An Overview of Halifax, Nova Scotia's Rental Housing Market

By

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Undergraduate Honours Thesis

A thesis submitted in fulfillment of the
requirements of GEOG 4526
for the degree Bachelor of Arts (Honours)

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August 18, 2022

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ABSTRACT

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Halifax, Nova Scotia is experiencing a major rental housing affordability and availability issue. Many Haligonians are under increasing financial pressure, posting their complaints via online forums and on social media concerning the increasing living costs. In response the Provincial Government imposed a rent cap, limiting annual increase to 2% and preventing "renovictions". The goal of this research is to look at the rental market across the Halifax Regional Municipality (HRM) exploring the geography of rental unit characteristics and prices. Using web scraping techniques on Kijiji and collecting data from local developers' websites the study employs a comprehensive dataset of up-to-date rental housing information in the HRM. Analysing the database in GIS software shows high unaffordability throughout the North end of Halifax's urban core and a lack of rental amenities available to those living inside the urban core. The second part of this study dives into the difference between primary and secondary rental housing in the HRM, observing secondary rental housing while being more expensive offer greater amenities than primary rental housing.

August 18, 2022

ACKNOWLEDGMENTS

I would like to express my deepest gratitude to Dr. Mathew Novak and Dr. Grek-Martin for their help on this thesis for both their patience and feedback during the research process.

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Chapter 1

Introduction

Recently, Halifax is seeing rising issues concerning the availability and affordability of rental housing. The city's population continues to grow while housing stock fails to keep pace. Multiple protests took place about affordable rental properties throughout 2020 and 2021, with participants expressing their worries of being able to afford a home and some expressing they may have to leave Halifax and Nova Scotia due to the high cost of living. As a result of the protests, along with the stresses brought on by the global Covid-19 pandemic, the Provincial Government enacted 2% rent control measure along with making it much more difficult for landlords to terminate leases due to renovations – commonly known as "renovictions". The success of these measures in question , $1500 a month for a unit is now considered affordable and Halifax continues to have the lowest vacancy rates relative to the rest of Canada at 1.9% (Palmeter, 2021; Walton, 2021; Seguin, 2021; Ndoro, 2021). It is safe to say affordable renting has become a hot topic within the city of Halifax, affecting many in the city on nearly everyone'mind even if they are not renters.

A major problem in the ongoing debate of affordable rental housing is the lack of current information the on the rental landscape of Halifax. Currently, the only sources of information available to the public is on a piecemeal basis through browsing rental listings or basic averages and medians provided by third party rental advertisements, such as *Zumper* (2022). The yearly CMHC rental market report consists of surveying urban populations of over 10,000; however, it does not cover the entirety of Halifax, while limiting data on pricing for buildings containing

three or more units (Ndoro, 2021). All these existing sources of information leave a lot to be desired in informing the citizens and policymakers of Halifax what exactly the rental market looks like.

The lack of information in this situation can be problematic as it leaves people with little information about the complete landscape of Halifax, leaving a reliance on news reporting, online forums, or family and friends. As a result, the population is left with an incomplete look of what Halifax's city trends are in terms of rental housing. For everyone to have a better understanding of how the rental market of Halifax we need to use more resources available such as online data, surveys, and discussions with developers and landlords to paint a better picture of what really is going on the city.

While a complete deployment of the aforementioned sources is beyond the scope of this research project, this thesis exploits online rental housing advertisement data. Online buying, selling is facilitated through, large websites such as Amazon, Craigslist, eBay, and Kijiji. Not only can one buy household essentials online, but people are also able to look into buying a house or renting housing all from the comfort of their computer or smartphone. The online marketplace that will be used in this research project is Kijiji.ca, a popular online portal where people from Halifax post hundreds of new advertisements daily. Kijiji is an ideal resource for this project because of its hosting of both developer led larger apartment complexes and secondary rental listings such as condos, townhouses, and full houses. The site gives further information on which type of housing holds different characteristics, pricing, and affordability within the city. Data pulled from Kijiji will be supplemented from data obtained directly from the large developers' websites including Killam and Southwest Properties.

The first goal of this research project is to provide an overview of the Halifax rental market by diving into spatial patterns of rental listings, looking specifically at the prices and affordability of rental units. The second goal of this research is to distinguish between the larger rental complexes that are purpose built containing three or more units and secondary rental housing which can be considered anything from buildings with less then three units, condos, houses or basements (RHB, n.d.). The purpose of distinguishing between the two rental unit types is to provide comparative information on their supply and pricing, along with how their characteristics such as parking, square footage, number of bathrooms, and if the unit contains laundry in unit, in the building or neither. Distinguishing these types may provide insight for improved policy to address the rental market issues moving forward

Beginning this thesis is a literature review covering the topic of rental housing through the changes in policy that have led to the current state of rental housing with both a national overview along with a focus on the particular conditions in Halifax. The literature review then continues with a discussion of the importance of affordable rental housing, tenant mobility in rental housing, demographics in rental housing, social inclusion issues occurring in rental housing, and finishes with the use spatial analysis on rental housing in past research. The next section will outline the methodology employed in this thesis, including how automated web scraping and manual data collection were employed, how the data was cleaned for analysis, and how analysis was conducted on each component of the research including spatial distribution, pricing, value, affordability, and rental characteristics. Next are the results of the study summarizing every listing collected to provide a general overview of the entire rental market, then moving into a more in-depth look into the differences of primary and secondary rental

housing. Moving then into the discussion to explain what the results mean for Halifax and finally the conclusion for suggestions on further research potential in the field of rental housing.

Chapter 2

Literature Review

2.1 Rental Housing in North America

North Americans generally prefer buying instead of renting, though rental housing is still an important part of housing in North America as it supplies housing for millions (Boeing and Waddell, 2017; Gilbert, 2016). With the rise of the middle class, suburbanization, and mortgages becoming more affordable a shift began to happen post WWII in the housing market, people in North America shifted from a majority living in rentals to more and more people becoming homeowners (Gilbert, 2016; Fetter, 2013; Spader, McCue, & Herbert, 2016; Immergluck, 2018). This shift is accompanied by policy promoting ownership as the ideal, including mortgage rite-offs in the US and the federal government's involvement with CMHC north of the border. Another popular reason renting has become less desirable in North America is the decreased financial incentive to rent housing. Governments of the United States and Canada incentivizes homeowning due to homeowners being able to gain financially with rising prices supplementing retirement funds (Gilbert, 2016). Culture also upholds the owner occupied single detached family house as the ideal housing format, especially amongst middle class families.

Even after this shift in policy and culture causing a boom in homeownership, more than 30% of North Americans still were in the rental market (Gilbert, 2016). A major shift happened after the recession in the mid-late 2000's that decimated many home-owners through the sub-prime mortgage scandals resulting in many loosing their homes and livelihoods. The rate of people living in rental housing increased to around 36% of the population occupying rental housing (Immergluck, 2018).

2.2 Rental Housing in Canada

Private rental housing is the second most common form of housing behind home ownership in Canada, while only one in ten Canadians live in social or affordable housing, which is housing supplied to people in of a place to live, with co-ops models being rarely employed (Martin, Hulse, Pawson, 2018). The general conditions of rental housing in Canada and its issues are not heavily written about in the realm of academia (Claveau, 2020). Instead research focuses on other major topics within the realm of rental housing such as the financialization of rental markets in Canada, affordable housing issues, and issues centred around discrimination in the rental housing market (August, 2020; Leviten-Reid & Lake, 2016; Auspurg et al., 2019)

In the 1960's and 1970's the federal government provided subsides and tax breaks for those developing purpose-built rental properties (Sewell, 1994; August, 2020). Since the 1980's rental housing became the domain of provincial governments, and increasingly became a target for low-income residents rather than middle and upper classes. As a result, developers opted to build more profitable condominiums rather than rental units (Suttor, 2015; Rosen & Walks, 2015; August, 2020). Since 2011 the Canadian rental housing stock has shifted once again as developers begin to build units for middle and upper income classes, while governments continue to under invest in affordable units. (Suttor, 2015; August, 2020).

Current issues being brought to attention about rental housing in Canada along with this targeting of higher income groups are the advent of corporate landlord and the financialization of rental properties, which is defined as the control or accumulation of rental housing by the financial elites or large corporations both domestically and increasing internationally (Brias, 2018; Revington & August, 2019; Kalman-Lamb, 2017). Problems arise as the units are

constructed on the cheap, using poor quality materials workmanship resulting in superficial nice but not long-lasting units (Revington & August, 2019). Revington and August (2019) show financialization has grown in Canada to target specific groups of people, notably students, resulting in further age segregation and higher costs of living for students. The results of this increasing financialization of rental market in Canada has led to further gentrification, rising rent prices, and forced tenet mobility or removal (Crosby, 2020; Revington & August 2020).

2.3 Rental Housing in Halifax

Academic research on rental housing in Halifax is limited, with government agencies such a CMHC and Statistics Canada providing additional information; however these reports often aggregate the information and do not fully contextualize their findings. CMHC's rental market report on rentals in Halifax written by Ndoro (2021) employs data collected from CMHC's rental market survey the report offers insights into the pricing, availability, and trends in the rental market for the target city. Ndoro (2021) states that Halifax vacancy rate grew to 1.9%, though still low when compared nationally it eased stresses on the market from the previous years 0.9% vacancy rate. Halifax in 2020 saw an average rent price of 1,170, an increase of 4.1%, which is noted as surprising due to the easing of the vacancy rates leading to a larger supply of rental housing (Ndoro, 2021). Across Canada gaps exist in the average prices between larger cities and mid-sized cities according to the CMHC (2021), with large cities such as Toronto and Vancouver showing average rents of approximately $1500 while Halifax is more comparable to a city such as Calgary, London, Winnipeg, and Bellville at approximately $1100 average monthly rent.

Though slightly outdated due to the use of 2016 census data the Canadian Rental Index (2021) gives us further insight to affordability in Halifax, showing that Halifax is an affordable

when looking at the average of all income groups. Upon closer inspection, however, the two lowest income groups within Halifax shows, the population fall under the unaffordable and extremely unaffordable category. Ren Thomas (2020) states that Halifax has a high number of renters paying over 30% of their income with 43.3% renters paying above the affordability threshold. August (2020) makes a point to mention that Halifax, at 52%, was in the upper percentile of Canadian cities when it comes to corporate entities acting as landlords, also known as financialization of rental properties.

2.4 Affordability

Buying a home requires great financial commitment, including securing a sizeable down payment, making monthly mortgage payments, as well as the myriad of maintenance costs the owner now has to cover (Bharti, 2022; Revington & Townsend, 2016). As a result rental housing can supply a more affordable option to those who cannot own homes, something that is especially true in countries whose housing policies strongly encourage home buying over renting homes, such as the case in Canada (Gilbert, 2016). If people are unable to accumulate a sufficient down payment or qualify for loans they will then mostly rely on rental housing. At the lower-end of the spectrum is where we begin to see further housing insecurity and increased vulnerability to homelessness, and the possibility of diverting income from food, medical and, dental to be able to afford adequate housing (Anderson et al., 2003).

According to the Canadian Mortgage and Housing Corporation (2018) people who spend 30 percent or more of their given income, before taxes, towards housing are considered to be living in affordable housing. Statistics Canada (2020) shows that in 2018, 1.6 million Canadians live in housing considered to be inadequate or unaffordable. According to Anacker (2019) people

who pay over the 30 percent threshold are in danger of diminishing household budgets, money which could be used to buy food, buy transportation, afford retirement, or the give the ability to pursue higher education. Kabelin (2019) makes the point affordable housing provides benefits beyond a place to live with improved health in children, better in school performance, improved mental health, better physical health, and financial stability. Though not all rental housing is affordable, the importance of affordable rental housing goes beyond monetary gains, it helps improves livelihoods of the people who inhabit the area.

2.5 Mobility and Flexibility of Renters

In most cases rental housing is contracted under year-to-year, month-to-month, or over a fixed-term (Dalhousie Legal Aid, 2019). Leasing rental housing allows the tenants more flexibility in finding housing that fits their financial, physical, and social needs due to the lack of long-term commitment compared to that of a mortgage (Malakouti et al., 2021; Nordvik, 2000). Renters tend to be more mobile due to lack of attachment, crime, or environmental stresses put on them by the surrounding neighbourhood (Temkin and Rohe, 1998; Boggess and Hipp, 2010; Dupree et al., 2007; Schultz et al., 2008; Taylor, 1996; Hatch, 2021).

Involuntary mobility is where the tenant is evicted from the premises, the building was condemned, or the landlord foreclosed on the property (Hatch, 2021; Crowley, 2003; Desmond & Shollenberger, 2015). The renovictions processes involve renovating a unit or complex to charge higher rent prices, removing current tenants who are paying lower rent prices (Wong, 2019). Demoviction is another process that results in forced mobility of tenants through demolition of a low-cost rent units, often torn down in favor of gentrification efforts resulting in newer buildings and higher rent costs. (Crosby, 2020).

2.6 Social Inclusion

Notable examples of social inclusion and discrimination in rental housing are documented in the Australian Housing and Urban Research Institute report (Tually, et al. 2011). The report describes social exclusion as caused by certain ideals people have about others, lack of success in the labour market, and political structures that put people with disabilities at a disadvantage (Tually et al., 2011). CMHC (2021) also reports about the difficulties of people with disabilities and medical complexes. In terms of ethnic discrimination in the rental housing market Auspurg et al. (2018) provides empirical evidence in Canada, Europe, and the United States of statistically significant occurrence of ethnic discrimination in rental housing markets.

Research about NIMBYism and affordable housing often go together with descriptions of social inclusion in housing. People who live on the middle to higher income level are sceptical or act hostile towards affordable housing efforts as the possibility of lower income peoples coming into their neighbourhoods, worries homeowners about depreciating home values and increasing crime in the neighbourhood (Devin-Wright, 2009). CMHC (2020) reports if people move away from nimbyism, accepting all to the neighbourhood, an increasing opportunity for affordable housing and employment will be seen in the area.

2.7 Rental Housing Demographics

Demographics of rental housing is a major research question when looking into the current state of rental housing. In the United States of America 28% of the population under 25 are renters, in this age group flexibility and mobility of rental units is an asset as it allows them to switch jobs and geographical locations without being committed to a mortgage (Joint Center for Housing Studies of Harvard University, 2011). As people age, they tend to become more stable in

jobs and life in general going more into home buying rather than renting housing. After 40 two-thirds of people own their homes (Joint Center for Housing Studies of Harvard University, 2011). Post age 55 one out of five people are back to living in rental units to lessen the burden and maintenance of home ownership (Joint Center for Housing Studies of Harvard University, 2011). Another factor to take into consideration is family status it is shown that people without children in the home are more likely to be renters than people who have children in the home (Joint Center for Housing Studies of Harvard University, 2011).

A comprehensive report of demographics is provided by the Canadian Rental Housing Index (2021) using 2016 Census data. The report narrows down to the municipal level geographically of demographics, allowing insights into Halifax's rental demographics, although being from 2016 the data can be considered out of date especially in Halifax which has seen much growth since the last census was enumerated. The demographic of families, made up of couples with and without children along with single parents, demographics demonstrate a majority of renters are couple without children, followed by couples with children, then females with kids, and finally males with kids being the lowest demographic in the family category (Canadian Rental Housing Index, 2021). In Halifax we see interesting results that go against the grain of current literature most renters are between the ages of 45-64 years in age while a close second is ages 15-29, but the lowest age group of people living in rental housing are people 65+ (Canadian Rental Housing Index, 2021). Compared to other observations, this is uncommon for an older population to be less common in the rental market, as established in the Joint Housing Studies of Harvard University (2011) as people age the trend is to go towards rental housing as it lessens the burden of maintenance on the property. Lastly, Halifax sees mostly non-indigenous and non-immigrants as renters in the market (Canadian Rental Housing Index, 2021).

2.8 Planning Rental Housing

Rental housing is an important part of making affordable housing; however, many barriers in planning and development of rental properties exist in both public and private-sector actors. Rental housing management occurs at the provincial level, meaning landlords, no matter if they are a large cooperate entity or not must abide by the policy set out by the province (Brias, 2018). Before developing rental properties, planning needs to be implemented at the municipality level, in the case of Halifax that would be the Halifax Regional Municipality (Lemphers, 2017). Dealing with the municipality and waiting for approval on development acts as a costly barrier into building rental housing (Lemphers, 2017). Developers in Halifax have often mentioned challenges such as zoning by laws, and rising development fees on top of difficulties working with the Halifax Municipal government (Lemphers, 2017; Housing and Homeless Partnership, 2014). The fact is for more rental housing to be produced, policy and planning must remove some of these barriers facing developers such as zoning to permit high density living, policy allowing secondary suits in residential housing, and less delays in rental housing development.

Scholars have been attempting to connect issues with zoning laws and land use planning to affordable housing development (Calder, 2018; Schuetz, 2009). So far they have only been able to make a significant connection between land use planning and affordable housing (Calder, 2018; Schuetz, 2009). In Canada planning rental housing faces many barriers such as lack of available rental housing data, lack of communication/partnership between the government and stakeholders, lack of community support tying back to nimbyism, and insufficient government funding (Thomas, 2019). In Halifax specifically Thomas (2020) criticizes Halifax's policy and planning by calling it basic and lacking creativity.

2.9 Primary and Secondary Rental Housing

The primary rental market or purpose-built rental housing as it is sometimes refereed to are rental housing that consist of three or more units (RHB, 2021). As, of 2015 Canada has 1.9 million purpose built rental housing (RHB, 2021). Secondary rental housing is rental housing not classified as purpose-built containing three units or less, and can include condominiums, and secondary suites in residential housing (CMHC, 2020; RHB, 2021). Other than describing the differences between the classification of purpose-built and secondary rental market housing little academic research is available comparing the differences of amenities, demographics, and pricing. Some research discusses the importance of purpose-built housing in the formation of a housing career for the youth or how important it is for the older generation due to less maintenance and easier accessibility to services (Hunter, 2020; Liddle et al, 2014). In all the topic of different types of rental housing and how they are different is a relatively untouched research question.

2.10 Long-Term and Short-Term Rentals

Currently North America's rental housing market is adding complexity as any structure can seemingly become a rental property. Two distinct rental types have become popular, short-term, and long-term rentals. Short-term rental housing definitions are scarce to come by; non-scholarly articles cite them as being anywhere from a day to a week stay at the rental property (Simmons, 2019). Online platforms such as AirBnB have created a whole new marketplace for these short-term rental properties. A popular topic resulting from short-term rental housing is the policy to try to manage its growth in cities, especially those with large tourist sectors, and ultimately if it is a net benefit for the city (Valenitine, 2020; Wachsmuth et al., 2018; Gant et al,

2021). Research shows that when STR's go unregulated they take away units that could be used for long-term rentals because landlords gain more profits for minimal work on the property itself (Watchsmuth et al., 2018, Valentine, 2020). Long-term rental housing are seen as more traditional rental housing where people intend to stay and live in the housing for an extended period resulting in year-to-year, month-to-month, or fixed term leases (Dal Legal Aid, 2019). Since the impacts of STR are considered a completely different research topic I will focus more on the studies of long-term rental housing; bringing in STR's only to discuss the impact on long-term rental housing.

2.11 General Overview of Web Scraping

Web scraping is a new form of data collection. Traditional data collection methods may take hundreds or thousands of hours, while web scraping can automate the process of manual collection and be able to collect data in minutes (DeVito et al., 2020). Web scraping can be defined as being a process of automation, involving no manual collection of data (Smith, 2019; Aydin, 2018; Broucke and Baesen, 2018). Meaning web scraping is a process that is done via codes, through various programming languages automating the data collection process. Alternatively, others describe web scraping as encompassing all data collection from the world wide web including manual collection (Saurkar, Pathare, and Gode, 2018). For this report, we will define web scraping as the former, a process that encompasses online automated data collection. Web scraping as an automated form of data extraction aligns with how I will be using web scraping in this research project.

According to Perez (2021) web scraping is a form of data collection, where unstructured data is collected directly from an website or html, the data is then re-organized and structured

through the web scraping process into a data frame. The reason why a scraper is necessary for this procedure is because websites or HTML files are a collection of unstructured data, which makes it difficult to perform any further analysis on (Perez, 2021; Aydin, 2018; Smith, 2019). Web scraping reformats unstructured data into a data set with structure in the form of excel, csv files, or data frames (Perez, 2021). Web scraping allows everyone access to the massive data library of the world wide web relatively quickly. It is important to note web scraping as a practice of data is not perfect, as major issues can arise. We will touch more on issues with web scraping later in this section.

2.12 Web Scraping in Practice

Utilization of web scraping is becoming more common in many ways across the data driven world in which we live (Broucke and Baesen, 2018). Many different data out in the world wide web provide resources for different researchers, private organizations, and public organizations to take advantage of the available information (Perez, 2021; Saurkar, Pathare, and Gode, 2018). For researchers web scraping opens the door for unlimited research opportunities with the data available on the web. In the private sector it allows for stronger competition between competing firms (Macapinlac, 2019). Public sectors use of web scraping allows public office to use data in finding improvements in things such as transportation, health, taxes, and tourism (Adkins, 2021).

Since short-term rental rates are readily available on the internet web scraping sites advertising rentals is a common occurrence. A website under the name AirDNA is scraping short-term rental data from both Airbnb and VRBO (AirDNA, 2021). Obtaining data through Airbnb and VRBO, AirDNA can give analytics on short-term rentals in areas of the users choosing,

AirDNA has become useful in current literature pertaining to short-term rental housing (Combs et al, 2020; Grisdale, 2018; Wachsmuth, 2019). Much of the research pertaining to short-term rentals centred around web scraping data is around city planning (Combs et al, 2020; Grisdale, 2018; Valentin, 2021). The data demonstrates observed in most cities observed short-term rentals are leading to housing loss (Wachsmuth, 2019; Valentin, 2021; Combs et al, 2020). Using AirDNA data researcher are coming up with solutions in policy and regulation to issues surrounding short-term rentals and the housing market (Wachsmuth et al, 2019; Valentin, 2021).

