Smart Growth and Affordable Housing: A Comparative Analysis between two Smart Growth based developed cities.

Keywords

Sustainable development – Smart Growth – Housing Affordability – Walkability – Arlington - Portland

Abstract

The world's increasing urbanization and the increasing importance of sustainability, bring interesting challenges for cities. These challenges led to the rise of sustainable urban development at the end of the previous century and resulted in concepts such as Smart Growth. One of the communal goals that sustainable urban developments and Smart Growth have is the provision of a variety of affordable housing for all income groups. A lot of research is done on Smart Growth and the relationship with housing affordability, which often results in negative outcomes. However, many studies fail to investigate multiple dimensions of housing affordability to broaden the scope. In order to study housing affordability in a sustainable context, this research investigates housing affordability as a principle of Smart growth based on economic and social factors. Two areas in Arlington and Portland are chosen as case studies because they are known for their Smart Growth efforts. Housing affordability is evaluated in both regions based on the housing expenditure-to-income ratio and walkable access a number of essential facilities. Walkability is evaluated by performing a density analysis and creating GIS maps that display the walkable service areas of amenities. This research finds that both regions struggle to provide affordable housing for moderate- and low-income groups when evaluating financial affordability. In terms of walkable, accessible facilities, both regions perform well for most facilities.

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1. Introduction

Because of continuously increasing urbanization together with the increasing awareness of the effects that human activities have on the world's climate, cities need to become more sustainable (Darlow, 1996). In 2016, it was estimated that more than half of the world's population lives in urban areas. And in 2050, the world's urban population will be doubled (UNITED NATIONS, 2016). This results in interesting challenges for cities. In the late 1980's, the term sustainable development gained awareness. Especially after the 1987 Brundtland Report of the World Commission on Environment and Development (WCED, 1987). This report is called 'Our Common Future' and defines sustainable development as: '*development that meets the needs of present generations without compromising the needs and abilities of future generations*' (WCED, 1987). Three values became known as the three E's. Equity, Economy, and Environment. The goal of Sustainable Development is to take action in a way that, none of the E's weaken each other but enforce each other (Mohammed et al., 2016). From the Sustainable development concept, several planning concepts are derived. According to Jepson & Edwards (2010), three main approaches can be distinguished, all with their own vision, principles, and scope. One of these approaches gained its knowledge in the late 20th century, Smart Growth.
Overall, Smart Growth intends to create sustainable cities by designing cities that are compact, walkable, accessible by public transport and supplied by a great variety of housing options (Edward & Haines, 2007). The leading principle for this research on sustainable development, is the affordability of housing for all income groups (Jepson & Edwards, 2010). This is the first aspect of SDG number 11 (UNITED NATIONS Department of Economy and Social Equity) and a principle of Smart Growth. In studies about Smart Growth, SDG11 is named in different ways. According to Talen & Knaap (2005), it aims for a range of housing opportunities and choices. Wey & Hsu, (2014) stress the importance of different price ranges. Anthony and Tomalty (2002) name the principle of greater affordability and more variety in terms of housing opportunities for people in various life stages.
Although the concept of Smart Growth has promising effects, many researches have shown negative outcomes. Especially the link with unaffordability and social injustice is mentioned frequently. Addison et al. (2012) claim that Smart Growth practices can cause gentrification and segregation by raising housing prices and attracting higher social classes via walkable, green neighbourhoods with sound public transit systems. Edwards & Haines (2007), address that Smart Growth may exclude low-income groups from housing markets. According to Alexander & Tomalty (2002), Smart Growth does not correlate with greater housing affordability or more greenspace access. Many articles name the phenomenon of rising housing prices and increasing injustices without providing actual numbers that substantiate these comments. This research seeks to investigate whether the claims about unaffordability and Smart Growth are justified. Furthermore, most of the studies on housing affordability and Smart Growth are solely investigating the economic and financial variables that determine the affordability. Measures of affordability fail to express the spatial implications that come with the location of housing (Fisher et al., 2009). Examining housing affordability purely as an economic concept undermines the overarching view of the interwoven sustainable factors that come with housing affordability. In other words, evaluating housing affordability only on housing costs is not enough and, focusing on the price alone can result in invalid statements about housing affordability (Fisher et al., 2009). Especially in the view of Sustainable Development, out of which Smart Growth is

derived. According to Wiesel et. al (2012), outcomes of sustainable development approaches are in many cases a trade-off between social and economic factors. In order to incorporate both dimensions and investigate housing affordability on a broader scope than solely numbers, this research will evaluate whether Smart Growth ensures that housing is affordable for all income groups by examining the affordability based on financial and social variables in two Smart Growth based cities; Arlington, VA and Portland, OR. This will result in a comparative analysis of housing affordability and walkability between two smaller areas that are chosen in each city. The chosen areas are zip code 97216 in Portland, OR, and 22203 in Arlington, VA. Arlington and Portland are chosen because both cities are known for implementing the principles of Smart Growth (Mohammed et al., 2016; O'Toole, 2004). The two zip codes are chosen because both governments have policies on affordable housing and claim to have provided affordable housing units in that area. This number is 1930 affordable rent units for 22203 and 464 affordable rent units for 97216 (Portland government, 2021; Arlington government, 2021).

This research aims to investigate whether the sustainable development approach Smart Growth is actually successful in realizing its goal of providing affordable housing for all income groups by examining housing affordability on both economic and social variables. The results form a comparative analysis that tries to identify whether the two research areas in both cities succeeded in terms of housing affordability.
In order to investigate the role of Smart Growth, the following research question is developed: Are areas planned according to Smart Growth principles successful in providing affordable housing in context of Sustainable Development Goal 11 in Arlington, VA & Portland, OR?
To answer this question, several sub-questions are developed:

- How does Smart Growth affect the housing market and its financial affordability?
- What is the role of the social dimension of sustainable development in housing affordability?
- Is Smart Growth conducive to providing affordable housing for all income groups in Arlington, VA & Portland, OR based economic variables and social variable?

The theoretical framework will describe all theories and concepts applicable to this research and provide background info on the studied cities. In the methodology, the choice of methods and the used data is explained. The results discuss the findings and provide statements about the research questions based on the analysis and the theoretical framework. The conclusion summarizes the research, highlights the main findings and limitations and provides recommendations for further research.

2. Theoretical framework

The overarching concept of this research is sustainable development and its goal of housing affordability for all income groups. Three dimensions of Sustainable Development can be distinguished. The ecological, economic and, social dimension (Pawloski, 2008). In this research, the emphasis will be on the social and economic dimension since 'housing affordability for all income groups' can be measured based on economic and social factors (Mohit & Azim, 2012; Mulliner & Maliene, 2011; Wiesel et al., 2012).

2.1 Smart Growth

Smart Growth gained its knowledge in the early '90s, and in essence, Smart Growth is a method to counter urban sprawl with special focus on policy mechanisms and land-use control (Jepson & Edwards, 2010). It holds a set of principles that guide neighborhoods and communities to develop in a way that they improve in livability, are economically compatible, and environmentally unharmful while still maintaining their sense of community (Mohamed et al., 2016). Principles of Smart Growth are walkability, mixed-use, urban density, diversified transportation, great variety of affordable housing choices, and preservation of public open space (Edwards & Haines, 2007; Jepson & Edwards, 2010). Smart Growth can be interpreted as a development approach that mixes belongings of the economic, environmental, and social/equity pillar (Addison et al., 2012). The economic and social pillar are particularly relevant for promoting affordable housing which leads to social justice and economic inclusion (Addison et al. 2012). According to the research on Smart Growth policies from different agencies of Ye et al. (2005), nine out of ten named affordable and mixed housing as one of their primary goals of all policies. But, in many studies, Smart Growth studies have critiqued social equality and economic inclusion in terms of affordable housing. Anthony (2003) finds that Smart Growth principles drives up housing prices and create unaffordable prices for housing. According to Downs (2005), the chance that Smart Growth results in affordable housing is very unlikely. Addison et al. (2012) argue that Smart Growth leads to gentrification and exclusion of certain groups. The study of Edwards & Haines (2007) evaluated 30 policy plans of Smart Growth communities. It finds that the principle of a range of housing variety and choices were present in 73% of the plans. But only 30% of the plans include action-oriented language. For example, the policy of planning/manufacturing for affordable housing was present in 43% of the plans, but only in 13% it was present and action-oriented (Edwards & Haines, 2007).

