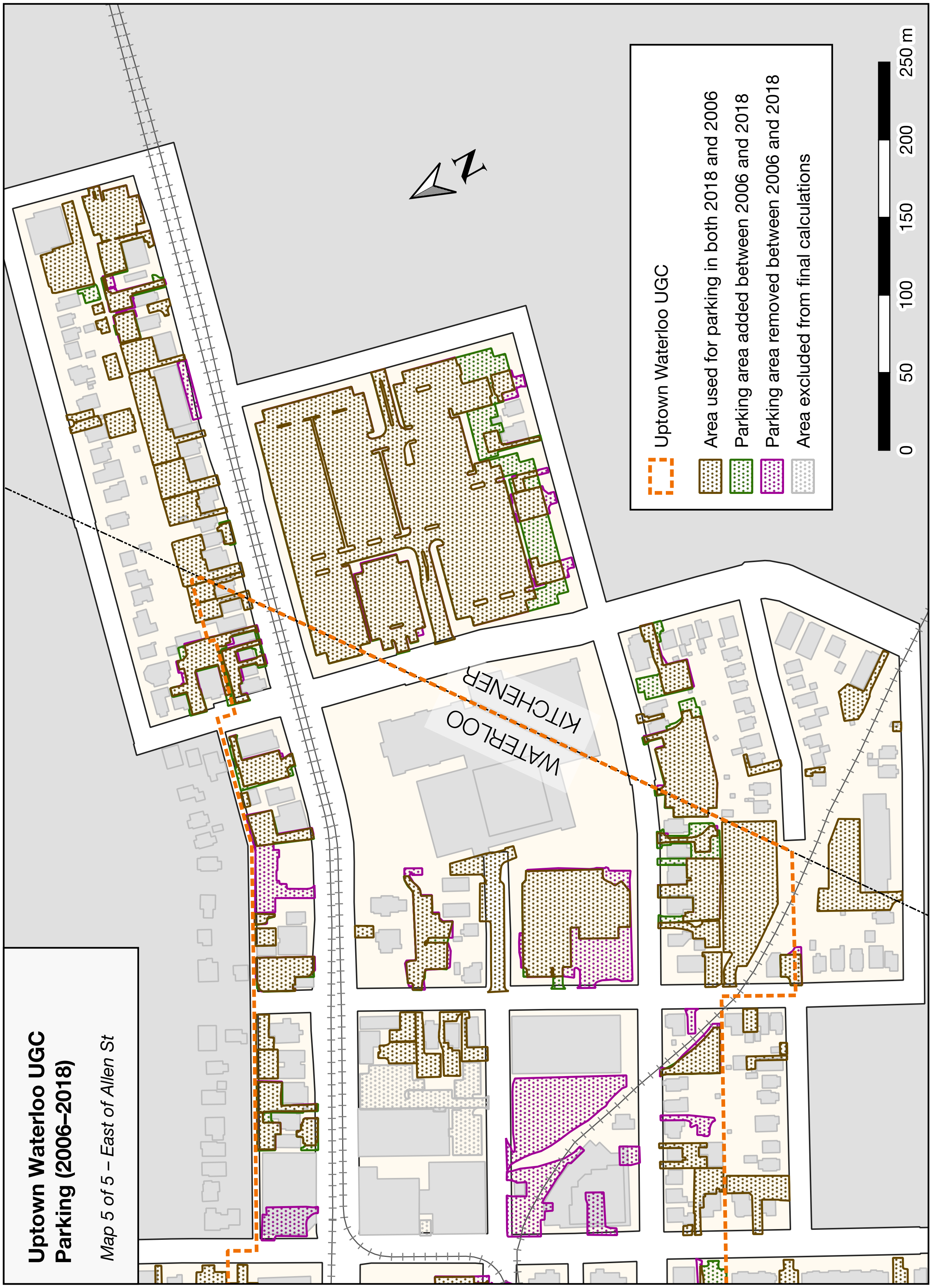


Uptown Waterloo UGC Parking (2006–2018)
Map 1 of 5 – Silver Lake / Erb St West
Uptown Waterloo UGC
Area used for parking in both 2018 and 2006
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
N
0
50
100
150
200
250 m


Uptown Waterloo UGC
Parking (2006–2018)
Map 2 of 5 – North of Erb St
N
Uptown Waterloo UGC
Area used for parking in both 2018 and 2006
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
0
50
100
150
200
250 m


Uptown Waterloo UGC Parking (2006–2018)
Map 3 of 5 – Southwest of Caroline St
Uptown Waterloo UGC
Area used for parking in both 2018 and 2006
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
Area excluded from final calculations
0
50
100
150
200
250 m
N


Uptown Waterloo UGC
Parking (2006–2018)
Map 4 of 5 – South of Erb St
N
Uptown Waterloo UGC
Area used for parking in both 2018 and 2006
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
0
50
100
150
200
250 m



Uptown Waterloo UGC
Parking (2006–2018)
Map 5 of 5 – East of Allen St
Uptown Waterloo UGC
Area used for parking in both 2018 and 2006
Parking area added between 2006 and 2018
Parking area removed between 2006 and 2018
Area excluded from final calculations
0
50
100
150
200
250 m
N
WATERLOO
KITCHENER

Appendix F

Policy Comparison Matrix

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Geographic axis												
On-site parking												
required pk spaces on same lot as land use	shall be provided	shall be provided	shall be provided	shall be provided	shall be provided	shall be provided	shall be provided	shall be provided	shall be provided	shall be provided	shall be provided	shall be provided
Tier description	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Tier value	1	1	1	1	1	1	1	1	1	1	1	1
Off-site parking												
required pk spaces on another lot		may be permitted within 150 m		may be permitted within walk-ing distance		may be permitted within 300 m	may be permitted within 400m				may be permitted within 120 m	may be permitted within walk-ing distance
			[implied for non-resid'l uses within Downtown Exemption Area]			in cases where on-site provision is not possible	in cases where on-site provision is not possible / practical				for non-resid'l uses	by means of minor variance or ZBA
		within certain zones				within certain zones	within certain zones				provided parking is not located in resid'l zone	
		and subject to entering into agree-ment		subject to entering into agreement		and subject to entering into agree-ment	and subject to entering into agree-ment					and subject to entering into agree-ment
off-site parking			permitted on contiguous site within CE Zone	may be permitted if adequate facilities available	may be permitted on site-by-site basis in secondary plan area		permitted on hydro ROW as accessory use for adjacent lot	may be permitted within CBD	permitted on hydro ROW as accessory use for adjacent lot			permitted within 800 m in UC Zone for post-sec'y inst'ns
		permitted in specific policy area(s)		permitted in specific policy area(s)	shall be considered in Downtown Parking Strategy	permitted in specific policy area(s)				may be considered in secondary plan area		
Tier description	(not con-templated)	in some cases	on a limited basis	in some cases	on a some-what limited basis	in some cases	in some cases	on a some-what limited basis	on a limited basis	on a limited basis	in many cases	in some cases
Tier value	1	4	2	4	3	4	4	3	2	2	5	4

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Exemption area												
specific exemption area	not defined	defined	defined	defined	not defined	not defined	not defined	not defined	defined	defined	not defined	not defined
nature of exemption	exemption for comm'l uses & places of worship within central area	exemption for all uses in defined (central) area	exemption for non-resid'l uses in defined (central) area	exemption for all uses in defined (central) area				exemption for retail uses & restaurants in defined (CBD) area	exemption for all uses in defined (central) area	exemption for non-resid'l uses in defined (central) area		
existence / nature of reduction		reduced requiremts for all uses surrounding defined area		reduced requiremts surrounding defined area	different requiremts in central area	different requiremts in central area	different requiremts in central area					different requiremts in central area
Tier description	exemption for some uses in central area	exemp'n for all uses in area, reduc'n for surr. area	exemption for non-res'l uses in central area	exemp'n for all uses in area, reduc'n for surr. area	modified requiremts in central area	exemption for some uses in central area	modified requiremts in central area	exemption for some uses in central area	exemption for all uses in central area	exemption for non-res'l uses in central area	no exemption area defined	modified requiremts in central area
Tier value	2	5	3	5	1.5	2	1.5	2	4	3	1	1.5
Parking for multiple uses on same site												
multiple uses / zones on same lot	provide pk at "blended" rate for each use *(may require more or less, depending on situation)*		provide amount req'd for each use within zone	provide amount req'd for each indiv'l use			provide amount req'd for each indiv'l use	provide amount req'd for each indiv'l use	provide amount req'd for each indiv'l use	provide amount req'd for each indiv'l use with some exceptions		provide req'd pk on parcel, may be in diff't zone *[implied: provide amt req'd for each use]*
pk for resid'l uses in non-resid'l bldgs	shall be separate & exclusive	shall be provided in ad'n to pk for non-res'l use	may use non-res'l spaces for req'd visitor pk	shall be separate & exclusive	shall be separate & exclusive				shall be physically & functionally separate	reduced requiremts in central area		
pk for home occup'ns	shall provide add'l pk on site	shall provide one add'l sp on site	add'l pk not required	shall provide sp for non-resident employee on lot	shall provide for exclusive use of home occup'n	add'l pk not req'd in duplex / mult. dw.	shall provide add'l pk on site	shall provide add'l pk based on floor area	add'l pk not required	(not specified)	(not specified)	shall provide add'l pk on site
Tier description	std approach (in general)	standard approach	std appr w. some on-site sharing	standard approach	standard approach	std appr w. some exceptions	standard approach	standard approach	std appr w. sharing for home occ'ns	std appr w. some exceptions	(not contemplated)	standard approach
Tier value	1	1	3	1	1	2	1	1	2.5	2	1	1

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Shared parking arrangements												
…in exchange for reduced requiremts				may be considered during devpmt review							may be considered	may be included in ZB
			may be permitted in mixed-use area	may be permitted for res'l component of mixed-use				may be permitted for properties in CBD				
…arrangements		shall be considered in higher-density res'l devpmt			may be included in zoning regulations	shall be encouraged		will be encouraged			shall be encouraged in Urban Area	
		shall be encouraged for secnd'y uses in res'l areas	will be considered in mixed-use areas			shall be encouraged for mixed-use	may be included in MTSA plans	will be considered for comm'l devpmt			is encouraged for mixed-use areas	shall be encouraged for specific uses in specific areas
					shall be considered for central area			supported in central area				
(in secondary plan areas)	shall be included in design of community facilities	will be explored for certain designations			are encouraged / will be explored							
(in special policy areas)							may be established				is encouraged / will be facilitated	shall be encouraged
Tier description	will consider on limited basis	will consider on somewhat limited basis	willing to consider	amenable	willing to consider	quite amenable	will consider on limted basis	amenable	does not contemplate	does not contemplate	quite amenable	will consider on somewhat limited basis
Tier value	2	2.5	3	4	3	5	2	4	1	1	5	2.5

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Cash in lieu of parking												
…may be permitted/used/etc.		√	√	√	√	√	√					
…will/should be encouraged		in central area					in UGC					
…may be used in central area		√		√	√			√		√		may consider adopting for UGC
…in special policy area		√										
…in secondary plan area	√				may consider as part of ZB							
…in other areas	in Institut'l areas			in intensif'n areas			in nodes & corridors			in Affordable Housing CIP area		
provisos	*(2nd'y plan area)* where munic'l pk facilities are/will be establ'd	*(within core)* if existing/planned pk within 400m of site			*(downtown)* provided adequate alternative pk available						where public facilities can accommodate demand	on basis that req'd pk can be provided in existing/planned public facilities
		(multi. dw. in core) if developer can secure sufficient off-site pk									or where it is no possible to meet ZB req'mts on site	on a site-by-site basis
Tier description	amenable in limited no. of cases	generally amenable, encourages in central area	generally amenable	generally amenable	generally amenable	generally amenable	generally amenable, encourages in central area	amenable in central area	(does no contemplate)	amenable in central area	generally amenable	generally amenable
Tier value	2	5	4	4	4	4	5	3	N/A	3	4	4

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Public parking												
(general policies)				City may acquire & develop lands to provide				Town may maintain & enhance supply in central area		City may undertake system in defined parts of city		City may acquire & develop lands to operate
as replacement for req'd pk	may establish in 2nd'y plan areas											
as criterion for cash-in-lieu	in 2nd'y plan area	in central area			in central area						may consider	shall consider when enter-ing agreemt
in/near central area	shall be provided	will be provided	shall be provided		will be provided City shall develop structure on Wilson St lot					may be expanded	should be supported in review of municipal pk strategy	
funds from cash-in-lieu…		will be used to invest in municipal facilities					will be used to acquire land & provide pk	may be used to acquire/develop facilities in central area				are intended to encourage creation of strategically located facilities
other policies	may require studies to consider when review-ing resid'l intensif'n will en-courage as option to re-place surface lots in 2nd'y plan areas	will develop plan to provide new municipal lots in central area will provide visitor pk near downtown attractions			shall prepare Downtown Pk Strategy that considers long-term strategy to maintain adequate supply			objectives include providing & upgrading municipal facilities where feasible				
Tier description	as possible altern've in some cases & as supplmt in central area	as possible alternative to req'd pk	as supplement in central area	as supplement in general	as supplement in central area	(does not contemplate)	as supplement in general	as supplement in central area	(does not contemplate)	as supplement in general	as possible alternative to req'd pk	as possible alternative to req'd pk
Tier value	3	4	2	1	2	N/A	1	2	N/A	1	4	4