With limited data being available in on non-purpose-built and long-term rental housing data, web scraping becomes a more useful tool, but one that is not always implemented. In Canada for example the census does include all type of rental information including those secondary units typically found on online websites including Kijiji; however, in some areas of Canada long term rental data has assumed to change significantly since the last census release in 2016. Moreover, the census data does not report individual rental market rates which can also quickly change. CMHC (2021) only focuses their rental market reports on purpose built rental housing. Web scraping allows for much of this missing data to be collected and subsequent analysis to be performed.

Boeing and Waddell (2017) exemplify how important rental data from the internet can be when gauging an understanding of the rental market. Using a web scraper built in Python Boeing and Waddell (2017) were able to retrieve data on eleven million Craigslist advertisements pertaining to rental housing across all the United States. Higher rents are found mostly in large cities, while lower rents are in small towns. Although Boeing and Waddell (2017) are also quick to point out data does suggest luxury accommodations in smaller sized cities considered to be

resort towns do show high rental prices as well. Affordability of cities and towns in the United States were also analyzed using a standard 30% percent of income rent burden. Boeing and Waddell's (2017) data have been massive for understanding spatial dynamics and how the rental market works with many papers dealing with United States rentals refer to their work. In the Canadian context there is precedent of using web scraped Kijiji on rental listings, in Pi (2017) to collect rental housing addresses form the Waterloo area in Ontario, Canada.

Web scraping is also used to conduct research regarding international housing markets (Tomal and Marona, 2021; Harten, Kim, and Brazier, 2020; Narseen, 2017). In the case of Tomal and Marona (2021) they were using web scraping to determine impacts of COVID-19 on the housing market in Poland where a reduction in private rental prices during both the first and second waves of the pandemic was witnessed (Tomal and Marona, 2021). In Sydney, Australia web scraped data opened discussion on room sharing as a source of affordable housing (Narseen, 2017). Finding room sharing as economically beneficial in geographical areas near universities, places of employment and areas of public transportation (Narseen, 2017). However, Narseen (2017) does use the data to provide context that overcrowding is a real issue in areas with room sharing, as well landlords are coming out more profitable due to room sharing.

An interesting method of using web scraped data in research comes from Harten, Kim, and Brazier (2021) researching Shanghai's rental market, producing better mapping and statistical analysis and ground truthing the data to see if online ads were legitimate. In their findings Harten, Kim, and Brazier (2021) show Shanghai that advertisements online do not show completely how the informal housing market functions. Additional costs for household essentials such as having a kitchen, bedding, and the amount of people living in the unit are extra charges

added to the total rent cost (Harten, Kim, and Brazier, 2021). This example of increased rent totals due to extra charges help illustrate the limitations of advertisements not always being truthful.

The studies above are just a small sample of literature using web scraping as a primary source of data collection. Many others from all over the world are using web scraping as a means to find answers in their own research (for example: Bricongne et al 2021; Zhang and Gurran, 2021; Im et al, 2017). One problematic issue to point out when pertaining to my current work with Halifax is the lack of literature in Canada. Currently the only form of academic writing found on web scraping can find is a masters thesis web long scraping term rentals is scraping long term rental prices from Kijiji (Pi, 2017). This lack of literature only spurs questions to why academics use it as a method in some countries but not Canada.

2.13 Benefits and Issues with Web Scraping

Even as more researchers begin to use web scraping as a method of data collection, little literature has been written about why web scraping is both beneficial and limiting. For this section we will be using a non-peer review academic literature in Raluca (2021) and Luscombe et al. (2021) articles to see how web scraping is both beneficial and limiting. According to Luscombe et al. (2021) web scraping is useful in five ways: Web scraping allows for collection of impossible to obtain data, obtain data where there is limited official data, filling gaps in official data, web scraping maybe the only way to obtain certain data timely, and allowing web scraping methods as codes to be seen online by other researchers (Luscombe et al., 2021).

In a blog post by Raluca (2021) they state even more reasons why web scraping as a data collection tool is valuable. Web scraping is seen as cost effective, cutting down on labour and

other expenses in comparison to collecting data manually (Raluca, 2021). Additionally, web scraping increases data accuracy as it does not fall too human error (Raluca, 2021)

Web scraping may seem like a revolutionary method of data collection, but web scraping does not come without faults. According to Luscombe et al (2021) the main issues with web scraping are in technical, ethical, and legal challenges that accompany it. We will discuss legality and ethics later in the paper so let's focus on technical issues that arise with web scraping. Luscombe et al (2021) states learning the basics of web scraping are a serious barrier due to scrapers utilizing dynamic programming languages that are difficult to learn. The steep learning curve of web scraping is an emphasis in the disadvantages of web scraping in Raluca (2021). Web scraping is not just mindless collection of data it requires knowledge that can be difficult to obtain (Luscombe et al, 2021; Raluca, 2021).

Although web scraping is a powerful tool in the realm of data collection, one must be aware of ethical concerns when using such a method. Rennie et al (2020) provides an example of San Francisco based company Strava, which is a social network for athletes. An issue with Strava from the US military and Government came when data from Strava allows for tracking of military and intelligence personnel. Web scraping if being misused has potential to violate individuals' privacy as sensitive data could emerge (Rennie et al., 2020; Krotov et al., 2020). Privacy does not only apply to an individual it can also apply to an entire organization as well. Web scraping potentially can expose confidential information about operations of an organization, for example if a web scraper is in use on employment ads on a recruiting website that individual has potential to estimate target audience, market share, and revenue (Krotov et al., 2020)

Beyond privacy concerns another ethical consideration that must be discussed is possible harm to the websites one is scraping. Smaller websites could affect how other consumers use the website at the same time slowing down or possibly crashing the website (Rocha, 2021; Krotov et al, 2020). Krotov et al (2020) mentions organizations may suffer in value as well if the organizations website is scraped. Reasons provided for a fall in value are based around researchers taking traffic away from the website as some people will use the researchers works instead of purchasing the data. Indirectly lower traffic on the websites also makes it more difficult for the organization to monetize off advertisements on their website (Krotov et al., 2020).

Web scraping is currently an interesting case when looking at its legalities. In most countries where web scraping is being conducted it is thought as a legal grey area, this is especially true in North America (Krotov and Silva, 2018; Luscombe et al., 2021). Web data is no stranger to the court system as Krotov and Silva (2018) mention illegal use of data, breach of contract, copyright, trespassing, and trade secrets all have been cited in court. Most of the legal issues that involve web scraping come from the US (Luscombe et al., 2021).

Luscombe et al. (2021) currently say no researcher using publicly available data has been in legal trouble when web scraping in the US, UK, and Canada. Even with their currently being no legal precedent, researchers should be careful as web scraping become more widely used (Luscombe et al., 2021). If web scraping were to become more widely used it creates potential for legal action to take place. If a researcher is able to follow the terms and conditions, copyright laws, and is gentle when scraping smaller websites web scraping conforms to the legal precedent currently set out (Rocha, n.d.).

Chapter 3
Methodology

3.1 Data Collection

Data collection for this research project was broken down into two methods, manual data collection from developers' websites and automated data collection from Kijiji.ca via web scraping. Manually collecting rental listing data required recording prices, number of bedrooms, number of bathrooms, square footage, parking sports available, air condition availability, the laundry situation, and every rental listing full address. These data points were collected from major developers located in the Halifax area, including Killam Properties, 444Rent, Northwest Properties, and Southwest properties. The process of collecting the data from the developers manually included creating a master excel sheet and making a record of which developer the data points came from followed by all the data points about the rental units recorded. Data for developer listings was collected by going into each individual developers' website go to the listing sections under the geographic location of Halifax.

As discussed in the preceding literature review, Web scraping is the process of collecting online data through automation, academic studies more recently have cited web scraping as being a valuable tool as a means to collect large amounts of publicly available data online to further expand research and data available for crucial research (Krotov & Silva, 2018). Major examples of web scraping being used are studies done by Harvard called The Billion Prices Project, examining inflation and changes in online retailers pricing (Cavillo, 2016). Implementing a web scraper is a crucial part of researching online prices, which over the last decade more and more web advertisements are being commonly used to find rental housing, as seen in the fact Kijiji has

a whole section of their website dedicated to rental housing. In the United States Boeing and Waddell (2017) collected over 7 million unique rental advertisements online through the online advertiser Craigslist. With the continuing movement into a digital world, and increasing amounts of data coming from online advertisement, web scraping data will allow researchers access to large amounts of data that can further improve understandings of characteristics and prices of what is being sold online.

The website Kijiiji.ca, a site which posts hundreds of rental listings daily, to increase the overall numbers of data points about rental properties in Halifax. To maximize efficiency of data collection and total data points being collected for the project, manual data collection was off the table, opting to automate data collection using a web scraper built in the programming language R. Building an automated web scraper in R allowed for hundreds of rental advertisements attributes to be collected in a matter of minutes from Kijiji. The web scraper collects the following data points: URLs for each advertisement, data or time posted, price, parking, bedrooms, bathrooms, square footage, air conditioning availability, if there are laundry machines in the unit, in the building, or neither, the advertisement ID, and the addresses of each advertisement. This data was collected daily over a two-week period and put into a master data excel sheet, the same master excel sheet as the one used for the developer owned rental properties. Using this methodology a rich dataset was created of over 5000 total rental listings and over 1700 unique rental listings.

Building a web scraper necessary for the task of obtaining rental advertisements leaves a lot of options for coding languages. Python is considered the most common coding languages when creating a web scraper and there are a lot of tutorials in academic writing, online, or in

videos about creating web scrapers using these languages (Mitchell, 2018). The language R was chosen however due to my own previous experiences conducting research projects in R. While developing this code for web scraping, I took influences through instructional academic writing such as Bradley and James (2019) and web scraping tutorial videos available online made by John Little (2019) a librarian at Duke University, who has made a great online video tutorials on being able to scrape data not only websites but through nested links, on the platform YouTube. In combination with John Little's (2019) tutorial and the writing of Bradley and James (2019) I was able to develop my own web scraper to collect all the necessary data for this research from Kijiji.

The code begins with downloading the proper packages available in R to execute certain types of codes. A package in R is described as a bundle of codes, data, documentation, and text which are developed by the community of people who use the R programming language (Wickham and Bryan, 2019). Web scraping packages are specifically designed for collecting and formatting data from the web were used to construct the web scraper in this research, the package that was used for web scraping in R is rvest created by Hadley Wickham (2019). Rvest has the capability to extract html nodes and html text from websites by collecting the html node which is the path in the html to a specific data point (Bradley & James, 2019). These tools were able to find exactly which data attributes from the webpage that the scraper wants to collect through finding html nodes (Bradley & James, 2019). In order to fully utilized these tools a browser extension called the selector gadget was used; the selector gadget is able to tell you exactly what the html node is for the data point you are trying to obtain. How the selector gadget operates is beyond the scope of this project, but to describe what it does is when clicking on a part of a webpage it will give you the exact node to collect that specific data point across all renal advertisements on Kijiji.ca. Another key package in the code for my web scraper is the tidyverse

packages which includes purrr which allows for a more efficient and easier way for the scraper to read through multiple pages on Kijiji and organize the data into a neat data frame (Wickham & Henry, n.d.).

Now having a better understanding of how packages work and how the web scraper functions and was utilized we can move into how my web scraper operates. Using the rental listing section of Kijiji.ca the URL showing all the advertisements was used as the base URL where we constructed the scraping changing the page number in the URL to %d in order to for the purrr package to filter through all the pages on Kijiji.ca needed to get every data point available at the time the scraper runs. From the original scraping of all the available pages on Kijiji.ca front pages price, bedrooms, and the URL for each advertisement were collected. The most important point of data for the rest of the web scraping processes then becomes the URL for each advertisement. Having the URL for each individual advertisement allows the scraper to then navigate or parse each of the links to obtain the rest of the data points that need to be collected. To do this the scraper navigated and collected all information from each of the links in xml format into a table. Once the table of parsed URL's is complete the web scraper then tells which specific data points needed from those advertisements. In this study unit descriptions including housing type and bathrooms, the advertisement description, and all extra amenities available were collected and put into a data frame. With this scraped data a completed dataset of Halifax's rental properties with the resources previously laid out was formed and put into a csv file.

3.2 Data Cleaning

Unfortunately, when data is collected from online sources that are not necessarily well structured or include missing values, data cleaning becomes an essential process before

conducting further analysis. For this research project manual data collection from larger developers in the HRM region did not need to be cleaned after collection, as the data points were being inputted the desired way for analysis to be performed and were eventually quality analysed manually. Data about rental hosing from Kijiji on the other hand came out with issues that needed to fix before further analysis could be performed. When the scraper originally collects all the data containing attributes about the rental property such as square footage, bathrooms, and amenities including parking and air conditioning available. When this happened, I had to perform analysis on the text manually to determine the square foot of each rental unit advertisement available that the web scraper collected.

Next what was needed was to separate the number of bathrooms from the clutter of text next to the bathroom total for that unit. For this issue a pattern within the text of that column was noticed, where a comma was put before and after the section of the text including the number of bathrooms. Knowing that a new column was able to be created using the data transformation feature of excel where all the bathroom units were then separated into individual columns within the data frame.

Further complications involved addressed data that involved cleaning. For ArcGIS to be able to read and understand the addresses a certain format needs to be had, either in single cell or multiple cell format. The key attributes needed for ArcGIS to read the addresses is the address, city, postal code, and province. In the Kijiji dataset due to possible error or misinputs of the people posting advertisements not all of the address data was available for each data point, sometimes the address was missing, or they would only have the FSA portion of the postal code,

and some provided neither just the area where the rental was located. To combat this issue unusable address points were excluded from the spatial analysis in GIS.

3.3 Analysis

The first step of analysis of the rich data set obtained through both advertisements on Kijiji.ca and large developers in Halifax Killiam, 444Rent, and Southwest properties were basic descriptive statistics. All of the basic descriptive statistics done for this research were done by using Microsoft excel and pivot tables. Using pivot table, I was able to determine the average price per bedroom for all units, the average value of each unit per bedroom, and the laundry characteristics for units in Halifax. For the second part of the results section distinguishing between primary and secondary rental units Microsoft Excel was used to create graphs to visualize the differences between primary and secondary rental housing when it came to pricing, value, and the different rental characteristics like parking, laundry, square footage, and average number of bathrooms per bedroom for each unit type.

When determining the spatial distribution of the rental listings collected an essential data point to have is the addresses said rental units, which were available in all of the different data sources used for this project. Having the rental units addresses allowed for the master excel document to be brought into ArcGIS pro to then use the geocoding geoprocessing tool in order to create point vector data values, to locate the geographic positions of each rental unit. Once geocoded all the data points were located on a map of Halifax Regional Municipality. Since a lot of the data points overlap one another a heatmap showing the density of listings was chosen to illustrate where each area of Halifax had high amounts of rental housing listings compared to other parts of the cities.

When analyzing pricing it was decided to represent it in two ways, on the level of the entirety of the Halifax Regional Municipality a table was used to show the averages of the entire city, while comparing them to values shown in CMHC's last rental market report (Ndoro, 2021). Obtaining the averages for the city was done through using excel to compute the average rent prices per bedroom number, ranging from Bachelor/Studio to 5 bedrooms. For each bedroom an average price was found for the totality of Halifax. The second way price was represented was spatially using ArcGIS and census tract level data available from the Canadian government's latest census (2016). The first step was using finding out how much the rent of an apartment was per bedroom, because comparing the average prices of each census tracts could lead to misleading data as some census tract areas may have higher bedroom numbers leading to higher average prices, doing pricing per bedroom eliminates this concern and tells the price of one bedroom in each of the census tracts in Halifax. Once the pricing per bedroom was done using the calculate field tool in ArcGIS pro, the spatial join geoprocessing tool was used to summarize the mean prices per bedrooms in each census tract area. This process produced the average price per bedroom at the census tract level in Halifax.

Value of a rental property as described in Boeing and Waddell (2017) is the price of the unit divided by the square footage of the rental unit. This is a good indicator to how much space or how large of an apartment one can get with their money. To determine value in our rental listing dataset we first need to create a new field labeled data, which was the price of each listing divided by the square footage of the listing to give us price per square foot. With this new field the average of value of a rental listing was able to be determined for each census tract when the data was summarized by the spatial join with the boundary shapefile provided by Statistics Canada (Statistics Canada, 2016).

Affordability was calculated using the average price per bedroom and yearly census tract level income data from the 2016 Canadian Census, it should be noted that the 2016 census data can be considered out of date because of the significant growth in the HRM over the past 5-6 years (Statistics Canada, 2016). This result will show the affordability of one bedroom in each census tract region. The way the breaks in the mapping were constructed are based off the affordability measure set by the government saying anything over 30% of one's income used on housing is considered unaffordable and paying for housing using less then 30% of one's income is considered affordable. For the affordability calculation what was done was the yearly income data was divided my 12 to obtain the monthly income, then the average rent per bedroom was divided by the monthly income to see how affordable one bedroom in Halifax a month is. The same process was done to measure affordability in both primary and secondary rental housing.

To determine they layout of rental characteristics in the entirety of Halifax I mapped out the spatial distribution of parking, square footage, bathrooms per bedrooms in ArcGIS pro using choropleth mapping and 5 value ranges. For laundry data I created a chart to show the distribution of the different laundry option in Halifax rental properties. When it came to the primary and secondary rental housing, I opted to show graphs made in Microsoft Excel to give a comparison between each unit type when it came to rental characteristics.

3.4 Limitations of the Study

Web scraping although a very useful tool does come with its set of limitations. In the case of web scraping Kijiji.ca not all information was able to be web scraped from the page, when attempting to do scrap utilities of a rental listing it is represented as a checkmark not a by words meaning that the web scraper was not able to read the checkmarks as text values, instead leaving

them blank. The web scraper also had some limitations concerning having valuable information hidden in long bodies of text such as the table including all the amenities and the description section, making it more difficult in the data cleaning process to filter through and extract the correct data from the text body. Limitations with dates were a difficult limitation as when looking at the developer led data, they do not post the date when the advertisement was posted, meaning it is not possible to see which exact unit was on the market and for how long it was on the web for. For Kijiji the dates were a lot better, except for dates posted within a day or two, because they would read as how many hours ago the add was posted. One large limitation in this study is the implementation of a web scraper. Not coming from a background in computer programming of that type it took many months of work to build the web scraper. It was not something that was easily done in an afternoon it took a lot of extra time researching articles, academic works, and watching online tutorials to fully grasp how to make a web scraper and more importantly how to properly describe what a web scraper is.

One other limitation comes from the use of the 2016 Census data. Since the affordability analysis uses household income data from the 2016 Census, it can be considered out of date or not as accurate due to the increased growth of the HRM over the past 5-6 years. This was the best option to continue forward as it more accurately represents difference in affordability spatially compared to adding a blanket inflation increase across all census tracts. A blanket increase would not show accurately growth or lack of growth in different areas of HRM.

Another limitation on this research comes from the Kijiji users themselves. When the rental listing is posted on the website it is up to the person who uploads the advertisement to determine what goes in the ad and what does not go in the ad. In the case of the Kijiji data set

there was many observations that were missing things such as complete addresses, square footage, rent prices, and the different amenities that came with the rental unit. On the other side of that some users may have entered in these bits of information to the advertisement, but could have miss inputted the data, resulting in $250,000 a month rents or 1-bedroom apartments that are 10,000 square feet. Lastly, it is important to point out no one completely knows the accuracy of a rental listing until they are able to fully see the listing for themselves.

3.5 Study Area

The goal of this research is to give a full understanding of rental units over the entirety of the Halifax Regional Municipality. Halifax was chosen as a study area for the research is due to the recent concerns in the area about affordable rental housing, renovictions, and drastically increasing prices of rents. Halifax is a mid-sized city whose primary demographics consist of students or elderly people, two groups who are strongly impacted by increasing living costs (Revington & August, 2019; Levington-Reid & Lake, 2016). In addition to this Halifax is one the fastest growing urban cores in all of Canada according to recently released census data (Statistics Canada, 2022). These conditions have set up Halifax to an ideal case study for observing rental units, because of the long-term implications supply and characteristics of rental housing will have on the future of the region.

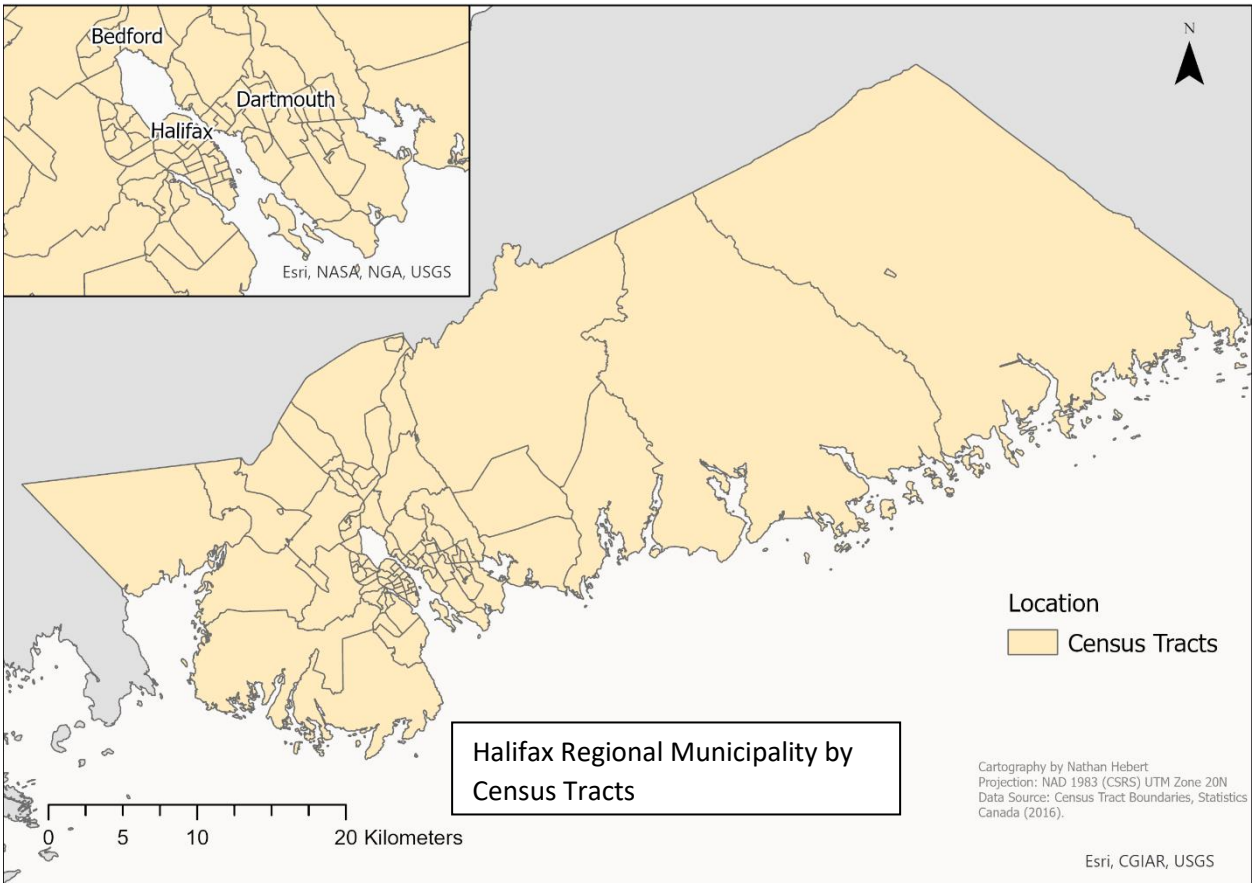

Figure 1 Map of HRM via Census Tracts

Chapter 4
Results

4.1 All Rental Housing in HRM

4.1.1 Spatial Distribution of Rental Listings

Halifax Regional Municipality was created with the amalgamation of the former cities of Dartmouth, Halifax, and Bedford, along with the former county of Halifax (Figure 1). The municipality stretches to less densely populated areas which is represented by the increasing sizes of the census tracts outside of the peninsula. To gain a better understanding of the rental housing listings spatial distribution, first we need to locate where the rental housing listings exist in our current data set.