2.2 Affordable housing

The most accepted rule for housing affordability in terms of costs and income is that the costs should not exceed 30% of the income (Hulchanski, 1995; Wiesel et al., 2012). With costs in this case being mortgage or rent. In the context of Sustainable Development concepts such as Smart Growth, affordable housing is not solely based on the economic ability to purchase and possess a house. For a house to be sustainable, social and environmental factors also play a role. In many cases, focusing on the economic aspect of housing, results in a threshold with social and environmental factors (Wiesel et al., 2012). For instance, a financially affordable house, but far from essential facilities, will still result in high transportation costs and a substantial environmental impact. This demonstrates that the borders between the different dimensions of sustainable development are small, and variables can be influential for each other. The most important ones for housing affordability are the economic and social dimensions. Smart Growth and sustainability cross each other in the aim of encountering the trade-off between the three 'E's' of sustainability (Equity, Environment and Economy) (Mohammed et al., 2016). There are several variables and criteria linked to housing that determines whether a house is affordable in view of sustainability. Examples of social variables are walkability, provision of public space, and access to services such as shops, schools and public transit stations (Johnson & Talen, 2008). Economic variables are income, housing prices, rent rates, and mortgage availability (Mulliner et al., 2011).

2.3 Smart Growth and the housing market

First of all, Smart Growth has an influence on the supply side of the housing market. Its growth limit principle, restricts the number of houses that can be developed. The principle of preservation of open space also limits this number (Addison et al., 2012; Downs, 2005; Mohammed et al., 2016; Edwards & Haines, 2007). This limiting supply instantly drives up the price of housing, even if demand stays unchanged. On the other side, principles that improve liveability such as walkability, open green space, and public transit access, make places more desirable. This increasement in demand also drives up the price of housing (Addison et al., 2012).

2.4 Financial affordability

The most acceptable way of measuring housing affordability economically is by calculating housing costs as a percentage of income (Bogdon & Can, 2003). Also known as the housing expenditure-to-income ratio (Hulchsanski, 1995). The rule of thumb used for measuring the actual affordability is that housing expenditures do not exceed more than 30% of a households' income in order to be considered affordable (Hulchanski, 1995; Wiesel et al., 2012).

2.5 Social affordability

When diving into social sustainability, an essential component is the concept of social equity. Social equity is deeply embedded in sustainable development (Hopwood et al., 2005) and this is also reflected in its definition that holds in account 'the present and future generations' (WCED, 1987). Social equity is also a key principle of Smart Growth and housing affordability. Which is seen back in the aim of being affordable for 'all income groups'. Social urban sustainability has physical and non-physical characteristics (Dempsey et al., 2011). Examples of non-physical characteristics are safety, sense of community, and social interaction. Physical factors are walkability, accessibility to local services, and urban design (Dempsey et al., 2011). Regarding measuring social equity, accessibility is vital factor (Burton, 2000). Walkable access to key facilities and public transportation networks is fundamental for the accessibility of a place (Burton, 2000). Key facilities are access to green space, shops, education, public transit systems, and health facilities (Dempsey et al., 2011; Mulliner et al., 2011). The relationship between housing and its location is becoming more and more important in defining affordability. Measuring and defining housing affordability on traditional measures such as expenditure-to-income ratio may be too limited since the surrounding facilities of the housing location influence the welfare and quality of life (Fisher et al., 2009). This research evaluates a mix of physical social variables measured in accessibility.

2.6 Walkability

According to Liao (2020), walkability in an essential factor in sustainable urban development because it reduces greenhouse gas emission and contributes to social interaction (Whyte, 2012). Walking is also considered as the most sustainable mode with the least influence on infrastructure and congestion (Merlin et al., 2021). So, walking has social and environmental advantages, and since it does not involve costs, also economical.

2.7 Arlington, Virginia

Arlington adopted its first Smart Growth strategies in the late '80s and early '90s. The focus was on planning for sophisticated transit corridors after Transit-Oriented Development ideas, mixed-use, public open space, and maintaining existing neighbourhoods (Mohammed et al., 2016). The aim of Smart Growth implementation was to offer jobs, schools, shops, and open space all within walkable distance of housing and public transit systems. A lot of these plans worked out well for Arlington. Arlington has three major public transit systems formed as lines which are called transit corridors. In one of the transit corridors, 40% of people use public transport for commuting. Furthermore, 16% of Arlington's population does not even own a car because they can fully rely on walkability and public transport and prefer to walk (Mohammed et al., 2016).

All these implemented Smart Growth principles made Arlington a desirable place to live in (Mohammed et al., 2016) and resulted in a shift in terms of demographics. Between 2000-2012, an increase of 32.1% of 25-to-34-year-old residents against a total increase of 16.7% of the population. Furthermore, an increase of high-wage jobs attracted high-wage workers. Between 2000 and 2012, the number of households earning more than 200.000 US dollars, gained with 59,8% (Arlington County Affordable Housing Plan, 2015). With Washington DC as a nearby city, housing demand and thus prices have risen notably (Mohammed et al., 2016). As a reaction, the Government of adopted strategies such as the 'affordable housing investment fund', which enables private developers to create affordable housing through a loan provision (Mohammed et al., 2016). Still, between 2010 and 2040, an additional 37 percent of housing for income groups under <30% AMI (Area Median Income) has to be developed. This is a total of 3700 housing (Arlington County Affordable Housing Plan, 2015).