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Community benefits												
possible community benefits…	include public pk facilities		include public parking	include public pk above req'mts	include public parking	include public parking	include public parking	include undergnd or in-bldg pk for attached devpmt		include underground parking	include public parking	
in central area		may use benefitting assessmt			include public pk as priority						include underground parking	
effects of increased height/density				will review suitability of site w.r.t pk								will review suitability of site w.r.t pk
Tier description	may use comm. ben. provisions	may use similar provisions	may use comm. ben. provisions	may use, but avoid adverse effects	may use comm. ben. provisions	may use comm. ben. provisions	may use comm. ben. provisions	may use provisions for non-surf pk	(does not contemplate)	may use provisions for non-surf pk	may use comm. ben. provisions	avoid adverse effects
Tier value	5	4	5	2	5	5	5	3	1	3	5	1
On-street parking												
on-street pk…	will be encouraged to replace some at-grade pk	may replace some on-site parking				may replace some on-site parking						
		for non-res'l devpmt				in some comm'l areas						
	in 2nd'y plan area	in 2nd'y plan area										
	shall be considered in design of community facilities	shall only be permitted	may be permitted on any street		should be permitted	may be provided		should be re-introduced/ encouraged	may be considered	may be permitted		shall be one consideration
		where it does not interfere with traffic	in uptown mixed use area		in central area	in nodes & corridors		in central area	in central area	as regulated by Council		in special policy area
	shall be permitted				shall generally be facilitated							when zoning for ancillary uses
	in special policy area				in 2nd'y plan area							

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
On-street parking (cont'd)												
The City/Council…	may establish standards that include on-street pk		may permit on-street pk ratios in devpmt appl'ns	may establish appropriate on-street pk facilities		may consider alternative standards including on-street pk			shall generally support phasing out of on-street pk	may decide to restrict or remove on-street pk		may establish appropriate on-street pk facilities
	in 2nd'y plan area			in res'l plans of subdiv'n		in new resid'l devpmts			from arterial roads			in res'l plans of subdiv'n
	may require studies that consider improvmt of pk				shall prepare a Downtown Pk Strategy							
	with appl'ns for resid'l intensif'n				that assesses on-street pk policies							
Tier description	somewhat amenable	amenable in ltd circumstances	somewhat amenable	amenable in ltd circumstances	amenable in ltd circumstances	somewhat amenable	(does not contemplate)	amenable in ltd circumstances	not amenable	not amenable	(does not contemplate)	amenable in ltd circumstances
Tier value	3	2	3	2	2	3	N/A	2	1	1	N/A	2
Economic axis												
Infrastructure/municipal service												
referred to/listed as municipal service	√	√						√				
referred to/listed as infrastructure			√		√				√	√		
as part of road/transport'n network		√		√	√	√			√	√	suggested as	√
		(only w.r.t 2nd'y plan area)							mentioned w.r.t "approaches to infrastr. devpmt		component to consider in linking downtown activities	
Tier description	clearly considers as service	likely considers as infrastr.	clearly considers as infrastr.	likely considers as infrastr.	clearly considers as infrastr.	likely considers as infrastr.	not specifically addressed	clearly considers as service	likely considers as infrastr.	clearly considers as infrastr.	possibly considers as infrastr.	likely considers as infrastr.
Tier value	1	1.5	1	1.5	1	1.5	2	1	1.5	1	2	1.5

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Municipal parking facilities												
municipal facilities…	shall be provided	shall be provided	shall be provided					will be provided & upgraded				
	in convenient locations in city centre	in core comm'l area	in convenient locations accessible to downtown					where feasible				
the City/Council…		will develop a downtown pk plan		may acquire & develop lands to provide pk	shall continue to play active role in downtown supply			shall work in conjunction w. BIA on program		may undertake system of off-street parking	should review existing munic'l pk strategy	may acquire & develop lands to operate pk facilities
		to provide new munic'l lots at strategic loc'ns			shall continue to acquire, operate & pursue devpmt			for acquis'n & dvpmt of off-street facilities		in defined parts of city	with goal of supporting public facilities	
					shall develop public pk str on Wilson St lot			may acquire add'l lands in central area		intends to pursue ongoing improvemts to central area		
					may acquire, develop & operate public pk facilities			to maintain & enhance supply of short-term pk		including on- & off-street facilities		
funds from cash-in-lieu…		will be invested in constr'n of munic'l lots		may be used to acquire lands for strategically located public facilities		shall be used for acquis'n of lands or prov'n of off-street pk	will be used as funding source for strategically located facilities					shall be used for acquis'n of lands or prov'n of off-street pk
							will be used for acquis'n of lands or prov'n of off-street pk					will be used in consid'n of existing or planned municipal facilities

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Municipal parking facilities (cont'd)												
(other policies)										strategies include expanding mun'l pk in specific area		responsibility of providing pk will be shared
										& investig-ating oppor-tunities to add supply in specific area		by develop-ers, landown-ers, tenants, users & tax-payers
Tier description	committed to active role	intends to play active role	committed to active role	may play active role	committed to active role	intends to play active role	intends to play active role	committed to active role	(does not contemplate)	intends to play active role	vague intent of playing active role	may play active role
Tier value	1	1.5	1	2	1	1.5	1.5	1	N/A	1.5	2.5	2
Pricing												
				may regulate charging of fees			will develop MTSA plans that may in-					may use range of mechanisms
							clude pricing as TDM strategy					that include pricing
Tier description	(does not contemplate)	(does not contemplate)	(does not contemplate)	may use	(does not contemplate)	(does not contemplate)	may consider	(does not contemplate)	(does not contemplate)	(does not contemplate)	(does not contemplate)	may use
Tier value	N/A	N/A	N/A	3	N/A	N/A	2	N/A	N/A	N/A	N/A	3
Pedestrian safety/traffic calming												
	shall be permitted	will be en-couraged at appropriate locations	shall be implemented		may be permitted	shall be provided on pedestrian-focused streets	is encouraged	shall be encouraged	may be considered	may be used as traffic managemt strategy	shall be considered	will be included as design feature
	in special policy area	in 2nd'y plan area	in certain areas		in certain instances	in comm'l & mixed-use areas	where compatible with transit	along commercial frontages	particularly in UGC			in special policy area
Tier description	in limited no. of places	in limited no. of places	in some places	(does not contemplate)	in somewhat limited no. of places	in some places	generally	in some places	will generally consider	in somewhat limited no. of places	generally	in limited no. of places
Tier value	3	3	2	N/A	2.5	2	1	2	1.5	2.5	1	3

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Community improvement projects / areas												
criteria for designating CIP areas	deteriorated or insuffic't parking	inadequate parking facilities	deficient munic'l pk facilities		deteriorated or deficient munic'l pk facilities	deteriorated or insuffic't parking		problems related to parking	deficient parking facilities		inadequate parking facilities	deteriorated or insuffic't parking
		(for comm'l or ind'l uses)			shortage of land to accommodate facilities	shortage of land to accommodate facilities			(in comm'l or ind'l areas)		(in comm'l or employmt areas)	incompatible land uses from factors such as pk
existing CIPs / areas								in central area: deficient pk	in & near UGC: to address deficient pk, lack of off-str. pk			
Tier description	yes, as general criterion	yes, for specific areas / uses	yes, as general criterion	no	yes, multiple criteria	yes, multiple criteria	no	yes, with existing CIP	yes, with existing CIP	no	yes, for specific areas / uses	yes, multiple criteria
Tier value	2	2.5	2	3	1.5	1.5	3	1	1	3	2.5	1.5
Commercial parking												
				City may encourage devpmt								City may encourage devpmt
Tier description	(does not contemplate)	(does not contemplate)	(does not contemplate)	may encourage	(does not contemplate)	(does not contemplate)	(does not contemplate)	(does not contemplate)	(does not contemplate)	(does not contemplate)	(does not contemplate)	may encourage
Tier value	N/A	N/A	N/A	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3
Attitudinal axis												
Parking supply												
(increase supply)				encourage new facilities to accommodate unmet demand				ensure no shortage will results from		encourage prov'n for res'l properties by relaxing other stds		
	provide new pk when needed in central area		provide new pk when needed			ensure off-site pk remains available	ensure off-site pk remains available	expansion of properties that use common pk areas		explore opportunities to expand supply near central area		ensure off-site pk remains available

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Parking supply (cont'd)												
												establish stds to ensure supply meets dvpmt needs
(ensure demand is met)					consider long-term strategy to ensure ade-quate down-town supply					consider facilitating prov'n of off-street pk		plan pk in UGC to pro-mote conven-ient travel by all modes
		make sure demand is satisfied in central area		provide pk to meet de-mand levels gener'd by land uses	provide pk to meet demands generated by land uses			ensure only pk needed to meet peak demand is provided				provide pk for all devpmt
(match supply to demand)						continue to provide pk in UGC			recommend pk not exceed min reqmts in central area			consider existing supply when considering cash-in-lieu
						ensure adeq. pk while avoiding excess supply						ensure pk areas balance needs of motorists w. other travellers
				support TOD by reudcing reqmts or limiting surplus supply	support devpmt of employmt areas that minimize surface pk	support devpmt of employmt areas that minimize surface pk				support devpmt of employmt areas that minimize surface pk		plan facilities to meet needs while ensur-ing efficient use
(manage/limit supply)					consider encouraging supply mgmt	prohibit new surf. lots in central area	reduce supply needs as TDM objective		require long-term pk mgmt strat. in mixed-use areas		plan transit stn site w auto pk as lowest priority	limit surf. lots near LRT stns
							establish stds to support altern've modes				ensure stds don't under-mine other travel modes	consider stds to encourage other modes
							discourage creation of new suf. lots					support TDM by restricting supply

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Parking supply (cont'd)												
(reduce supply)					encourage design of pk areas that support redvpmt				design surf. pk to support potential redvpmt near transit hubs			promote potential reuse or redvpmt of pk lots
							develop pk reduc'n strat. for UGC & MTSAs					
Tier description	increase supply as necessary	ensure demand can be satisfied	increase supply as necessary	provide abundant supply	ensure demand can be satisfied	match supply to demand	limit supply where possible	ensure demand can be satisfied	match supply to demand	provide abundant supply	manage supply	ensure demand can be satisfied
Tier value	4	4	4	5	4	3	2	4	3	5	2.5	4
Parking demand												
(increase supply)				encourage dvpmt of pk to satisfy any unmet demand				find sol'ns for problems that new projects might cause in CBD	require in-creased stds for special policy area if demand needs it	require possible prov'n of pk above usual zoning reqmts		
(satisfy demand)				provide pk to meet demand levels gener-ated by uses	provide pk to meet demand generated by land uses				provide suf-fic't balance of off-street pk in central areas			establish stds to provide supply that meets dvpmt needs
					provide pk to meet needs of downtown				provide suf-fic't balance of off-str pk in special policy area			consider existing supply when considering cash-in-lieu
(manage supply)			provide pk for mixed uses based on alternate, peak-period formula		encourage shared pk to meet peak demand in 2nd'y plan area							adopt stds in stn areas that reflect desire to reduce auto use

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Parking demand (cont'd)												
(reduce demand)			use transit service to reduce pk demand			support transit-supportive employmt areas w. reduced pk				use transit to reduce need for off-street pk		
			promote transit dwntn to reduce demand				reduce pk sp. demand to support other modes					support rapid transit as way to reduce demand
			design pk areas to be used for pub-lic purposes when de-mand is low				establish standards to support other modes				reduce standards where other modes feasible	consider standards that encourage other modes
(reduce supply)							support potential redvpmt of surface pk					
Tier description	(does not contemplate)	(does not contemplate)	reduce demand	increase sup-ply to satisfy demand	ensure suffic-ient supply for demand	encourage reduced demand	reduce demand	avoid supply problems	ensure suffic-ient supply for demand	ensure suffic-ient supply for demand	encourage reduced demand	match supply to demand
Tier value	N/A	N/A	2	5	4	2.5	2	4.5	4	4	2.5	3
Reduced parking requirements												
shall be permitted…		for all uses	for non-resid'l uses	for non-resid'l uses	for heritage structures		for non-resid'l uses					
		in areas surrounding central area	in mixed-use zones	in areas surrounding central area	provided total reduc'n is no more than 5 sp.		in mixed-use zones					
					for comm'l devpmt							
					in special policy area							
will be…		established for seniors housing										

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Reduced parking requirements (cont'd)												
may be permitted…			through approval of developmt applications	in community core areas	within downtown	for heritage properties		for dvpmts with TDM plan				where sharing is feasible or transit available
			in mixed-use areas	for mixed-use dvpmt in intensif'n areas	for affordable housing							where pk can be more efficiently provided off-site
			with cash-in-lieu or TDM plan	to encourage TOD	for resid'l devpmt & intensif'n							on site-specific basis w. cash-in-lieu
					in 2nd'y plan area							
shall/will be considered…	in 2nd'y plan area				in special policy area	in central area	for all new dvpmt/re-dvpmt related to UGC					
					in Downtown Strategy, for com'l dvpmt	in intensif'n areas	for dvpmts that adopt TDM					
						in mixed-use areas	to conserve heritage resources				shd. be considered in review of mun. pk strategy	shall be encouraged in special policy area
may be considered…		for seniors housing & affordable housing	in mixed-use areas	through dvpmt review process	as part of pk study, esp. in central area & intensif'n areas		for dvpmts that adopt TDM measures	where mixed-use dvpmt is permitted		for industrial properties, on site-by-site basis	where alternate travel modes are available	
		in some resid'l areas		as part of TDM plan			in MTSA plans	in central area			in mixed-use areas	
				to support heritage conserv'n	to facilitate heritage conserv'n						in special policy areas	to facilitate heritage conserv'n
				in design guidelines for infill/redvmt								
Tier description	on a limited basis	willing to permit	willing to permit	willing to permit	in some cases	reasonably willing to permit	reasonably willing to permit	in some cases	(does not contemplate)	on a very limited basis	on a limited basis	in some cases
Tier value	4	2	2	2	3	2.5	2.5	3	N/A	4.5	4	3