Employing the geocoded rental listings addresses in the software ArcGIS Pro, a map, was created to show where the location of rental listings across Halifax Regional Municipality (Figure 2). This map illustrates the strongest concentration of rental housing listings are located around the peninsula area of Halifax (Figure 2). The glaring trend in the map below is the clear decrease in listings once leaving what many consider to be the urban core of Halifax Regional Municipality. Moving away from the urban core continue to move outwards in the municipality fewer rental properties are owned by big name developers and less listings are being advertised through Kijiji.

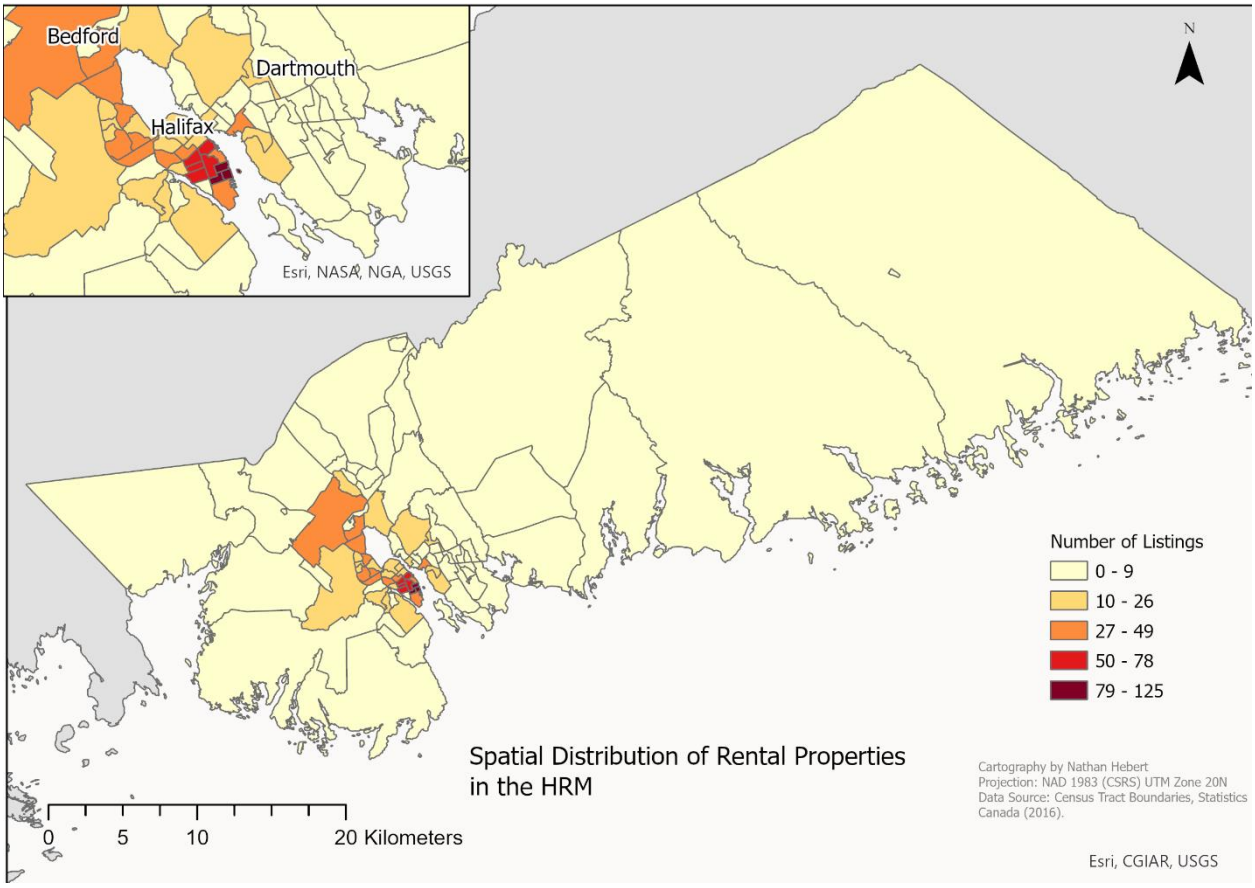

Figure 2 Distribution of Rental Properties

4.1.2 Pricing

Number of Beds	Average Price
Bachelor/Studio	$1130.53
1	$1438.08
2	$1928.60
3	$2198.76
4	$2878.17
5 or more	$3538.94

Table 1 Average Prices of Rentals per Number of Bedrooms

The largest concern of renters in Halifax over recent years has been the increasing prices of rental units available. Over the course of the pandemic, which caused economic hardships for many, led to protests about rising rental housing costs within HRM, causing the government to take action in the form of a yearly percentage-based rent cap. To see if worries about pricing are valid throughout Halifax as an entire municipality, an average of the data collected by larger developers and Kijiji were compared to the prices represented by CMHC 2021 rental market report (2021). Table 1 above shows the differences in average rent prices broken down by the number of bedrooms that are within the unit. An extreme increase in rental prices is to be considered problematic for the city, as we will get into in the affordability section rapidly increasing prices could lead to housing insecurity among some of the population.

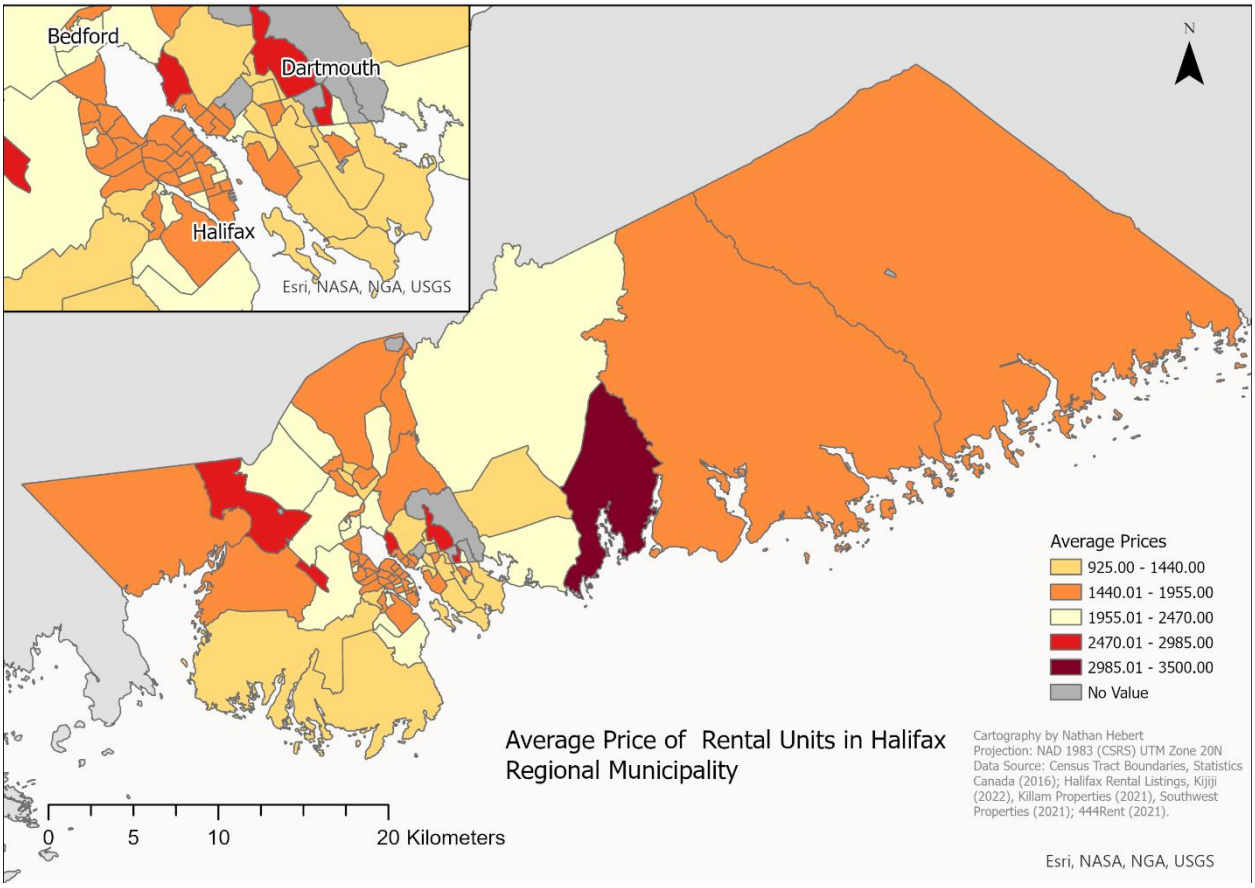

Figure 3 Average Rent Prices for all Rental Units

To move a step further beyond values in a table a map of the HRM is shown for the average prices of all units per census tract (Figure 3). Upon inspection of this map, much of the peninsula, a place expected to be more expensive, falls into the second lowest category, and some other areas of HRM being more expensive even though they are outside of the higher populated areas. This can be explained by a simple variable of number of bedrooms. Near the peninsula we saw more 1 – 2-bedroom apartments while on the outskirts of the HRM rental units with more bedrooms were more common explaining this price difference we see in the map above (Figure 3).

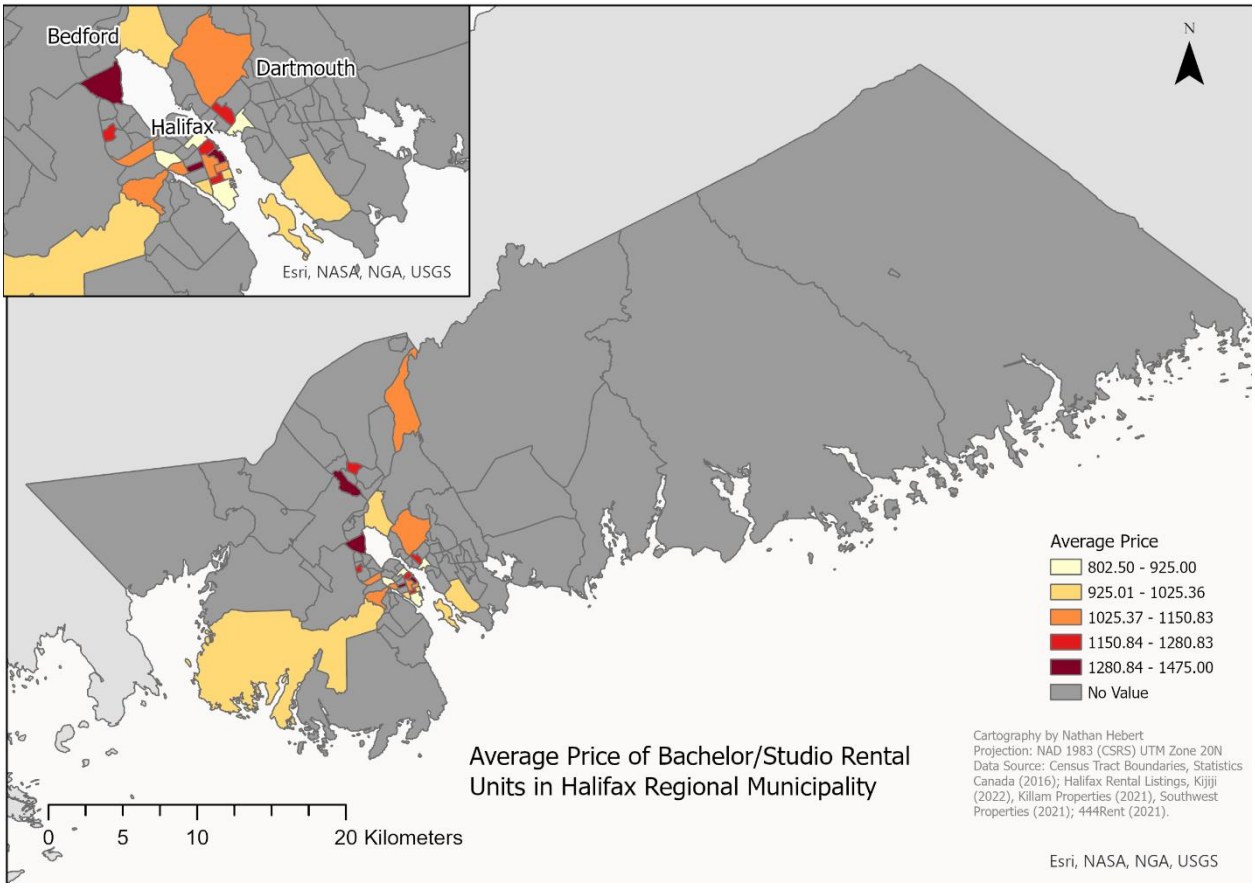

Figure 4 Average Price of Studio Rental

To combat the issue of bedroom total being a key influencer in the pricing of rental units, each bedroom unit type has been mapped out starting with Bachelor and Studios (Figure 4). Shown in the map Bachelor apartments are not that common among all areas in the HRM, seeing a majority of studio rentals in the Bedford, Dartmouth, and Halifax County area surrounding the peninsula. Taking a look deeper into Halifax County a trend occurs where the closer a unit is to the harbour the more expensive the unit tends to be, and as we move further away from the peninsula prices begin to decrease.

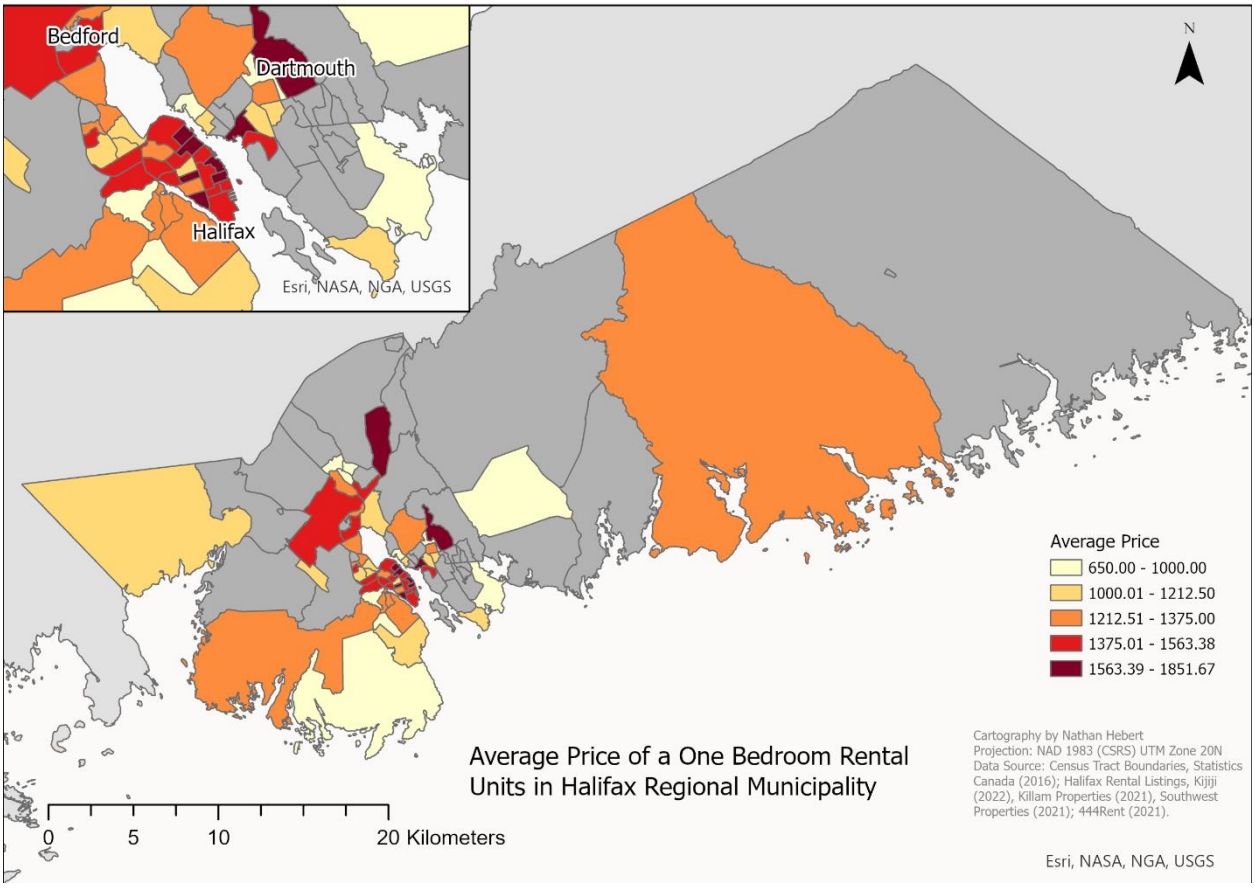

Figure 5 Average Price of One Bedroom Rental

Analyzing the one-bedroom units gives more data points then the previous studio units but shows some similar trends (Figure 5). In looking at 1-bedroom apartments there are more of them spread out through the HRM, but again seeing higher density of listings in the Halifax, Dartmouth, and Bedford area, The average pricing trends are similar to what is seen before in the bachelor units. Units located in the higher populated areas or near the water tend to see higher prices then units outside of those areas. In Halifax's urban core, specifically the peninsula, higher prices are extremely noticeable in almost all census tracts.

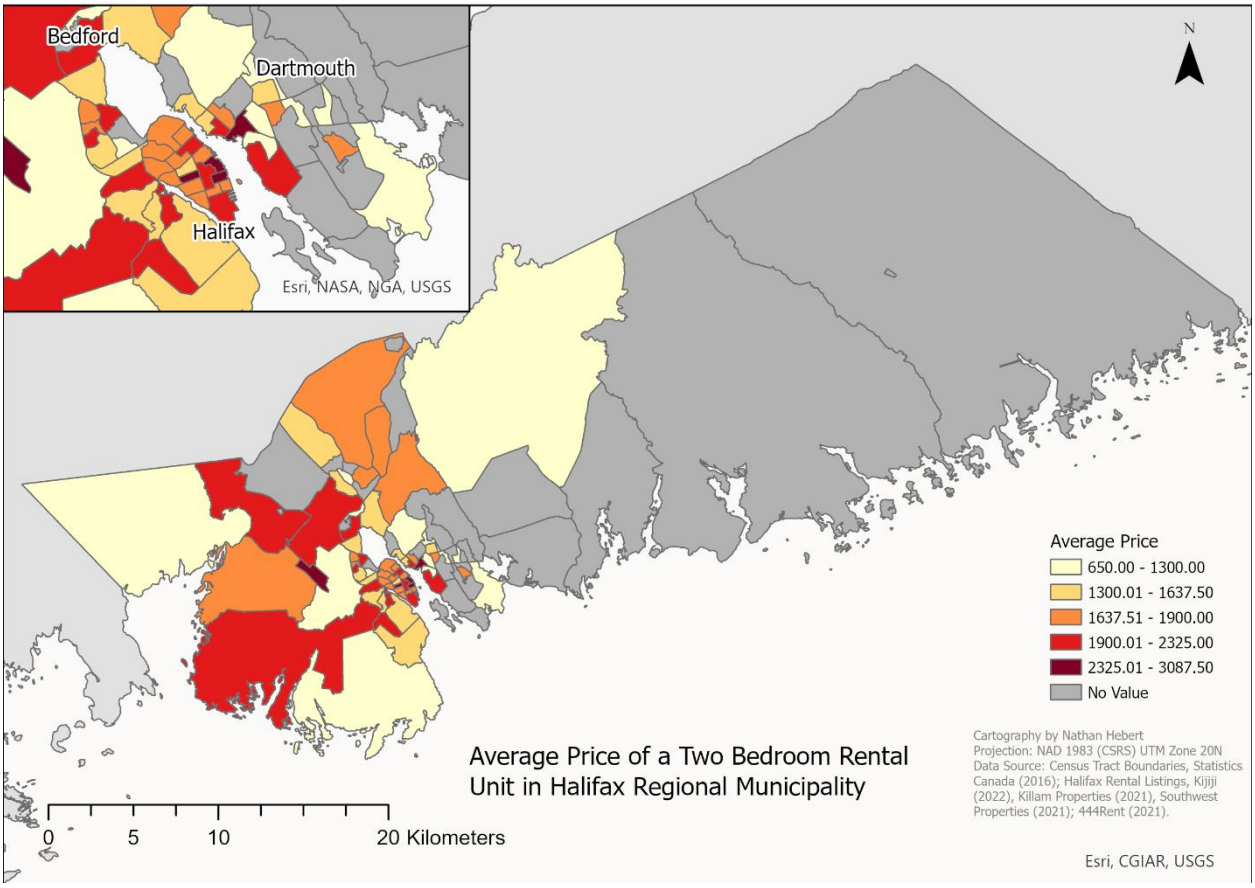

Figure 6 Average Price of Two Bedroom Rental

Examining the two-bedroom units, we see more units available through the HRM compared to the previous two (Figure 6). The pricing trends are similar to the previous where Halifax seems to have expensive units located all along the peninsula, but with the two bedrooms taking a closer look at Dartmouth we see areas near the peninsula with lower average priced two-bedroom units. South and west of Halifax we see other census tracts start to have increased pricing as well showing some high average prices outside of the main core and peninsula areas.