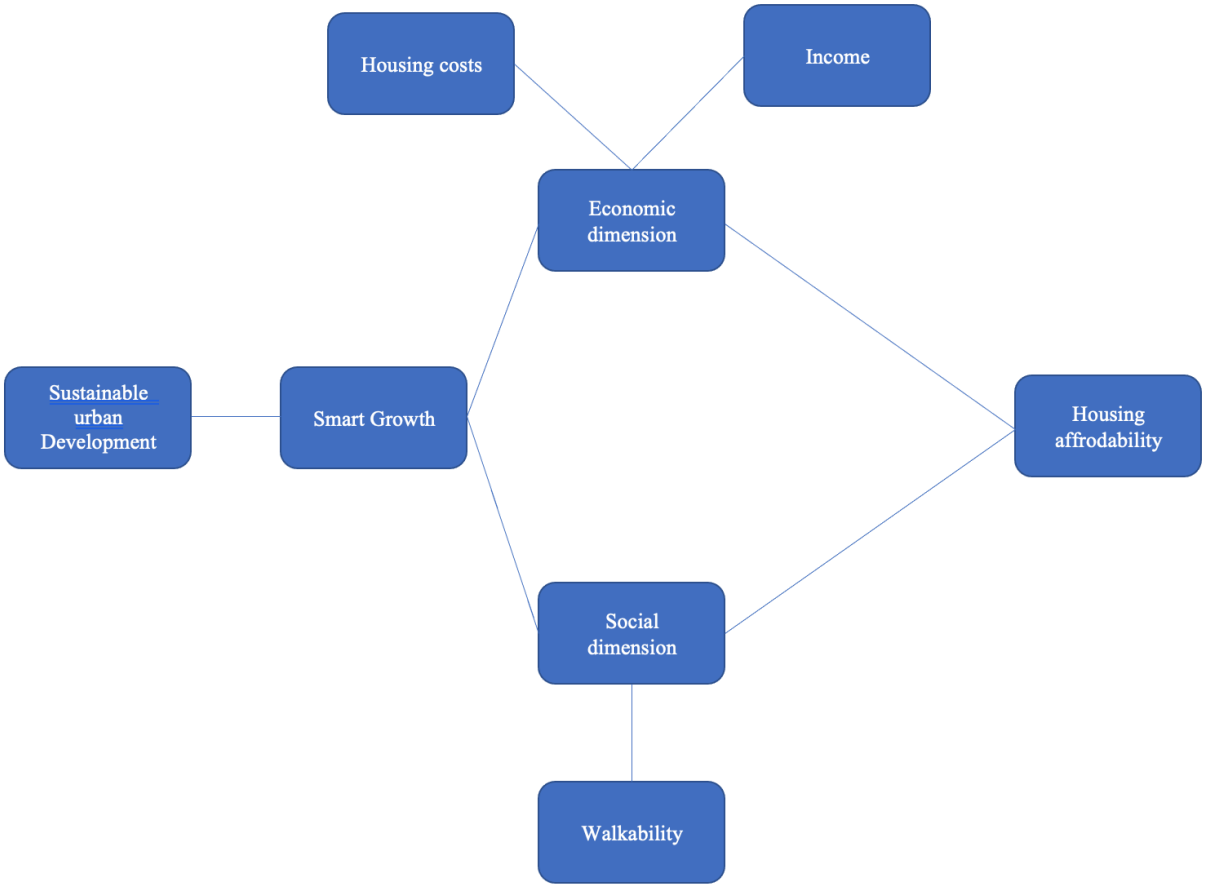
2.8 Portland, Oregon

Portland adopted Smart Growth strategies since the early '90s as a reaction on the predicted growth number of the Metro government. For years, Portland has been the world's leading Smart Growth city, advocating compact urban design, promoting public transit and walkability. The metro government predicted that the Portland region would grow by 80 percent between 1990 and 2040 (O'Toole, 2004). Emphasis was on the development of public transport systems, promoting walkability, and discouraging car use by not improving highways and carparks. At the same time, set growth limits to protect and preserve farmlands (Mohammed et al., 2016). According to Portland's planners, Smart Growth implementation would result in less congestion, open space, reduced transportation costs, and affordable housing. (O'Toole, 2004). But in reality, many of these plans failed. Congestion increased, and the expansion and protection of green open space did not happen in reality (O'Toole, 2004). According to O'Toole (2004), development land for housing raised from 20.000 dollars to 200.000 dollars in just six years. Downs (2002) also claims that between 1990 and 1994, housing prices in Portland have risen faster than comparable metro regions. According to Mohammed et al. (2016), there are many variables that influence the affordability of the housing market in Portland. However, the implementation of Smart Growth principles definitely plays its part on the supply side. But not only housing prices have risen. Portland has an estimated low-income population of 25.042. Currently, 4200 affordable houses are being developed and delivered in the coming years. This leaves a gap of 20.000 affordable homes for Portland's residents (Key Actions to Increase Affordable Housing Construction, 2021). In terms of walkability, Portland's ambitions are promising. Portland is famous for its 20-minute city concept which states that all essential facilities are accessible within 20-minute walking distance (Gower & Grodach, 2021).

Based on the critics of Smart Growth as regards to the affordability of the housing market, this research expects that both areas struggle with realising affordable housing for all income groups in terms of financial affordability. In terms of walkability and accessibility, it is expected that both regions are doing well based on their status on Smart Growth.

This study is not affected by ethical considerations since no individual or institution is harmed while performing research.

Figure 1: Conceptual model (self-derived, 2022).



The conceptual model (figure 1) shows all applicable relations to this research. From left to right, it visualizes that Sustainable Urban Development has led to Smart Growth, which has an economic and social dimension. The economic and social dimension influence the housing affordability. In this research, walkability is the factor that influences the social dimension, and housing costs and income affect the economic dimension.

3. Methodology

This research compares housing affordability in both regions bases on social and financial variables. Secondary data is used for a financial analysis and a social analysis. Both analyses exist out of two parts in order to get viable results. The research questions about the role of Smart Growth on the housing market and the role of the social dimension in Smart Growth is answered based on a literature review.

Data sets from the United States Census Bureau, an official and thus reliable agency of the ministry of economy form the U.S. Government, is used for analyzing both areas. They collect data about economy and population every year. Extensive surveys are held every ten years. This research uses 2020 data sets, the latest with all necessary information. Data includes population, households, housing tenure, area median income (AMI) and housing costs. Data sets also show the number of households (rental-/owner-occupied) spending over 30% of their income on housing costs. All data can be selected for specific zip codes.

3.1 Financial analysis

The first part evaluates the data about number of households per income level that spend more than 30% of income on housing costs. This data immediately shows how many households exceed the 30% threshold for both rental and owner-occupied households with or without mortgage. From these numbers, percentages can be computed which shows which household groups struggle the most with housing affordability.

The second part of the analysis covers the housing market of both areas based on the current rental- a recently sold buyers-market data (figures 9 to 12). The recently sold market is used instead of the current market to give an accurate indication of actual selling prices. Income data is obtained from the US Census Bureau and market data is derived from the National Association of Realtors. The same income levels are used, and the maximum spendable amount on housing costs of each income group is calculated based on the 30% rule (figure 2 & 3)**.** The National Association of Realtors provide a real estate website that allows to evaluate all rentals and listings in a particular zip code divided by houses and apartments. Data is considered valid since other websites give comparable results.

For the rental market, costs of all current available rental properties are evaluated, differing between homes (single- and multi-family) and apartments/condos. Using the income levels based on the 30% fist rule, a table can visualize how many rental properties are available for specific income levels (figures 10 & 12)

For the buyer's market, all recently sold housing prices are evaluated, again differing between houses and apartments/condos. The timespan of evaluation of the recently sold market is between 20th May and 17th November 2022. Monthly costs are computed using the mortgage calculator of the National Association of Realtors. A 30-year-fixed mortgage is used with an interest rate of 6.663% based on current mortgage rates. The down payment is set at 13% since this is the median percentage of 2022 (Bankrate, 2022). The National Association of Realtors also includes property tax-based and home insurance costs. Property tax is based on past tax rates and the average county tax rates. Home insurance is based on property value. The resulting monthly costs of all list prices are allocated to an income level that is based on the 30% rule. It is then known how many houses could have been sold at certain income levels Figure 9 & 11).

After both analyses, the tables provide info on which income levels either struggle the most with housing costs or have the most options in terms of housing for each region. Income levels, however, do not give information on income groups, since median incomes can differ per city. Therefore, the groups are defined using the area median income (AMI) of both zip codes. The percentages that allocate an income level to a specific group differ and are defined by their own government (figures 4 & 5). This allows to classify the income levels to a certain income group at the end of the analysis.

3.2 Social analysis

For the social analysis, this research investigates the walkable accessibility for several facilities. First, all locations of the facilities need to be determined. The locations are either derived from GOOGLEMAPS.com or OpenStreetMap. Afterward, walkable distances to facilities need to be defined. There are several factors that influence walkability. For example, time of the day, weather, built environment, and personal attitudes (Merlin et al., 2021). These factors could vary per day, place or person. The willingness to walk is also strongly linked to the purpose of the trip (merlin et al., 2021), a factor that is less sensitive for those variables. Therefore, this research only trip purpose when determining walking distance, with the facilities being the purpose. The trip purpose determines distance, so, walking to work or school is linked to longer trips than grocery stores. Example of an explanation is the timespan between the walking trips or having to walk with bags full of groceries. Recreational trips tend to have the highest distance, followed by work and school. Stores and shops are, in most cases, the shortest walking trips (Kuzmyak et al, 2014). This research, therefore, defines different distances for variables based on scientific literature that studied walkability. Pocock et al. (2019) found that education facilities are within walkable distance as long as they are within 2.25 km

from home. Christiansen et al. (2014) set this distance at under 2 km in his research. This research uses 2.25 km because the study of Pocock et al. (2019) is more recent. For public transit stations, a bus stop needs to be reachable in a ¼ mile or approximately 400 m, and a rail node must be reachable in a ½ mile or approximately 800 m in order for it to be reachable (Canepa, 2007; Zhang et al., 2021; Dong & Zhu, 2015). The threshold for grocery stores and shops is 1145 feet or about 440 m (Moudon et al., 2006). On walkability to open public space and walkability to health services was not literature findable. Therefore, their distances are defined by the 20-minute city concept. The 20-minute concept is a sustainable city design concept that has its roots in Portland in the early '90s. The 20-minute city concept aims to ensure that all essential facilities are within a 20-minute walkable distance from home (Gower & Grodach, 2021). In order to calculate the distance that could be covered with 20 minutes of walking. Daniel & Forde (2019) did research on average walking speed between different population groups resulting in an average of 1.316 m/s or about 4.7 km/ph. Meaning that a 20-minute walk covers about 1600 meters or 1 mile (Merlin et al., 2021).