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Exemption from parking requirements												
exemption…	for certain uses	for all uses	for non-resid'l uses	for all uses			for each existing lot (one-time)	for certain uses	for all uses	for non-resid'l uses		
	in central area	in central area	in central area	in central area			in downtown zones	in central area	in central area	in central area		
				may be permitted in community core areas		for home businesses in mult. dw's			for home occup'ns	with cash-in-lieu, in central area		
						for certain comm'l uses in emplymt zones	for certain comm'l uses in retail core zone			for first 4 dw units on comm'l lot in central area	for first 4 dw units in mixed-use building	
						for certain insitut'l uses in waterfront zones	for existing bldgs not on public streets in market zn			for second suites in central area	may be considered generally	may be considered on site-specific basis
						for open space uses in waterfront zones		for dog kennels & agric'l uses		for affordable housing, in CIP area		
						for certain temp. uses in certain zones						
uses where min. req'd pk = 0 spaces	social service facility in UGC	public transit facility	home business & home day-care			almost all resid'l uses in downtown zones		home occup'ns w. floor area ≤ 10 sq.m		neighbourhood parks		some home occup'ns
						most comm'l uses in downtown zones						
						certain comm'l uses w. GFA < 450 sq.m in certain zones						
Tier description	in some cases	willing	willing	willing	(does not contemplate)	willing	in some cases	in some cases	willing	willing	on a limited basis	on a limited basis
Tier value	3	2	2	2	N/A	2	3	3	2	2	4	4

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Maximum parking standards												
in zoning by-law	apply to non-resid'l uses in mixed-use zone		apply to non-resid'l uses in mixed-use zones			apply to mult. dw's in downtown zones					apply to places of assembly / banquet halls, places of worship & shopping centres	apply to all lots & structures in station area mixed-use zones
	in 2nd'y plan area					apply to some resid'l uses in comm'l-mixed use & TOC zones						
in official plan (w.r.t ZB)	ZB shall establish in 2nd'y plan area											
					ZB may include for mixed-use areas		ZB may establish, as appropriate				ZB may establish	ZB may include provisions for
(elsewhere in official plan)	may be establ'd, esp. for mixed-use areas, in 2nd'y plan areas				may be established, where appropriate		may be established for specific policy areas	will be employed in central area				shall be included in regulations for lands near LRT stns
	may be specified for ind'l designation in 2nd'y plan areas				shall be considered in Downtown Pk Strategy							
	will be considered for community & inst'l areas in 2nd'y plan area											
Tier description	for some uses in some areas	does not contemplate	for some uses in some areas	does not contemplate	may consider	for some uses in some areas	may consider	may consider	does not contemplate	does not contemplate	for some uses in all areas	for some uses in some areas
Tier value	2.5	4	2.5	4	3	2.5	3	3	4	4	2	2.5

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Adverse effects												
"shall not cause," etc., in ZB	home occup'ns	home occup'ns	home occup'ns					home occup'ns	home occup'ns			
									bed & break-fast estabmts			
					temporary pk in ind'l zones				short-term rentals			
"shall not cause," etc., in OP		public utilites & emergecy services			public & private infrastr.	community uses in res'l areas						
			home occup'ns				home occup'ns	home occup'ns	home occup'ns			home occup'ns
		day-care centres	2nd dwelling units									
					multi-unit res'l dvpmt		resid'l intensif'n		resid'l intensif'n	in trans'l sub-area		
						inst'l uses			int'l uses			
						local comm'l uses			comm'l dvpmt			
									auto-related uses			
									ind'l dvpmt			
						temp. uses						
			C of A: enlargemt of non-conf. use or struct.	C of A: enlargemt of non-conf. use or struct.								C of A: enlargemt of non-conf. use or struct.
other policies (OP)				may consider reduc'n or exemption				submission of study required				
				where pk fac-ilities wd be incompatible				assessing impact on pk in CBD				
				& where reduc'n does not generate adv. effects				for any major dvpmt/ redvpmt project				
Tier description	concerned	concerned	concerned	not very concerned	somewhat concerned	somewhat concerned	somewhat concerned	concerned	very concerned	not very concerned	not concerned	somewhat concerned
Tier value	4	4	4	2	3	3	3	4	5	2	1	3

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Required parking areas												
req'd pk areas…								must be available exclusively for pk purposes at all times				
…shall not be occupied by…	outdoor storage areas	open storage in comm'l or ind'l zones	bldg used to store garbage		outdoor storage in comm'l or ind'l zones	outdoor storage in arterial comm'l zone						
	seasonal produce sales	outdoor play space for day nurseries						outdoor display areas				
							food carts	decks				patios
								donation boxes				donation boxes
								shipping containers				shipping containers
…may be occupied by…				vehicles/ trailers for sale/rent at auto serv. stn		seasonal garden centre in certain zones						temp. public or farmers' market
…provided that…				no more than 50% req'd sp are used		no more than 10% req'd sp are used						≥ 1 sp. per vendor on site provided
…may be occupied by…				temp str's for sale of seasonal products								
…provided that…				no more than 10% req'd sp are used								
(other policies)			may block req'd pk for group home		food vehicle shall occupy defined pk sp							
			prov'd at least 2 sp accessible									
Tier description	insistent	insistent	not very concerned	not very concerned	insistent	somewhat insistent	not concerned	quite insistent	not concerned	not concerned	not concerned	somewhat insistent
Tier value	4	4	2	2	4	3	1	5	1	1	1	3

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
"Adequate" or "sufficient" parking												
"adequate" parking…								shall be req'd for all dvpmt or redvpmt	shall be encouraged for all dvpmt	shall be provided for all perm'd uses	shall be provided for all dvmt/redvmt	
	shall be req'd in 2nd'y plan areas											
…shall be provided…			for resid'l uses in mixed-use dvpmts			for resid'l dvpmt			for resid'l dvpmt			
		in mixed-use areas										
		for school uses in res'l areas							for instit'l dvpmt			
	for comm'l dvpmt										for major comm'l ctrs	
												will be provided in employmt areas
						for community parks						
…shall be encourage, etc., in certain areas	for comm'l dvpmt									shd. be provided for dvpmt/redvpmt	shall be provided for dvpmt	
	in central area									in Transition Uses subareas	within MTSA	
…shall be/is criterion/condition, etc…		for resid'l dvpmt			for multi-unit res'l dvpmt	for resid'l dvpmt	will be emphasized in design of multi-res'l dvpmt	for resid'l dvpmt		for resid'l dvpmt		
			for housing intensif'n						for resid'l intensif'n	for infill housing		
					for new mixed-use dvpmt							for ancillary comm'l uses
	for instit'l dvpmt	for new instit'l areas				for uses ancillary to instit'l uses						
			for ngbrhd comm'l sites		for ngbrhd comm'l ctr					for local comm'l uses		for comm'l corridor dvmt
					for serv. comm'l dvmt							

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
“Adequate” or “sufficient” parking (cont’d)												
…shall be/is criterion/condition, etc.…	for indust’l dvpmt				for new office dvpmt	employmt area dvpmt shall have regard for						
						for commun-ity uses in certain areas						
		for home occup’ns					for live–work units					
		for 2nd dw. units						for acessory apt.				
			for garden suites					for garden suites				
			for day-care centres					for B&Bs	for B&Bs			
								for BLR houses				
			for offices in resid’l areas				for display facilities in empl. areas				for farm-related uses	
		cemeteries shall have regard for										must be pro-vided for cemeteries
									for conven-ience stores in res’l areas	for adult entertainment uses	for agri-tourism	
		for minor variances										
		for enlargmt of legal non-conf. uses/structures	for enlargmt of legal non-conf. uses/structures					for enlargmt of legal non-conf. uses/structures				for enlargmt of legal non-conf. uses/structures
				for temp. uses	for temp. uses							
City/Council, etc…				shall not fac-ilitate enlgmt of existing comm’l uses in other areas unless adeq. pk available	will ensure adeq. pk provided for demands gener’d by land uses	shall use standards to ensure adeq. pk while avoiding excess supply				may encour-age provision of adeq. off-street pk for resid’l uses, esp. in central area		will plan for adeq. pk to be provided in UGC

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
“Adequate” or “sufficient” parking (cont’d)												
City/Council, etc…										may require pk above ZB stds to ensure adeq. supply in 2nd’y plan area		
(other policies re. adequate parking)		may be criterion for site plan approval	redvpmt by infilling downtown surface lots will ensure adeq. supply					redvpmt/ expansion of mall shall be encouraged so long as adeq. pk provided				
sufficient parking…			shall be provided in downtown						shall be taken into account for dvpmt in central areas			
			shall be criterion for designating mixed-use areas		shall be provided for non-resid’l uses in resid’l areas				shall be taken into account for dvpmt along corridors		shall be considered w.r.t dvpmt for transit stn site	will be considered for ancillary uses in low-dens. res’l areas
			shall be criterion for comm’l areas			shall be criterion for instit’l dvpmt		shall be criterion for instit’l dvpmt				
			shall be criterion for empl-comm					shall be criterion fo com’l dvpmt				
			will be req’d for comm’l & ind’l uses in escarpmt urban desig.		will be considered in dvmt of community & reg’l parks				will be criterion for drive-thru facilities			shall be required for B&B establishmts
City/Council, etc…				may require suff’t off-street pk for demand usually generated by use			will have regard for ability to provide when considering instit’l uses					
							will be satisfied on-site pk suff’t for temp. uses					

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
"Adequate" or "sufficient" parking (cont'd)												
necessary parking…	shall be provided for resid'l dvpmt	will be criterion for resid'l areas										
		shall be provided on-site for comm'l dvpmt										
		shall be provided on-site for indust'l dvpmt										
City…							will work to ensure prov'n is considered in siting educ'l uses					
Tier description	moderately insistent	insistent	insistent	not very concerned	insistent	insistent	not very concerned	quite insistent	quite insistent	quite insistent	insistent	moderately insistent
Tier value	3	4	4	2	4	4	2	5	5	5	4	3
Demand management												
TDM measures…				may be considered to justify reduced reqmts	may include reduced pk standards	may include reduced pk standards	will be considered in Station Area Plans					
City, etc…			may require maj. employment dvpmt to establish TDM plan					may require lrg. employmt dvpmt to estab. TDM strategy				
			will encourage opportunities to develop TDM measures		may encourage pk supply mgmt as TDM measure		will encourage dvpmt of ind'l areas that incorporate TDM					
	will consider reduced reqmts for dvpmts with TDM plan in 2nd'y plan areas		may permit reduced pk stds with TDM plan	may consider reduced reqmts with TDM plan in appl'n review	may permit reduced reqmts for dvpmts with TDM plan		will consider reduced reqmts with TDM measures	may permit reduced pk stds with TDM plan				

	BAR	BNF	BRL	CAM	GUE	HAM	KIT	MLN	OSH	PET	STC	WAT
Demand management (cont'd)												
City, etc… (*cont'd*)				may consider reduc'n or exemp'n w. TDM plan	may grant reduc'n w. TDM plan in 2nd'y plan area							
				may permit bonusing where dvpmt provides pk demand reduc'n	shall consider pk mgmt & demand-side solutions in Downtown Strategy				shall be addressed in plans/guide-lines for transp'n hubs & commuter stns			
transportation objectives…			to reduce pk demand by incorporating TDM				to reduce pk supply needs & demand for pk spaces					to support TDM-rel'd measures by restricting pk supply, where appropriate
Tier descriptions	considers	(does not contemplate)	encourages *and* may require	considers	considers, may encourage	considers	encourages or may require	encourages or may require	considers	(does not contemplate)	(does not contemplate)	considers
Tier values	3	N/A	1.5	3	2.5	3	2	2	3	N/A	N/A	3
Rounding												
fractional values shall be rounded…	(does not specify)	(does not specify)	(does not specify)	(does not specify)	up, to next higher whole number	down, to next lower whole number	to nearest whole number	up, to next higher whole number	to nearest whole number	up, to next higher whole number	to nearest whole number	up, to next higher whole number
Tier descriptions	up or down	up or down	up or down	up or down	up	down	up or down	up	up or down	up	up or down	up
Tier values	3.5	3.5	3.5	3.5	4	3	3	4	3	4	3	4

Appendix G

K-Means Cluster Analysis Procedure

The following procedure was used to conduct *k*-means cluster analysis (with $k = 3$) on the twelve points representing municipal policy positions. The analysis was performed using Microsoft Excel's Visual Basic for Applications (VBA) programming environment.

1. **Selection of initial values.** Three distinct points out of the twelve policy positions were selected as staring values, and their (x, y, z) coordinates (i.e., their geographic, economic, and attitudinal axial positions, respectively) used as the initial mean values for the three clusters. The VBA program cycled through all 220 possible combinations of starting points.
2. **Assignment to clusters.** Each of the twelve policy positions was assigned to the cluster to whose current mean value the policy point was the closest. Distances were calculated using the Pythagorean theorem in three dimensions.
3. **Calculation of cluster means.** The (x, y, z) coordinates for each cluster's mean value were (re-)calculated by finding the average (mean) value for each policy position belonging to that cluster in the current iteration.
4. **Comparison with previous iteration.** If none of the twelve policy positions had been assigned to a different cluster over the most recent iteration of Steps 2 and 3, then it was determined that the three clusters had achieved convergence. If such convergence had not been achieved, then the program returned to Step 2 in order to perform another iteration.

