Metro Boston Perfect Fit Parking Initiative

Phase 1 Report: New Metrics and Models for Parking Supply and Demand

Report by the **Metropolitan Area Planning Council**

February 2017

About MAPC

The Metropolitan Area Planning Council (MAPC) is the regional planning agency serving the people who live and work in the 101 cities and towns of Metropolitan Boston. Our mission is to promote smart growth and regional collaboration. Our regional plan, MetroFuture, guides our work as we engage the public in responsible stewardship of our region's future.

We work toward sound municipal management, sustainable land use, protection of natural resources, efficient and affordable transportation, a diverse housing stock, public safety, economic development, clean energy, healthy communities, an informed public, and equity and opportunity for all.

Acknowledgements

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Background

Parking is a hotly debated issue that reflects the demographic, building, and neighborhood characteristics of a given community. Moreover, transportation infrastructure, design, and travel behaviors are rapidly evolving. As national trends have indicated, more urban residents are forgoing driving and vehicle ownership in favor of more sustainable transportation options, such as walking, bicycling, public transit, carpooling, and carsharing. Despite these changes, parking requirements have generally remained stagnant over time. Additionally, these requirements tend to be determined outside the context of actual parking utilization data. Parking requirements that are uniform across an entire municipality, regardless of development type, and are not responsive to location and changes in demographics, can lead to the construction of excess parking. This is especially concerning for sites like multifamily developments, where significant resources are invested in parking facilities.

In general, there has been limited quantitative analysis of the factors that influence residential parking demand.[1] The Center for Neighborhood Technology (CNT) has spearheaded efforts to collect data on parking utilization at residential developments in several urban areas, including King County, Washington and Washington, D.C.[2,3] This prior work aimed to move away from the one-size-fits-all parking requirements by using parking utilization data to create a more current picture of parking demand in a particular community or region so parking requirements are more comparable to the actual amount of parking residents use.

MAPC's Perfect Fit Parking Initiative has a similar goal: reduce the construction of excess parking by better aligning parking supply and demand. Reducing excess parking can lower development costs, free up land for other uses that more directly benefit the public, such as open space and affordable housing, and potentially encourage the use of other modes of transportation (See Appendix A for a more in-depth description of the consequences of excess parking). Ultimately, using parking utilization data to drive decision-making, rather than a one-size fits all approach, allows for communities to respond to changing demographics and commuting practices.

To understand existing parking trends in the region, the Metropolitan Area Planning Council (MAPC) collected parking supply and utilization data at multifamily residential developments in five municipalities in MAPC's Inner Core subregion: Arlington, Chelsea, Everett, Malden, and Melrose. The relatively arbitrary nature of determining parking requirements is reflected in the surveyed municipalities; between these five communities, parking requirements for multifamily developments range anywhere from 1 to 2 spaces per unit. While several of these communities have taken steps to

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[1] Rachel Weinberger, "Death by a Thousand Curb-Cuts: Evidence on the Effect of Minimum Parking Requirements on the Choice to Drive," *Transport Policy*, Urban Transport Initiatives, 20 (March 2012): 93–102, doi:10.1016/j.tranpol.2011.08.002.

[2] "Right Size Parking: Final Report" (King County Metro, August 2015), http://metro.kingcounty.gov/programs-projects/right-size-parking/pdf/rsp-final-report-8-2015.pdf.

[3] Jonathan Rogers et al., "Estimating Parking Utilization in Multi-Family Residential Buildings in Washington, D.C.," *Transportation Research Board*, November 13, 2015, http://www.cnt.org/sites/default/files/publications/DR1_TRB_DC%20Multifamily%20Parking%20Utilization.pdf.

reduce excess parking by allowing for a reduction in parking requirements in some of the most walkable and transit-oriented districts, the preliminary findings from Phase 1 reveal there is more work to be done.

Despite the demographic diversity among these communities and the wide range of developments surveyed, excess parking was found in 91% of surveyed developments. **Across all developments, parking was supplied at an average of 1.15 parking spaces per residential unit, though only 0.85 parking spaces per unit were occupied.** The resulting "utilization rate" (occupied parking spaces as a percent of total parking spaces) was 74%, meaning nearly one-quarter of the observed parking spaces, which were observed during anticipated peak utilization hours—overnight on a weeknight— were vacant. MAPC recommends that parking lots at multifamily residential developments reach a peak utilization rate of 90-100%. This allows for efficient use of space and limits the construction of excess parking spaces while ensuring some extra space is available for guests, snow storage, or other unanticipated events.

In addition to these observations, MAPC developed a statistical model that investigated a total of 18 neighborhood and building characteristics. After exploring all of those variables, MAPC's Phase 1 model included parking supply per unit and the number of jobs accessible via transit within 30 minutes after controlling for tenure and affordability. This model explained approximately 73% of the variation in parking demand per unit. **The single factor most strongly associated with parking demand per unit is parking supplied per unit.** The number of jobs accessible via transit within 30 minutes is also associated, although less so, with parking demand.

The importance of exploring smart parking strategies in the Metro Boston area largely rests in the need for these communities to accommodate the growing demand for housing throughout the region. The findings and recommendations discussed in this report will help communities reconsider how parking requirements and policies can be a tool to limit the amount of excess parking constructed and leverage transit-oriented and walkable development.

This report is intended to advance the conversation about parking requirements at multifamily developments in the Metro Boston area by reporting on the initial data findings of the Phase 1 work. The findings and recommendations discussed in this report are first in several phases of analysis. MAPC intends to build on these initial findings by collecting data at more multifamily developments in different communities, particularly those that are even more proximate to the urban core. With a more comprehensive dataset, MAPC will refine its statistical model and ultimately create digital tools that allow municipalities to use observed parking demand and the model results to inform municipal parking policy. By 2018, MAPC will have published a collection of resources available to communities looking to implement a smart parking strategy and reduce the burden of excess parking on developers, residents, and municipalities alike.

Definitions of terms used in this report:

- *Parking Supply per Unit*: the number of existing parking spaces per housing unit, averaged for a building
- *Parking Utilization Rate*: the percent of existing parking spaces actually occupied by a vehicle during the field survey
- *Parking Demand per Unit*: the number of occupied parking spaces per occupied housing unit, measured at the building level

Project Area Context

Arlington, Chelsea, Everett, Malden, and Melrose were the five municipalities surveyed as part of the Phase 1 analysis. These municipalities were selected because, although they are all located in the Inner Core, they vary in their community character, demographics, and transit accessibility. Additionally, given the rapidly growing demand for housing in Metro Boston, communities just outside the dense urban core have an important role to play in meeting the region's housing needs. MAPC has projected that the Greater Boston area will need to create up to 435,000 new housing units by 2040. A large proportion of these units will be in multifamily developments in urban areas, and these five municipalities will play a critical role in addressing these needs. Below is a map of these communities in the context of the Great Boston area (Figure 1).

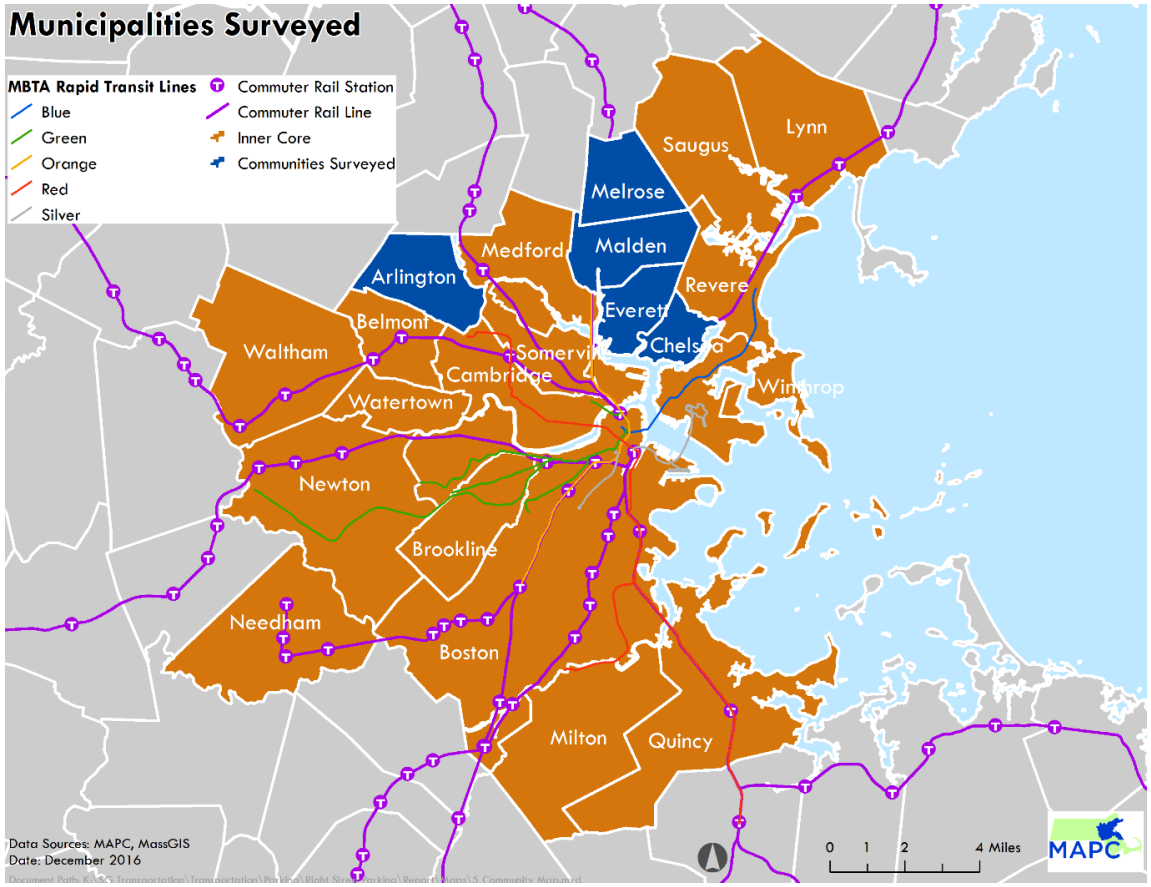


Figure 1: Map of Inner Core Subregion with the Municipalities Surveyed

Located in the Inner Core, these municipalities and others in the Metro Boston region are seeing rapid growth. Population in these five cities and towns grew by 6.4% from 2010-2015, as compared to the Inner Core as a whole, which grew by 5.6% from 2010-2015[4].