The first method is a density analysis which counts the number of a certain facility and divides that number through the area size to compute the mean distances per facility. These distances are then compared to their determined walkable distance of that facility. The limitation of this strategy is that is assumes equal spread of facilities and is not applicable for areas that only contain one of a certain facility. For instance, one train station in an area of 4.00 km2 means a mean distance of 4.00 km, which is technically very unlikely.

The other strategy used to analyze walkability is creating GIS maps with the facilities as center points and their determined walkable distances as a radius. The maps are made with ArcGIS. The data on the locations of facilities is derived from OpenStreetMap. These maps immediately show what parts are covered by facilities and what are not and is, therefore, the most accurate analysis of this study when it comes to the social variables. The limitation of this strategy is that it does not take into account roads and routes that a person needs to walk which can lead to small differences in actual walking time.

4. Results

4.1 Financial analysis

ZIP 22203, Arlington

The first part of the financial affordability analysis is based on the data derived from the United States Census Bureau. For ZIP 22203, 15,23% of the owner-occupied households with a mortgage spend more than 30% of their income on housing costs. For owner-occupied without a mortgage, this number 12.74%. The rent sector did the worse with, 41.20% of the renters spending more than 30% of their income on housing costs. Figure 7 provides an overview of which income levels has the highest percentage per occupation group. For 'rental occupied' households, the distribution between the income levels is pretty even, but still, the lowest groups contain the most households that struggle with their housing costs. For the 'owner-occupied households with a mortgage', the highest percentage lies in the $75.000 income level. For ZIP 22203, $75.000> means more than the moderate-, middle- or high-income group (Figure 5). With the table of the Census Bureau only going to $75.000, making statements about high- and- moderate income groups are hard since the middle group starts at $89.000 for ZIP 22203 (figure 5). In the 'owner-occupied households without a mortgage' row of the table, the highest percentage is for the income level $35.000 to $49.999. This is the very low-income group (figure 5).

ZIP 97216, Portland

For ZIP 97216, 41,80% of the owner-occupied with mortgage households paid more than 30% of their income on housing costs. For owners without a mortgage, this number was 27,50%. Again, the percentage was the highest for the renting households; 58,49%. When evaluating the numbers in figure 8, it is seen that for ZIP 97216 'rental occupied' households, the income level below $20.000 has

the most households that exceed the 30% rule of thumb. In ZIP 97216, this is the low and extreme-low-income group. For 'owner-occupied households with mortgage', the highest percentage is for the income level above $75.000, which can be middle- or high-income groups in 97216 (figure 4). Without a mortgage, this again is the income level below $20.000, which is low and extreme-low-income group (figure 4). Overall, we can say that in ZIP 97216, predominantly the lower income groups are struggling with housing costs.

ZIP 97216, Portland

The second part of the financial analysis examines the housing availability in both areas. For the recently sold market of ZIP 97216, the first thing that stands out is that there are only 4 apartments recently sold and 97 houses. The houses become available from the income level between $75.000 and $99.999. However, most sales were in the $100.000 till $149.999 (figure 9). No houses or apartments were sold in the income levels representing the extremely-low, low- and moderate-income groups (figure 4). When examining the table about the rental market (figure 10), the first thing noted is that the rental market in ZIP 97216 is very small. There is one apartment for the moderate-income group available, but no houses. All apartments and houses are available for middle-income groups and higher (Figures 4 & 10).

ZIP 22203, Arlington

The first thing that is noticeable when examining the recently sold table of ZIP 22203 (figure 11), is that houses are affordable from the income levels of $150.000, which is above the middle-income group (figure 5). Apartments, however, are available from income levels starting at $25.000k, which is the extremely-low income group in 22203 (figures 5 & 11). Some apartments are available for low- and moderate-income groups (about 20), but most are available for middle- and high-income group (figure 11). Figure 12 shows that ZIP 22203 predominantly is a rental and apartment market. Over 400 apartments are available for different income groups, and 38 apartments are available for $50.000 – $74.999 (figure 12) which sits between low- and moderate-income-group for 22203 (figures 5). The most available apartments are affordable for moderate- and middle-income groups. The very-low, lower and extremely-low income groups have no available apartments that can be considered affordable (figure 5 & 12).

Figure 27: Location of ZIP 97216 in relation to the city of Portland highlighted in green (self-derived, 2022).

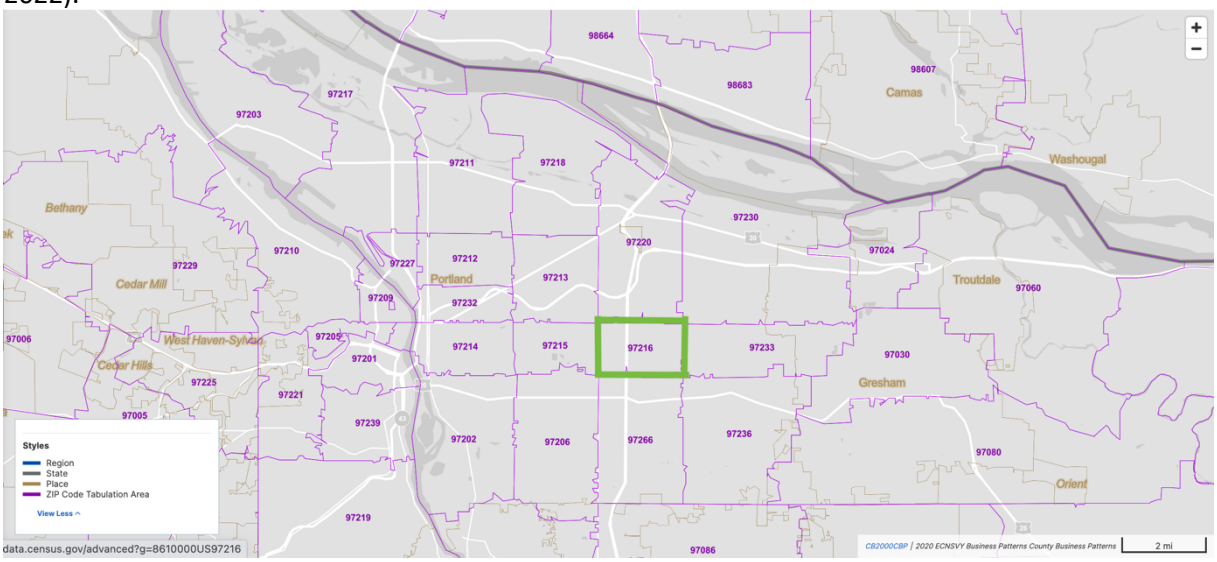
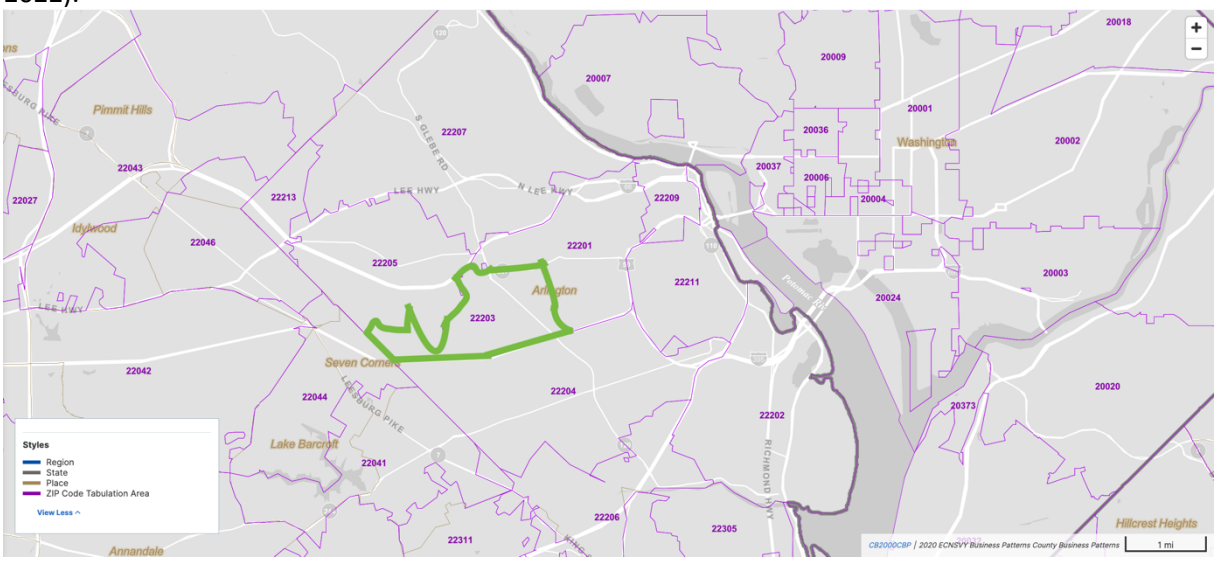