5. **Calculation of sum-of-squares error.** The sum-of-squares error (SSE) for the converged cluster arrangement was calculated by taking the sum of the square of the distance between each policy point and its respective cluster mean. The SSE value was recorded along with the three starting values that had been selected in Step 1.

In general, this procedure achieved convergence for each cluster arrangement (based on a unique set of starting points) within three or four iterations of Steps 2 through 4. Because only twelve policy positions were involved, it was possible to cycle through all 220 possible combinations of starting points in a reasonably short period of time in order to determine the optimal cluster arrangement, i.e. the arrangement with the lowest SSE. This optimal arrangement, which had a SSE value of 1.5524, is the one shown in Table 23 on p. 160.

Appendix H

Adjustments and Corrections Made to Initial Results from Mapping Phase

The following tables identify all adjustments and corrections made to the initial results from the mapping phase of the project (see Results, pp. 105–110). All area measurements are given in square metres [m^2] and have been rounded to the nearest whole number.

Barrie

Summary of adjustments and corrections

Parking lot ID	Reason for adjustment/correction
BAR43.P17	Aborted development project; vacant but accessible for parking purposes in 2016.
BAR43.P34	Primary use appears to be outdoor storage, but still accessible for parking purposes in 2016/2019: corrected to “no change.”
BAR45.P08	Site undergoing redevelopment in 2016/2019.

Initial and adjusted/corrected area measurements

	Initial values			Adjusted/corrected values		
Parking lot ID	Area in 2004	Area in 2016/19	Change in area	Area in 2004	Area in 2016/19	Change in area
Block BAR.43						
BAR43.P17	30	1,066	+1,036	0	0	0
BAR43.P34	936	0	–936	936	936	0
All other parking lots on block (P01–P16, P18–P33, P35)	22,519	25,258	+2,739	22,519	25,258	+2,739
Total (BAR.43)	23,484	26,324	+2,840	23,454	26,193	+2,739

Parking lot ID	Initial values: Area in 2004	Initial values: Area in 2016/19	Initial values: Change in area	Adjusted/corrected values: Area in 2004	Adjusted/corrected values: Area in 2016/19	Adjusted/corrected values: Change in area
Block BAR.45						
BAR45.P08	7,840	0	−7,840	0	0	0
All other parking lots on block (P01–P07, P09–P11)	33,325	26,300	−7,025	33,325	26,300	−7,025
Total (BAR.45)	41,164	26,300	−14,865	33,325	26,300	−7,025

Brantford

Summary of adjustments and corrections

Parking lot ID	Reason for adjustment/correction
BNF24.P05	Site undergoing redevelopment in 2006.
BNF24.P07	Site undergoing redevelopment in 2006.
BNF24.P08	Site undergoing redevelopment in 2006.
BNF24.P09	Site undergoing redevelopment in 2006.
BNF24.P10	Site undergoing redevelopment in 2006.
BNF24.P11	Site undergoing redevelopment in 2006.
BNF33.P01	Site undergoing redevelopment in 2018.
BNF33.P02	Site undergoing redevelopment in 2018.
BNF33.P03	Site undergoing redevelopment in 2018.
BNF33.P04	Site undergoing redevelopment in 2018.
BNF33.P05	Site undergoing redevelopment in 2018.

Initial and adjusted/corrected area measurements

Parking lot ID	Initial values: Area in 2006	Initial values: Area in 2018	Initial values: Change in area	Adjusted/corrected values: Area in 2006	Adjusted/corrected values: Area in 2018	Adjusted/corrected values: Change in area
Block BNF.24						
BNF24.P05	0	3,362	+3,362	0	0	0
BNF24.P07	857	0	−857	0	0	0

Parking lot ID	Initial values: Area in 2006	Initial values: Area in 2018	Initial values: Change in area	Adjusted/corrected values: Area in 2006	Adjusted/corrected values: Area in 2018	Adjusted/corrected values: Change in area
Block BNF.24 (cont'd)						
BNF24.P08	310	0	−310	0	0	0
BNF24.P09	329	0	−329	0	0	0
BNF24.P10	441	0	−441	0	0	0
BNF24.P11	64	0	−64	0	0	0
All other parking lots on block (P01–P04, P06)	1,186	1,125	−61	1,186	1,125	−61
Total (BNF.24)	3,188	4,487	+1,300	1,186	1,125	−61
Block BNF.33						
BNF33.P01	244	0	−244	0	0	0
BNF33.P02	162	0	−162	0	0	0
BNF33.P03	658	0	−658	0	0	0
BNF33.P04	449	0	−449	0	0	0
BNF33.P05	101	0	−101	0	0	0
All other parking lots on block (*none*)	--	--	--	--	--	--
Total (BNF.33)	1,514	0	−1,514	0	0	0

Burlington

Summary of adjustments and corrections

Parking lot ID	Reason for adjustment/correction
BRL15.P01	Site undergoing redevelopment in 2018.
BRL15.P02	Site undergoing redevelopment in 2018.
BRL15.P03	Site undergoing redevelopment in 2018.
BRL15.P04	Site undergoing redevelopment in 2018.
BRL15.P05	Site undergoing redevelopment in 2018.
BRL15.P06	Site undergoing redevelopment in 2018.

Parking lot ID	Reason for adjustment/correction
BRL23.P25	Driveway erroneously identified as parking lot.
BRL46.P09	Construction site in 2018.
BRL46.P14	Construction site in 2018.

Initial and adjusted/corrected area measurements

	Initial values			Adjusted/corrected values		
Parking lot ID	Area in 2005	Area in 2018	Change in area	Area in 2005	Area in 2018	Change in area
Block BRL.15						
BRL15.P01	330	0	−330	0	0	0
BRL15.P02	114	0	−114	0	0	0
BRL15.P03	89	0	−89	0	0	0
BRL15.P04	1,168	0	−1,168	0	0	0
BRL15.P05	173	0	−173	0	0	0
BRL15.P06	73	0	−73	0	0	0
All other parking lots on block (*none*)	--	--	--	--	--	--
Total (BRL.15)	1,947	0	−1,947	0	0	0
Block BRL.23						
BRL23.P25	56	0	−56	0	0	0
All other parking lots on block (P01–P24)	16,732	19,377	+2,645	16,732	19,377	+2,645
Total (BRL.23)	16,778	19,377	+2,590	16,732	19,377	+2,645
Block BRL.46						
BRL46.P09	2,623	3,513	+890	0	0	0
BRL46.P14	811	0	−811	0	0	0
All other parking lots on block (P01–P08, P10–P13)	44,579	33,476	−11,103	44,579	33,476	−11,103
Total (BRL.46)	48,013	36,990	−11,024	44,579	33,476	−11,103

Cambridge

Summary of adjustments and corrections

Parking lot ID	Reason for adjustment/correction
CAM01.P01	Vacant but accessible for parking purposes in 2006: addition corrected to “no change.”
CAM01.P03	Partially overlaps CAM01.P01 in 2006: removal corrected to “no change.”
CAM08.P06	Partially overlaps redevelopment on CAM08.P07 site in 2006: corrected to include only area outside redevelopment (no change to parking area).
CAM08.P07	Site undergoing redevelopment in 2006.
CAM08.P18	Removal associated with redevelopment on CAM08.P07 site: excluded from final calculations.
CAM08.P19	Removal associated with redevelopment on CAM08.P07 site: excluded from final calculations.
CAM08.P21	Removal associated with redevelopment on CAM08.P07 site: excluded from final calculations.
CAM08.P22	Removal associated with redevelopment on CAM08.P07 site: excluded from final calculations.

Initial and adjusted/corrected area measurements

	Initial values			Adjusted/corrected values		
Parking lot ID	Area in 2006	Area in 2018	Change in area	Area in 2006	Area in 2018	Change in area
Block CAM.01						
CAM01.P01	0	976	+976	0	0	0
CAM01.P03	420	0	–420	0	0	0
All other parking lots on block (P02)	2,389	2,389	0	2,389	2,389	0
Total (CAM.01)	2,808	3,364	+556	2,389	2,389	0
Block CAM.08						
CAM08.P06	1,968	1,511	–457	1,511	1,511	0
CAM08.P07	0	4,887	+4,887	0	0	0
CAM08.P18	373	0	–373	0	0	0
CAM08.P19	1,199	0	–1,199	0	0	0
CAM08.P21	528	0	–528	0	0	0

Parking lot ID	Initial values: Area in 2006	Initial values: Area in 2018	Initial values: Change in area	Adjusted/corrected values: Area in 2006	Adjusted/corrected values: Area in 2018	Adjusted/corrected values: Change in area
Block CAM.08 (cont'd)						
CAM08.P22	237	0	–237	0	0	0
All other parking lots on block (P01–P05, P08–P17, P20, P23–P24)	5,314	4,887	–427	5,314	4,887	–427
Total (CAM.08)	9,619	11,285	+1,666	6,825	6,398	–427

Guelph

Summary of adjustments and corrections

Parking lot ID	Reason for adjustment/correction
GUE05.P01	Site undergoing development in 2006.
GUE33.P01	Site undergoing redevelopment in 2018.
GUE55.P01	Site undergoing redevelopment in 2018.
GUE55.P02	Site undergoing redevelopment in 2018.
GUE55.P03	Site undergoing redevelopment in 2018.
GUE55.P04	Site undergoing redevelopment in 2018.
GUE55.P05	Site undergoing redevelopment in 2018.
GUE55.P06	Site undergoing redevelopment in 2018.

Initial and adjusted/corrected area measurements

Parking lot ID	Initial values: Area in 2006	Initial values: Area in 2018	Initial values: Change in area	Adjusted/corrected values: Area in 2006	Adjusted/corrected values: Area in 2018	Adjusted/corrected values: Change in area
Block GUE.05						
GUE05.P01	0	1,471	+1,471	0	0	0
All other parking lots on block (P02–P19)	6,518	7,630	+1,112	6,518	7,630	+1,112
Total (GUE.05)	6,518	9,101	+2,582	6,518	7,630	+1,112

Parking lot ID	Initial values: Area in 2006	Initial values: Area in 2018	Initial values: Change in area	Adjusted/corrected values: Area in 2006	Adjusted/corrected values: Area in 2018	Adjusted/corrected values: Change in area
Block GUE.33						
GUE33.P01	2,722	0	−2,722	0	0	0
All other parking lots on block (*none*)	--	--	--	--	--	--
Total (GUE.33)	2,722	0	−2,722	0	0	0
Block GUE.55						
GUE55.P01	0	1,272	+1,272	0	0	0
GUE55.P02	0	955	+955	0	0	0
GUE55.P03	803	0	−803	0	0	0
GUE55.P04	512	0	−512	0	0	0
GUE55.P05	563	0	−563	0	0	0
GUE55.P06	1,444	0	−1,444	0	0	0
All other parking lots on block (*none*)	--	--	--	--	--	--
Total (GUE.55)	3,321	2,227	−1,094	0	0	0

Hamilton

Summary of adjustments and corrections

Parking lot ID	Reason for adjustment/correction
HAM023.P02	Site undergoing redevelopment in 2005.
HAM061.P03	Site undergoing redevelopment in 2018.
HAM061.P04	Site undergoing redevelopment in 2018.
HAM061.P05	Site undergoing redevelopment in 2018.
HAM061.P06	Site undergoing redevelopment in 2018.

Hamilton (*cont'd*)

Initial and adjusted/corrected area measurements

	Initial values			Adjusted/corrected values		
Parking lot ID	Area in 2005	Area in 2018	Change in area	Area in 2005	Area in 2018	Change in area
Block HAM.023						
HAM023.P02	373	1,189	+816	0	0	0
All other parking lots on block (P01, P03–P05)	1,171	1,171	0	1,171	1,171	0
Total (HAM.023)	1,545	2,369	+816	1,171	1,171	0
Block HAM.061						
HAM061.P03	215	0	–215	0	0	0
HAM061.P04	218	0	–218	0	0	0
HAM061.P05	717	0	–717	0	0	0
HAM061.P06	105	0	–105	0	0	0
All other parking lots on block (P01–P02)	8,948	5,679	–3,269	8,948	5,679	–3,269
Total (HAM.061)	10,204	5,670	–4,525	8,948	5,679	–3,269

Kitchener

Summary of adjustments and corrections

Parking lot ID	Reason for adjustment/correction
KIT20.P01	Site undergoing construction/redevelopment in 2006.
KIT20.P02	Site undergoing construction/redevelopment in 2006.
KIT20.P03	Site undergoing construction/redevelopment in 2006.
KIT20.P04	Site undergoing construction/redevelopment in 2006.
KIT35.P12	Site undergoing construction/redevelopment in 2018.
KIT35.P17	Site undergoing construction/redevelopment in 2018.
KIT35.P18	Site undergoing construction/redevelopment in 2018.

Parking lot ID	Reason for adjustment / correction
KIT35.P19	Site undergoing construction / redevelopment in 2018.
KIT35.P22	Vacant but accessible for parking purposes: removal corrected to "no change."