These five municipalities fall into two distinct Community Types[5]. Chelsea, Everett, and Malden are Metropolitan Core Communities. They typically have a densely populated urban character, and minority, immigrant, and low-income residents comprise a large share of their population in comparison to other communities. Housing ranges from triple-deckers to large multifamily developments, and these communities generally have a higher share of renter-occupied housing.

On the other hand, Arlington and Melrose are characterized as Streetcar Suburbs. Development in these communities tends to be village- and transit-oriented, and the housing stock is generally a mix of single family homes, 2-4 family houses, and mid-size multifamily homes. The population is moderately diverse and typically more affluent than communities in the metropolitan core. While all of these communities are located in the Inner Core, MAPC's most dense subregion, transit accessibility is generally greater in the Metropolitan Core Communities than in the Streetcar Suburbs. The following infographic highlights demographic and transportation information about each of the five communities, as well as the Inner Core region as a whole (Figure 2). Further demographic information about each municipality surveyed is available in Appendix B.

[4] MAPC Census population estimates

[5] In order to support planning, analysis, and policy development, the Metropolitan Area Planning Council has created a classification system of municipalities in Massachusetts. MAPC has identified five basic community types across the state. The criteria used to define Community Types include land use and housing patterns, recent growth trends, and projected development patterns. The Community Type system can be used to understand how demographic, economic, land use, energy, and transportation trends affect the Commonwealth's diverse communities.
http://www.mapc.org/sites/default/files/Massachusetts_Community_Types_-_July_2008.pdf

Figure 2: Five Municipality Comparison of Demographics (source: U.S. Decennial Census, 2010 and American Community Survey, 2010-2014)
** Median household income is for Greater Boston Metropolitan Statistical Area*

Differences between the surveyed communities are also observed in how residents get to work. As Figure 3 demonstrates, the more affluent suburban communities (Arlington and Melrose) tend to have a higher percentage of workers who drive, whereas more residents commuting from the Metropolitan Core Communities utilize alternative forms of transportation.

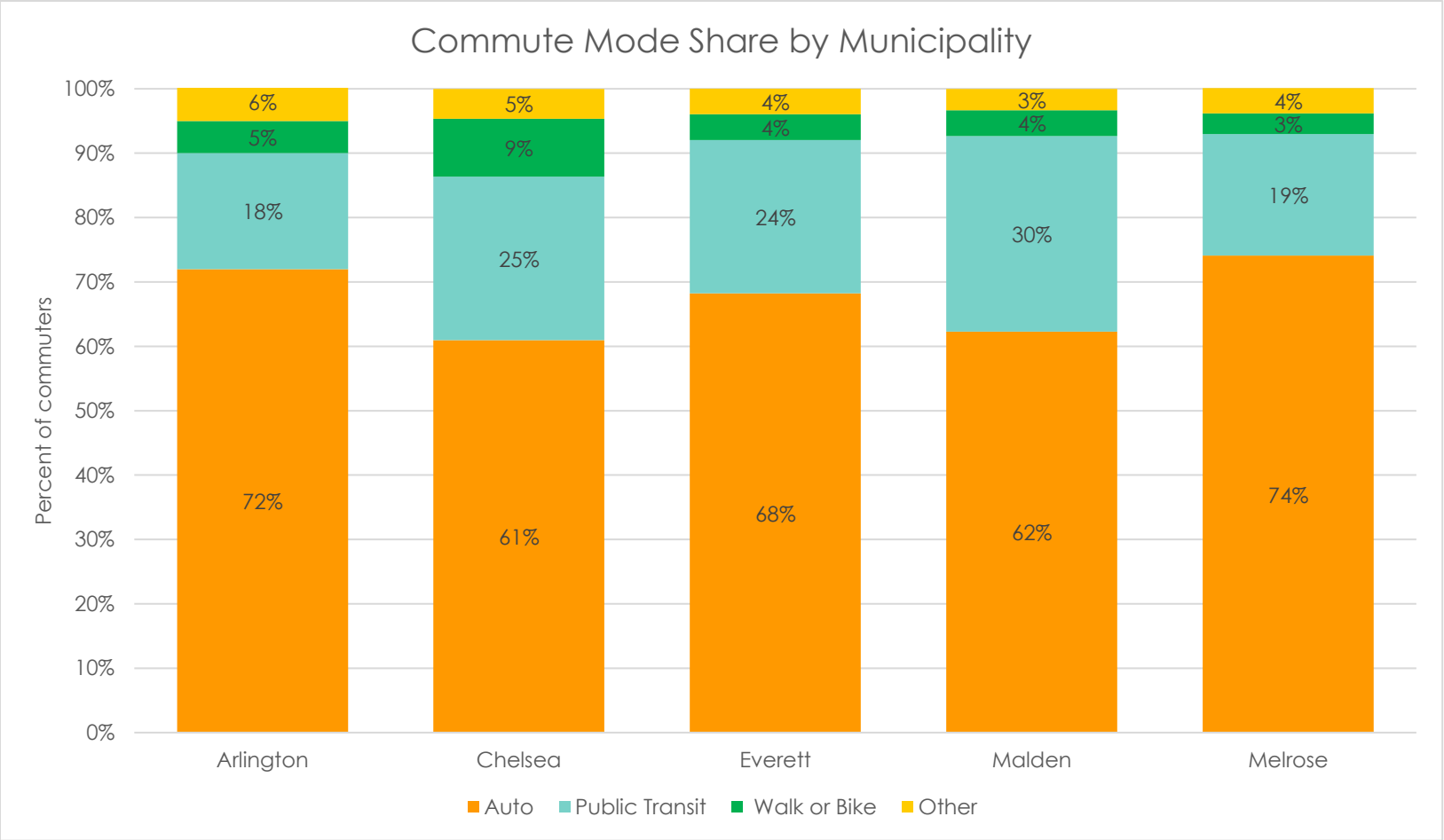


Figure 3: Commute Mode Share (Auto, Public Transit, Walk or Bike, or Other) by Municipality

Methodology

MAPC worked directly with each municipality to create a list of multifamily residential properties to be surveyed. All sites were multifamily developments with nine or more units. After all locations were identified, surveys and parking counts were used to obtain data specific information regarding each development. Finally, MAPC created a statistical model to analyze a subset of the data collected. Each step of the methodology is described below. MAPC's methodology builds on the previous work done by CNT.

Property selection: To select properties in Chelsea, Everett, Malden, and Melrose, MAPC worked with the planning department and city assessor in each municipality to identify multifamily residential developments that would qualify for the parking study. After manually filtering through the resulting developments with each municipality, MAPC was left with 396 properties to be surveyed across the four communities. A large number of the properties were lacking contact information for property management, so the sample size was reduced to 265.

For property selection in Arlington, municipal staff selected nine multifamily residential properties for the parking analysis. Developments were selected based on size, location and ownership type. Properties ranged in size from 24 to 176 units, and the types of developments varied, including subsidized and luxury, rental and condominium, and old and new developments. Across the five communities, the total of 274 properties were contacted to participate in the next steps of the data collection process.

Surveys: After the properties were selected, the property manager or owner of each development was contacted to complete a two-page survey regarding parking at their development. Questions detailed the type and number of housing units at each development, as well as the type and number of parking spaces available to residents. The survey asked further questions about parking, including whether there is a waitlist for parking, how residents can obtain additional parking beyond what is provided, if needed, and if there is anyone aside from residents that utilize parking on-site. A total of 126 surveys were completed (a response rate of 46%). A copy of the survey is available in Appendix D.

Overnight counts: Following the completion of the surveys, MAPC assessed peak residential parking utilization by conducting overnight (12:00 AM-4:00 AM) parking observations to confirm the number of parking spaces and to count the number of parked vehicles at each of the sites. Of the 126 surveyed properties, 22 properties did not provide off-street parking and 24 properties were inaccessible for overnight counts. Issues of accessibility were largely related to the lack of availability of on-site staff who could grant access to secured lots. Therefore, MAPC was able to successfully obtain occupancy information and retrieve data from 80 of the 126 properties visited overnight. Counts took place overnight on a weeknight in an effort to survey properties when it was assumed the majority of residents were home and residential parking usage rates would be at their peak. Counts in Chelsea took place in July 2015, and counts in Everett, Malden, Melrose, occurred in December 2015 and January 2016. Of the 80 properties surveyed, six were in Arlington, 20 were in Chelsea, 10 were in Everett, 25 were in Malden, and 19 were in Melrose. A map of all surveyed properties is shown in Figure 4.