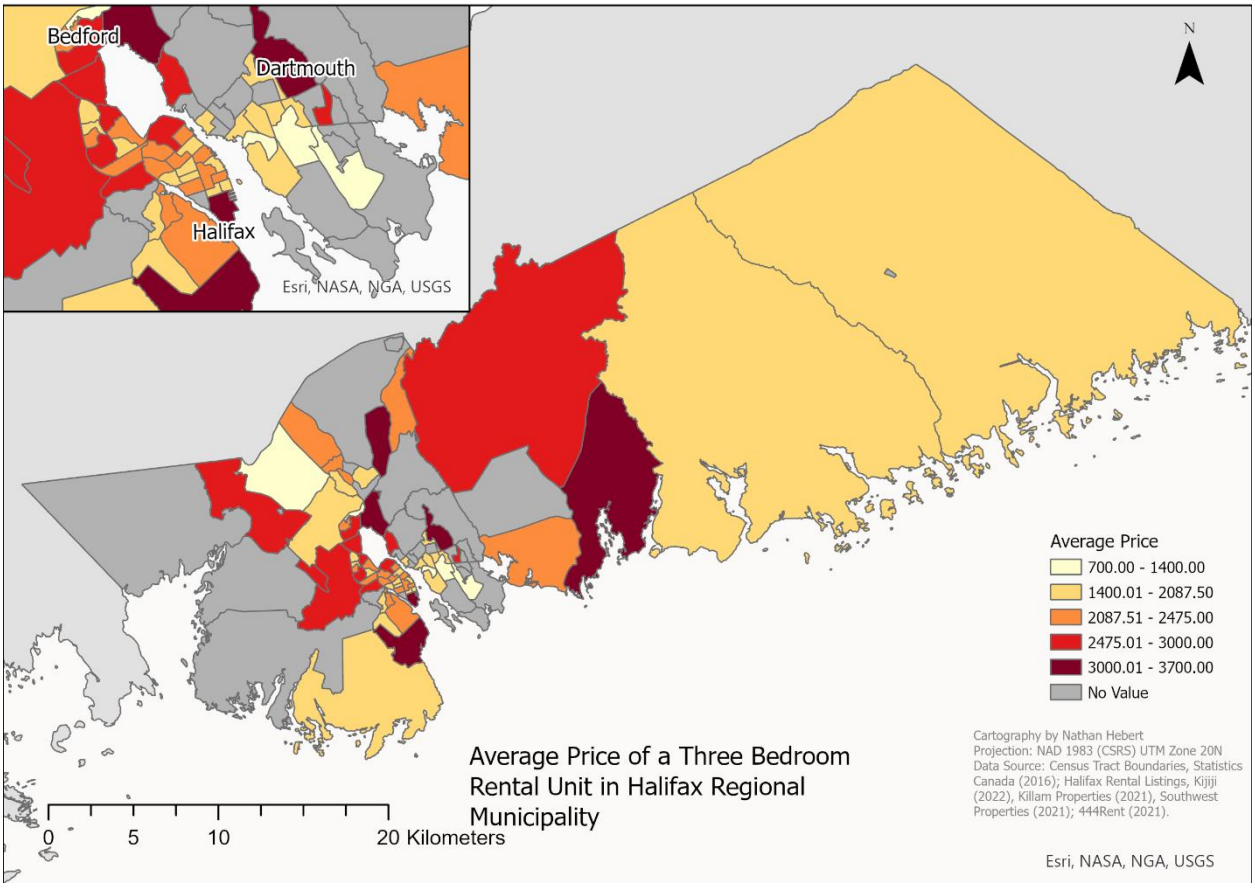

Figure 7 Average Price of Three Bedroom Rental

Three-bedroom units is where the trend observed for the previous 3-bedroom types starts to change. If we begin to look at the same area in Halifax we were before, we see those same census tracts now in the lower two groups of average pricing. Another change is in the Bedford area where the map shows all the areas are in the higher two price groups. The map also shows higher price groups in all directions outside of the Halifax County urban core demonstrating three bedrooms as a common yet expensive rental option.

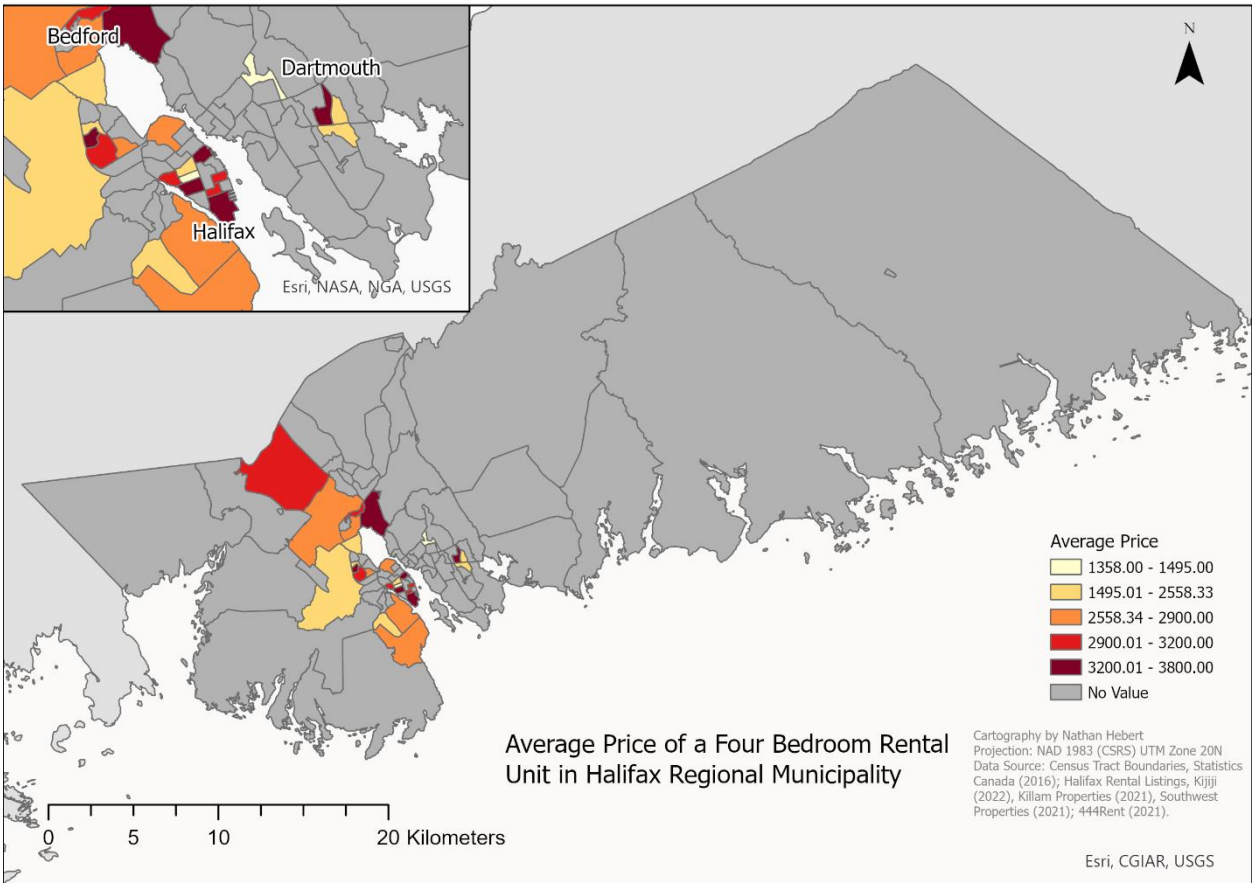

Figure 8 Average Price of Four Bedroom Rental

As the number of bedrooms increase there becomes less and less units on the market within the municipality. In the map above there is a sparsity in Halifax County while the Bedford area is full of four-bedroom units. Concerning the pricing of the units for the few units seen throughout the HRM at the census tract level there are some sparse areas of high pricing still within Halifax's urban core and the Bedford area with a few census tracts recording high prices in the northern part of the Dartmouth area.

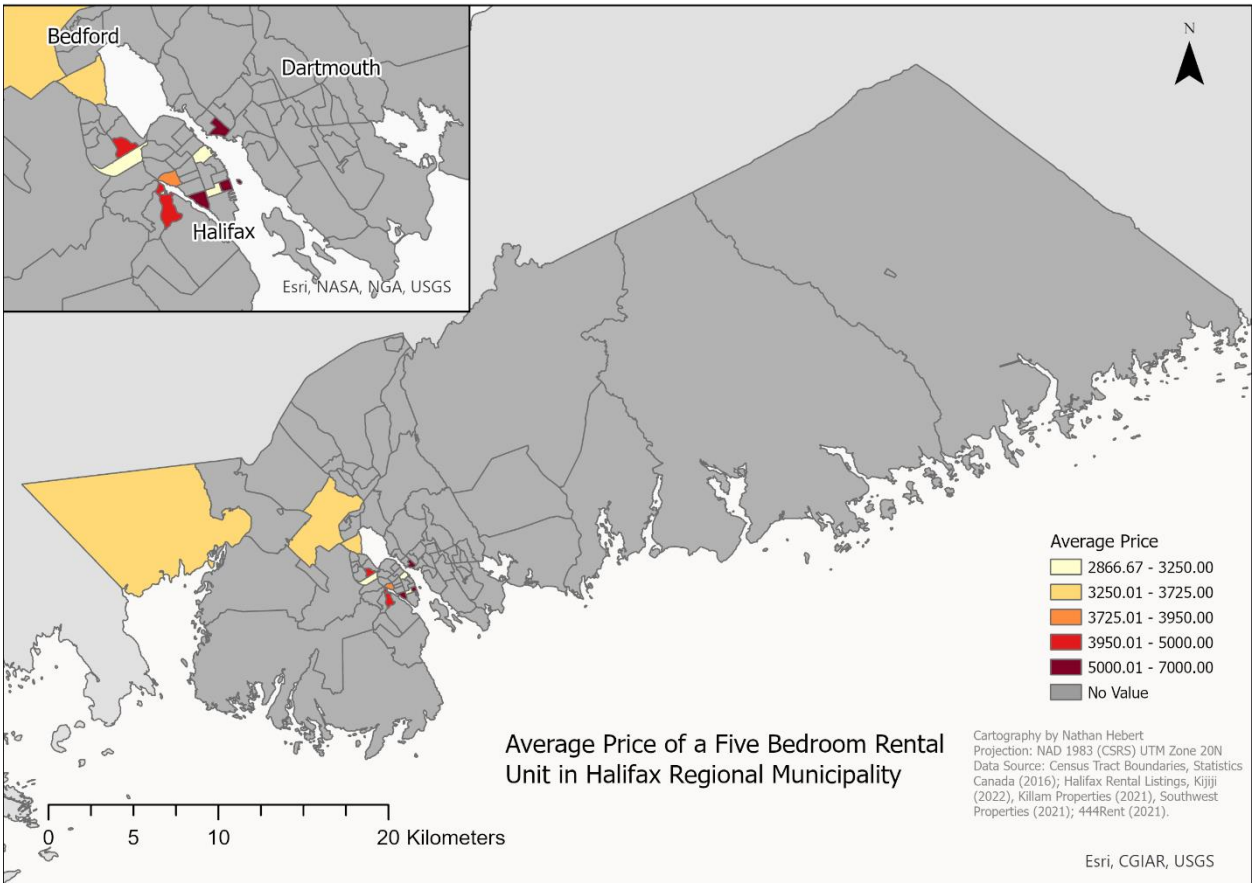

Figure 9 Average Price of Five Bedroom Rental

Five-bedroom rental units are the hardest to come by in the HRM. In the map above only a handful of census tracts contain rental units of five or more units (Figure 9). Therefore, it is difficult to determine any spatial trends when concerning the average pricing of the units due to such few data points.

4.1.3 Value

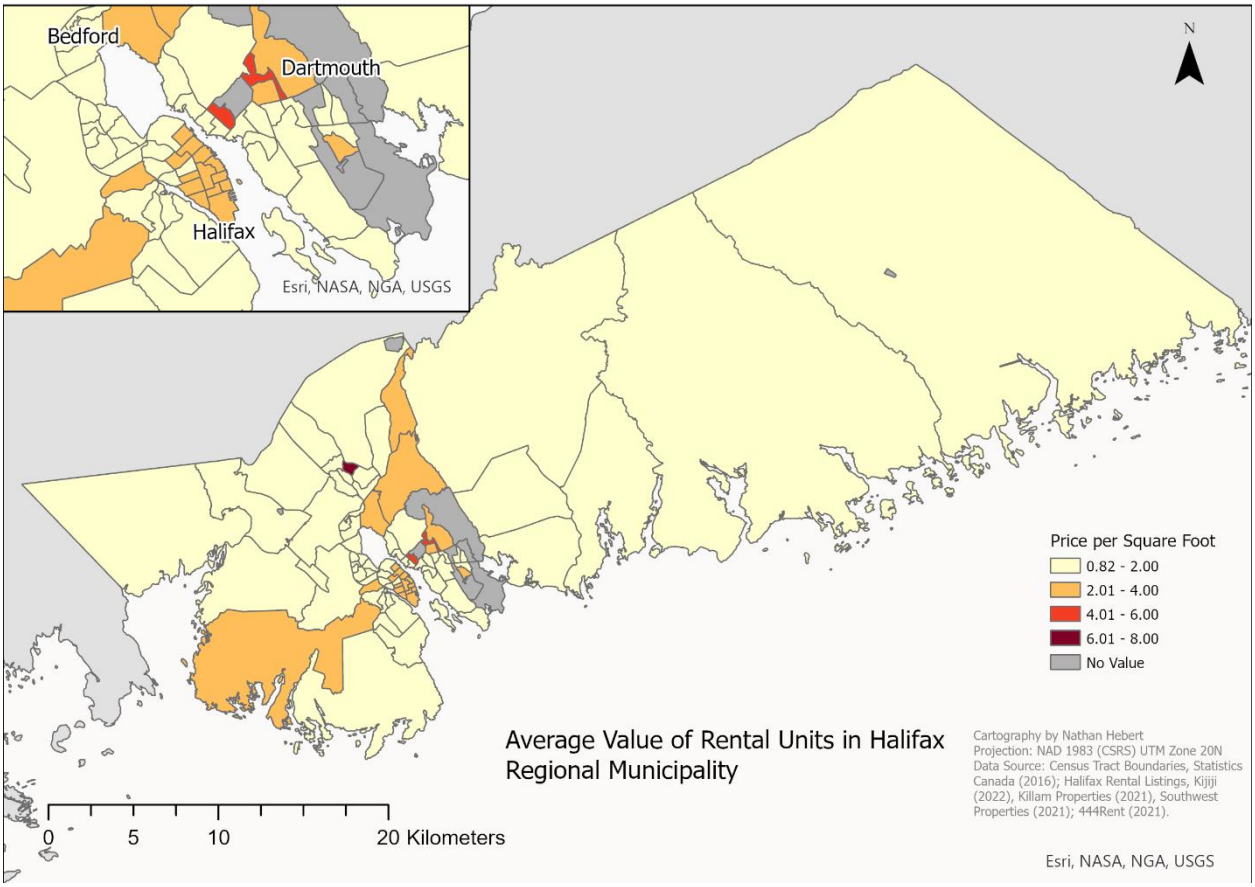

Figure 10 Price per Square Foot for All Rentals

Number of Beds	Average Price/Square Foot
Bachelor/Studio	2.85
1	2.22
2	1.91
3	1.62
4	1.46
5 or more	1.37

Table 2 Average Square Footage per Number of bedrooms

Table 2, reveals the value of rental listings change with the number of bedrooms, with a trend of increasing cost per square foot in the smaller units. One receives more space for their money with the more bedrooms they get in their rental housing. This may help explain why developers are preferring to build smaller units, usually bachelors and 1- bedrooms, as they receive the highest return on their investments in these circumstances.

Spatially, the map above shows the distribution of cost per square foot through the entirety of HRM via census tracts (Figure 10). A noticeable trend seen is most census tracts in the HRM have good cost per square foot relative to each other. Unsurprisingly, the Halifax core shows slightly less value in rental units relative to other rental units outside the core. One surprising point of data is in Dartmouth which show poorer cost per square foot relative to the surrounding area.

4.1.4 Affordability

Number of Beds	Average Price	Yearly income needed to be affordable
Bachelor/Studio	$1130.53	$45,221.20
1	$1438.08	$57,523.20
2	$1928.60	$77,144.00
3	$2198.76	$87,950.40
4	$2878.17	$115,126.80
5 or more	$3538.94	$141,557.6

Table 3 Income needed to live affordably in Halifax

Table 3 illustrates affordability of each unit type based on the standard 30% income rule established by the Canadian government and employed by many researchers. It is important to point out that this is before taxes that the calculation takes place meaning this is not the entirety of the income someone would bring home. Unsurprisingly the average annual income needed rises as the number of bedrooms increase; more bedrooms usually equate to more expensive meaning higher income is needed to afford them. To contextualize this table is average income seen in Halifax, what was found is that average total income seen for all receipts of the 2016 census is $46,440 before taxes and the total household income is $69,522. Though it is hard to say that this number is accurate in 2022, it is the most recent data available as the 2021 census data is still not available. Even 1-bedroom apartments are unaffordable for the average

Haligonian. This is troublesome if people have spouses, children, or family they live with and only are bringing in one income, down the line it could lead to housing insecurity within the city.

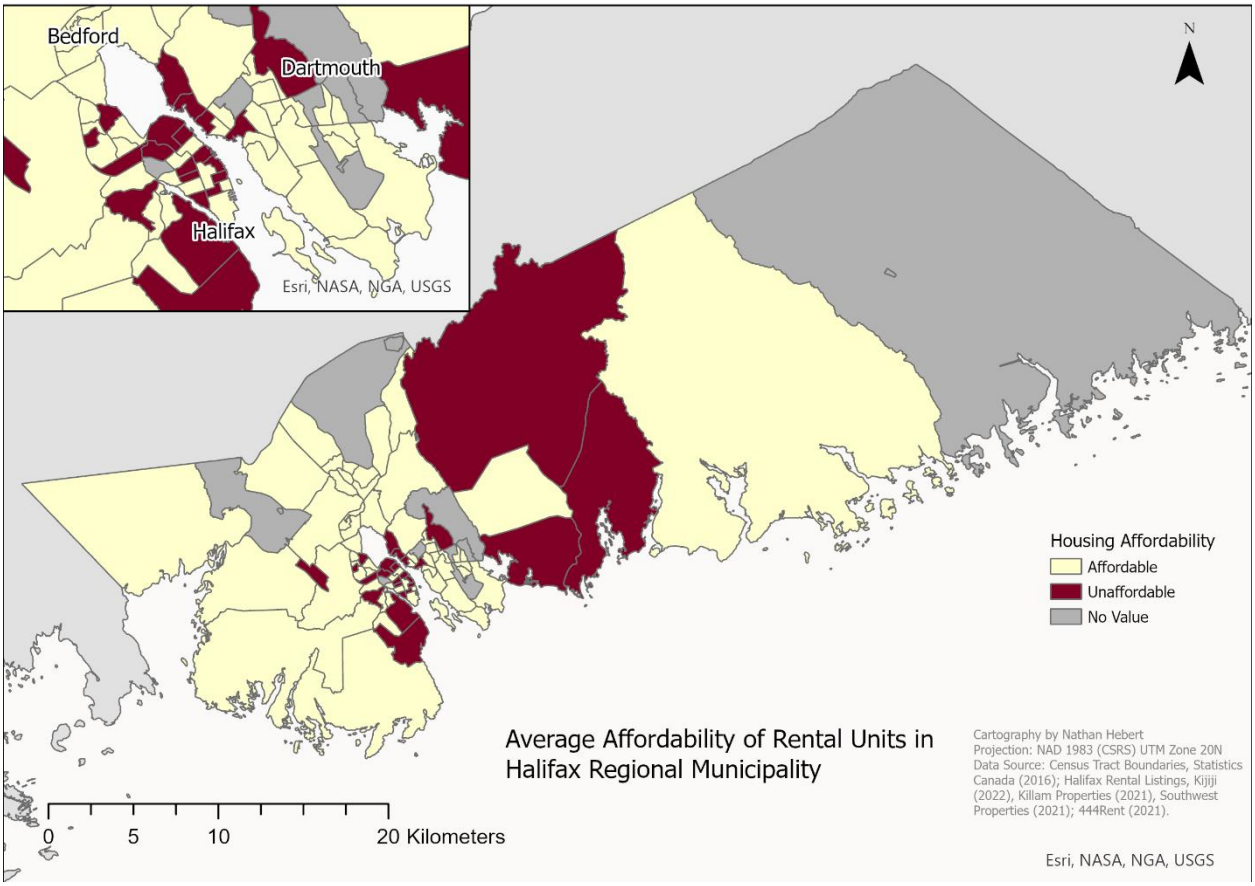

Figure 11 Affordability of All Rentals

Observing all available rental pricing and household income data from the 2016 census an affordability measurement was performed to see how affordable the HRM is per census tract (Figure 11). The map above illustrates a common trend when concerning all rental types and bedroom types, around the former Halifax County it is more common to see unaffordable census tract areas relative to other areas around it such as the Bedford region. Unaffordability should

also be noted outside of Halifax County, in the northern regions of the Dartmouth area there is an increased amount of affordability in the larger census tracts.