Initial and adjusted / corrected area measurements

	Initial values			Adjusted / corrected values		
Parking lot ID	Area in 2006	Area in 2018	Change in area	Area in 2006	Area in 2018	Change in area
Block KIT.20						
KIT20.P01	0	12,255	+12,255	0	0	0
KIT20.P02	201	201	0	0	0	0
KIT20.P03	590	0	–590	0	0	0
KIT20.P04	2,938	0	–2,938	0	0	0
All other parking lots on block (*none*)	--	--	--	--	--	--
Total (KIT.20)	3,728	12,456	+8,728	0	0	0
Block KIT.35						
KIT35.P12	932	650	–282	0	0	0
KIT35.P17	216	0	–216	0	0	0
KIT35.P18	1,000	0	–1,000	0	0	0
KIT35.P19	2,496	0	–2,496	0	0	0
KIT35.P22	348	0	–348	0	0	0
All other parking lots on block (P01–P11, P13–P16, P20–P21, P23–P24)	47,141	39,951	–7,190	47,141	39,951	–7,190
Total (KIT.35)	52,134	40,601	–11,532	47,141	39,951	–7,190

Milton

Summary of adjustments and corrections

Parking lot ID	Reason for adjustment/correction
MLN04.P13	Area still accessible for parking purposes: removal corrected to "no change."
MLN28.P01	Site vacant but still accessible for parking purposes in 2005: addition corrected to "no change."
MLN29.P06	Site undergoing construction/redevelopment in 2018.

Initial and adjusted/corrected area measurements

	Initial values			Adjusted/corrected values		
Parking lot ID	Area in 2005	Area in 2018	Change in area	Area in 2005	Area in 2018	Change in area
Block MLN.04						
MLN04.P13	1,539	0	−1,539	1,539	1,539	0
All other parking lots on block (P01–P12)	16,510	14,618	−1,892	16,510	14,618	−1,892
Total (MLN.04)	18,049	14,618	−3,432	18,049	16,157	−1,892
Block MLN.28						
MLN28.P01	0	2,534	+2,534	0	0	0
All other parking lots on block (P02–P23)	29,415	33,548	+4,132	29,415	33,548	+4,132
Total (MLN.28)	29,415	36,082	+6,667	29,415	33,548	+4,132
Block MLN.29						
MLN29.P06	932	0	−932	0	0	0
All other parking lots on block (P01–P05, P07–P12)	39,632	45,955	+6,322	39,632	45,955	+6,322
Total (MLN.29)	40,565	45,955	+5,390	39,632	45,955	+6,322

Oshawa

Summary of adjustments and corrections

Parking lot ID	Reason for adjustment/correction
---	*(no adjustments or corrections made)*

Peterborough

Summary of adjustments and corrections

Parking lot ID	Reason for adjustment/correction
PET06.P17	Vacant but still accessible for parking purposes in 2018: removal corrected to "no change."
PET19.P01	Site undergoing demolition/redevelopment (situation unclear): excluded from final calculations.

Initial and adjusted/corrected area measurements

	Initial values			Adjusted/corrected values		
Parking lot ID	Area in 2005	Area in 2018	Change in area	Area in 2005	Area in 2018	Change in area
Block PET.06						
PET06.P17	1,347	0	−1,347	1,347	1,347	0
All other parking lots on block (P01–P16, P18)	11,785	11,313	−472	11,785	11,313	−472
Total (PET.06)	13,132	11,313	−1,819	13,132	12,660	−472
Block PET.19						
PET19.P01	353	185	−167	0	0	0
All other parking lots on block (P02–P06)	2,736	1,749	−987	2,736	1,749	−987
Total (PET.19)	3,089	1,934	−1,155	2,736	1,749	−987

St. Catharines

Summary of adjustments and corrections

Parking lot ID	Reason for adjustment/correction
STC12.P08	Site undergoing redevelopment in 2018.
STC15.P09	Vacant but accessible for parking purposes in 2018: removal corrected to "no change."
STC17.P12	Vacant but accessible for parking purposes in 2018: removal corrected to "no change."
STC52.P09	Site appears vacant but accessible for parking purposes in 2006: addition corrected to "no change."

Initial and adjusted/corrected area measurements

	Initial values			Adjusted/corrected values		
Parking lot ID	Area in 2006	Area in 2018	Change in area	Area in 2006	Area in 2018	Change in area
Block STC.12						
STC12.P08	1,676	713	−963	0	0	0
All other parking lots on block (P01–P07, P09)	15,372	14,074	−1,298	15,372	14,074	−1,298
Total (STC.12)	17,048	14,787	−2,261	15,372	14,074	−1,298
Block STC.15						
STC15.P09	415	0	−415	0	0	0
All other parking lots on block (P01–P08, P10–P11)	9,893	7,885	−2,008	9,893	7,885	−2,008
Total (STC.15)	10,308	7,885	−2,423	9,893	7,885	−2,008
Block STC.17						
STC17.P12	3,934	0	−3,934	0	0	0
All other parking lots on block (P01–P11, P13–P15)	5,199	5,383	+184	5,199	5,383	+184
Total (STC.17)	9,133	5,383	−3,749	5,199	5,383	+184

Parking lot ID	Initial values: Area in 2006	Initial values: Area in 2018	Initial values: Change in area	Adjusted/corrected values: Area in 2006	Adjusted/corrected values: Area in 2018	Adjusted/corrected values: Change in area
Block STC.52						
STC52.P09	0	2,586	+2,586	0	0	0
All other parking lots on block (P01–P08, P10–P15)	11,768	6,391	−5,377	11,768	6,391	−5,377
Total (STC.52)	11,768	8,977	−2,791	11,768	6,391	−5,377

Waterloo

Summary of adjustments and corrections

Parking lot ID	Reason for adjustment/correction
WAT56.P01	Site undergoing redevelopment in 2006.
WAT56.P02	Site undergoing redevelopment in 2006.
WAT56.P03	Site undergoing redevelopment in 2006.
WAT56.P04	Expansion associated with redevelopment underway in 2006: increase in area corrected to "no change."
WAT56.P05	Reduction associated with redevelopment underway in 2006: decrease in area corrected to "no change."
WAT56.P06	Expansion associated with redevelopment underway in 2006: increase in area corrected to "no change."
WAT56.P09	Addition associated with redevelopment underway in 2006: addition corrected to "no change."
WAT58.P01	Parking lot crosses municipal boundary: adjusted to include only portion within City of Waterloo.
WAT58.P02	Parking lot crosses municipal boundary: adjusted to include only portion within City of Waterloo.
WAT58.P06	Parking lot crosses municipal boundary: adjusted to include only portion within City of Waterloo.
WAT58.P07	Parking lot located within City of Kitchener: excluded from final calculations.
WAT58.P08	Parking lot located within City of Kitchener: excluded from final calculations.
WAT58.P09	Parking lot located within City of Kitchener: excluded from final calculations.
WAT58.P11	Parking lot located within City of Kitchener: excluded from final calculations.

Parking lot ID	Reason for adjustment / correction
WAT58.P12	Parking lot located within City of Kitchener: excluded from final calculations.
WAT58.P13	Parking lot located within City of Kitchener: excluded from final calculations.
WAT58.P14	Parking lot located within City of Kitchener: excluded from final calculations.
WAT61.P01	Parking lot crosses municipal boundary: adjusted to include only portion within City of Waterloo.
WAT61.P02	Parking lot located within City of Kitchener: excluded from final calculations.
WAT61.P03	Parking lot located within City of Kitchener: excluded from final calculations.
WAT61.P04	Parking lot located within City of Kitchener: excluded from final calculations.
WAT61.P05	Parking lot located within City of Kitchener: excluded from final calculations.
WAT61.P06	Parking lot located within City of Kitchener: excluded from final calculations.
WAT61.P07	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P03	Parking lot crosses municipal boundary: adjusted to include only portion within City of Waterloo.
WAT62.P04	Parking lot crosses municipal boundary: adjusted to include only portion within City of Waterloo.
WAT62.P05	Parking lot crosses municipal boundary: adjusted to include only portion within City of Waterloo.
WAT62.P06	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P07	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P08	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P09	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P10	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P11	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P12	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P13	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P14	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P15	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P16	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P17	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P18	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P19	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P20	Parking lot located within City of Kitchener: excluded from final calculations.

Parking lot ID	Reason for adjustment/correction
WAT62.P21	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P22	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P23	Parking lot located within City of Kitchener: excluded from final calculations.
WAT62.P24	Parking lot located within City of Kitchener: excluded from final calculations.

Initial and adjusted/corrected area measurements

	Initial values			Adjusted/corrected values		
Parking lot ID	Area in 2006	Area in 2018	Change in area	Area in 2006	Area in 2018	Change in area
Block WAT.56						
WAT56.P01	0	549	+549	0	0	0
WAT56.P02	0	311	+311	0	0	0
WAT56.P03	0	1,434	+1,434	0	0	0
WAT56.P04	221	227	+6	221	221	0
WAT56.P05	318	315	–3	318	318	0
WAT56.P06	351	360	+10	351	351	0
WAT56.P09	0	70	+70	0	0	0
All other parking lots on block (P07–P08)	535	535	0	535	535	0
Total (WAT.56)	1,424	3,800	+2,376	1,424	1,424	0
Block WAT.58						
WAT58.P01	1,515	1,515	0	771	771	0
WAT58.P02	2,943	2,943	0	2,710	2,710	0
WAT58.P06	2,002	2,146	+143	229	243	+14
WAT58.P07	543	722	+179	0	0	0
WAT58.P08	424	424	0	0	0	0
WAT58.P09	32	32	0	0	0	0
WAT58.P11	0	51	+51	0	0	0
WAT58.P12	135	135	0	0	0	0
WAT58.P13	44	44	0	0	0	0
WAT58.P14	57	57	0	0	0	0

	Initial values			Adjusted/corrected values		
Parking lot ID	Area in 2006	Area in 2018	Change in area	Area in 2006	Area in 2018	Change in area
Block WAT.58 (cont'd)						
All other parking lots on block (P03–P05, P10, P15)	2,043	2,460	+417	2,043	2,460	+417
Total (WAT.58)	9,738	10,528	+790	5,753	6,184	+431
Block WAT.61						
WAT61.P01	19,790	22,359	+2,569	369	369	0
WAT61.P02	1,931	1,876	–55	0	0	0
WAT61.P03	179	631	+452	0	0	0
WAT61.P04	336	0	–336	0	0	0
WAT61.P05	448	0	–448	0	0	0
WAT61.P06	292	0	–292	0	0	0
WAT61.P07	121	0	–121	0	0	0
All other parking lots on block (*none*)	--	--	--	--	--	--
Total (WAT.61)	23,097	24,866	+1,769	369	369	0
Block WAT.62						
WAT62.P03	322	322	0	298	298	0
WAT62.P04	267	267	0	267	267	0
WAT62.P05	674	674	0	109	109	0
WAT62.P06	433	433	0	0	0	0
WAT62.P07	561	561	0	0	0	0
WAT62.P08	1,043	1,043	0	0	0	0
WAT62.P09	457	457	0	0	0	0
WAT62.P10	258	250	–8	0	0	0
WAT62.P11	313	333	+20	0	0	0
WAT62.P12	1,395	1,414	+19	0	0	0
WAT62.P13	273	273	0	0	0	0
WAT62.P14	137	137	0	0	0	0

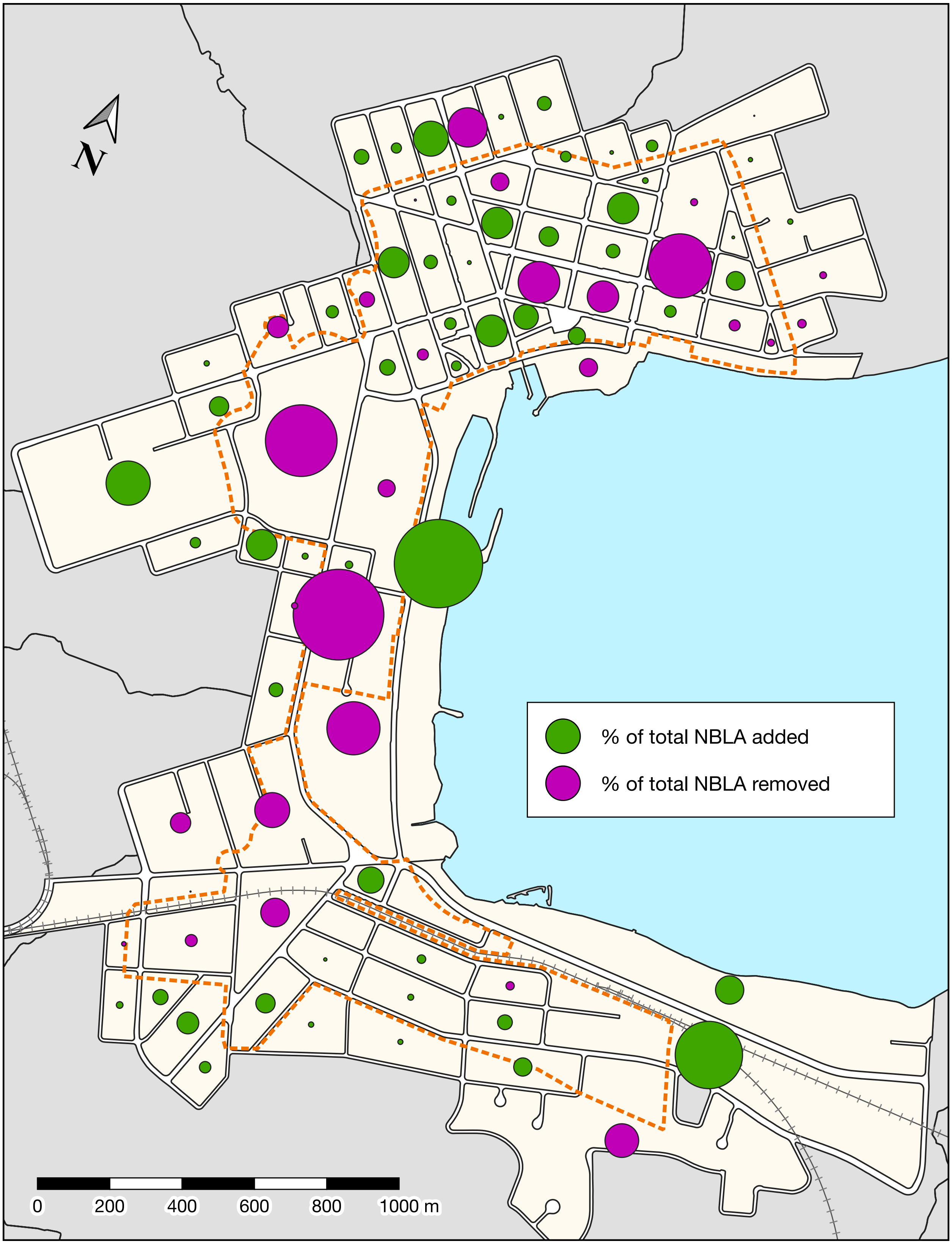
Parking lot ID	Initial values			Adjusted/corrected values		
	Area in 2006	Area in 2018	Change in area	Area in 2006	Area in 2018	Change in area
Block WAT.62 (cont'd)						
WAT62.P15	968	968	0	0	0	0
WAT62.P16	93	107	+13	0	0	0
WAT62.P17	0	100	+100	0	0	0
WAT62.P18	39	39	0	0	0	0
WAT62.P19	58	58	0	0	0	0
WAT62.P20	81	81	0	0	0	0
WAT62.P21	122	122	0	0	0	0
WAT62.P22	94	94	0	0	0	0
WAT62.P23	53	0	−53	0	0	0
WAT62.P24	219	0	−219	0	0	0
All other parking lots on block (P01–P02)	1,347	1,443	+96	1,347	1,443	+96
Total (WAT.62)	9,206	9,175	−30	1,952	2,048	+96