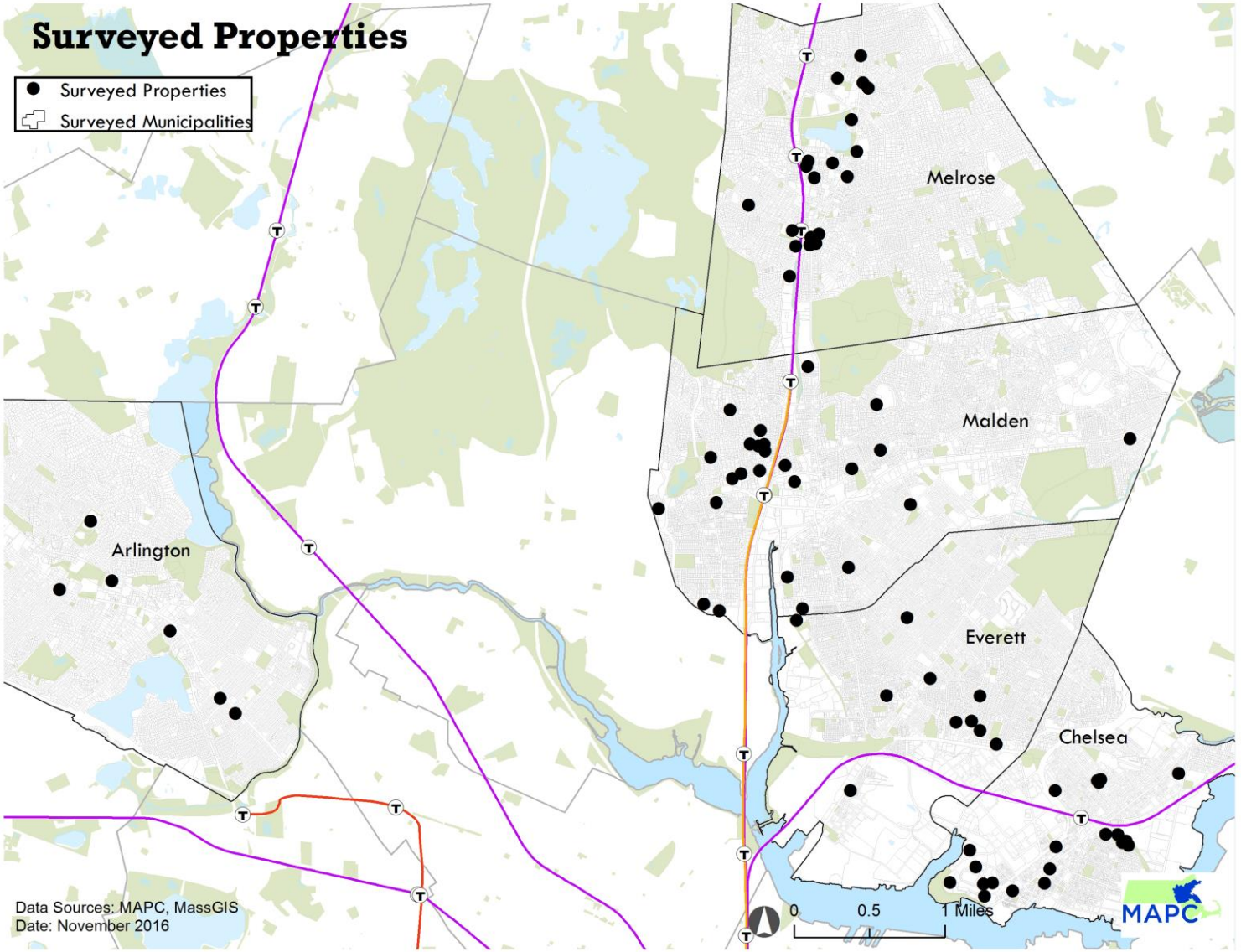


Figure 4: Location of Surveyed Properties Accessible at Time of Data Collection (N=80)

Data analysis: MAPC used the survey results to produce descriptive statistics about parking utilization, and to create a model of parking demand per unit. The key descriptive statistic is *the parking utilization rate*, which is the number of occupied spaces as a percent of all spaces on site. The statistical modeling was designed to predict *parking demand per unit*, defined as the number of occupied parking spaces per occupied residential unit. *Parking supply per unit* was also calculated for each property, defined as the number of built parking spaces per residential unit.

Estimation of the parking demand model is described in detail in the Perfect Fit Parking Initiative Phase 1 Technical Memo and is summarized here. Of the 80 properties with both overnight parking counts and property owner surveys, 11 properties were excluded from the model: seven properties had full parking lots and four sites were missing information on affordable housing units. MAPC chose to exclude properties that had full parking lots because unconstrained parking demand could not be ascertained, and the structure of the statistical model required information regarding number of affordable units for each development. Therefore, 69 observations were available for modeling. An ordinary least squares regression model was used to investigate a total of 18 building and neighborhood variables for their potential influence on the parking demand per unit. After testing several models and finding that all yielded very similar results, MAPC opted to use a simple model that controlled for affordable housing units and housing tenure (rental/ownership). This model found two variables to be strongly associated with the number of parking spaces demanded per unit: parking supply per unit and the number of jobs accessible within 30 minutes via transit.

The model created during this process will be updated in future phases as data from additional municipalities is collected. For a complete description of the parking demand model, please see the Perfect Fit Parking Initiative Phase 1 Technical Memo.

Findings

How much parking is utilized?

Prior to the modeling exercise, MAPC analyzed data from the 80 properties where overnight parking counts were conducted (including those that were full or had incomplete affordability data). The majority of properties (62) surveyed only offered surface lot parking. While 13 developments offered both garage and surface lot parking, five only offered garage parking. A total of 4,511 spaces were counted, serving 3,913 units.

Only seven of the 80 observed parking lots were fully occupied. This means that 91% of the properties surveyed had vacant parking spaces. Furthermore, only 12 of the properties surveyed had a parking utilization rate in MAPC's recommended 90-100% range. While nearly two-thirds of the properties fell within the 60-90% utilization range, 6 had a utilization rate of less than 50%. **Overall, MAPC observed a parking utilization rate of 74% across the surveyed properties, indicating that about one in four spaces counted was vacant.** Figure 5 shows the parking utilization rate for each of the 80 surveyed properties.

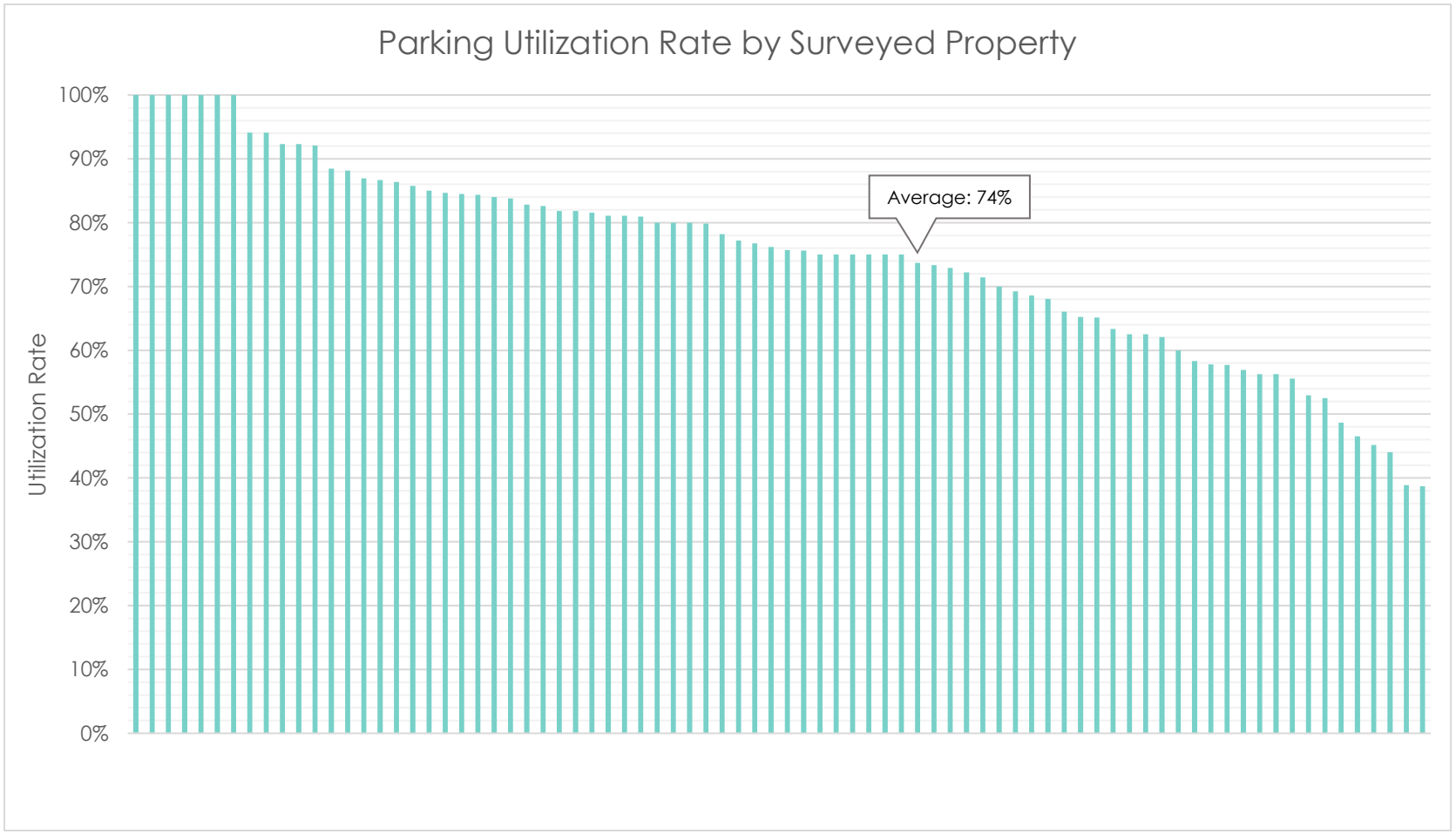


Figure 5: Parking Utilization Rate by Surveyed Property (N=80)

In order to get a sense of the scale of the amount of parking that is being constructed and utilized at each property, another key metric is the number of parking spaces supplied per residential unit. MAPC observed a range of 0.2 to 2.2 parking spaces supplied per unit, with the average being 1.15 parking spaces per unit. While approximately 31% of properties observed supply less than one parking space per unit, about 21% supplied 1.5 spaces per unit or more. Figure 6 demonstrates the range of supply.