Figure 28: Location of ZIP 22203 in relation to the city of Arlington highlighted in green (self-derived, 2022).



4.3 Social analysis

The density analysis is an easy strategy to calculate average distances to all facilities. Figures 13 and 14 display all average distances that are computed per facility. The problem that arose was that for some facilities, only 0 or only 1 was present in the area. Resulting in an unrealistic long distance because the area size was divided by 1 ('n.a.' in table). Examining figure 13 of ZIP 97216, all computed distances are lower than the maximum given based on literature, except for supermarkets. That distance comes out at 813 m on average which exceeds the 440 m set by Moudon et al. (2016). The same scenario applies for ZIP 22203 (figure 14), only distances slightly differ. Distances for education are longer, and distances to parks are less. Supermarkets are again too far with a distance of 800 m on average.

The GIS analysis results in a total of 12 maps, 6 per area, that display the walkable service area of each facility. In the ultimate scenario, facilities completely cover the whole area in all maps. For ZIP 97216, this is the case of parks in the area (figure 15). Schools almost completely cover the area (figure 6). The map on health services (figure 17), on which no realistic average distance can be calculated in the density analysis, shows that almost the whole area is covered in ZIP 97216. The map shows 2 rings, one that displays the 20-minute walk service area, and one that displays the 10-minute walk. In terms of public transportation, almost the whole area of ZIP 97216 is serviced by bus stops (figure 18). Rail nodes, however, are further away (figure 19). In line with the density analysis, figure 20 shows that supermarkets are not in its defined walkable distance for most parts of the area.
In ZIP 22203, parks also completely cover the area (figure 21). In contradiction with ZIP 97216, schools and bus stops are also completely servicing the research area (figure 22 & 23). This is in line with the result of the earlier performed density analysis. Railways and hospitals, however, are less reachable in ZIP 22203 (figure 24 & 25). Also in ZIP 22203, grocery stores do not cover much of the research area (figure 26). This again is in line with the density analysis.

Both areas can be considered walkable which is in line with Mohammed et al. (2016) who also research policies in both areas. He concludes that both areas are successful in promoting mixed-use and walkable and compact development.

4.4 Discussion

Based on the analysis of the data accumulated from Census Bureau, a few statements can be made. First of all, the data shows that overall, ZIP 97216 contains higher percentages of households paying more than 30% of their income on housing costs (figure 8). When examining the table with income levels and income groups, extreme-low- and low-income groups struggle the most in both areas (figure 4 & 5). The households with a mortgage are in both cities the middle- and high-income groups that have the highest percentage of households exceeding the 30%. In ZIP 22203, this contains also the moderate-income group (figure 7).
The performed market analysis shows that low- and moderate-income groups were not able to buy houses in both regions. In ZIP 22203, apartments are available for moderate-income groups and some for low-income groups whereas in ZIP 97216 nor houses nor apartments could have been sold in those groups. In the rental sector, again houses are not available for low- and moderate-income groups. Apartments are available for lo and moderate-income-groups in ZIP 22203, in ZIP 97216 only for moderate.
The density analysis gives an indication of average distances and the GIS analysis is more accurate in displaying all serviced area for each facility. Both areas are very walkable for most facilities. Only supermarkets really are not accessible on foot in both areas.

5. Conclusion

This study sought to investigate the role of the sustainable development concept of Smart Growth on housing affordability based on social and financial factors. For this, two areas of cities are chosen that are developed based on Smart Growth principles. The methodology consists out of reviewing literature and performing data analyses on social and financial factors that determine housing affordability. The financial analysis is mainly based on the housing expenditure-to-income ratio with 30% income on housing expenses as max as rule of thumb (Hulchanski, 1995; Wiesel et al., 2012). Data on demographics and income is derived from the United States Census Bureau, and data on the real estate market is derived from the National Association of Realtors. The social analysis evaluates the walkability of both areas to essential facilities.
From the literature, it can be stated that Smart Growth and its goal of providing affordable housing for everyone is far more promising than the real-life outcomes. Many studies have expressed their critics since the early adaption of Smart Growth and name the relationship between Smart Growth and an unaffordable housing market and gentrification (Addison et al., 2012; Alexander & Tomalty, 2002; Downs, 2005; Mohammed et a., 2016; O'Toole, 2004; Wiesel et al., 2012). Most studies evaluate housing affordability solely on its financial characteristics. In view of sustainable development, from which smart growth is derived, inclusion of social sustainability and its factors is also necessary to prevent invalid statements about affordability from being made (Fisher et al., 2009). When it comes to measuring social sustainability, accessibility is an important measure (Burton, 2000). This study, therefore, performed an area analysis in both cities based on economic and social variables.
Based on data from the Census Bureau, this study finds that the rent-occupied household group, in ZIP 97216 the and the extreme low-income groups struggle the most with affordability. For ZIP 22203, this is more evenly spread along income groups, but the lower group still has the most households that exceed the rule of thumb. For the households with a mortgage, middle- and high-income groups contain the most households exceeding the 30%. And for households without a mortgage, this again, are the low- and extreme-low-income groups. The evaluation on data from the The National Association of Realtors finds that for low-and-moderate income groups, no housing (single- or multi-family) is affordable. In ZIP 22203, some apartments for low- and moderate-income groups are affordable in the rental sector. Overall, the lower income groups struggle the most with their housing costs. This is in line with studies which claim that Smart Growth can lead to gentrification, exclusion of certain groups, and does not correlate with greater affordability (Addison et al., 2012; Edwards & Haines, 2007; Alexander & Tomalty, 2002).