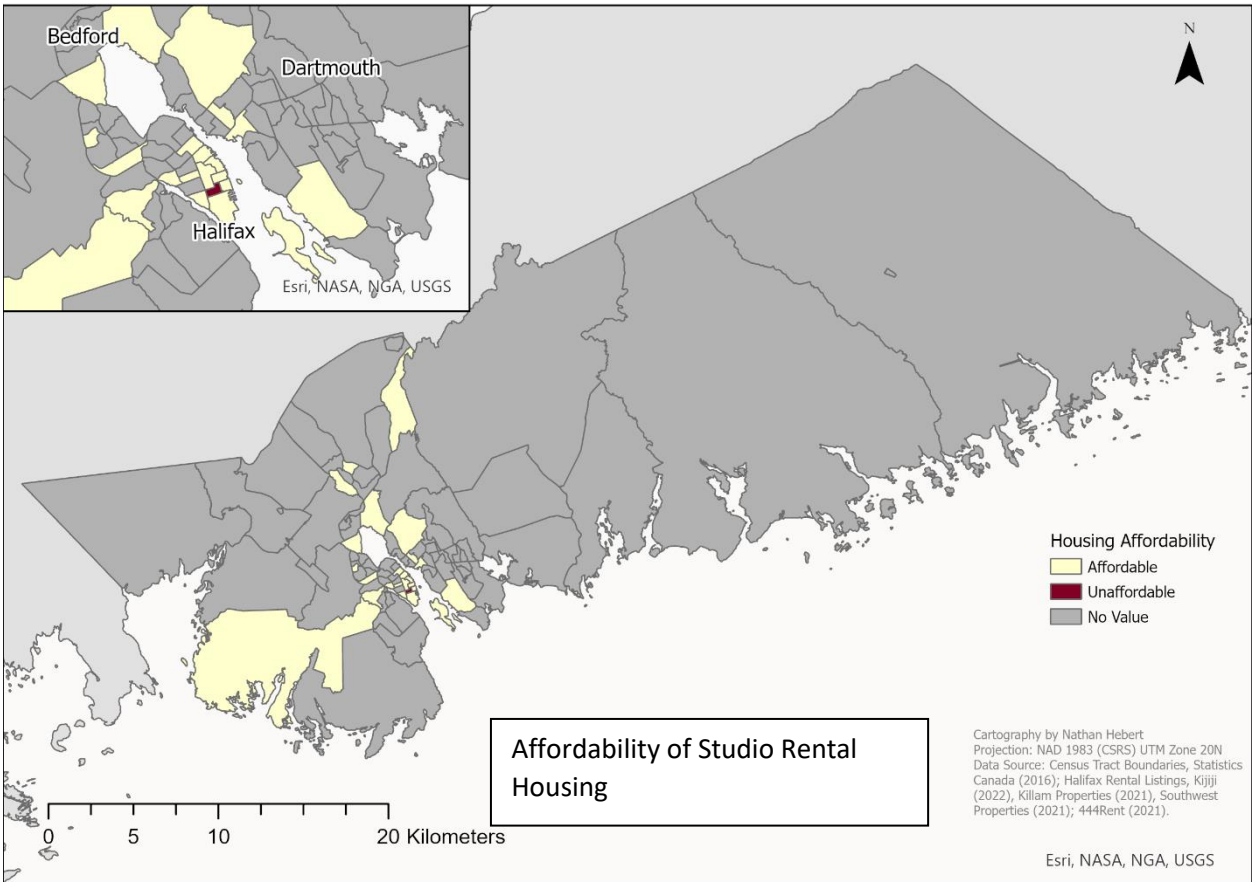

Figure 12 Affordability of Studio Rental

Unsurprisingly, one of the more affordable bedroom options within the HRM are studio rental units (Figure 12). As seen in the map above only one census tract area in the available data points in unaffordable according to the 30% income measurement. This is a likely cause of studio rental units being the least expensive of the bedroom types because of it having the least amount of rooms and minimal space.

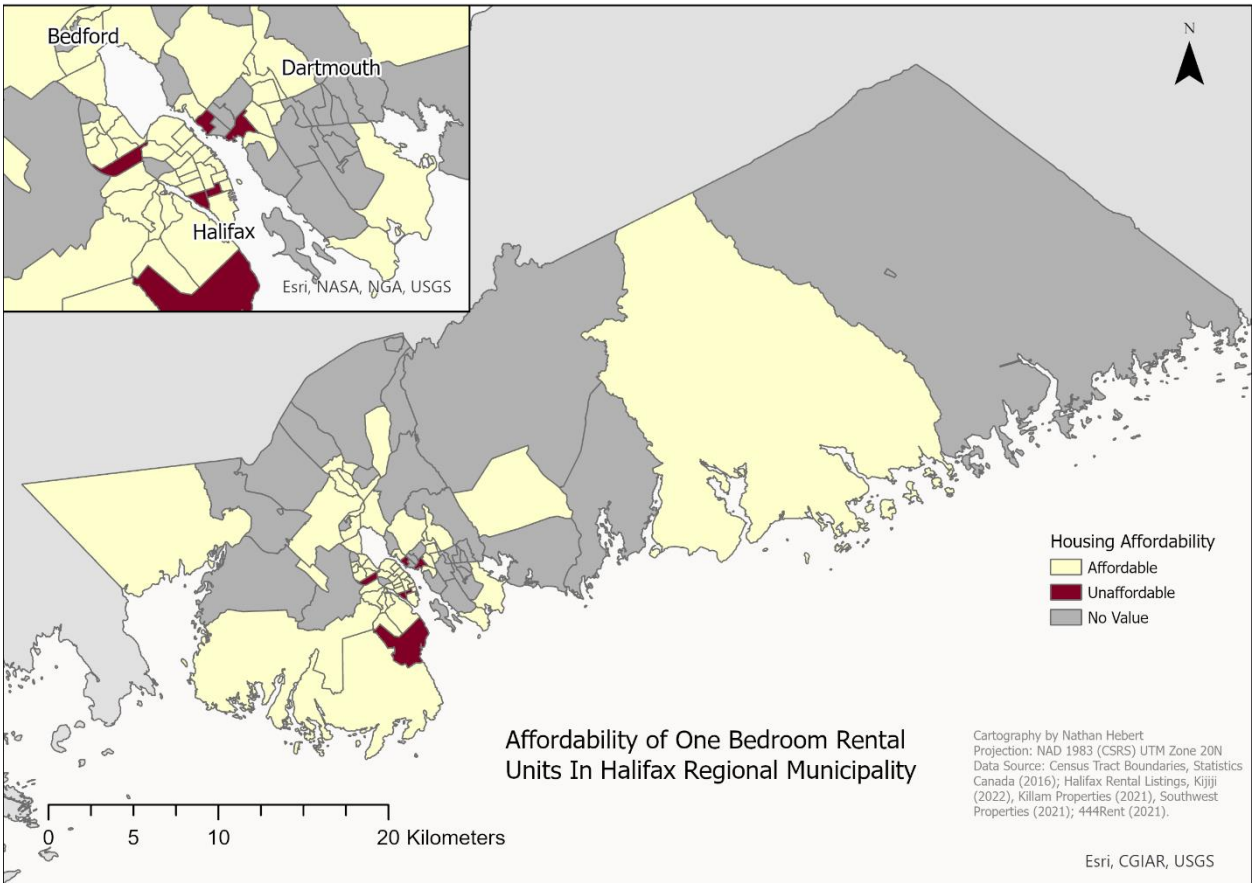

Figure 13 Affordability of One Bedroom Rentals

One bedroom rental units follow a similar trend is observed to that of the studio apartment; more affordable units due to the lower average prices of rental units (Figure 13). Again, because these units are designed to be less expensive because of the limited square footage and bedroom options they are made to be more affordable than larger units with more bedrooms. Some unaffordable sections are observed in a few census tracts surrounding the peninsula on in Dartmouth and in both the northern and southern census tracts of Halifax County.

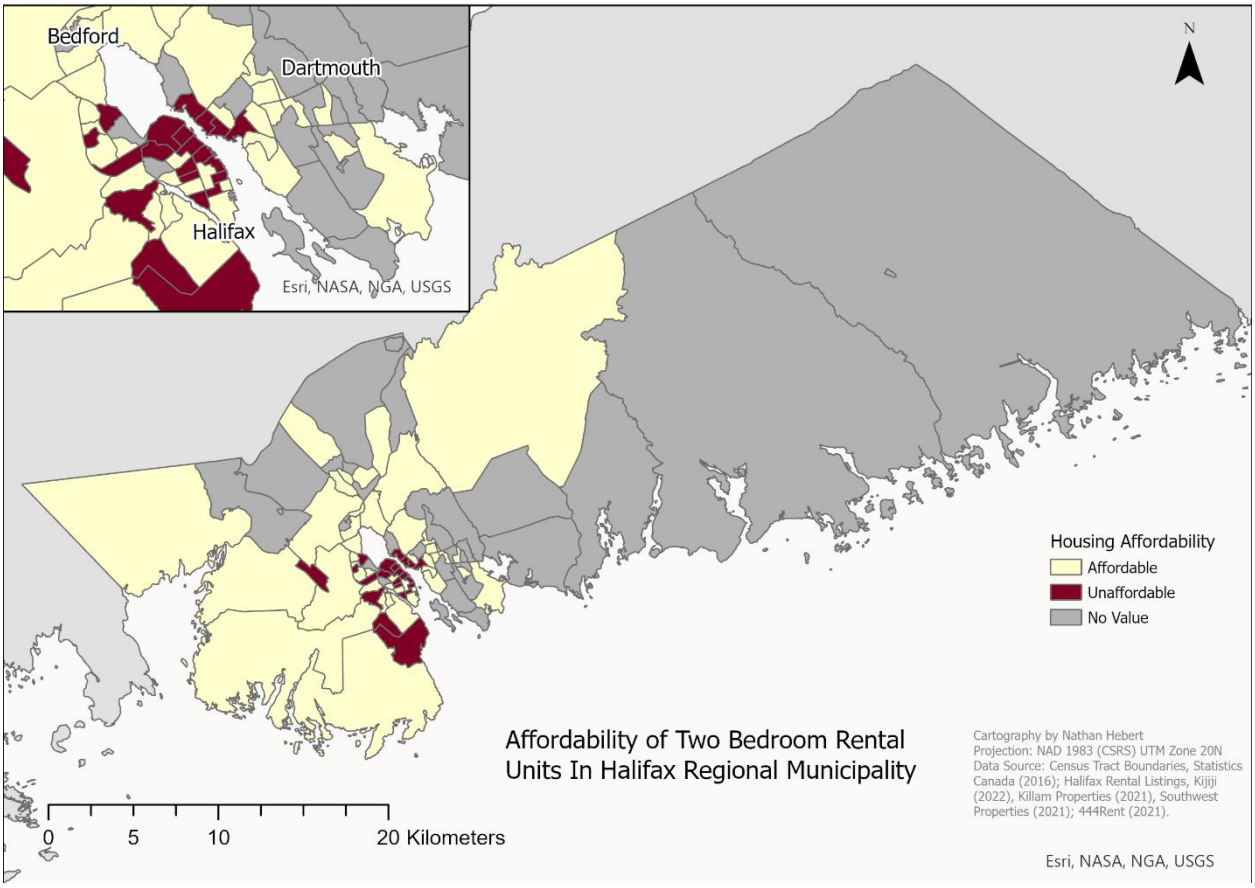

Figure 14 Affordability of Two Bedroom Rentals

Two-bedroom rental units is where the HRM is starting to see some of those affordability issues mentioned at the beginning of this study. In the map above it is seen many census tracts within the former Halifax County are unaffordable (Figure 14). Looking at the specific areas it is shown that the North end of Halifax and the peninsula area are the areas with the most unaffordability. Likely a result of the recent gentrification of the North End of Halifax causing rental prices to rise in an area of low-income in the HRM.

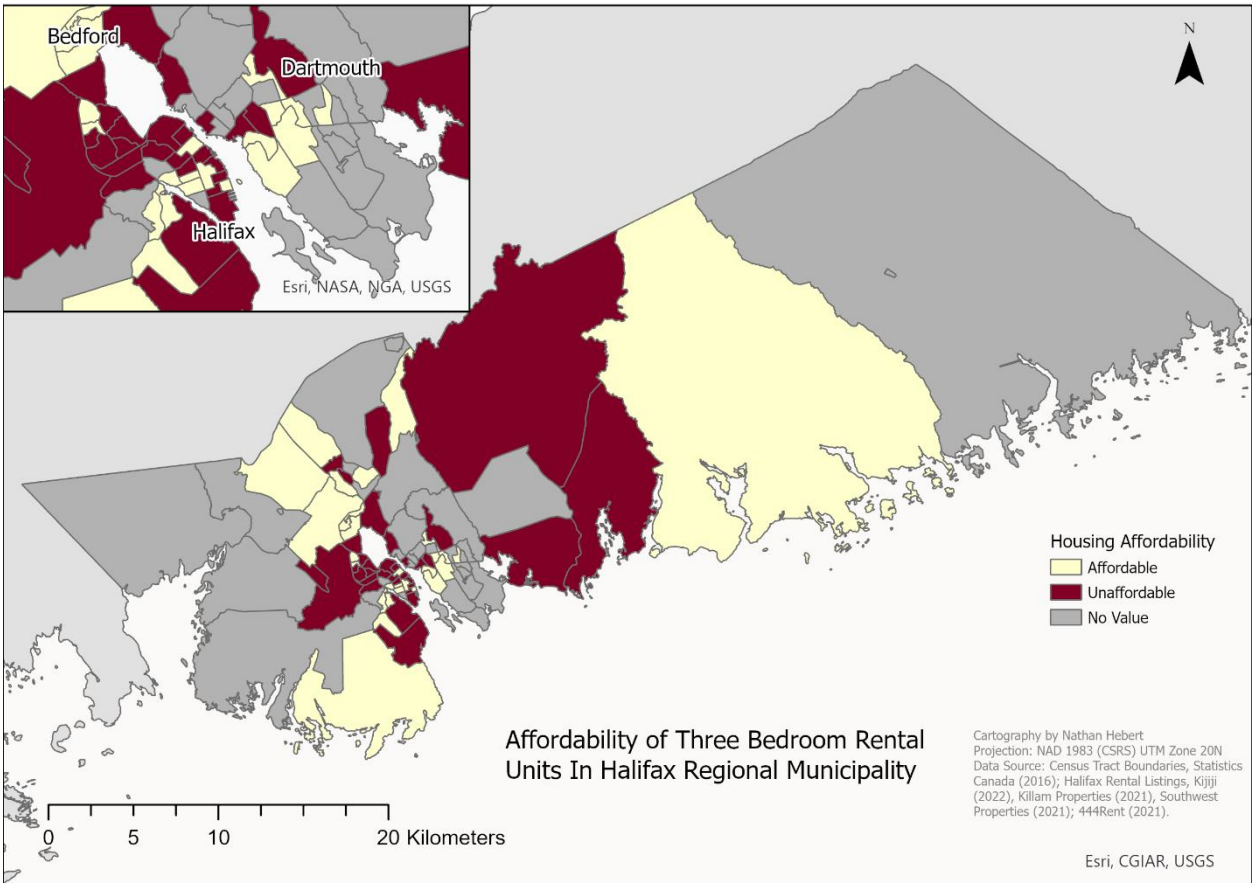

Figure 15 Affordability of Three Bedroom Rentals

In the three-bedroom rental units the Halifax County experiences similar trends spatially to what is seen from the two-bedroom rental units. What is different are the surrounding census tracts of Halifax County have become less affordable with the additional bedroom (Figure 15). With 3-bedroom rental units increasing unaffordable is being seen in Dartmouth and its immediate surrounding census tract, the same can be said with Halifax County as the outskirts are now showing to be more unaffordable as the bedroom number rises (Figure 15).

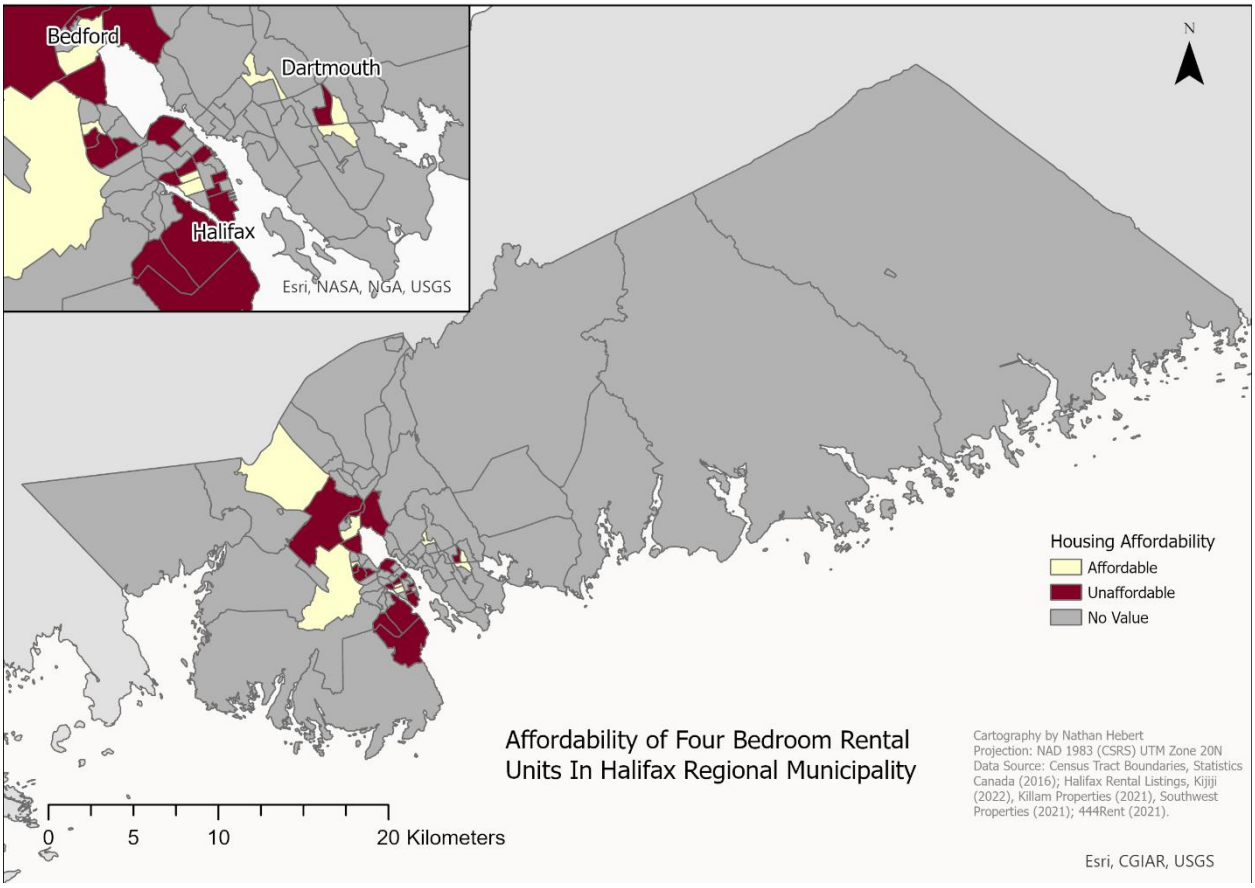

Figure 16 Affordability of Four Bedroom Rentals

Due to the rarity of four-bedroom rental units in the HRM we see a sparse number of units available through the municipality. What can be seen with the limited data is most four-bedroom units listed are unaffordable for the relative census tract (Figure 16).

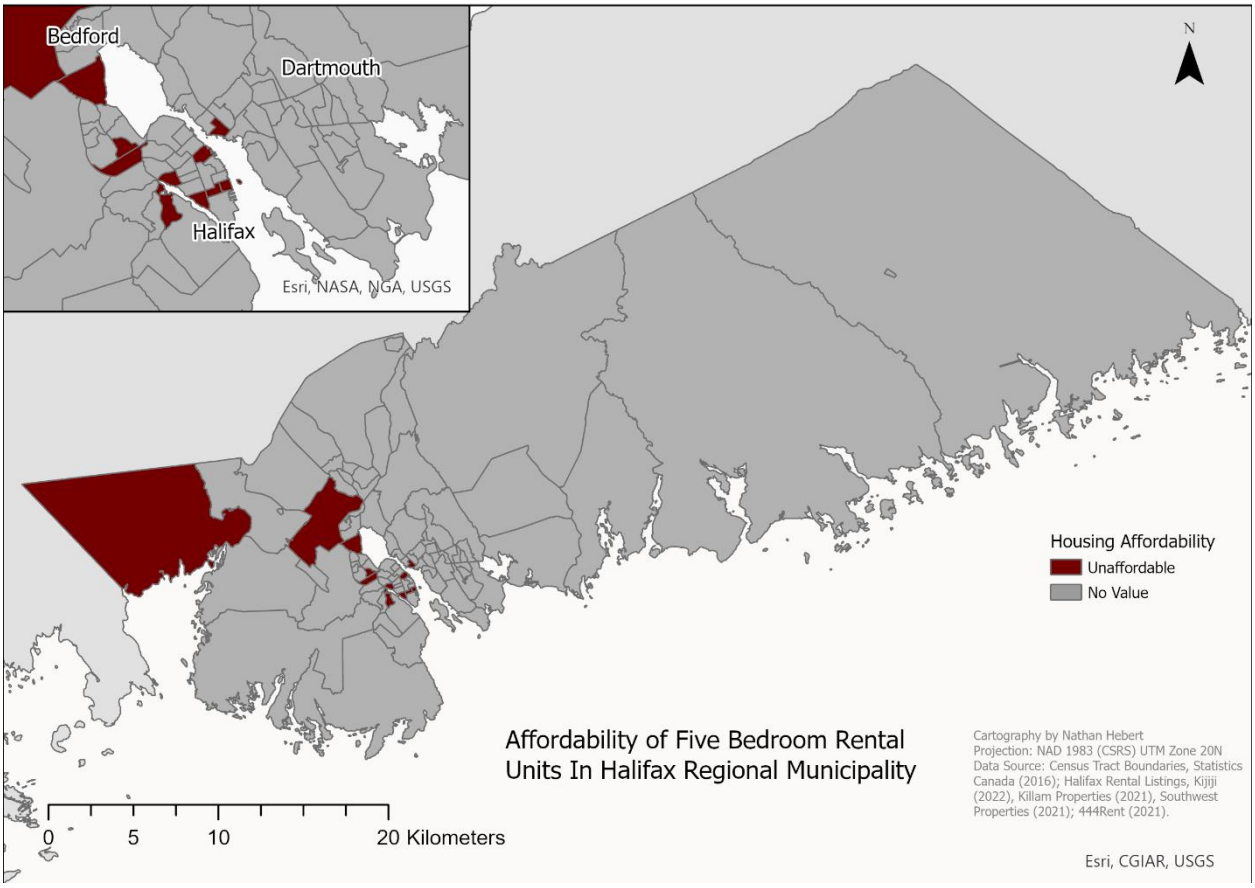

Figure 17 Affordability of Five Bedroom Rentals

As previously mentioned, 5 or more bedrooms in the HRM is a rare bedroom number to rent, leading to limited amounts of listing data. From what data is a available we see complete unaffordable concerning when looking at household income by census tract across the HRM (Figure 17).