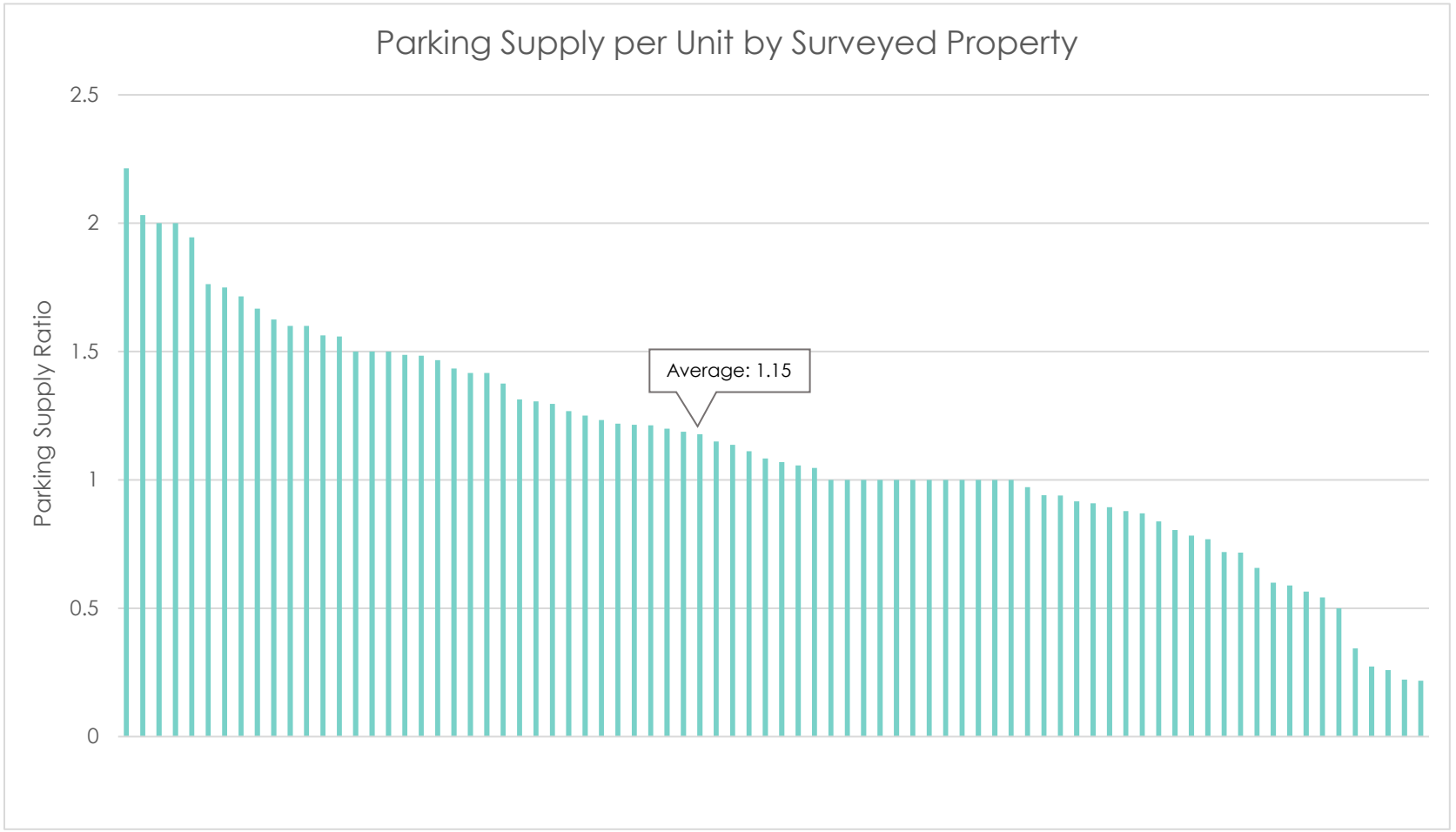


Figure 6: Parking Supply per Unit by Surveyed Property (N=80)

Like parking supply per unit, observed parking demand per unit also varied widely. Figure 7 below depicts the parking demand per unit by surveyed property. The average parking demand per unit was 0.85 and ranged from 0.2 to 1.5 spaces per unit. Despite this range in demand, all municipalities observed had an average parking supply rate of over one space per unit, while demand was generally one space per unit or less.

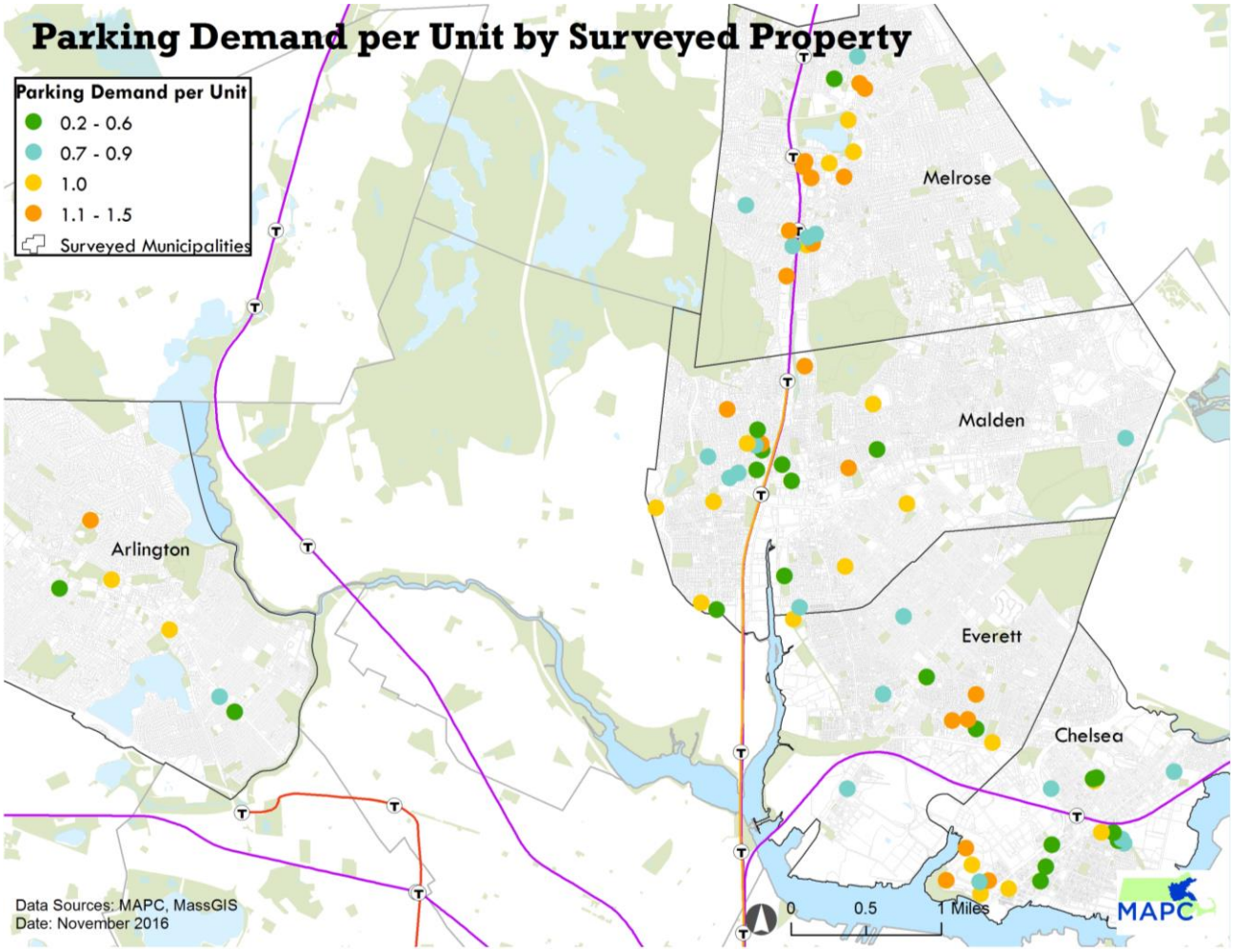


Figure 7: Parking Demand per Unit by Surveyed Property

Despite the difference in demographics, parking requirements, and rates of parking supply and demand per unit across Arlington, Chelsea, Everett, Malden, and Melrose, excess parking was found in all five communities. This trend is in line with previous parking studies conducted by other organizations, including CNT and the State Smart Transportation Initiative (SSTI).

On average, approximately one in every four parking spaces observed were unused, resulting in approximately 1,200 vacant parking spaces. Furthermore, there were 17 sites where supply exceeded demand by 0.5 to nearly 1 parking space per unit. Figure 8 demonstrates this excess parking phenomenon.

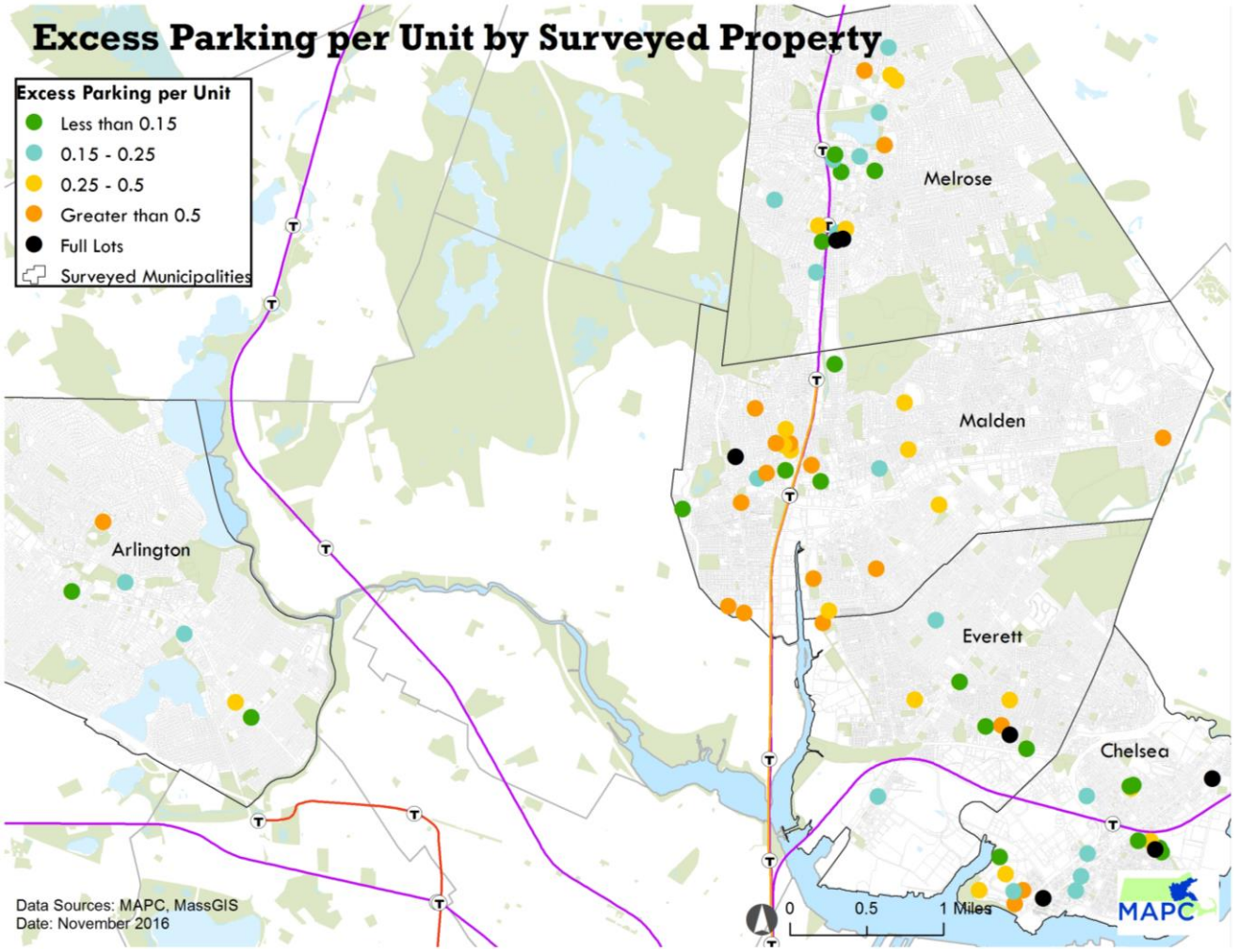


Figure 8: Excess Parking per Unit by Surveyed Property

Although to varying degrees, the construction of excess parking occurs in all five municipalities surveyed. The prevalence of excess parking is perpetuated by a discrepancy between the amount of parking required, supplied, and utilized. Table 1 demonstrates how despite the variation in these metrics across the five municipalities, excess parking is a universal issue.