Appendix I

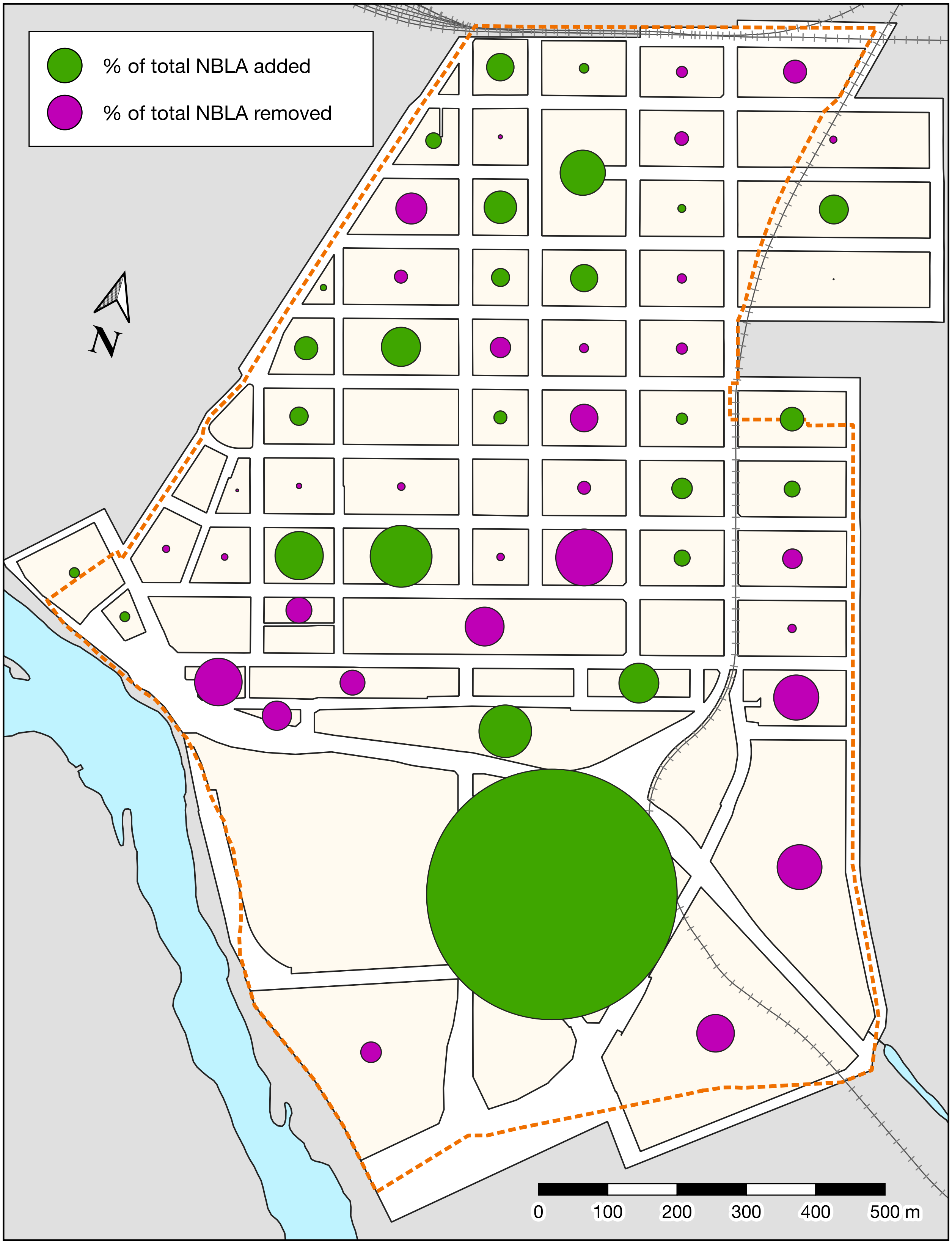
Distribution of Net Block-Level Changes in Parking Area

Each map shows the share of the total net block-level area (NBLA) added or total NBLA removed for each individual block with the area of interest for the municipality.

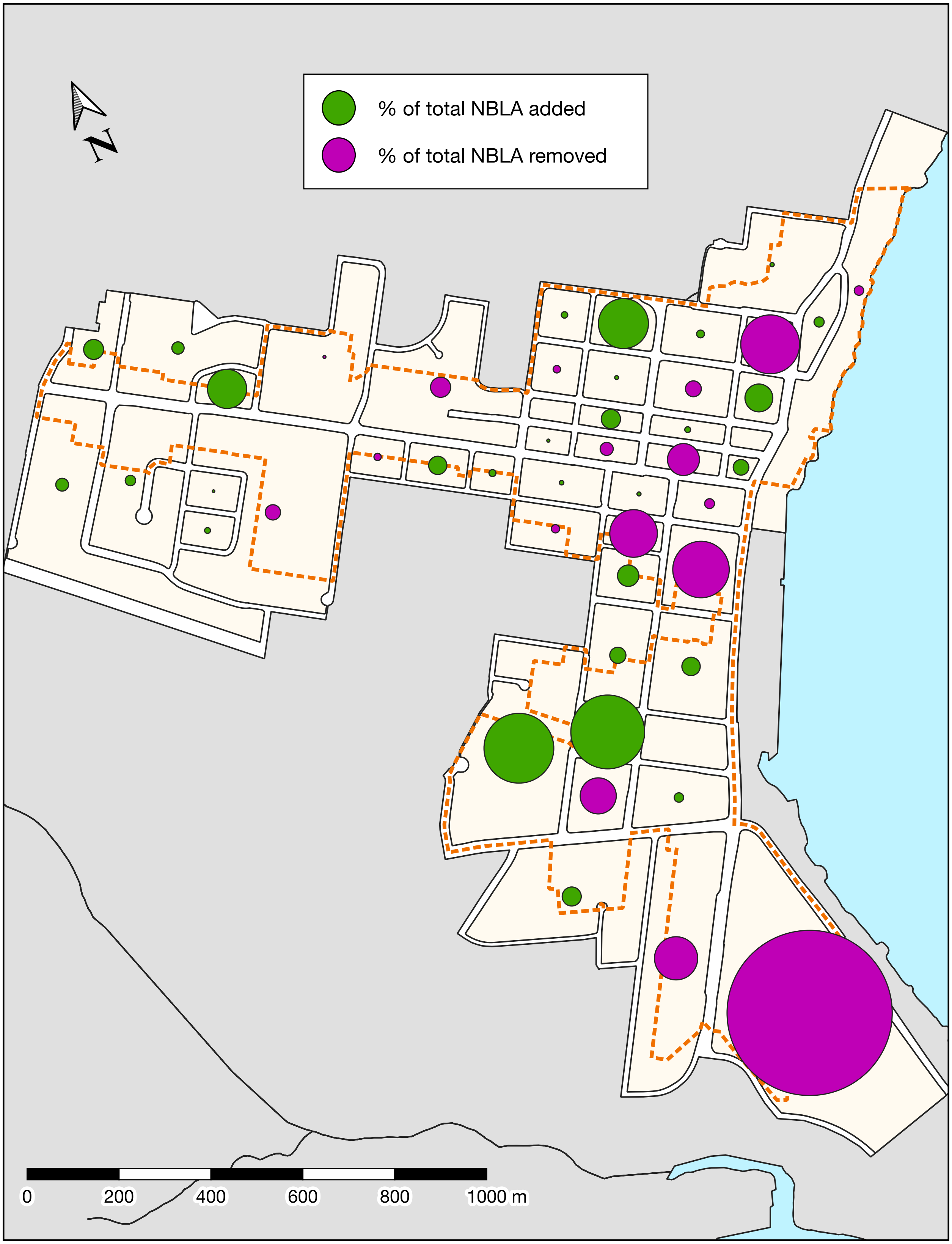
Distribution of net block-level changes, Downtown Barrie UGC



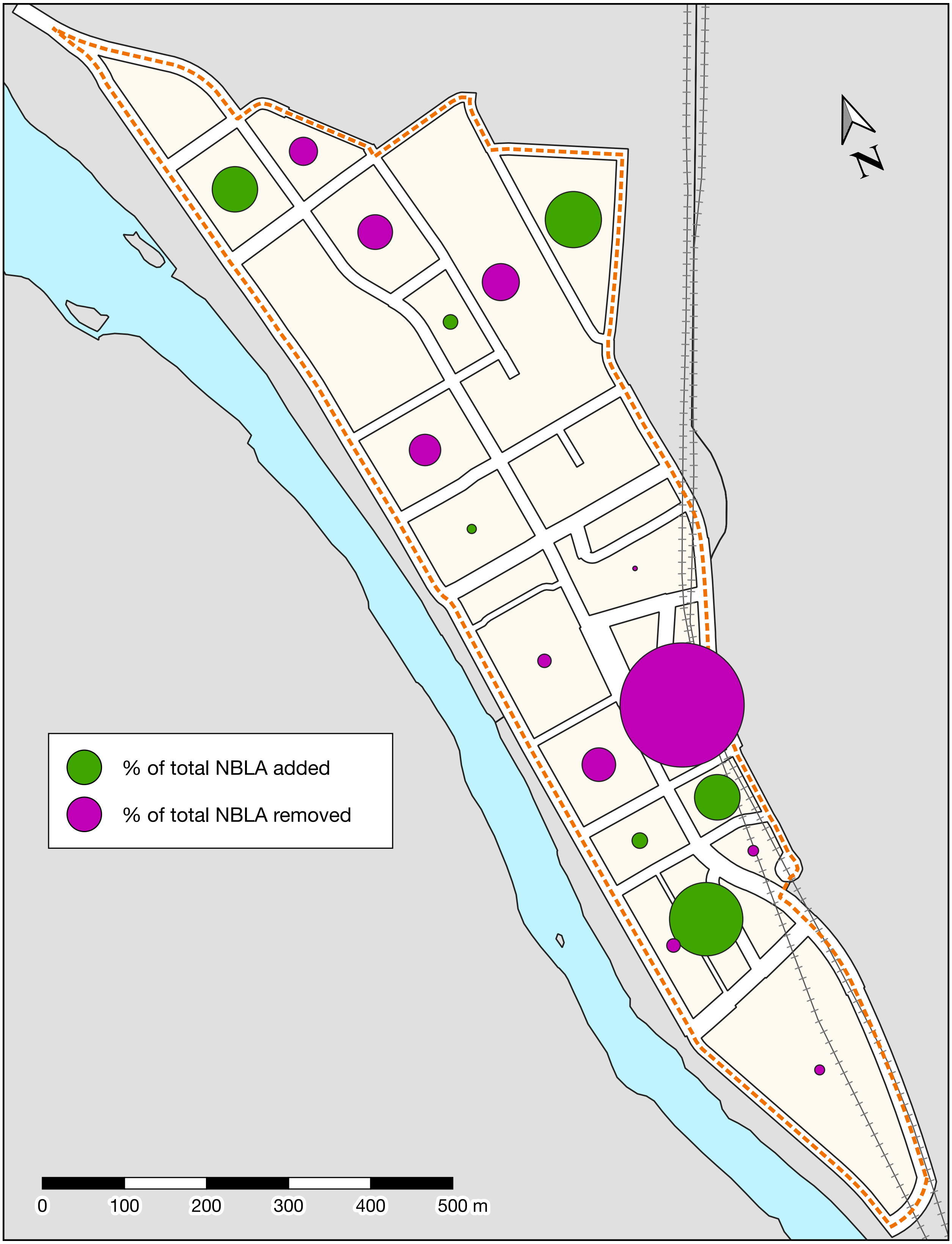
Distribution of net block-level changes, Downtown Brantford UGC