The walkability analysis shows that both cities are performing well. Almost all facilities are accessible within their defined distance. Overall, ZIP 97216 is doing better when it comes to walkability. This mainly because the rail node is more centrally positioned.
The performed analyses in this study had their limitations. For the financial analysis, 30% is used for the expenditure-to-income ratio. Although this is the most widely accepted percentage in this field of research, this percentage could still differ for population groups in different life phases. For the analysis of the recently sold market based on data from the National Association of Realtors, a down payment is used of 13%. This is the median in 2022 for the United States and is used because a lot more houses would become unaffordable if no down payment is used. Furthermore, in the analysis of the recently sold market, no maintenance costs were included since they can differ significantly between housing types and sizes.
Regarding walkability, only the trip purpose and it a determined distances is considered in the evaluation. This is done because other personal and environmental factors are hard to measure. The density analysis limits because it assumes that facilities are spread out throughout the aera. Next to that, distances are not computable if only one of a certain facility is present, since this would result in an unrealistic long distance. The GIS analysis is more accurate. The only aspect that limits the evaluation is that walking routes are not taken into account.
Social factors that influence housing affordability can be distinguished in physical and non-physical factors (Dempsey et al., 2016). This study focuses on physical factors in the form of walkable access to facilities. Further research could investigate the role of Smart Growth and non-physical factors that influence housing affordability. Another recommendation for future studies is to investigate the role environmental dimension of sustainable development in housing affordability.

Appendices

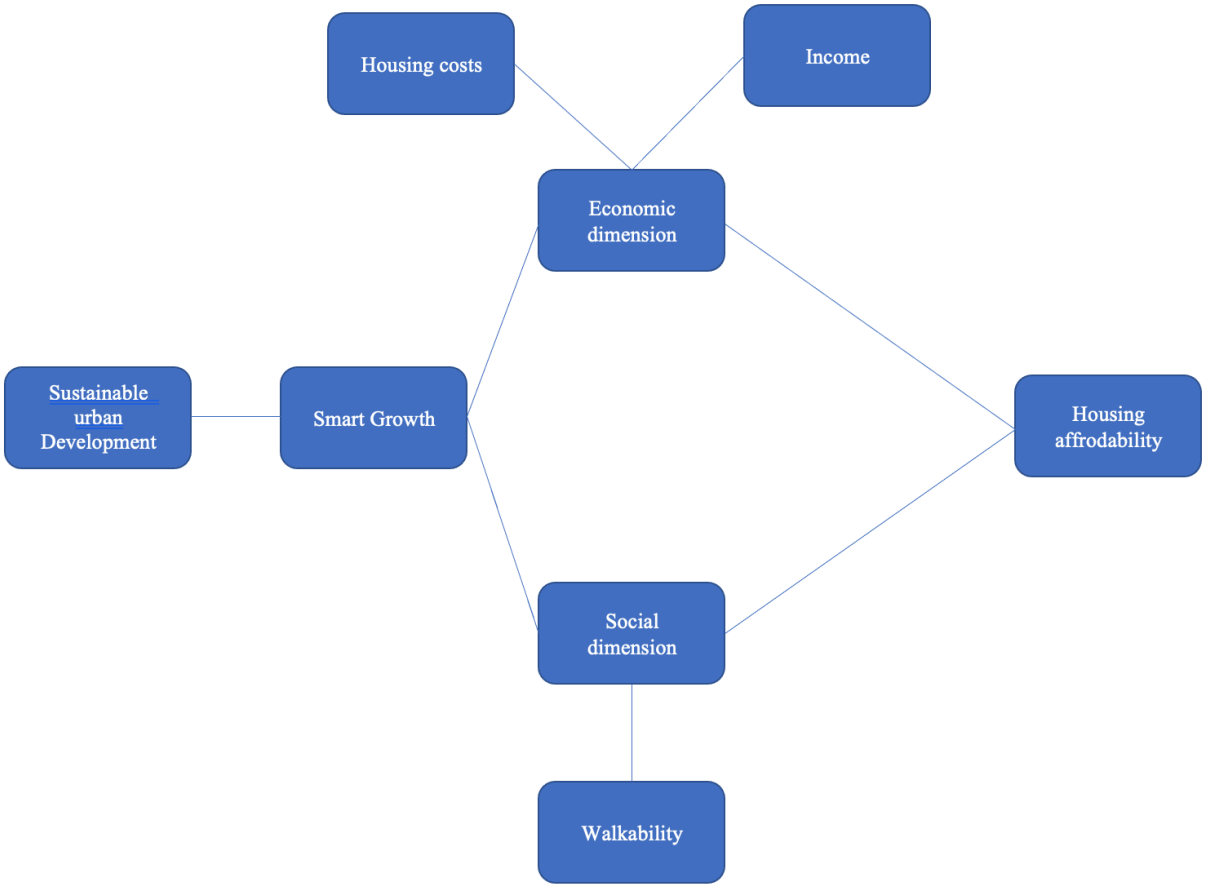


Figure 1: Conceptual Model (self-derived, 2022).

Figure 2: Income levels from Census Bureau with their calculated spendable amount on housing costs (Census Bureau, 2020; self-derived, 2022).

ZIP 97216 Portland, OR			
12 MONTH INCOME	PERCENTAGE OF HOUSEHOLDS	NUMBER OF HOUSEHOLDS	30% INCOME RULE PER MONTH
<$10.000	%5,5	385,055	<$250
$10.000 – $14.999	%5,4	378,054	$250 -$374
$15.000 – $24.999	%9,0	630,090	$375 - $624
$25.000 – $34.999	%10,8	756,108	$625 - $874
$35.000 - $49.999	%13,0	910,130	$875 - $1249
$50.000 – $74.999	%20,9	1.463,209	$1250 - $1874
$75.000 - $99.999	%11,4	1.008,144	$1875 - $2499
$100.000 – $149.999	%12,7	889,127	$2500 -$ 3749
$150.000 – $199.999	%8,2	574,082	$3750 - $4999
$200.000>	%3,0	210,03	$5000>
MEAN INCOME = $55.795			
MEDIAN INCOME = $70.982			
TOTAL NUMBER OF HOUSEHOLDS: 7.001			

Figure 3: Income levels from Census Bureau with their calculated spendable amount on housing costs (Census Bureau, 2020; self-derived, 2022).

ZIP 22203 Arlington, VA			
12 MONTH INCOME	PERCENTAGE OF HOUSEHOLDS	NUMBER OF HOUSEHOLDS	30% INCOME RULE PER MONTH
<$10.000	%4,6	593,4	<$250
$10.000 – $14.999	%2,0	258	$250 -$374
$15.000 – $24.999	%6,4	825,6	$375 - $624
$25.000 – $34.999	%3,4	438,6	$625 - $874
$35.000 - $49.999	%6,5	838,5	$875 - $1249
$50.000 – $74.999	%9,6	1.238,4	$1250 - $1874
$75.000 - $99.999	%11,9	1.535,1	$1875 - $2499
$100.000 – $149.999	%17,4	2.244,6	$2500 -$ 3749
$150.000 – $199.999	%13,4	1.728,6	$3750 - $4999
$200.000>	%24,8	3.199,2	$5000>
MEAN INCOME = $143.601			

MEDIAN INCOME = $112.448
TOTAL NUMBER OF HOUSEHOLDS: 12.900

Figure 4: Income groups as determined by government (self-derived, 2022; Portland government, 2021; Census Bureau 2020).

Income groups ZIP 97216 based on 2020 income data		
55.795 = median income		
Extremely-low	<30% AMI	<$16.738,5
Low	<50% AMI	<$27.897,5
Moderate	<80% AMI	<$44.636

Figure 5: Income groups as determined by government (self-derived; Arlington government 2017; Census bureau 2020).

Income groups ZIP 22203 based on 2020 income data		
$112.448 = median income		
Extremely-low	<30% AMI	<$33.734,40
Lower	<40% AMI	<$44.979,20
Very low	30-50% AMI	$33.734,40 - $56.224
Low	50-60% AMI	$56.224 – $67.468,80
Moderate	60-80% AMI	$67.468,80 - $89.958,40
Middle	80-120% AMI	$89.958,40 - $134.937,60

Figure 6: Facilities with their determined distance and source (self-derived, 2022).