	Parking Requirements[6]	Average Parking Supply per Unit	Average Parking Demand per Unit	Utilization Rate
Arlington	1.15 spaces per unit	1.40	1.04	74%
Chelsea	1.5 spaces per unit	1.05	0.81	76%
Everett	2 spaces per unit	1.14	0.80	71%
Malden	1 space per unit	1.09	0.73	67%
Melrose	2 spaces per unit	1.23	1.00	81%

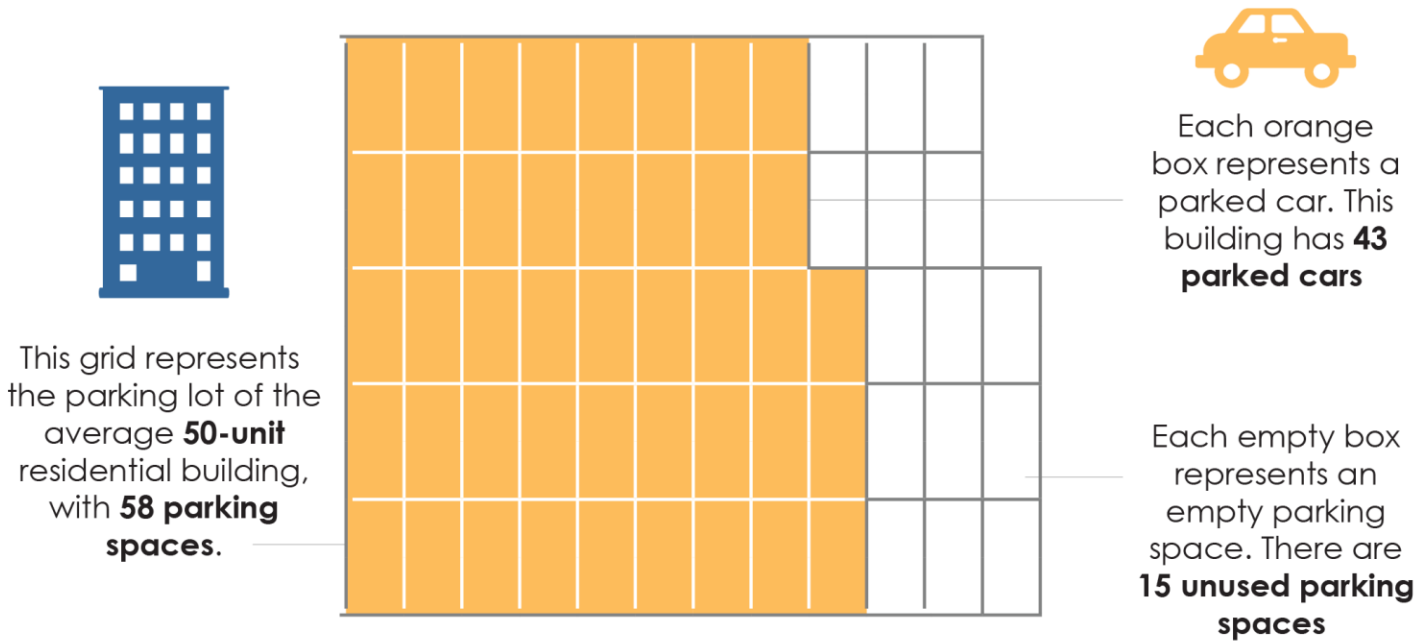
Table 1 Parking Required, Constructed, and Utilized by Municipality

While in several municipalities the average amount of parking supplied was still below the amount of parking required, parking demand per unit was still consistently below parking supply per unit. Figure 9 demonstrates the relationship between parking demand per unit, parking supply per unit, and the parking utilization rate at a single development. These descriptive statistics collectively informed the statistical analysis that explored the factors that drive parking demand in the first place.

[6] The parking requirements assume all units are one-bedroom. Arlington and Malden have different requirements per unit depending on the number of bedroom. Malden requires 1 space per bedroom, while Arlington requires the following: 1 space per studio, 1.15 spaces per one-bedroom, 1.5 spaces per two-bedroom, and 2 spaces per three-bedroom.

PARKING PATTERNS

Across five municipalities, the average residential building has about **50 units** and **58 parking spaces.**



The average lot is 74% full

Figure 9: Summary Graphic of Observed Parking Patterns

What factors influence parking demand?

To provide a more robust basis for smart parking policies, MAPC created a statistical model to evaluate what building and neighborhood characteristics predict parking demand. As described previously, this method was based on survey results for 69 properties that had less than 100% utilization and complete information about housing affordability. The model identified what building and neighborhood characteristics potentially influence the amount of parking demanded per residential unit. The model found that, of the 18 variables tested, **parking supply per unit and job accessibility were the two most significant factors associated with parking demand per unit.** Figure 10 demonstrates the relationship between parking supply per unit and parking demand per unit.

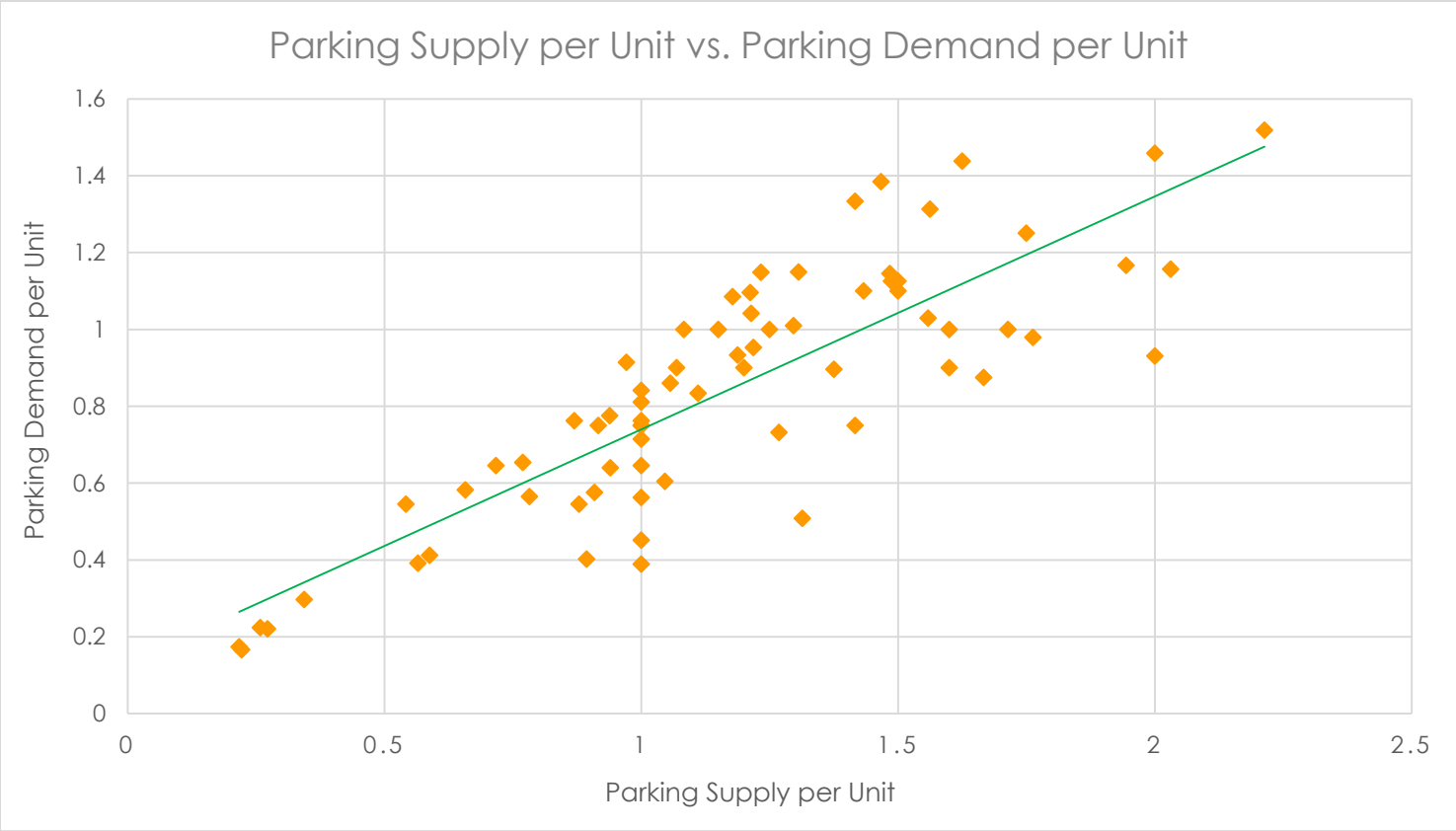


Figure 10: Parking Supply per Unit vs. Parking Demand per Unit (N=69)

Parking supply per unit was by and large the dominant factor associated with parking demand per unit, accounting for nearly 71% of the variation per unit. The correlation between parking supply and parking demand was positive, indicating the more parking supplied per unit, the more parking demanded per unit. Parking demand per unit was more modestly influenced by the neighborhood's job accessibility, as measured by number of jobs accessible by transit within 30 minutes. **As jobs accessibility increases, parking demand per unit decreases.** Job accessibility by transit accounted for nearly 26% of the variation in the parking demand per unit (Figure 11).