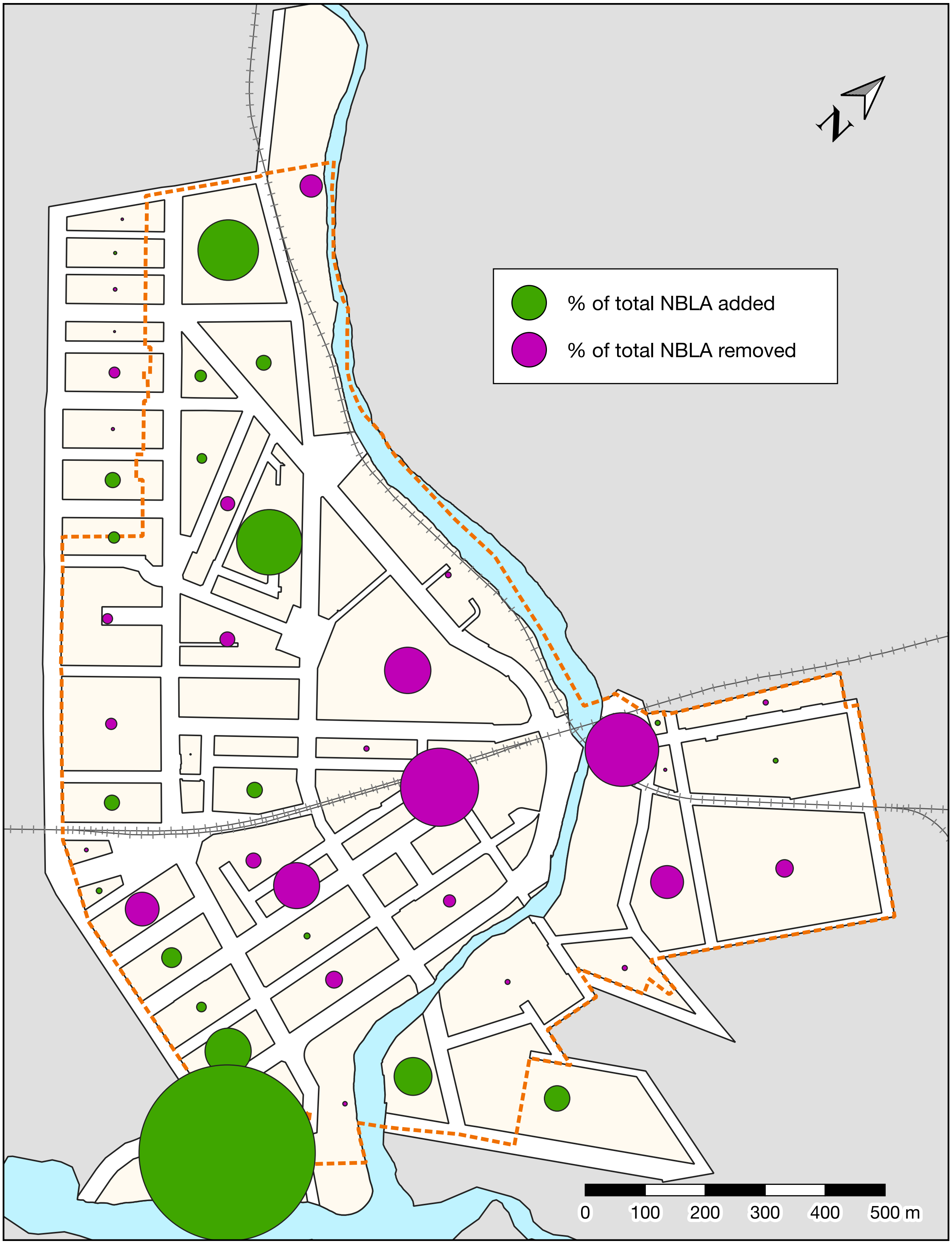
Distribution of net block-level changes, Downtown Burlington UGC



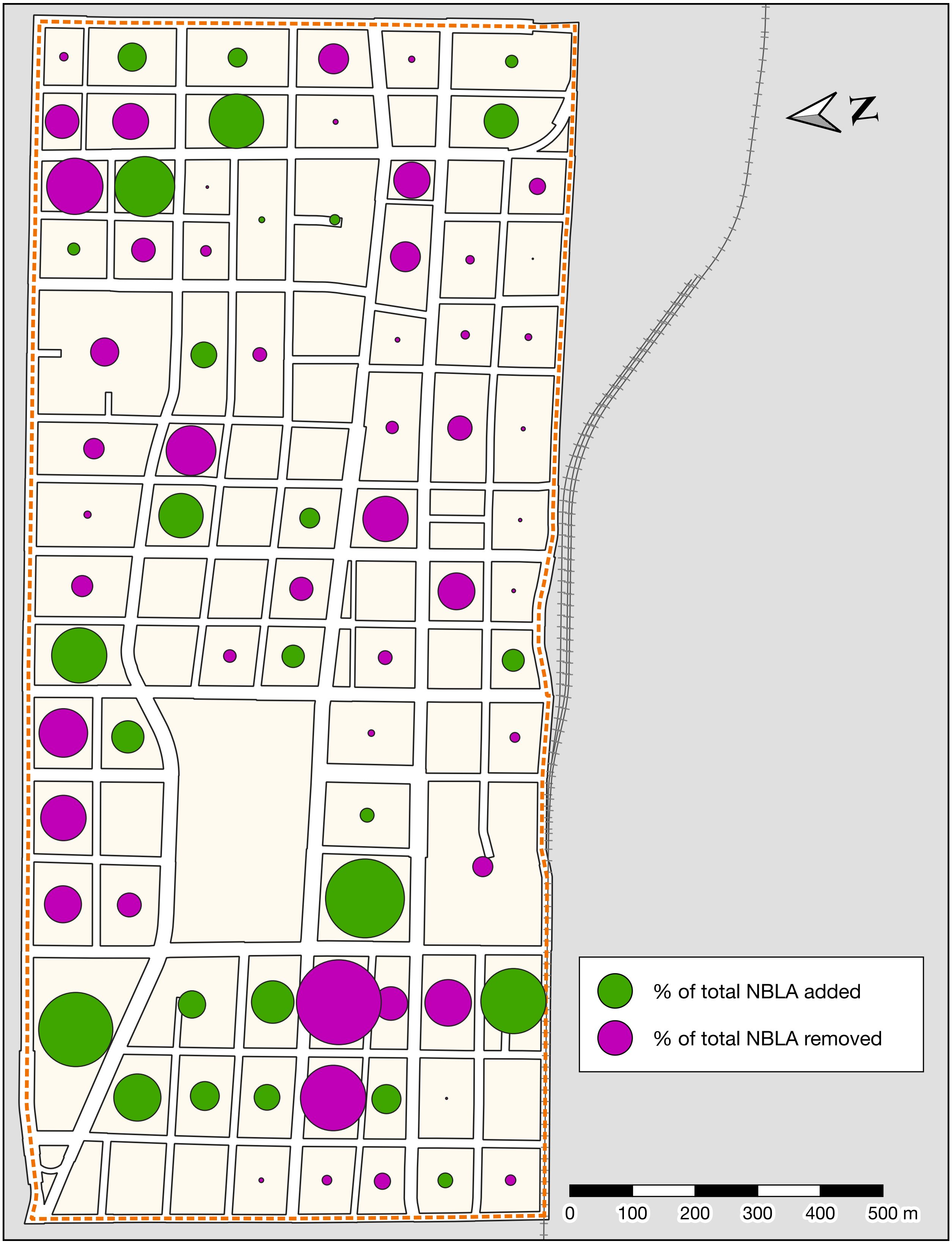
Distribution of net block-level changes, Downtown Cambridge UGC



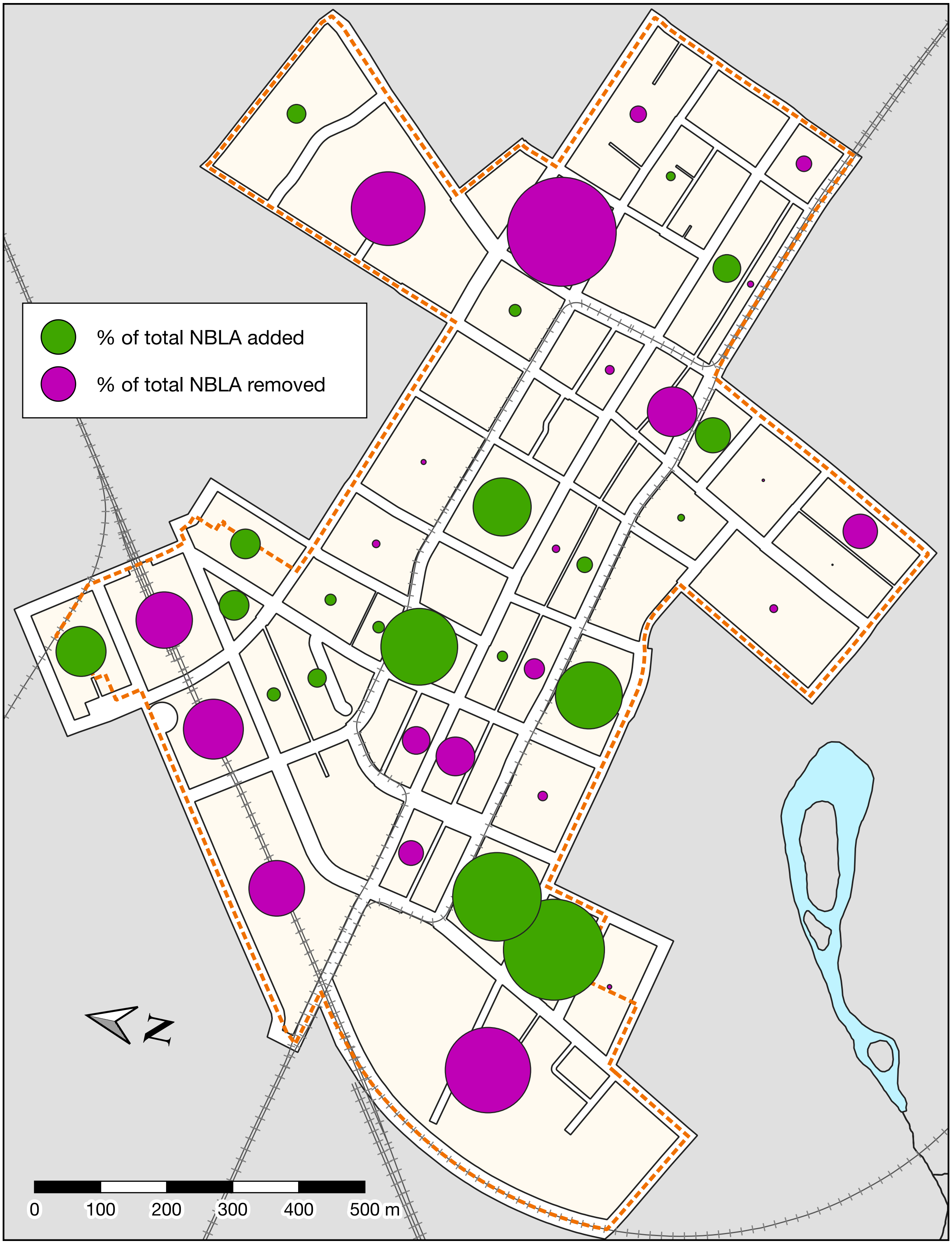
Distribution of net block-level changes, Downtown Guelph UGC



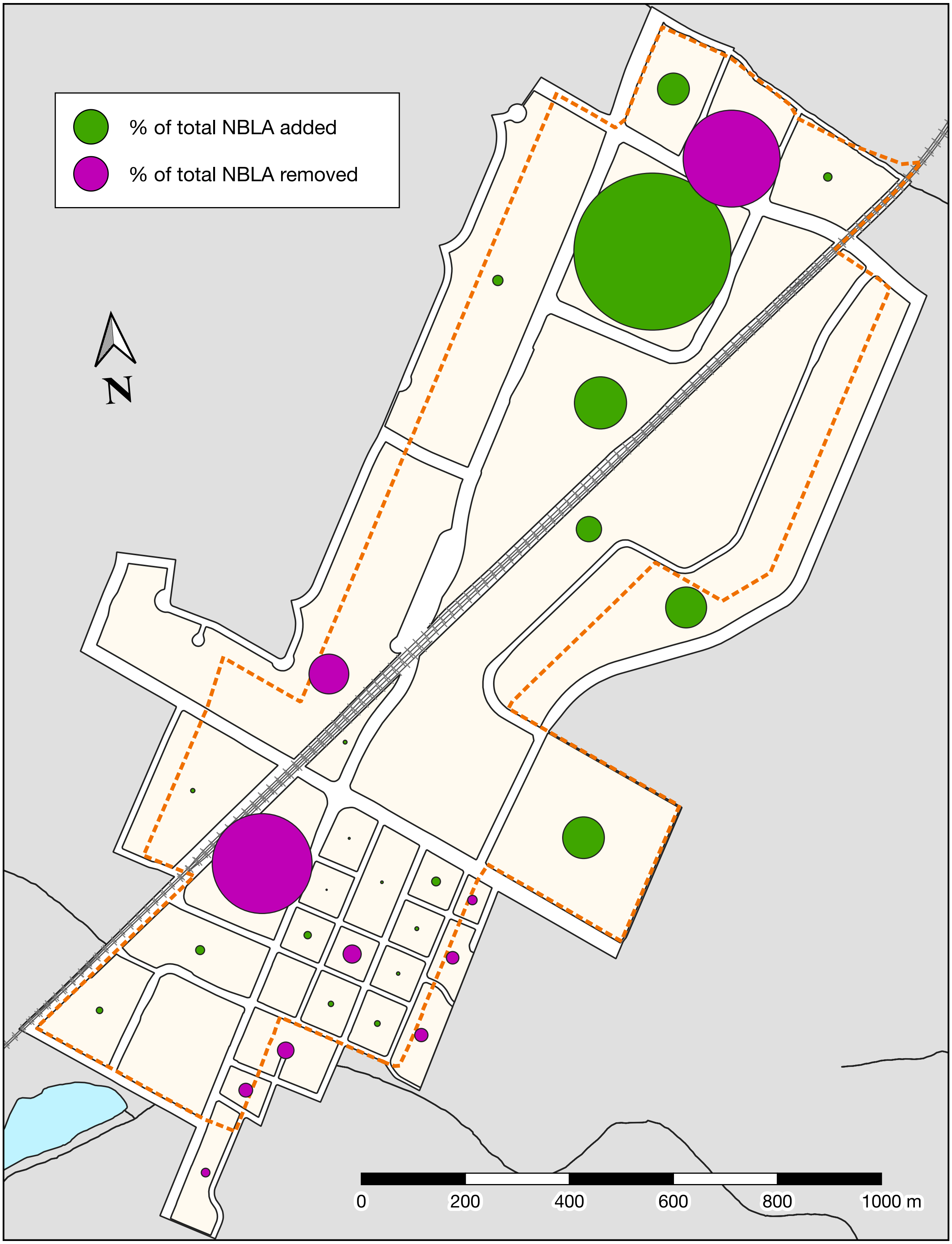
Distribution of net block-level changes, Downtown Hamilton UGC