WALKABLE AMENITY	DISTANCE	SOURCE
EDUCATION FACILITIES	<2,25km	Pocock et al., 2019
SHOPS	<440m	Moudon et al., 2006
PUBLIC TRANSIT BUS	<400m	Canepa, 2007; Zhang et al., 2021; Dong & Zhu, 2015
PUBLIC TRANSIT RAIL	<800m	Canepa, 2007; Zhang et al., 2021; Dong & Zhu, 2015
PARKS	<1600m	Gower, 2021
HEALTH SERVICES	<1600m	Gower, 2021

Figure 7: Income levels and the amount of household that exceed the 30% of income spend on housing costs (Census Bureau, 2020; self-derived).

ZIP 22203 housings costs exceed 30% of income 4459/ 12.900=43,56						
	rental occupied (8691 total)	In % of total	Owner with mortgage (2948 total)	In % of total	Owner without mortgage (1248 total)	In % of total
<$20.000	719	8,3%	35	1,2%	28	2,2%
$20.000 - $ 34.999	897	10,3%	10	0,3%	0	0,0%
$35.000 – $49.999	506	5,8%	64	2,2%	90	7,1%
$50.000 – %74.999	765	8,8%	72	2,4%	28	2,2%
$75.000>	694	8,0%	268	9,1%	13	1,0%
Total percentage of households exceeding 30%: 4459/12900 * 100% = 34,56%						

Figure 8: Income levels and the amount of household that exceed the 30% of income spend on housing costs (Census Bureau, 2020; self-derived).

ZIP 97216 housings costs exceed 30% of income 3192/7001						
	Rental occupied (2920 total)	In % of total	Owner with mortgage (3230 total)	In % of total	Owner without mortgage (851 total)	In % of total
<$20.000	605	20.7%	153	4,7%	216	24,4%
$20.000 - $ 34.999	428	14,7%	404	12,5%	18	2,1%
$35.000 – $49.999	375	12,8%	253	7,8%	0	0,0%
$50.000 – %74.999	254	8,7%	391	12,1%	0	0,0%
$75.000>	46	1,6%	149	4,6%	0	0,0%
Total percentage of households exceeding 30%: 3192/7001*100= 45,59%						

Figure 9: Income levels and the number of houses that are recently sold in their affordable range (self-derived, 2022; National Association of Realtors, 2022; Census Bureau 2020).

ZIP 97216 Portland, OR. RECENTLY SOLD MARKET				
12 MONTH INCOME	MONTHLY COSTS FOR HOUSING ACCORDING 30% INCOME RULE	NUMBER OF HOUSEHOLDS PER INCNOME GROUP (NO DECIMALS)	NUMBER RECENTLY SOLD HOUSES MONTHLY COSTS ACCORDING TO 13% MORTGAGE INCLUDING RANGE OF SOLD PRICES	NUMBER OF RECENTLY SOLD APPARTMENTS/CONDO'S ACCORDING TO 13% MORTGAGE RATE INCLUDING RANGE OF SOLD PRICES
<$10.000	<$250	385	0	0
$10.000 – $14.999	$250 -$374	378	0	0
$15.000 – $24.999	$375 - $624	630	0	0
$25.000 – $34.999	$625 - $874	756	0	0
$35.000 - $49.999	$875 - $1249	910	0	0
$50.000 – $74.999	$1250 - $1874	1.463	0	1 ($180K)
$75.000 - $99.999	$1875 - $2499	1.000	8 ($275K - $335K)	1 ($273K)
$100.000 – $149.999	$2500 -$ 3749	889	62 ($345K - $492.5K)	2 ($375 - $450K)
$150.000 – $199.999	$3750 - $4999	574	25 ($500K - $655K)	0
$200.000>	$5000>	210	2 ($720 - $809)	0
TOTAL NUMBER OF HOUSEHOLDS: 7.001				

Figure 10: Income levels and the number of houses that are available for rent in their affordable range (self-derived, 2022; National Association of Realtors, 2022; Census Bureau 2020).

ZIP 97216 Portland, OR. CURRENT RENTAL MARKET				
12 MONTH INCOME	MONTHLY COSTS FOR HOUSING ACCORDING 30% INCOME RULE	NUMBER OF HOUSEHOLDS PER INCNOME GROUP (NO DECIMALS)	AVAILABLE HOUSES ON RENT MARKET PER INCOME GROUP	AVAILABLE APPARTMENTS ON RENT MARKET PER INCOME GROUP
<$10.000	<$250	385	0	0
$10.000 – $14.999	$250 -$374	378	0	0
$15.000 – $24.999	$375 - $624	630	0	0
$25.000 – $34.999	$625 - $874	756	0	0
$35.000 - $49.999	$875 - $1249	910	0	1
$50.000 – $74.999	$1250 - $1874	1463	0	4
$75.000 - $99.999	$1875 - $2499	1000	4	2
$100.000 – $149.999	$2500 -$ 3749	889	4	0
$150.000 – $199.999	$3750 - $4999	574	1	0
$200.000>	$5000>	210	0	0
TOTAL NUMBER OF HOUSEHOLDS: 7.001				

Figure 11: Income levels and the number of houses that are recently sold in their affordable range (self-derived, 2022; National Association of Realtors, 2022; Census Bureau 2020).

ZIP 22203 Arlington, VA. RECENTLY SOLD MARKET				
12 MONTH INCOME	MONTHLY COSTS FOR HOUSING ACCORDING 30% INCOME RULE	NUMBER OF HOUSEHOLDS PER INCNOME GROUP (NO DECIMALS)	NUMBER RECENTLY SOLD HOUSES MONTHLY COSTS ACCORDING TO 13% MORTGAGE INCLUDING RANGE OF SOLD PRICES	NUMBER OF RECENTLY SOLD APPARTMENTS/CONDO'S ACCORDING TO 13% MORTGAGE RATE INCLUDING RANGE OF SOLD PRICES
<$10.000	<$250	593	0	0
$10.000 – $14.999	$250 -$374	258	0	0
$15.000 – $24.999	$375 - $624	825	0	1
$25.000 – $34.999	$625 - $874	438	0	4
$35.000 - $49.999	$875 - $1249	838	0	2
$50.000 – $74.999	$1250 - $1874	1.238	0	12
$75.000 - $99.999	$1875 - $2499	1.535	0	10
$100.000 – $149.999	$2500 -$ 3749	2.244	0	39
$150.000 – $199.999	$3750 - $4999	1.728	2 ($555K & $680K)	22
$200.000>	$5000>	3.199	42 ($712.5 - $1725K)	9
TOTAL NUMBER OF HOUSEHOLDS: 12.900				

Figure 12: Income levels and the number of houses that are available for rent in their affordable range (self-derived, 2022; National Association of Realtors, 2022; Census Bureau 2020).

ZIP 22203 Arlington, VA. CURRENT RENTAL MARKET				
12 MONTH INCOME	MONTHLY COSTS FOR HOUSING ACCORDING 30% INCOME RULE	NUMBER OF HOUSEHOLDS PER INCNOME GROUP (NO DECIMALS)	AVAILABLE HOUSES ON RENT MARKET PER INCOME GROUP	AVAILABLE APPARTMENTS ON RENT MARKET PER INCOME GROUP
<$10.000	<$250	593	0	0
$10.000 – $14.999	$250 -$374	258	0	0
$15.000 – $24.999	$375 - $624	825	0	0
$25.000 – $34.999	$625 - $874	438	0	0
$35.000 - $49.999	$875 - $1249	838	0	1
$50.000 – $74.999	$1250 - $1874	1.238	0	38
$75.000 - $99.999	$1875 - $2499	1.535	0	170
$100.000 – $149.999	$2500 -$ 3749	2.244	0	165
$150.000 – $199.999	$3750 - $4999	1.728	5	25
$200.000>	$5000>	3.199	2	8
TOTAL NUMBER OF HOUSEHOLDS: 12.900				

Figure 13: Facilities and their computed average distance (self-derived, 2022).