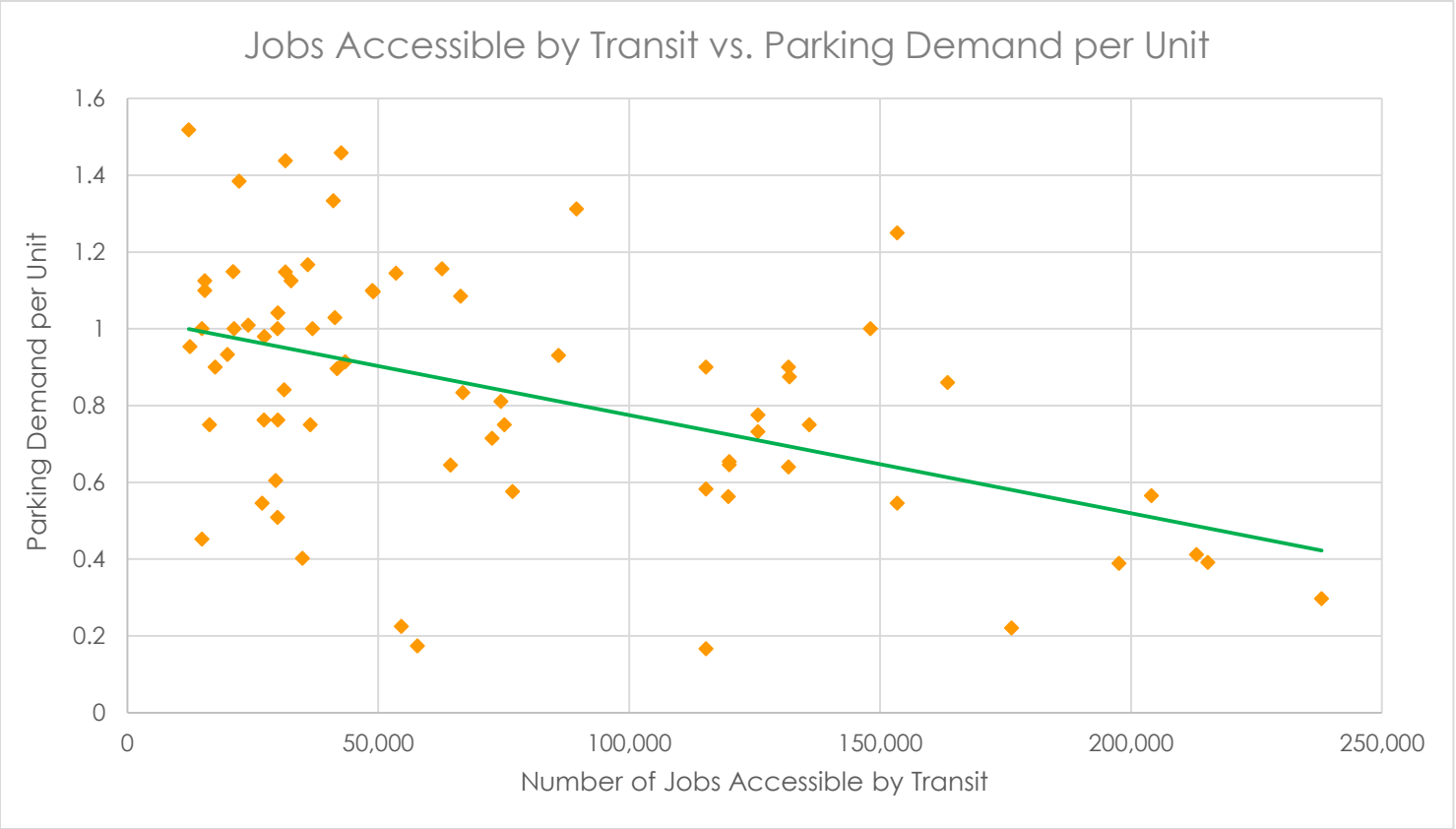


Figure 11: Job Accessibility by Transit vs. Parking Demand per Unit (N=69)

Parking supply as the driver of parking demand demonstrates that communities have the opportunity to shape future development patterns by implementing parking requirements that are better aligned with actual parking utilization. A data-driven approach to modifying parking requirements and instituting smart parking policies can not only reduce the amount of excess parking constructed, but can also reduce development costs and make additional land available for more productive uses.

Limitations

While the data collection and the data analysis were robust and thorough processes, there are inevitably some limitations to this methodology and these findings. Reaching property managers and owners proved to be challenging across the five municipalities. For the data collection in Arlington, municipal staff served as a liaison between MAPC and the property managers and owners, which helped increase response rates. However, some information was still difficult to obtain from property management, particularly with regard to rent and purchase price. While MAPC explored a variety of proxies for this information, none proved to be reliable data.

Another significant obstacle to a more complete dataset was the property accessibility. Twenty-four properties surveyed did not have accessible parking lots, with secured parking garages comprising the majority of this number. Given that about one-fifth of the surveyed properties were not accessible to MAPC staff, this challenge will need to be addressed as additional data collection moves forward. MAPC will continue to refine its data collection method to ensure these gaps in information are minimized in the future.

Finally, MAPC's Phase 1 model findings are consistent with the theoretical framework used and with previous research done by others. However, there is a lack in consensus on the factors that drive demand for parking utilization, and there are few studies that attempt to model parking utilization.[7] Therefore, these findings will serve as a preliminary platform for discussion as MAPC continues to explore additional building and neighborhood factors that may influence parking demand per unit.

[7] "Right Size Parking Final Report," King County Metro.

Discussion

The findings illustrate how, across the five communities, **more parking is supplied than is demanded**. Among the 80 properties surveyed, the overall parking utilization rate was 74%. For residential developments, MAPC recommends that parking during peak utilization times should reach 90-100%. Furthermore, on average, 1.15 parking spaces are provided per unit when only 0.85 parking spaces per unit are utilized. This prevalent and substantial oversupply of parking indicates that all five study area municipalities would benefit from parking strategies that better align parking supply with demand. However, parking is a particularly context-specific issue. MAPC also found that neighborhood transit access measured by the number of jobs accessible by transit within 30 minutes may influence the need for parking. Therefore, multifamily buildings with good transit access may require even less parking per unit.

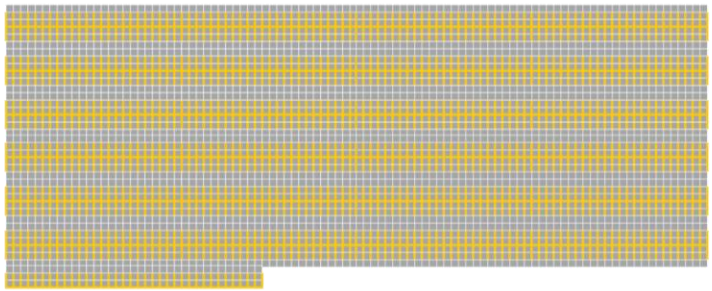
Left unchecked, this disparity between the amount of parking supplied per unit and the amount demanded per unit leads to the construction of excess parking and more congested roads[8]. Rather than use this space for parking, this valuable urban land could instead be put to more productive and beneficial uses. This includes the development of open space, affordable housing, or other uses that would potentially provide a higher tax base. Figure 12 below illustrates the potential alternatives for all of the excess parking spaces counted during the overnight observations.

[8] Donald C. Shoup, "The Trouble with Minimum Parking Requirements," *Transportation Research Part A: Policy and Practice* 33, no. 7–8 (September 1999): 549–74, doi:10.1016/S0965-8564(99)00007-5.

Oversupplied = Lost Opportunity

EXCESS PARKING SPACES

In Arlington, Chelsea, Everett, Malden, and Melrose combined, MAPC observed 1,187 unused parking spaces. This means that for every 10 housing units in the surveyed buildings, there are, on average, 3 excess parking spaces.



1,187 unused parking spaces

356,100 sq ft of empty space

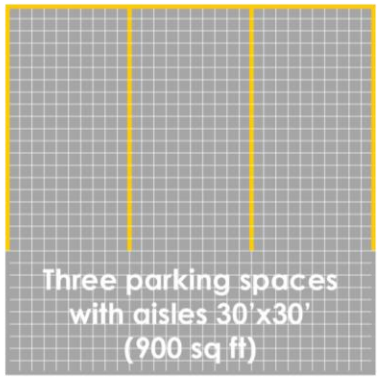
$11,870,000 in unnecessary construction

At 300 square feet per parking space, that translates into 356,100 square feet of unused space and, with construction costs at $10,000 per surface lot parking space, $11,870,000 of unnecessary spending.

HOUSING AND OPEN SPACE

Overbuilt parking spaces observed in Arlington, Chelsea, Everett, Malden, and Melrose could instead be used to build 427 2-bedroom housing units or 8 acres of parks, playgrounds or open space.

900 square feet of space could be used for:



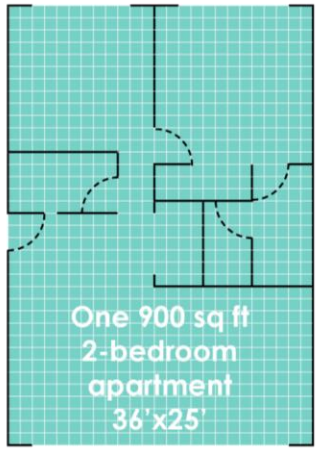


Figure 12: Implications of Excess Parking

Fortunately, swathes of valuable urban land relegated to serve as excess parking is not inevitable. There are several strategies communities can implement to ensure that the amount of parking provided is informed by the amount of parking demanded. Given that the statistical model revealed parking supply to be the primary driver of parking demand, and that excess parking was found in all communities surveyed, the following section offers several strategies that are specifically tailored around reducing parking oversupply.