A common trend observed amongst the affordability is quite a logical one, as the number of bedrooms increase more and more of the census tracts across the HRM become unaffordable. Issues are still seen within the Halifax County, as many census tracts begin to become

unaffordable at the two-bedroom level meaning rental units attempting to house multiple people, or families are just currently not affordable in the Halifax Regional Municipality.

4.1.5 Rental Characteristics

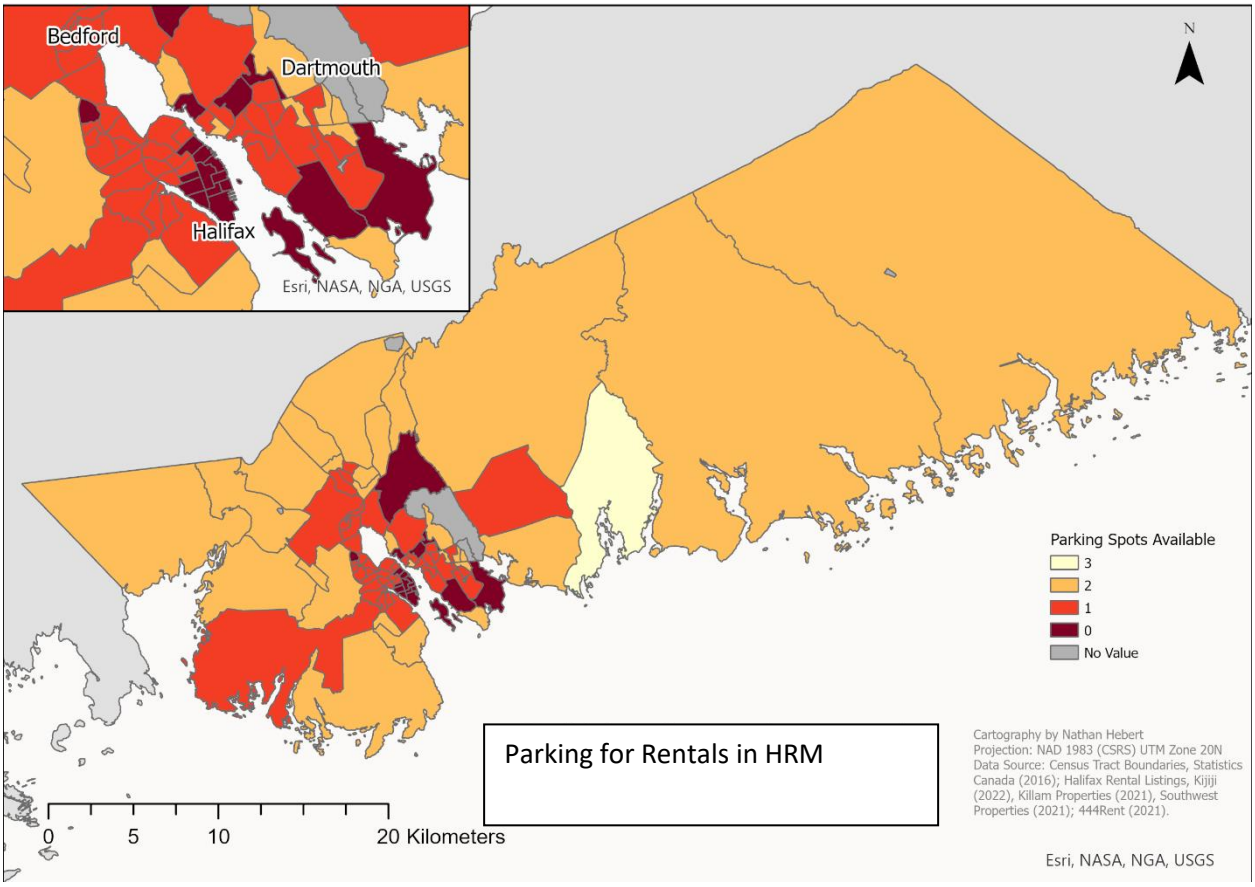

Figure 18 Parking Spots Available

One thing that is not discussed enough in rental housing are the characteristics of the rental unit beyond the price. Unfortunately, the large developer sites as well as Kijiji often do not include data for unit characteristics for every unit posted. Since many rental units were collected into our dataset sufficient a number of units with characteristics were collected. For this study I chose to focus on rental characteristics including parking spots available, square footage, number

of bathrooms, and type of laundry available for the unit. Observing Figure 18 above, showing that the number of available spaces decreases in the urban cores of both Halifax and Dartmouth. Moving further outside of the urban core we start to see parking spots more common within the units along with some areas producing multiple parking spots available for the tenants.

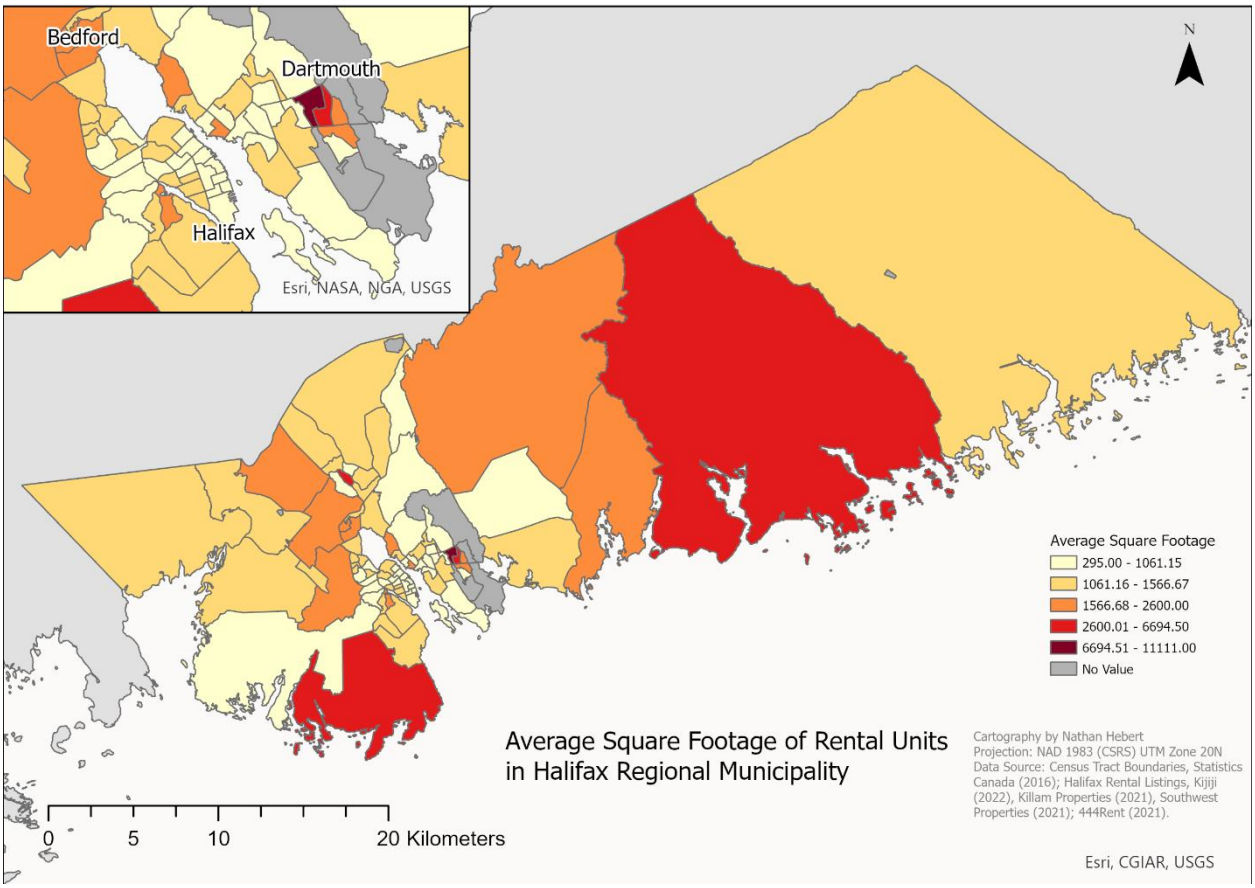

Figure 19 Square Footage of Rentals

When looking at square footage breakdown in HRM, first let's acknowledge a large range of values, Figure 19 above illustrates spatial distribution of the square footage per census tract. The map indicates a clear trend, average square footage increases the further removed from the urban core.

Looking at the different laundry situation throughout the entire HRM it is more common to see in laundry inside the rental complex rather then the laundry being directly inside a tenant's rental unit. The number of bathrooms is related more to a spatial factor where the number of bathrooms is low in the urban core and increase while moving outward, again relating to the higher amount of low bedroom numbers in Halifax's urban core.

4.2 Primary vs Secondary Rental Housing

4.2.1 Spatial Distribution

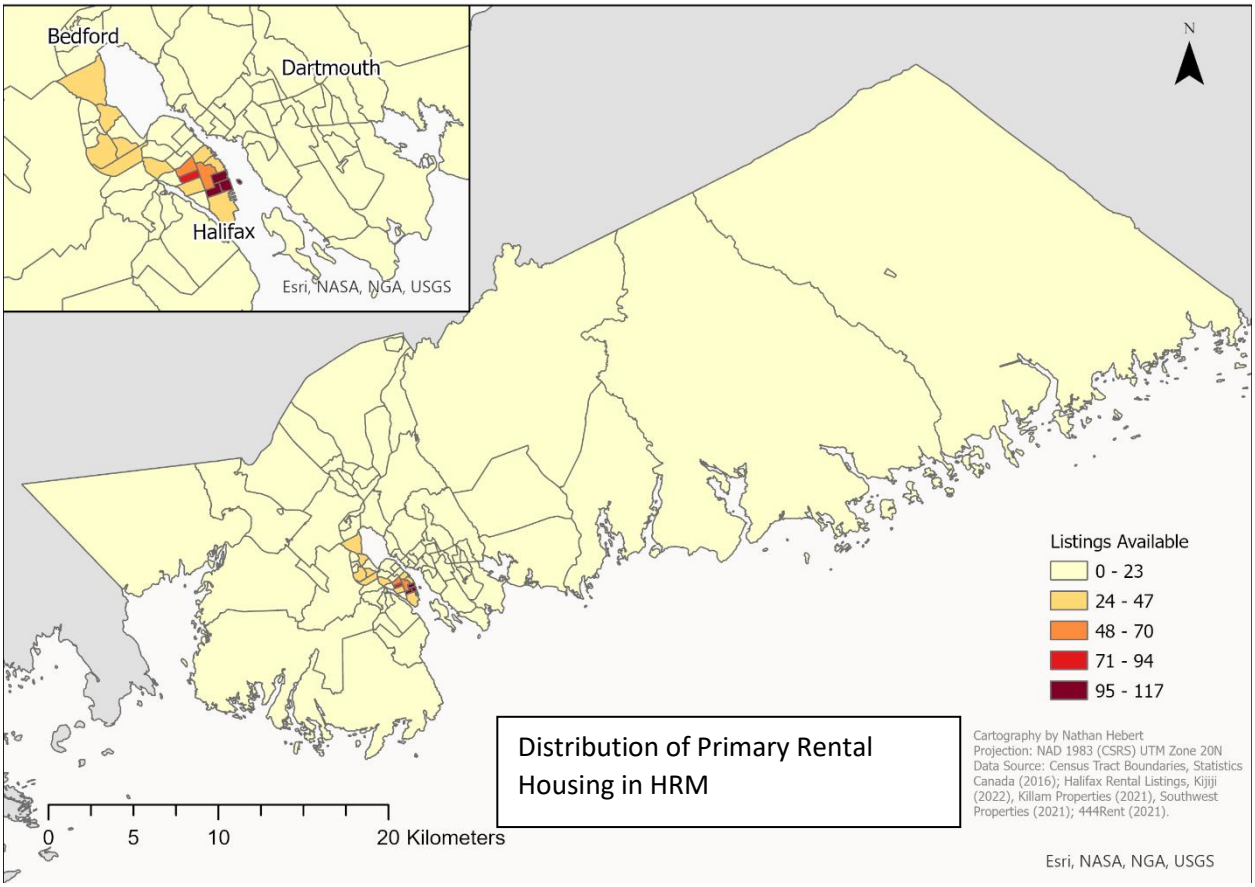

Figure 20 Distribution of Primary Rentals

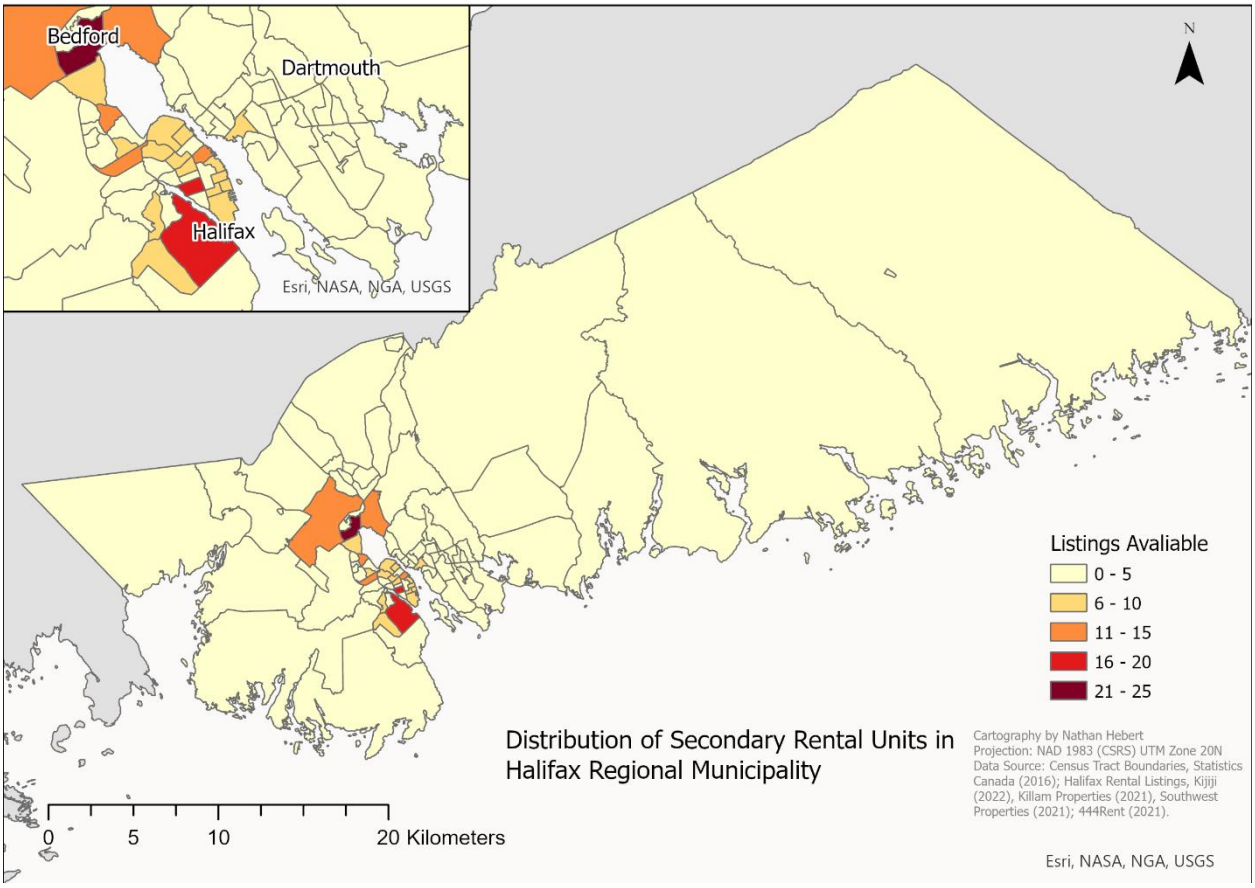

Figure 21 Distribution of Secondary Rentals

Figure 20 shows the locations and density of every primary listing gathered in the data collection process of this study, revealing, a large density of primary rental in the downtown core located more towards the South End and middle, with greater sparsity moving out of the urban core and into less populated census tracts. Meanwhile Figure 21 demonstrates a different distribution of rental listings for the secondary market rental housing. Looking again at the

downtown core we still see a large density of rental listings, but in this case the density of the listings is much more dispersed than what was shown with the primary rental housing.

4.2.2 Pricing

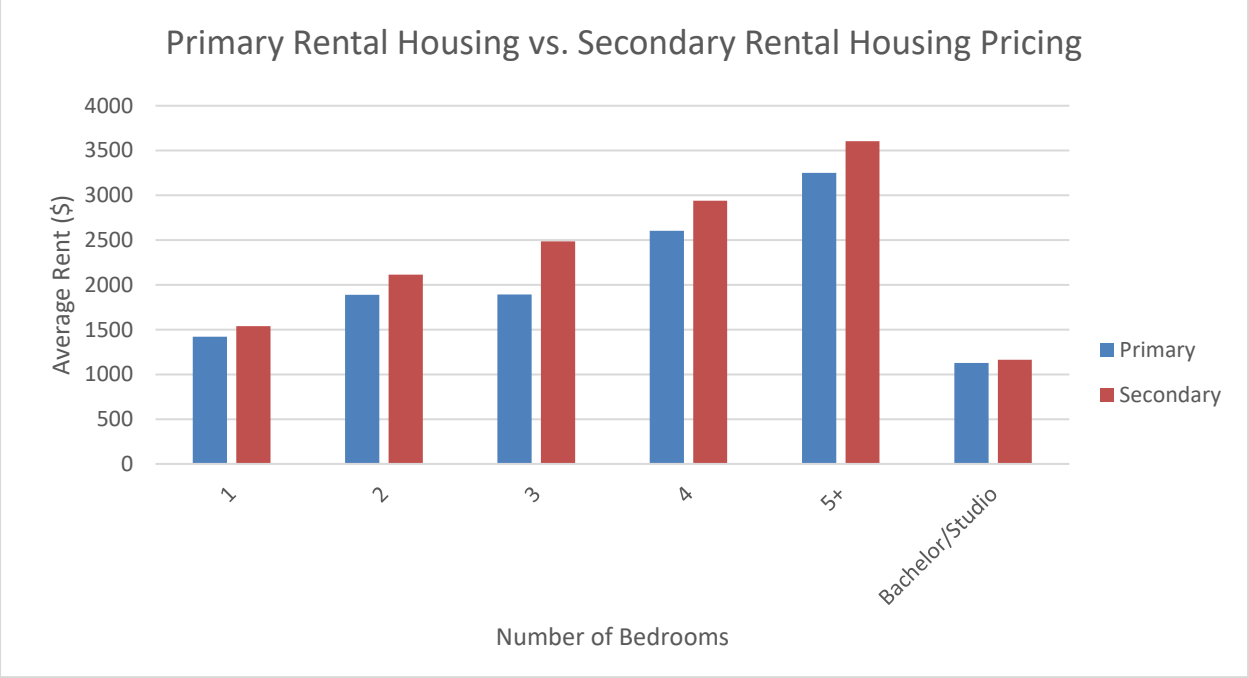

Figure 22 Primary vs. Secondary Rentals Pricing

A noticeable trend seen when observing primary and secondary rental units price points is there is a clear distinction from an aggregate view that secondary rental units are slightly more expensive than that of primary rental units. An argument can be made and will be seen through this section of this results chapter that a reason why secondary units may see an overall higher price point is the inclusion of better characteristics. In some cases, the secondary rental units may

even have extra expenses included such as wifi, a backyard, heat, water, and electricity. Throughout this chapter a deeper dive into the full characteristics of each unit type will help understand their overall differences within HRM.