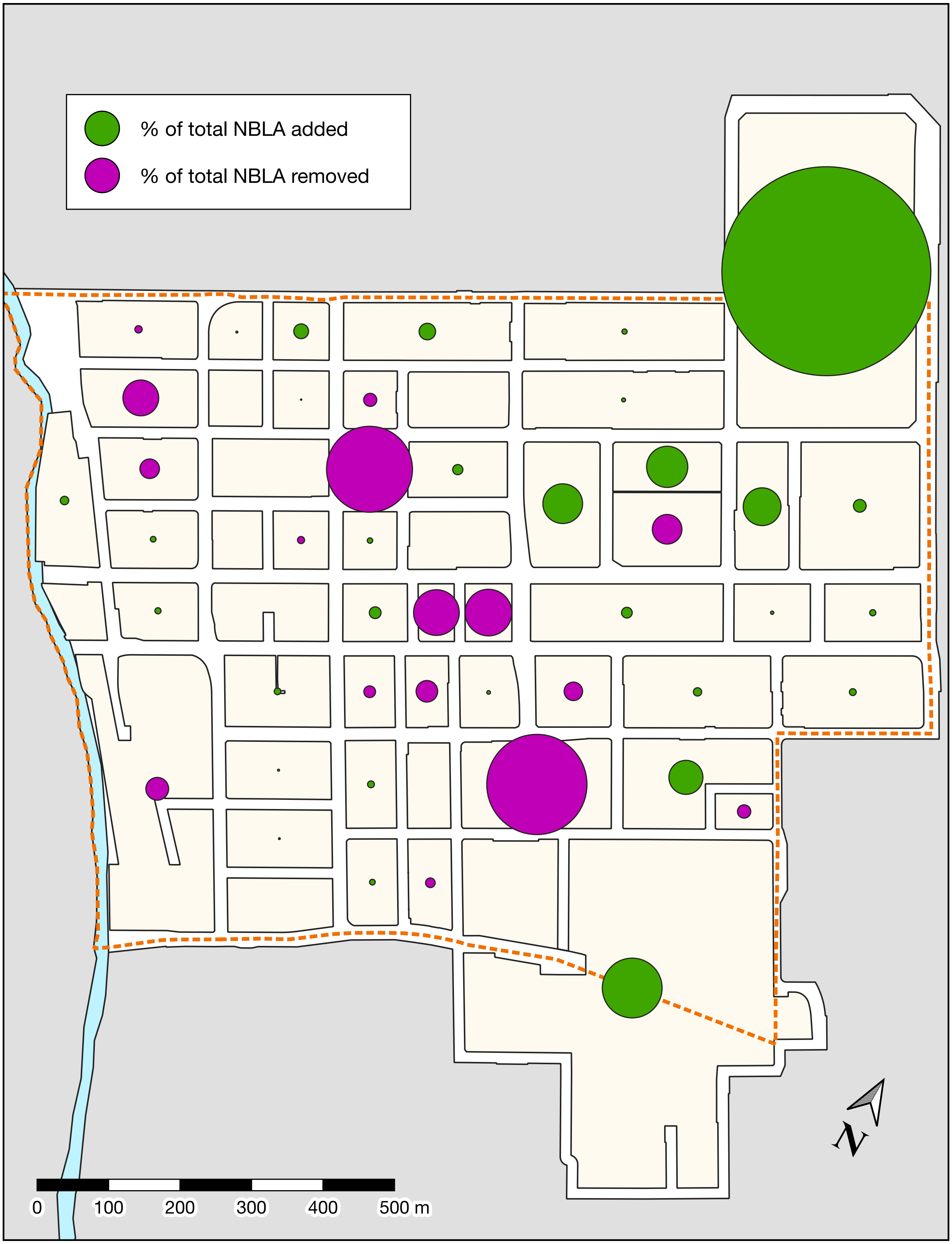
Distribution of net block-level changes, Downtown Kitchener UGC



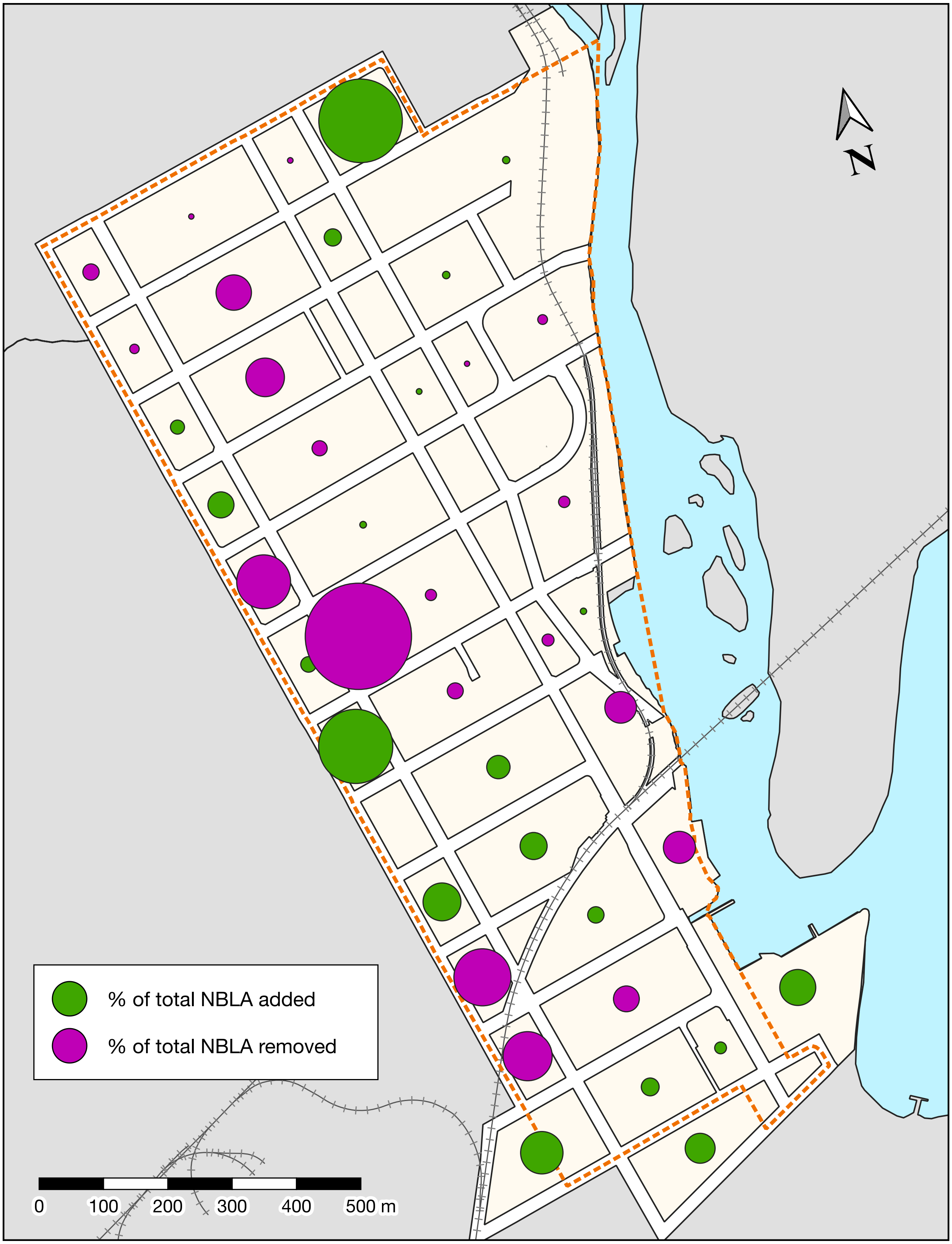
Distribution of net block-level changes, Downtown Milton UGC



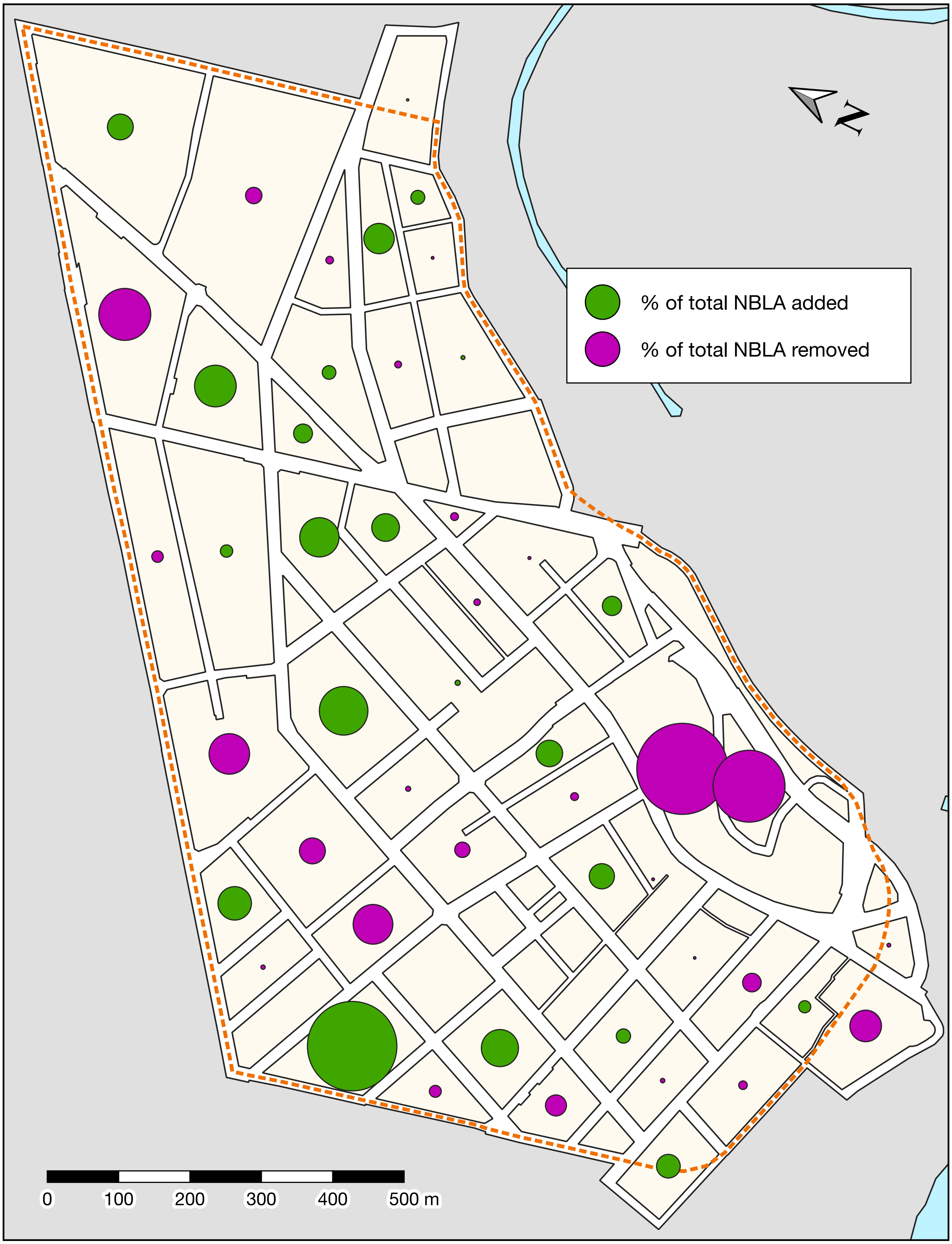
Distribution of net block-level changes, Downtown Oshawa UGC



Distribution of net block-level changes, Downtown Peterborough UGC



Distribution of net block-level changes, Downtown St. Catharines UGC



Distribution of net block-level changes, Uptown Waterloo UGC