Parking Supply Reduction Strategies

As the trends toward less vehicle ownership and less driving continue, parking requirements must be reevaluated in order to limit the amount of land that is dedicated to parking that will go unutilized. While several communities have already taken steps to better align the amount of parking supplied and demanded at multifamily developments, MAPC has determined excess parking to be a widespread occurrence. Fortunately, there are several tools and resources available to communities that are looking to reevaluate their municipal parking policies and further avert the construction of excess parking. Below is a list of strategies to accomplish that goal:

Reduce minimum parking requirements. Reducing the amount of parking that developers are required to build is perhaps one of the most fundamental ways to reduce the amount of parking supplied. This still allows developers to have the option to build above the designated minimum, but developers are not forced to construct a minimum number of spaces that is far beyond what is actually demanded. One place to start may be to implement reduced parking requirements for some of the municipality's most walkable and transit-oriented districts. In April 2016, the Town of Arlington voted to reduce minimum parking requirements in some districts downtown, and the City of Melrose approved a similar zoning amendment in their downtown and around three commuter rail station areas at about the same time.

Implement maximum parking requirements. In some cases, it may make more sense to manage parking supply by instituting a parking maximum rather than a parking minimum. Parking maximums give the municipality greater control over the amount of spaces constructed, and can be used in conjunction with a parking minimum. This is already being done some communities; the City of Chelsea's Smart Growth Overlay District has a parking minimum of 1.25 spaces per unit, and a parking maximum of 2 spaces per unit.

Eliminate minimum parking requirements. Eliminating parking requirements allow developers more discretion in determining the appropriate amount of parking for multifamily developments. Like maximum parking requirements, eliminating requirements altogether opens up the possibility of no-parking developments. Given this prospect, eliminating minimum parking requirements may be most useful in a transit-oriented neighborhood, assuming fewer resident will rely on cars in this setting.

If the multifamily development is within a mixed-use building, utilize shared parking between customers and residents. By not numbering spaces or tying spaces to specific units, commercial users can utilize parking spaces during the day, and residents can park at night, which allows for a more efficient use of the lot. The City of Chelsea has a similar system already in place. A similar way to manage existing supply more efficiently is to allow for municipal parking located within a given distance of a development to count toward a required parking minimum.

In addition to these strategies aimed at reducing supply, there are actions communities can take to reduce the burdens of existing excess parking on their residents. The following recommendations are general strategies all communities can take beyond amending the municipality's zoning bylaw.

Unbundle parking from rental cost or purchase price. By separating the cost of the parking from the cost of housing, residents who do not need parking do not have to pay for an amenity that they will not utilize. This could be done for all parking spaces, or, if one space per unit is ultimately included in rent or purchase price, property owners and managers could require residents to pay for additional spaces. Unbundling helps keep housing costs affordable, particularly for residents who do not have vehicles. Alternatively, property owners and managers could opt to "reverse bundle," or offer residents a discount on their rent or purchase price if they do not need a parking space and parking is included.

Consider a fee in lieu of parking for developers that wish to construct less parking than is prescribed by zoning. This provides developers with the option to pay into a municipal fund if they wish to construct fewer spaces than are required. For example, the Town of Needham requires developers that construct buildings within certain districts pay a one-time fee to the Needham Center Off-Street Parking Fund if they construct fewer spaces than required, and the fee per space increases proportionally with the number of spaces not constructed.

Encourage the use of car-sharing services, such as Zipcar, through carsharing credits. Carsharing credits allow for developers to use the construction of a single carsharing space to count for multiple residential parking spaces

Conclusion

The appeal of these strategies is that they are intended to be flexible and easily tailored to the unique challenges and opportunities in each community. To continue learning more about what other approaches could be most effective in addressing significant mismatch between parking supply and demand, MAPC will extend its data collection efforts in additional communities within the Inner Core, particularly those which are more walkable, bikeable, and transit-accessible. This will allow MAPC to refine its methodology and create an even more robust statistical model. Surveying more communities will extend the applicability of MAPC's findings, and help create more context for when certain factors will be more influential than others. Ultimately, this information will be utilized to create an online tool that communities can utilize to better predict parking demand and help inform parking requirements. Below is a description of the tasks that follow and an approximate timeline for Phases 2 and 3.

Phase 2: November 2016-June 2017

- Collect data in additional Inner Core communities, including Boston, Cambridge, Somerville, and Quincy
- Refine statistical model using additional data

Phase 3: June 2017-June 2018

- Continue to collect data in other communities interested in data-driven parking policies
- Use data and model to create online tool that provides comparable data and recommended parking strategies

While there are slew of strategies available to municipalities looking to reduce excess parking, our findings suggest that parking demand is, to a significant extent, influenced by abundant parking supply. Limiting the amount of parking at multifamily residential developments may both reduce costs and increase development potential, while also encouraging more households to live in the neighborhood without owning a vehicle, therefore contributing to more sustainable transportation, a healthier local economy, and better urban design. By using zoning and other tools to generate a parking supply that is better aligned with actual demand, municipalities can foster the development of more walkable, transit-oriented, and inclusive communities.

Appendix A: The Problem with Excess Parking

Excess parking carries a wide range of economic and environmental burdens. Constructing parking beyond what is demanded can pose several barriers to the development of dense, walkable communities. Some of these barriers are described below:

Encourages more driving. First and foremost, studies have shown that excess parking can actually cause more driving. Researchers have found that an increase from 0.1 to 0.5 parking spaces provided per resident corresponds with a 30% increase in commuter automobile mode share.[9] In CNT's analysis of data collected for the Washington D.C. Park Right Calculator, parking supply was found to be the variable that correlates the most with parking utilization, with parking supply accounting for 66% of the variation in observed utilization.[10]

Another study compared vehicle commuting mode share between residents of Jackson Heights, Queens, and Park Slope, Brooklyn. Despite the fact that neighborhood indicators predicted a higher vehicle mode share in Park Slope, Jackson Heights residents were 28% more likely to commute to work by car.[11,12] One notable difference between the communities was the availability of off-street parking—37% of Jackson Heights residents who owned vehicles had access to off-street parking, compared to 14% in Park Slope.[13] Although there are likely a variety of factors that collectively influence transportation decisions, it is clear that the availability of parking is one of the primary considerations.

Contributes to environmental degradation. Parking's role in putting more cars on the road also has significant environmental implications. The Environmental Protection Agency estimates that 60% of the transportation sector's greenhouse gas (GHG) emissions come from light duty vehicles, which include passenger cars, SUVs, and minivans.[14] While there are several determinants of driving patterns, parking expert Donald Shoup argues that minimum parking requirements increase the amount of land area set aside for parking, and subsequently, allow for more cars to create more traffic congestion.[15]

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[9] Chris McCahill et al., "Effects of Parking Provision on Automobile Use in Cities: Inferring Causality," *Transportation Research Bureau,* November 2015, http://www.ssti.us/wp/wp-content/uploads/2016/01/TRB_2016_Parking_causality_TRB_compendium.pdf.

[10] Jonathan Rogers et al., "Estimating Parking Utilization in Multi0Family Residential Buildings in Washington, D.C.," *Transportation Research Bureau*, November 13, 2015, http://www.cnt.org/sites/default/files/publications/DR1_TRB_DC%20Multifamily%20Parking%20Utilization.pdf.

[11] Rachel Weinberger et al., "Guaranteed Parking – Guaranteed Driving: Comparing Jackson Heights, Queens and Park Slope, Brooklyn Shows That a Guaranteed Parking Spot at Home Leads to More Driving to Work." (Prepared for Transportation Alternatives, October 2008).

[12] Neighborhood indicators include income, car ownership, and vehicle and transit commuting times to the Central Business District.

[13] Ibid, 7.

[14] U.S. Environmental Protection Agency, Office of Air and Radiation, "Fast Facts on Transportation Greenhouse Gas Emissions," Overviews and Factsheets, accessed November 3, 2016, https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions.

[15] Donald C. Shoup, "The Trouble with Minimum Parking Requirements," *Transportation Research Part A: Policy and Practice* 33, no. 7–8 (September 1999): 549–74, doi:10.1016/S0965-8564(99)00007-5.

If there are more single-occupant vehicles on the road, this not only implies greater traffic congestion and higher GHG emissions, but also means fewer people utilizing more sustainable travel options, such as public transit, walking, and biking. This serves as a barrier to the Commonwealth's mode shift goal of tripling the share of trips taken by walking, bicycling, or public transit. Even parking lots themselves can have a negative environmental impact, with large expanses of pavement dedicated to parking contributing to the heat island effect and impeding sustainable stormwater management practices.

Serves as a barrier to dense, walkable development. In addition to the environmental toll of more single-occupant vehicles on the road, there are significant financial burdens associated with the over-construction of parking. Setting aside the cost of land acquisition, paving and striping, and engineering work required for proper drainage, parking construction costs alone can hinder development. Parking structure construction costs in the Boston area are above the national average, with the average parking structure costing approximately $75 per square foot per space, or $22,500 per space, to construct.[16,17] Construction costs are lower for surface lot parking; generally, surface parking lots comprise about 10% of total development costs, and on average cost about $10,000 per space to construct.[18] Developers interviewed for a parking study in Chicago indicated that developments typically do not fully recoup the full cost of constructing and maintaining parking lots, regardless of whether or not parking is included in rent or purchase price.[19]

Sometimes, the cost of constructing parking as prescribed by parking requirements can prevent development altogether. Michael Manville and Donald Shoup found that in Los Angeles, the parking requirements were so restrictive that buildings would have to be partially demolished in order to comply with the City's regulations.[20] Given the greater Boston area's increasing demand for housing, reducing the burden on developers by creating data-driven parking requirements can encourage housing production by decreasing construction costs and supporting future development in high density regions with good transit accessibility.

[16] "Rider Levett Bucknall, "USA Report: Quarterly Construction Cost Report, Fourth Quarter 2015," 2015, http://rlb.com/wp-content/uploads/2016/01/rlb-usa-report-fourth-quarter-2015.pdf.
[17] Assumes that parking spaces and associated aisle space are approximately 300 square feet.
[18] Victoria Transport Policy Institute, "5.4: Parking," in *Transportation Cost and Benefit Analysis: Techniques, Estimates and Implications*, 2nd ed., 2016, http://www.vtpi.org/tca/tca0504.pdf.
[19] Center for Neighborhood Technology, "Stalled Out: How Empty Parking Space Diminish Neighborhood Affordability," March 2016, http://www.cnt.org/sites/default/files/publications/CNT_Stalled%20Out_0.pdf.
[20] Michael Manville and Donald C. Shoup, "Parking Requirements as a Barrier to Housing Development: Regulation and Reform in Los Angeles," *University of California Transportation Center*, February 1, 2010, http://escholarship.org/uc/item/1qr84990.