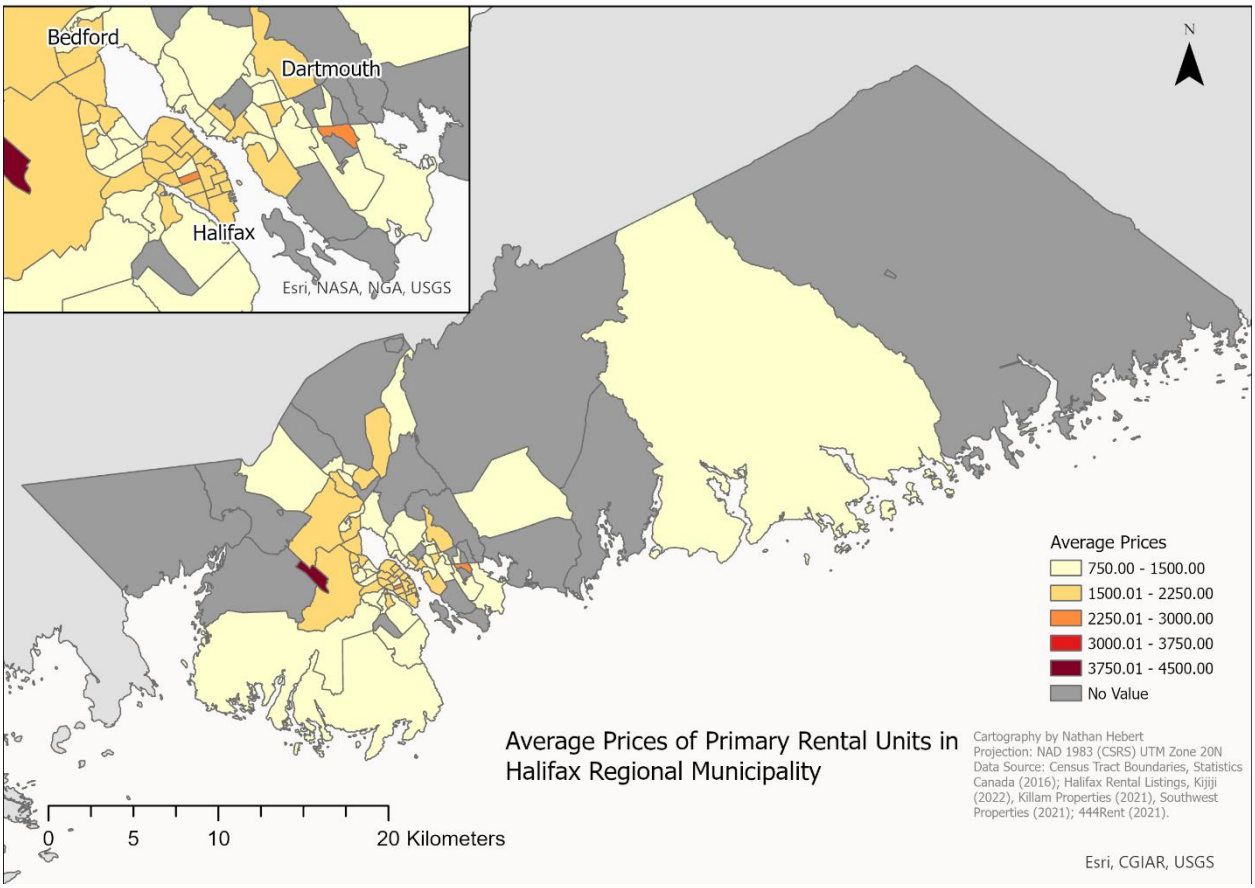

Figure 23 Average Pricing of Primary Rentals

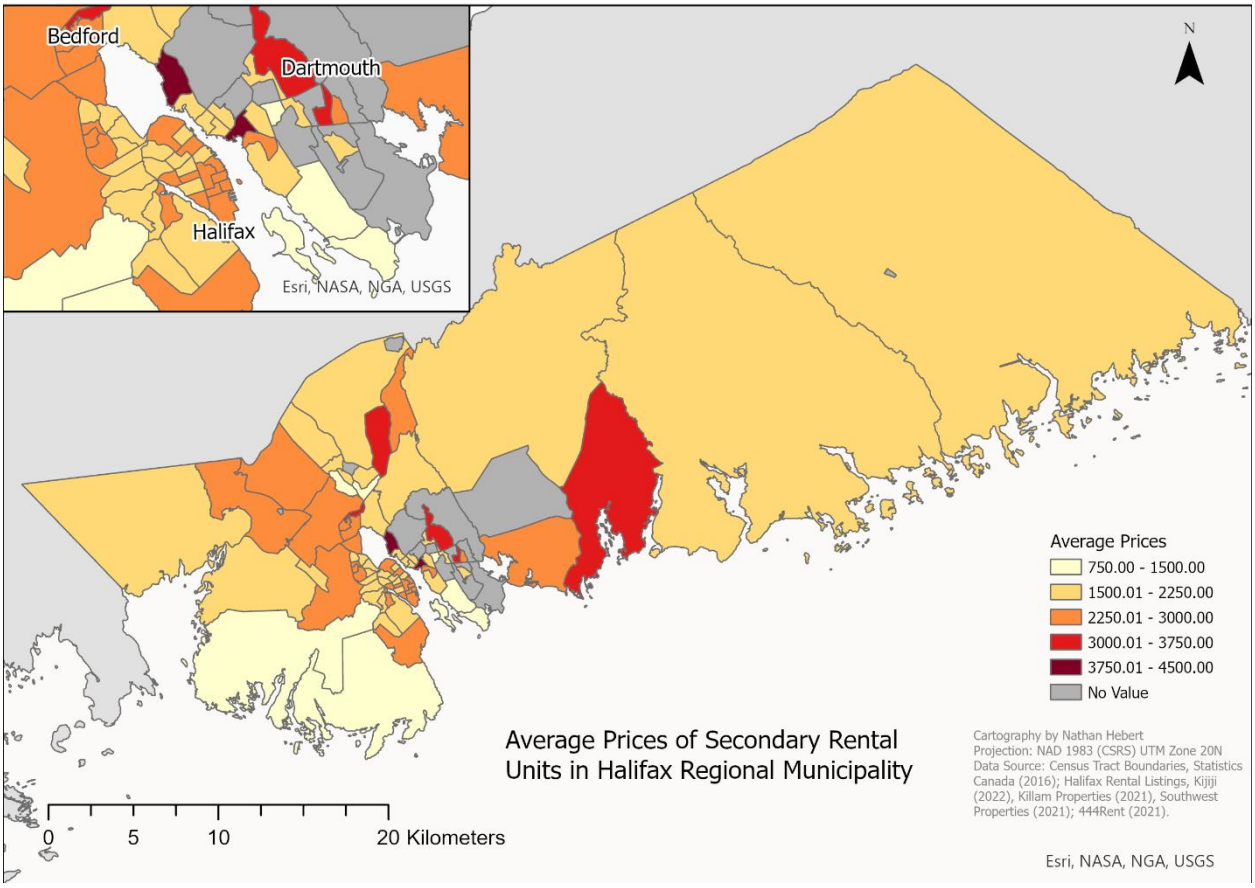

Figure 24 Average Pricing of Secondary Rentals

An important aspect of this research is to differentiate the characteristics of primary and secondary rental housing. In Halifax, shown in the graph above, Figure 23, differences in prices through the entire Halifax Regional Municipality, as secondary rental housing on average is more expensive than primary rental housing. This trend holds true for all rentals; however, the greatest difference is found in units with three bedrooms.

Observing the differences in prices using census tract level data for both primary and secondary units spatially, a similar trend to Figure 24 is seen with the price points of primary and secondary varying. Again, in a majority of the HRM secondary rental housing sees higher

consistently higher price points by census tract. In the Halifax urban core there is only a slight difference in pricing between the two rental units, but moving outside of the urban core to the outskirts there is a more drastic difference in price. In the areas where there are no primary rental units, the secondary rental units are surprisingly more expensive. This could be a result of multiple variables such as low supply of rental housing in the area and increased number of bedrooms.

4.2.3 Values

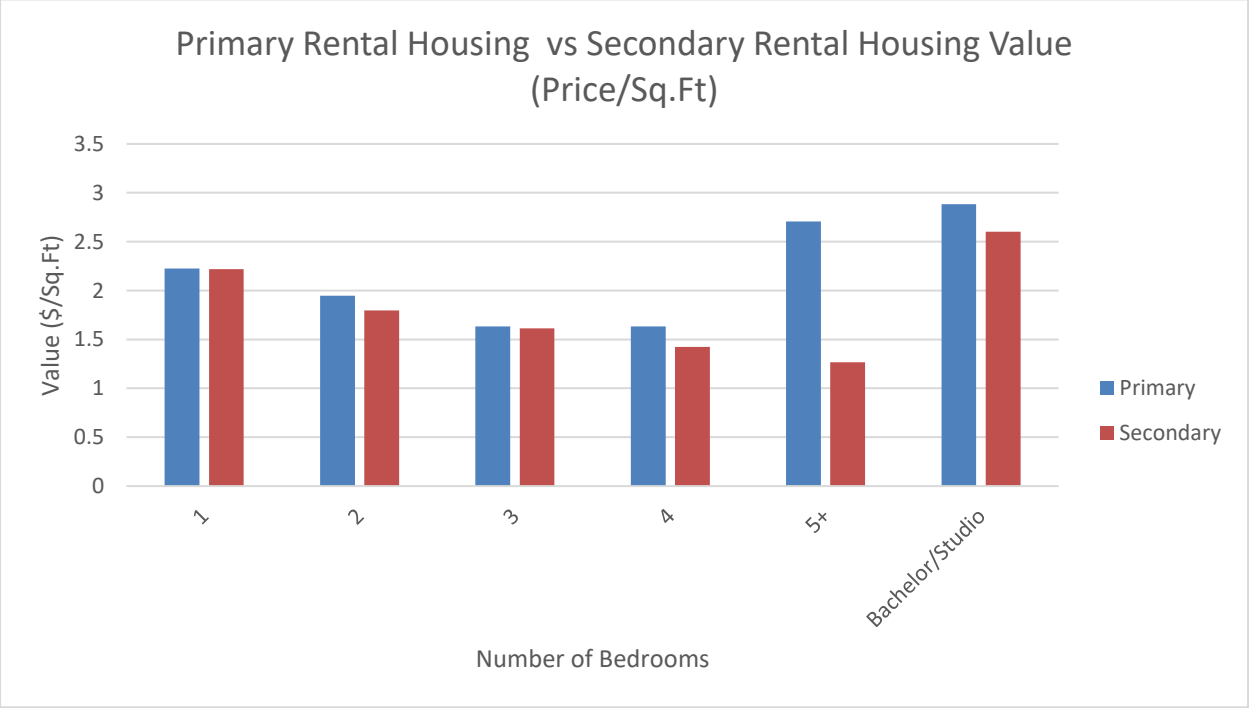

Figure 25 Primary vs. Secondary Price per Square Foot

In totality across HRM primary and secondary units have similar price per square foot or for 1- and 3-bedroom units, however in other bedroom sizes it is clear that a renter is receiving worst value per square foot in primary rental housing, with the greatest difference being five or greater bedroom units (Figure 25). This can be explained by going back to the definition of

secondary rental housing, while primary rental units are limited to purpose built apartments, secondary rental units can be an entire house or townhouse which would in most cases have larger square footage then a apartment unit.

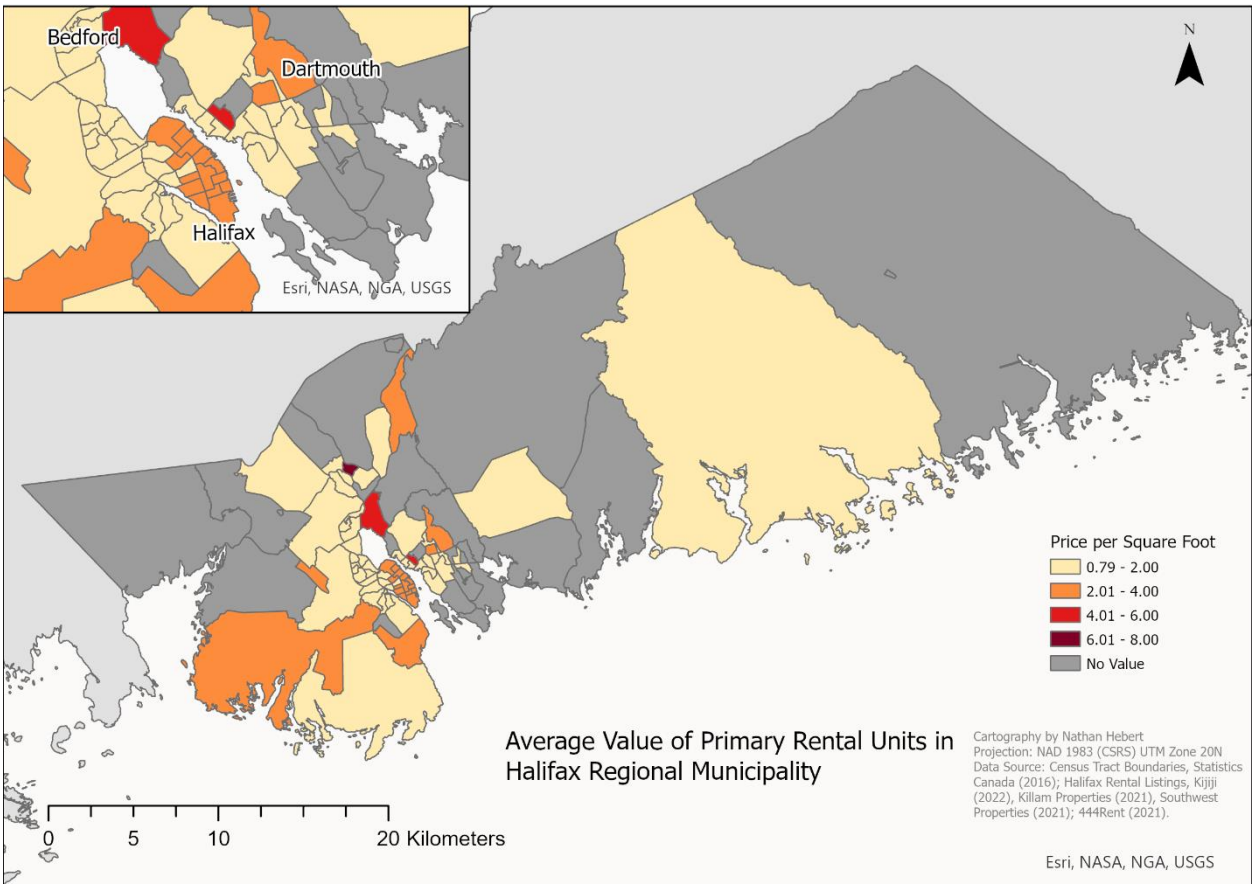

Figure 26 Primary Rentals Price per Square Foot

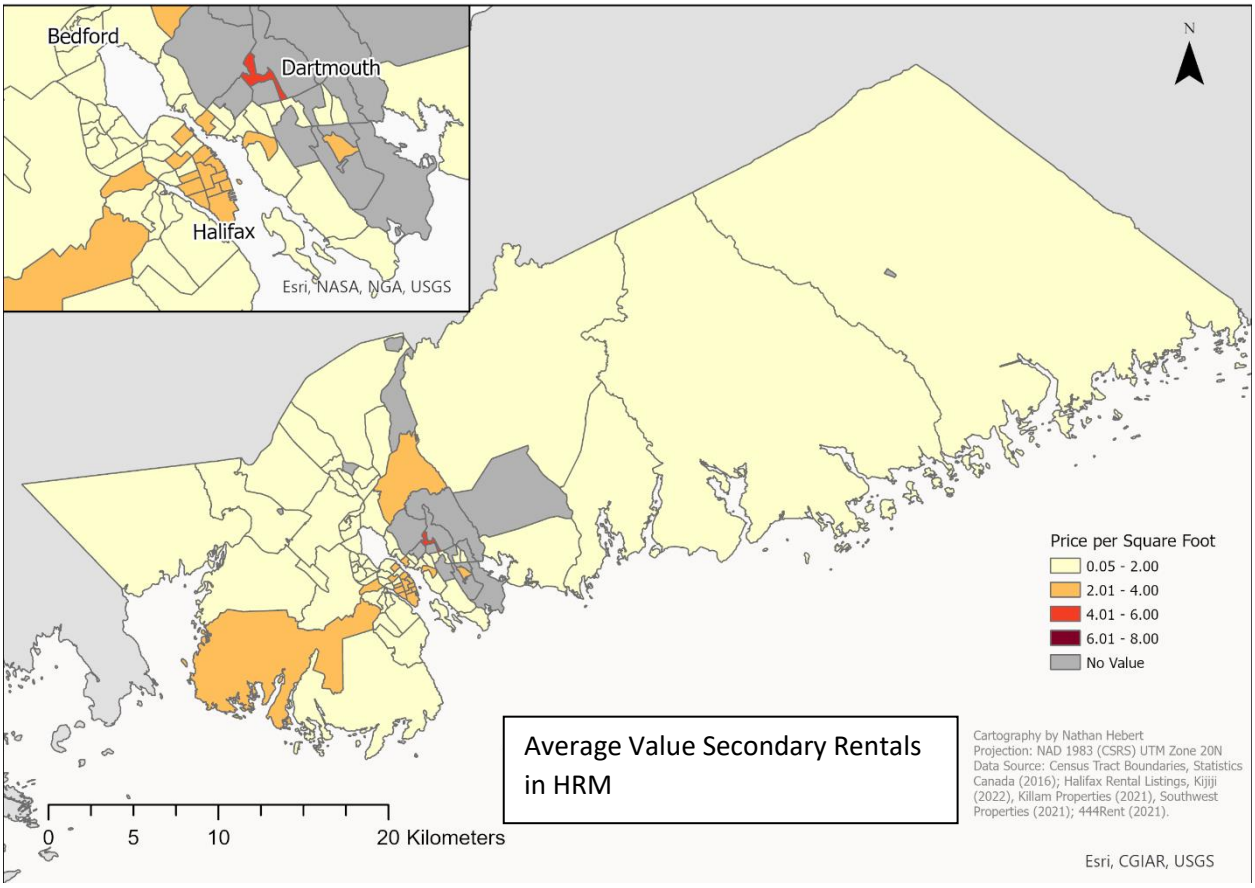

Figure 27 Secondary Rentals Price per Square Foot

Primary rental housing sees low value numbers around the Halifax peninsula and areas within the Dartmouth along with Bedford that are located near the ocean, meaning renters are paying a premium to live closer to the ocean and waterfront area around the Halifax urban core for primary built rental housing. Secondary rental housing in general sees a little different spatial trends, in totality the price per square foot is better consistently around the municipality, renters are seeing more value size wise for there dollars spent. Again near the peninsula there are some

census tracts which so relatively higher values, although in all less census tracts in Halifax's urban core hold better value for secondary rental housing rather than primary rental housing

4.2.4 Affordability

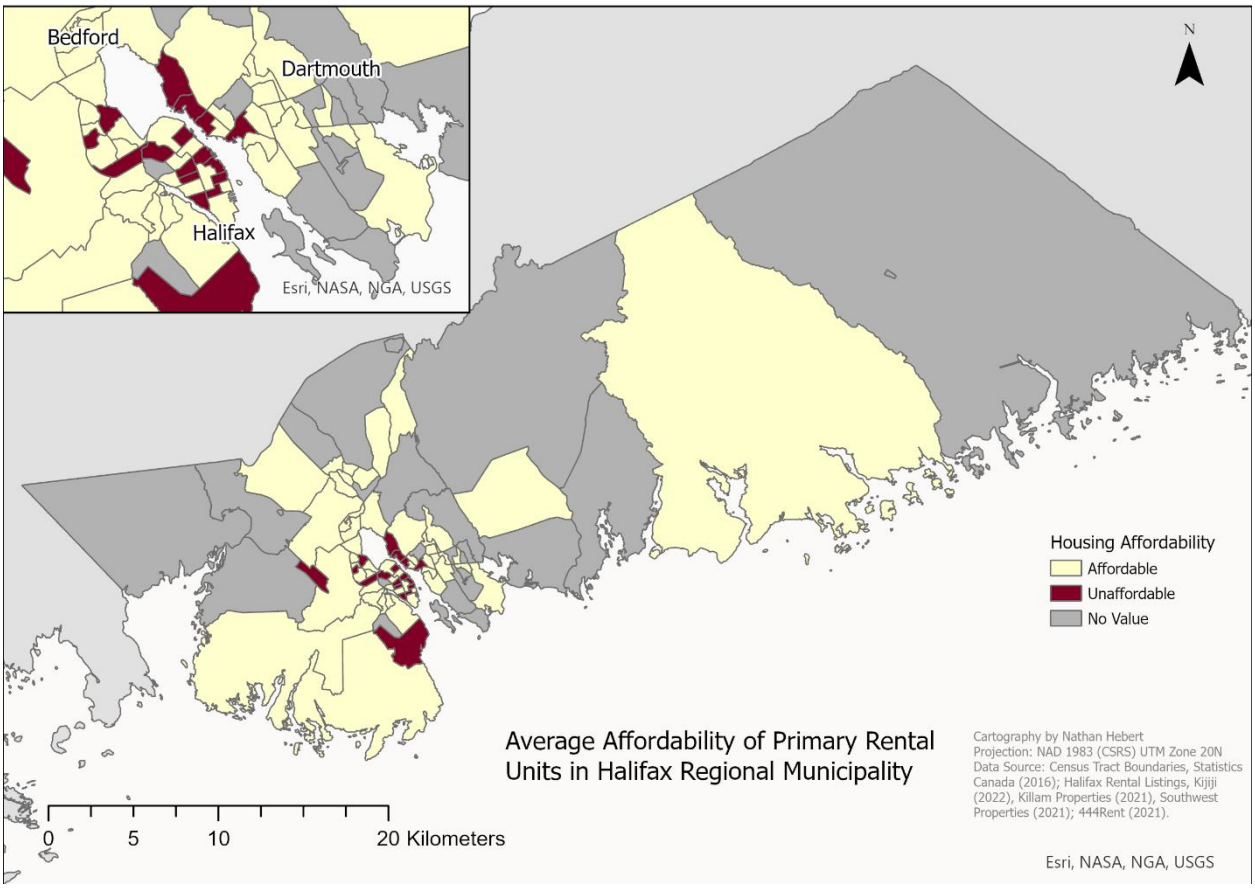

Figure 28 Affordability of Primary Rentals

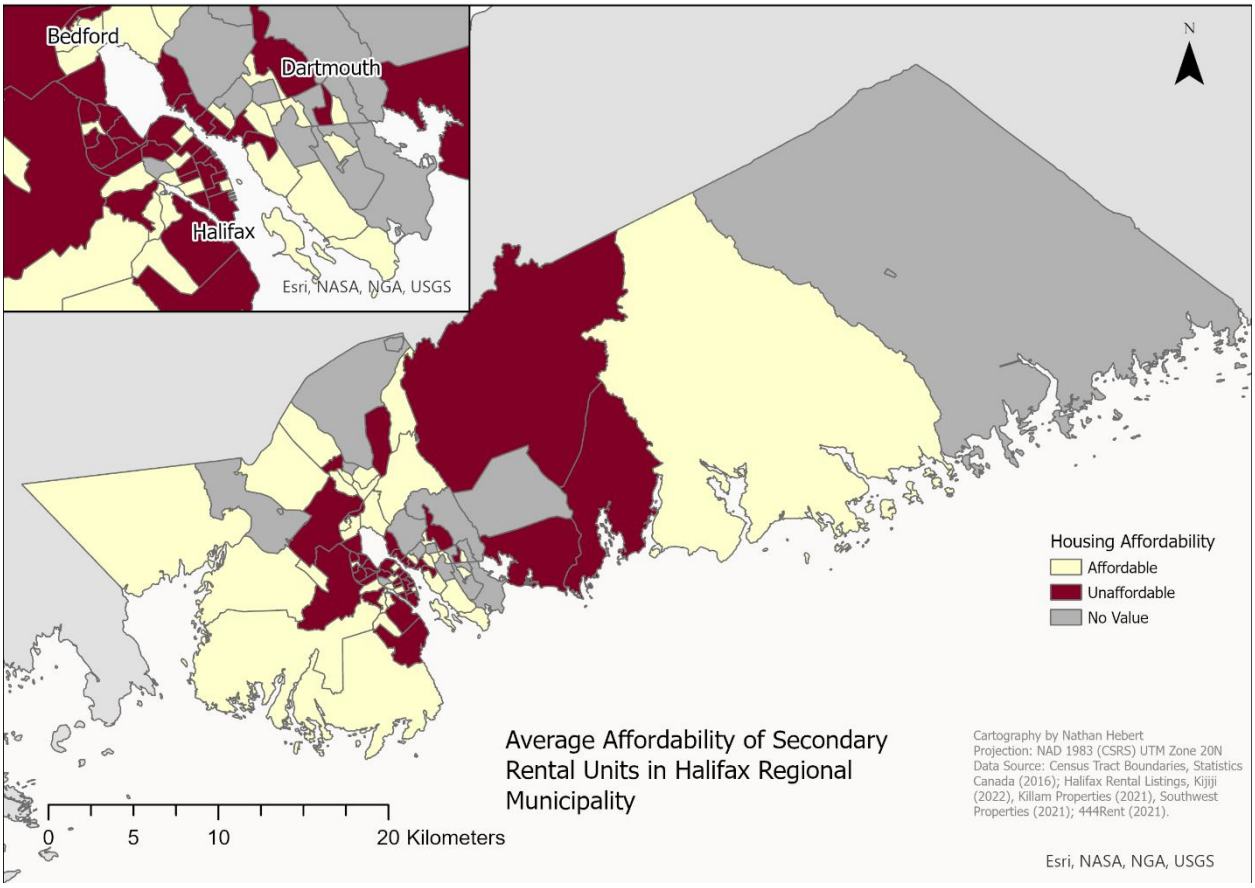

Figure 29 Affordability of Secondary Rentals

The two maps above, representing primary and secondary rentals, demonstrate differences in affordability between the two through HRM. Primary rental housing sees a majority of census tracts being affordable when just looking at the rent prices, showing a difference from the total of HRM in the previous part of this chapter, affordability is seen both in census tracts in and out of the urban core. Secondary rental housing from an affordability standpoint is concerning, many of the same census tracts that are affordable for household incomes for primary rentals become unaffordable once secondary rental units are in focus.

4.2.5 Amenities

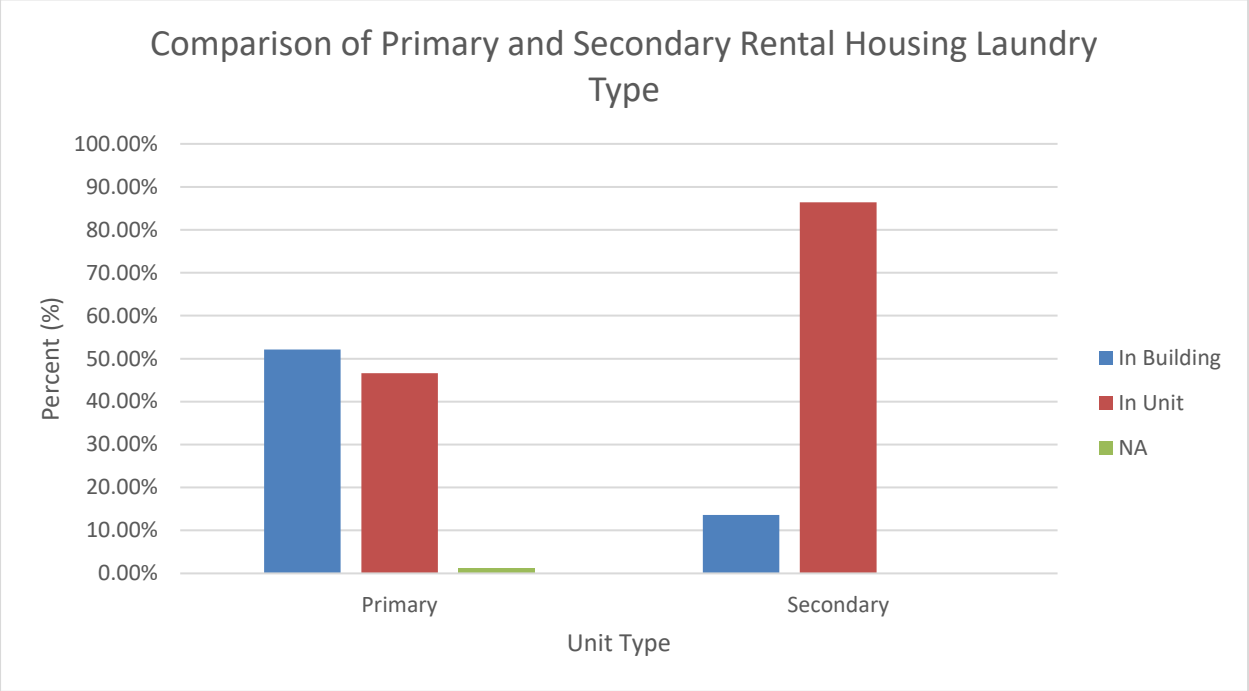

Figure 30 Primary vs Secondary Laundry Situation

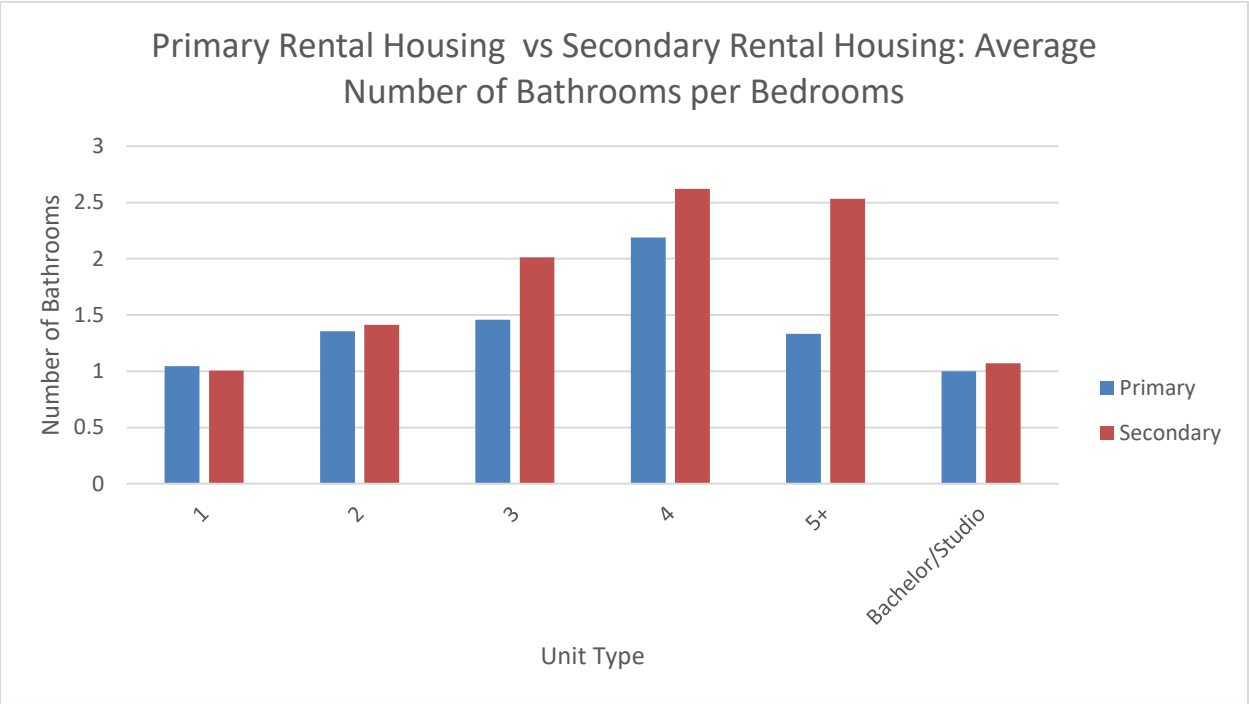

Figure 31 Primary vs. Secondary Number of Bathrooms

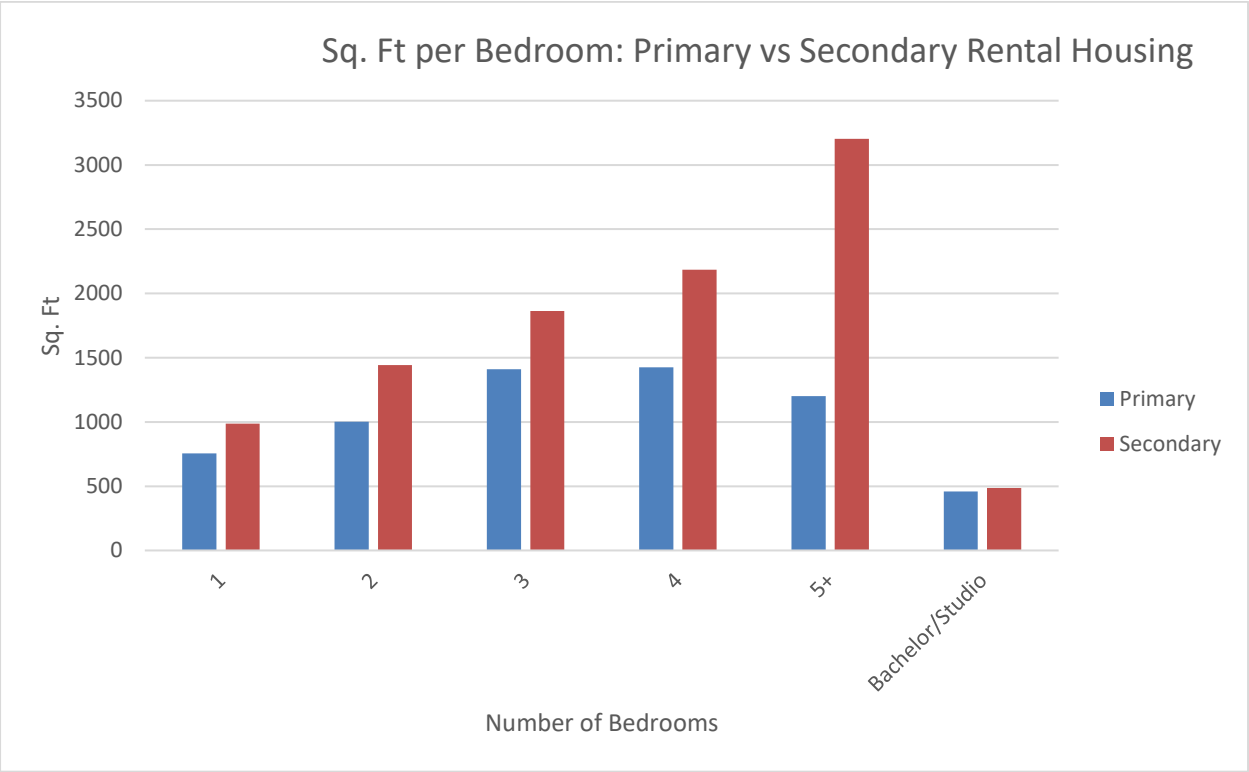

Figure 32 Primary vs. Secondary Square Footage

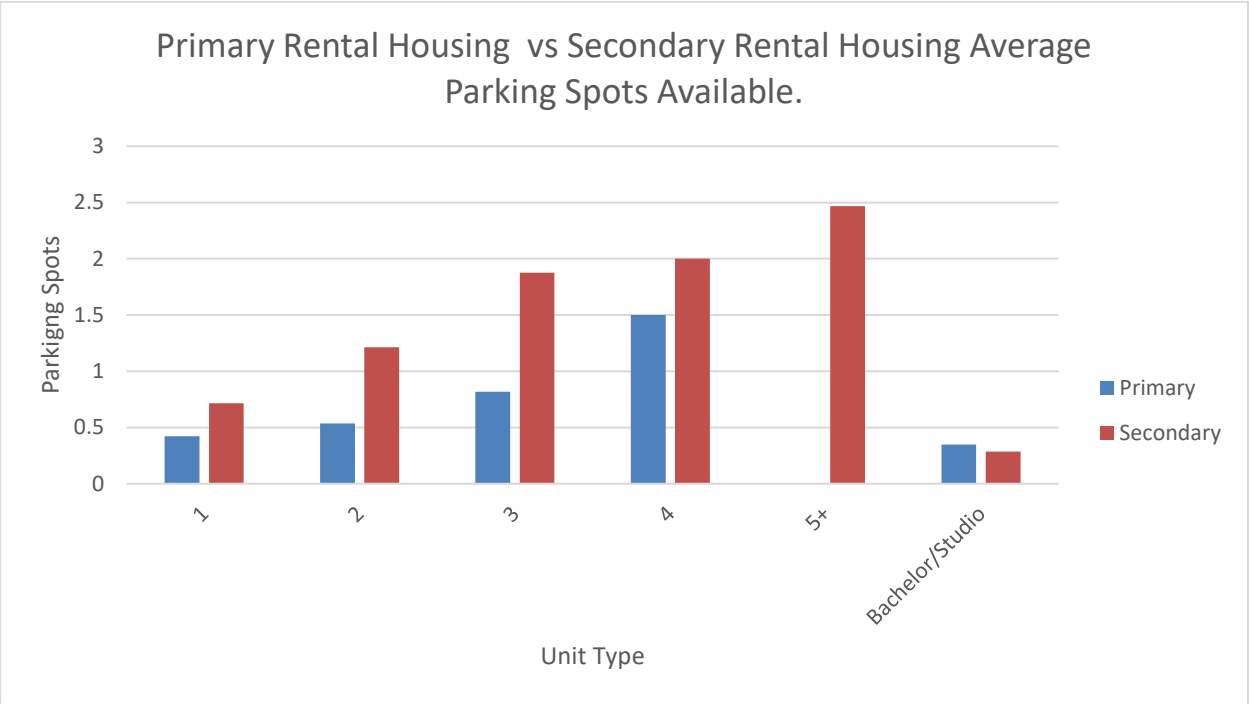

Figure 33 Primary vs. Secondary Available Parking Spots

Analyzing the data surrounding amenities for primary and secondary rental housing, a clear difference in the number of amenities provided for each unit type. Secondary rental housing, although overall more expensive on average, in unit laundry is more common, more bathrooms are usually available, larger square footage per bedroom, and more parking is available. Secondary rental housing provides more extras to potentially make a tenets life easier for an extra price. Primary provides less expensive and more affordable rental options but leave out some amenities and, in some cases, one may have to pay extra to receive some of the same amenities available for secondary rental unit tenants.

Chapter 5
Discussion

Haligonians have reason to be concerned about the current state and future conditions of rental housing in their city. Affordability in both urban and suburban areas. Average prices of rent will likely increase in coming years, especially once the current 2% rent cap expires. If this trend continues Halifax may see continuing housing insecurity and people migrating out of province due to unaffordable housing costs in both home ownership and rental housing. On top of the increasing unaffordability in the urban core amenities are sparse, people are likely to not have access to parking, living in smaller units with fewer bedroom than those rentals in the suburbs or exurbs of HRM. Of note to policymakers are the areas of where affordability is especially low, with noteworthy areas found across the peninsula and especially in the North End.

We see several distinctions when comparing primary and secondary units in terms of price and amenities. This is likely a situation of consumer preferences and needs, with no type being better than the other. If a family is searching for a place with parking, more square footage, and other amenities it would be best to pay the increase on paper rent of secondary rental housing. While someone who does not need those extra amenities and space would be better off sticking with primary built rental housing in HRM.

The results of this study allow for actionable insights by both the province and people finding appropriate rental housing in Halifax. For the province this study provides insights to the aggregate pricing around the HRM and visibility into affordability issues. With this information now available and methodology of data collection of online advertisements shown as possible, the provincial and municipal governments can start investigating and applying action to the rental housing issues seen throughout Halifax. As for the people of Halifax this study provides pricing

benchmarks of what they can expect from rental units through the municipality. Providing also, insights into the different characteristics of rental units in HRM.

Outside of the results for of this thesis, one of the most important aspects is the advancement in data collection demonstrated with web scraping. The methodological advancement shown demonstrates the possibilities for policymakers and others to not be reliant on insufficient data from organizations such as CMHC or must wait for the Canadian Census to come out, it is possible with web scraping to create an amazingly rich data set. In just two weeks of scraping data over 5000 listings were collected, over longer periods of time hundred of thousands or even millions of listings would be able to be collected. Demonstrating web scraping in this context is valuable to future research on the Canadian rental housing market and will hopefully inspire more research to be conducted in this understudied topic.

Limitations of this study pertain to the data available, and the methodology involved with web scraping. If more data were available and consistent within both the large developers' websites along with Kijiji.ca the dataset would have been more complete than. A major limitation was with the user generation of Kijiji listings, creating errors and inconsistent data. In some cases, there would be no data available for some categories while other times, there were clear mis inputs skewing the data either up or down i.e. a sq. footage of 1 or sq. footage of 100,000 for example. Other limitations of this research is it cannot predict the future of Halifax's rental market, as it is meant to be a snapshot into Halifax's current rental market state. No comment on outside factors such as is the area nice to live, is it diverse, or other social inquiries were beyond the scope of this study.

Another limitation comes from the affordability data and analysis. As 2016 Canada's census data was the only official income data available. Due to Halifax's rapid growth in recent

years income numbers are likely different then they were in 2016. In order to alleviate this issue, we considered a blanket increase rate based on inflation; however, the issue arose parts of Halifax may have grown at much different rates. For example, in the North End of Halifax, where much unaffordability is shown in the study, has been gentrified recently, meaning in 2022 higher incomes are likely to be seen in that area compared to 2016. The other issue with the affordability measures is lack of rental unit data in a census tract. Few rental housing units are being advertised in some of the Census Tracts, especially in the periphery, of likely known skewing the data either high or low based on the limited number of listings.

Future considerations for research should be take build on top of this solid foundation laid out. This study showed it is possible to collect large amounts of data around Halifax's long-term rentals with the addition of web scraping as a form of data collection. With access to such a rich data source many possibilities of future research are created. Thinking longer-term researchers could collect data using a web-scraper for many years providing a time series analysis and trends seen over longer periods of time in the rental housing market.

In the shorter-term future study considerations should investigate more advanced statistics in the analysis portion of this study. The current study only provides basic descriptive statistics, with the inclusion of census data and other web scraped data more advanced statistical analysis can be done on the HRM rental market. Research can be done to determine which variables have the most influence on rental housing in an census tract. A major future research consideration will be an updated affordability measure with the release of the 2022 Canadian Census, providing a more accurate assessment of incomes within a census tract.

If we take this research even further, moving past only pricing, demographics would be a great usage for this research. With the inclusion of demographic data researchers could start

pinpointing what age, ethnicity, gender, martial status, etc. are paying for rental housing in the HRM. Moving that even further the affordability measurement supplied in this study could be applied to the demographic level now looking at both spatial and demographic issues of affordability within the HRM.

Improvements to the web scraper are needed to do many of these future research ideas. As discussed a major issue with web scraped data is the reliance on the people creating the advertisements to be as accurate as possible as it simply copies and pastes what is already there. In this study errors were mostly found in the details outside of the address and pricing of the rental unit, square footage was sometimes not a reasonable number and sometimes the advertiser would leave blanks in many of the amenities although the description of the rental unit would mention said amenities included. For further statistical analysis to be done many of the amenity recording issues will need to be fixed to have the best chance of providing more meaningful results.

Overall, this thesis although with its limitation provides policymakers insights on where to focus attention to when attempting to solve rental housing issues within the HRM. Beyond that this thesis also illustrates advancements in collecting data on rental housing using web scraping, leading to future higher-level research of the HRM or other parts of Canada rental housing markets.

Chapter 6
Conclusion

The goal of this research project was divided into two main research questions: first, to demonstrate a general overview of the basic characteristics of rental housing in Halifax and compare the characteristics of primary and secondary rental housing. In the general overview it is seen that Halifax has poor affordability across its urban and suburban areas, and even some of the rural districts, with rentals becoming more unaffordable as the number of bedrooms increases. Rentals also offer low amenities in the urban core, including square footage and parking. Prices per square are the highest in the urban core, easing up the further distance away from what is considered downtown.

Comparing primary and secondary rental housing the noticeable trend is secondary housing is less affordable compared to primary rental housing. What secondary housing ended up offering is better value for money square footage wise and increased amenities relative to the primary rental housing. Demonstrating the choice of which is better for a tenet is reliant on own preferences and needs. Tenants looking for primary housing with not many amenities and lower base rents are likely to stay within the urban core, while people or families wanting more bedrooms and amenities would opt for higher base rents of the secondary rentals.

Overall, this study demonstrates information on the rental market is accessible and the supplies Haligonians and the province with a snapshot of the HRM's current rental housing market from a pricing perspective. This study also provides methodological advancements into data collection of rental properties, the possibility of creating large rich data sets containing rental information is possible and could be used in future research spanning from pricing influences on

affordability in different demographics. The analysis gives policymakers actionable insights on where in Halifax to focus efforts in combating affordability issues, alongside how to fight affordability issues by developing further rental housing supply. The public can also benefit from this research as well through using the maps to help determine affordable places to live inside the HRM. This research is a starting point for both policymakers to dive into affordability issues further, demonstrating the role of large data sourced from the internet in documenting this pressing issue in years to come.

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