Disproportionately burdens low-income populations. Excess parking also takes away resources that could otherwise be allocated to other uses that have a more direct benefit to the public good, particularly the construction of affordable housing. According to a 2014 study, two parking spaces per unit can increase the cost of affordable housing construction by approximately 25%.[21] This means that in the greater Boston area, where the average construction cost for a 1,600 square foot development is around $254,000, a requirement of two parking spaces per unit could drive up costs by nearly $64,000.[22] With funding for affordable housing already scarce, these additional costs may make the construction of affordable housing cost-prohibitive.

Furthermore, passing the cost of constructing parking onto residents through rent or purchase price disproportionately impacts low-income populations. Since low-income individuals tend to spend a larger proportion of their earnings on housing and transportation than those in higher income brackets, bundling the cost of parking with the rent or purchase price has considerable equity implications. Additionally, those living in affordable units tend to drive less frequently and instead rely on alternative modes of transportation, meaning they are even more likely to be paying for parking that they will not utilize.

[21] Todd Litman, "Parking Requirement Impacts on Housing Affordability" (Victoria Transport Policy Institute, August 24, 2016), http://vtpi.org/park-hou.pdf.
[22] "The Greater Boston Housing Report Card 2015: The Housing Cost Conundrum" (The Boston Foundation, November 2015), https://www.tbf.org/~/media/TBFOrg/Files/Reports/GB%20HousingReportCard%20111315.pdf.

Appendix B: Demographics and Parking Policies in Surveyed Communities

	% population ages 18-34	% population non-Hispanic white	Median Household Income	% Housing Units that are Renter-Occupied
Arlington	18%	84%	$92,340	39%
Chelsea	31%	25%	$48,730	72%
Everett	27%	54%	$51,060	61%
Malden	28%	53%	$55,520	59%
Melrose	18%	90%	$86,410	33%
Inner Core Subregion	34%	59%	$74,670[23]	56%

	Arlington	Chelsea	Everett	Malden	Melrose
Reductions near transit				X	X
Smart growth overlay		X	X		X
Affordable/senior housing reduction		X	X	X	X
Sliding scale	X			X	
Use public parking to count toward minimum	X			X	
Parking maximums		X			

[23] Median household income is for Greater Boston Metropolitan Statistical Area

Appendix C: Parking Requirements in Surveyed Communities

Arlington: The parking requirements for multifamily developments are as follows: 1 spaces per studio, 1.15 spaces per one-bedroom unit, 1.5 spaces per two-bedroom unit, and 2 spaces per three-or-more-bedroom units. At Town Meeting in April 2016, the Town passed a zoning bylaw amendment that would allow for a reduction in parking requirements for multifamily development in some of the most dense residential and mixed-use business districts. Developers that take advantage of this reduction must complete a transportation demand management plan. It should be noted that Arlington does not permit on-street parking for more than one hour from 1am to 7am

Chelsea: Chelsea requires 1.5 parking spaces per dwelling unit in multifamily buildings. Exceptions are made for developments in the Waterfront District, which require 2 parking spaces per unit, and in the Naval Hospital Development-Residential (NHR) district, which requires one space per unit. The zoning ordinance requires an additional .5 space for every bedroom in excess of two in any unit. There are also exceptions made for multifamily dwellings constructed in the R-3 district, which is intended for high-density, multifamily housing development.

Some of the properties surveyed for this study were located in the Retail Business zoning district. In the Retail Business district, the first 5,000 square feet of usable gross floor area in nonresidential use is exempt from the parking requirement. For developments that are constructed for two or more distinct purposes, the zoning ordinance has created a system of parking credits that help discern the parking minimum based on anticipated parking utilization during five different time periods.

The City of Chelsea has already taken steps toward creating more context-specific parking requirements. The City created the Gerrish Avenue Smart Growth Overlay District (SGOD), which is intended to promote compact design, the preservation of open space, and increased production of a diversified housing stock. Here, multifamily dwelling units are permitted by right, and a minimum of 20% of the housing units constructed must be affordable. There is a parking minimum of 1.25 spaces per unit, but also a parking maximum of 2 spaces per unit.

Everett: The City of Everett zoning ordinance requires two parking spaces per unit for multifamily dwellings. An exception is made for public assisted elderly and handicapped housing, where the parking requirement is 0.5 spaces per unit. If there is more than one use in a building, the amount of parking required is based on the sum of the required spaces for each use. Following the adoption of the Lower Broadway Master Plan, the City created the Lower Broadway Economic Development District, which is intended to encourage high-density, mixed-used development and support the economic revitalization of Lower Broadway. For multifamily dwelling constructed in the LBEDD, parking requirements are one space per one bedroom unit and two spaces for each unit with two or more bedrooms, and the parking minimum may be reduced by up to 25% if it can be demonstrated that fewer parking spaces will not contribute to more traffic or endanger public safety in any way.

Malden: In Malden, multifamily developments must be constructed with one parking space per bedroom. However, the zoning ordinance states that the requirements can be reduced to 1.5 spaces per unit if the development is construction within 1,000 feet of a rapid transit or train station, and if the Planning Board determines decreasing the parking requirements will harm the public good or the surrounding neighborhood. If the residential development is located within a building with multiple uses, the amount of parking provided should be equal to the sum of the required parking for each use.

In the Central Business District, the parking requirement for all allowed residential uses is 1.5 parking spaces per unit. If the property is located within 2,000 feet of the property line of an MBTA rapid transit or train station, the requirement is reduced to 1.25 spaces per unit. If the property is located within 1,000 feet of the property line of an MBTA rapid transit or train station, the requirement is reduced to 0.75 spaces per unit. Additionally, if the property is within 400 feet of a City of Malden public parking facility, the parking requirement may be reduced further.

Melrose: The City of Melrose requires two parking spaces per unit for multifamily developments, with several exceptions. For multifamily developments that contribute affordable units, the Planning Board has the discretion to permit a parking reduction to 1.5 spaces per unit. Additionally, Melrose has several districts that permit the construction of multifamily dwellings with modified parking requirements. The Rail Corridor Overlay District, which runs along the Melrose Cedar Park Commuter Rail station, requires one space per dwelling unit. The Smart Growth District also has lower parking requirements for multifamily developments—one space per one bedroom unit, 1.5 spaces per two bedroom unit, and two spaces per three or more bedroom unit. The Smart Growth District applies to parcels on lower Washington Street in the Industrial-A district.

The City has also recently undergone some more comprehensive zoning reform that has led to reduced parking requirements within existing districts in close proximity to transit. The City recently rezoned the areas surrounding three commuter rail stations in the municipality to Business and Residential Mixed Use (BA-2), which is a type of zoning intended for transit-oriented, mixed use development. This amendment also reduced the parking requirements for multifamily dwellings in the General Business (BA-1) and BA-2 districts to be one space per dwelling unit. The Planning Board has the authority to permit shared or reduced parking requirements in the BA-1 and BA-2 districts if evidence supports that less parking is needed.

Appendix D. Property Owner/Property Manager Survey

METROPOLITAN AREA PLANNING COUNCIL: Residential Building Parking Study

DATE:	PROPERTY DEVELOPMENT:	ONSITE PARKING:

The Right-Size Parking Project is being conducted by the Metropolitan Area Planning Council, (MAPC), in partnership with the Cities of Chelsea, Everett, Malden and Melrose. This 2-page survey is about the types and amounts of parking provided for your building. The purpose of this survey is to assist these cities in determining how much parking is needed for new residential buildings. Your participation is voluntary and the survey should take about 10 minutes to complete. Please contact Kasia Hart by phone (617-933-0745) or email (khart@mapc.org) for further information.

SECTION 1 SITE CONTACT

1	Building name	
2	Address	Street: City: Zip:
3	Building manager	Company: Contact person: Title: Phone: Email:
4	☐ Check the box to receive periodic notifications on the project by email.	

SECTION 2 OCCUPANCY

			Studio	1 Bedroom	2 Bedroom	3+ Bedroom	TOTAL
1	Number of units by type						
2	Current number of vacant units						
3	Average cost	Monthly rent					n/a
		Purchase price					n/a
4	Number of subsidized units by type (Section 8, Rental Voucher or other program subsidy with a deed restriction)		Studio	1 Bedroom	2 Bedroom	3+ Bedroom	TOTAL
	Number of rentals						
	Number of condos						

5	Is your building rental, condo or both? Indicate the property split by unit type (If unit type is not present, write "0")	Rental		Condo	
		# of units		# of units	

METROPOLITAN AREA PLANNING COUNCIL: Residential Building Parking Study

DATE:	PROPERTY DEVELOPMENT:	ONSITE PARKING:

SECTION 3 PARKING

1	How many spaces are reserved for residents? (write "0" if type not present)	Surface lot	Garage	Bicycle	Scooter/ Motorcycle	
2	Is vehicular parking included in resident's monthly rental cost or the purchase of a condo?	Rental (yes/ no)	Number of spaces provided per unit:			
		Purchase (yes/ no)	Number of spaces provided per unit:			
3	If parking is not included as part of rent or ownership, what is the per-month cost to residents for a parking space? (If there is no cost, write "0")	Monthly cost				
4	Can a resident save money if they have a car but choose not to park onsite? (yes/ no)					
5	If a resident wants additional parking above and beyond what is included in residential costs or what they currently pay a monthly fee for, how are additional spaces assigned? Please check all boxes that apply. ☐ Spaces are first come, first serve ☐ If a unit requests a parking space, they must pay for each space separate from the rental or purchase price of the unit ☐ Other, specify:					
6	Is there a waitlist for residential parking spaces? (yes/ no)					
7	In addition to residential parking, does facility reserve space for other uses? If yes, indicate what the breakdown is below. (write "0" if type not present) (yes/ no)					

Parking Type	Commercial	Management	Handicapped	Car sharing	Other
Amount of spaces					

8	Does the facility lease and/ or allow non-residents to use parking? (yes/ no)						
	If yes, how many spots and which type of user is parking leased or opened to? (write "0" if type not present)						
	Nearby Residents/ Residential properties		Nearby businesses		City government		Other, specify
9	Do you think there are residents with cars who are parking off site? (yes/ no)						
10	Are there any recurring comments or complaints you hear from residents about parking in/around the facility? (Please list comments below) (yes/ no)						

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