AMENITIES ZIP 97216, OR (4.0 km2)		
AMENITY	NUMBER	AVERAGE DISTANCE
SCHOOLS	6	≈ 1083 m
PARKS	6	≈ 1083 m
GROCERY STORES	8	≈ 813 m
HEALTH SERVICES	1	
PUBLIC TRANSIT		
RAIL	1	≈ -
NODE	60	≈ 108 m

Figure 14: Facilities and their computed average distance (self-derived, 2022).

AMENITIES ZIP 22203, VA (6.5 km2)		
AMENITY	NUMBER	AVERAGE DISTANCE
SCHOOLS	2	≈ 2000 m
PARKS	6	≈ 666 m
GROCERY STORES	5	≈ 800 m
HEALTH SERVICES	0	
PUBLIC TRANSIT		
RAIL	1	≈ -
NODE	35	≈ 114 m

Maps

Figure 15: Walkable service area of parks in ZIP 97216 with a 10-minute walk and a 20-minute walk (self-derived, 2022; Openstreetmap, 2022).

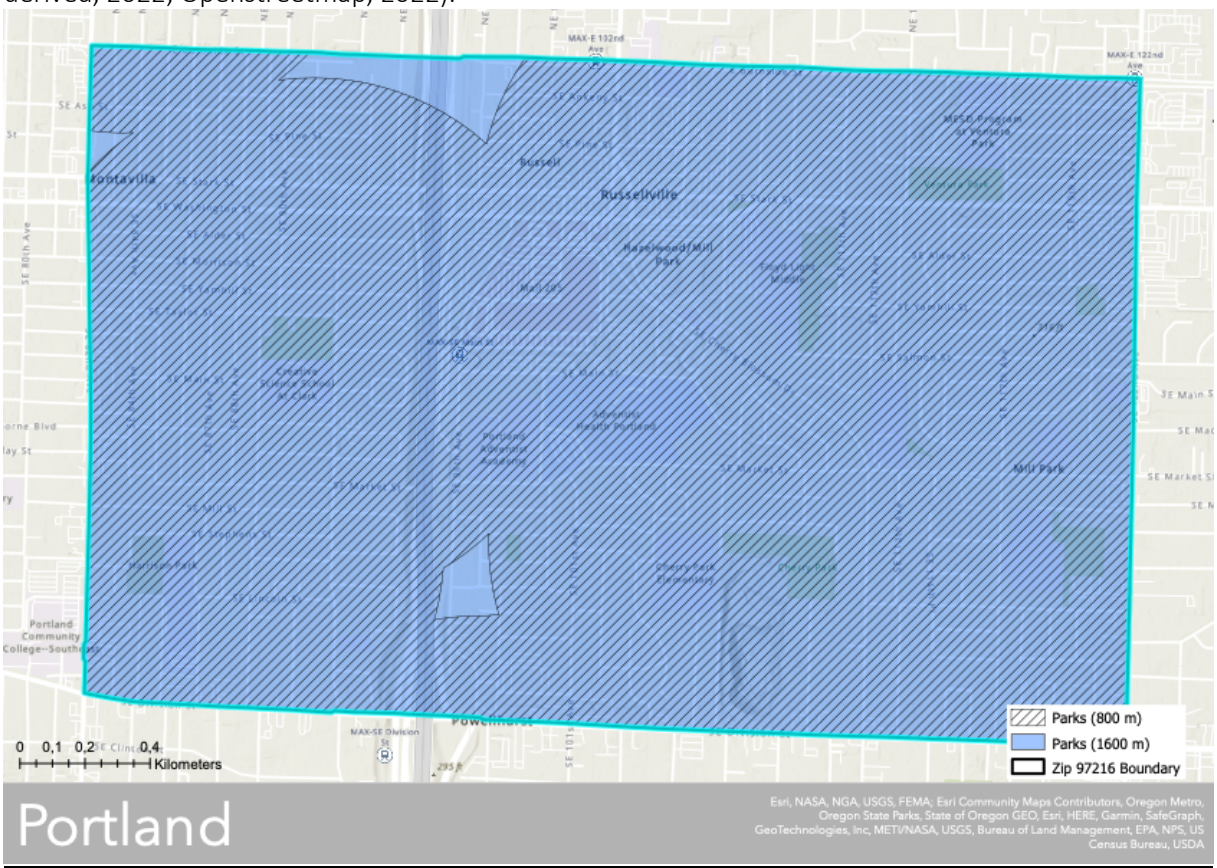


Figure 16: Walkable service area of schools in ZIP 97216 (self-derived, 2022; Openstreetmap, 2022)

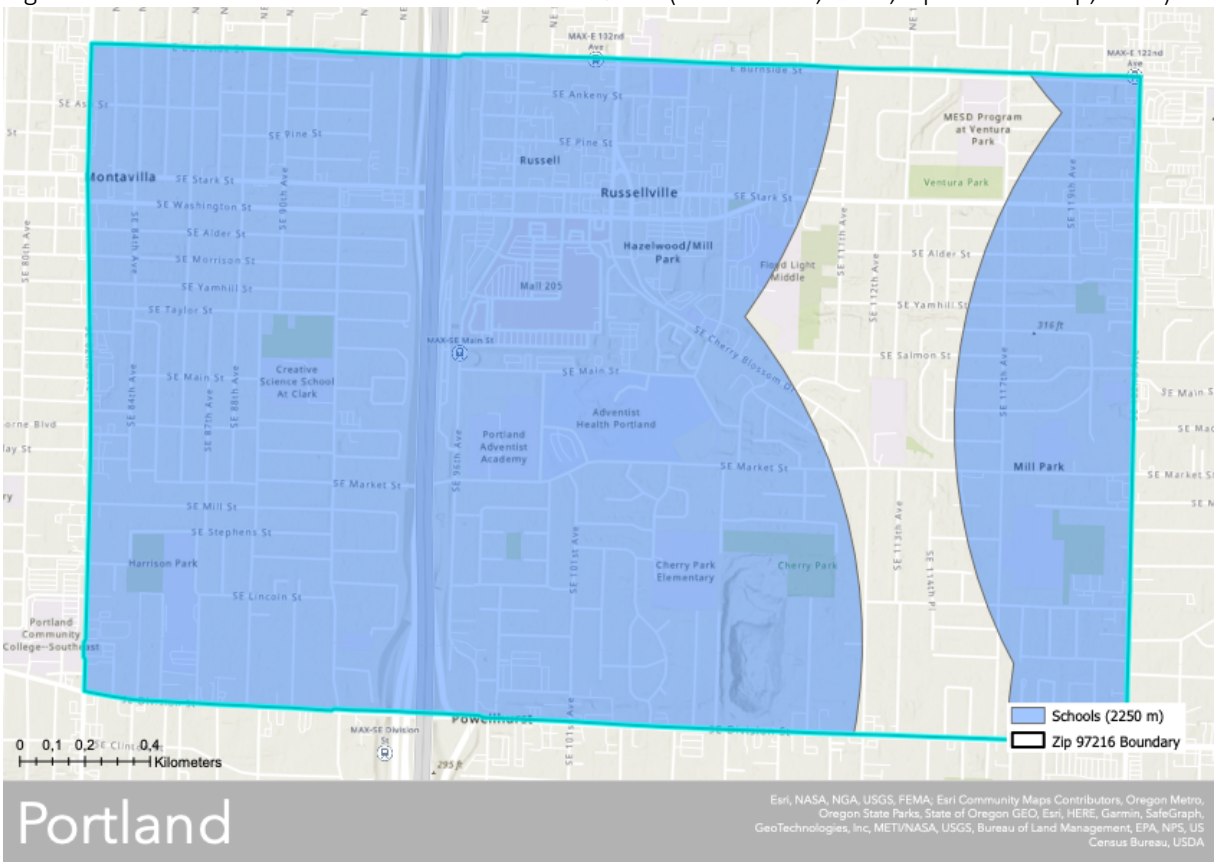


Figure 17: Walkable service area of hospitals in ZIP 97216 with a 10-minute walk and a 20-minute walk (self-derived, 2022; Openstreetmap, 2022).

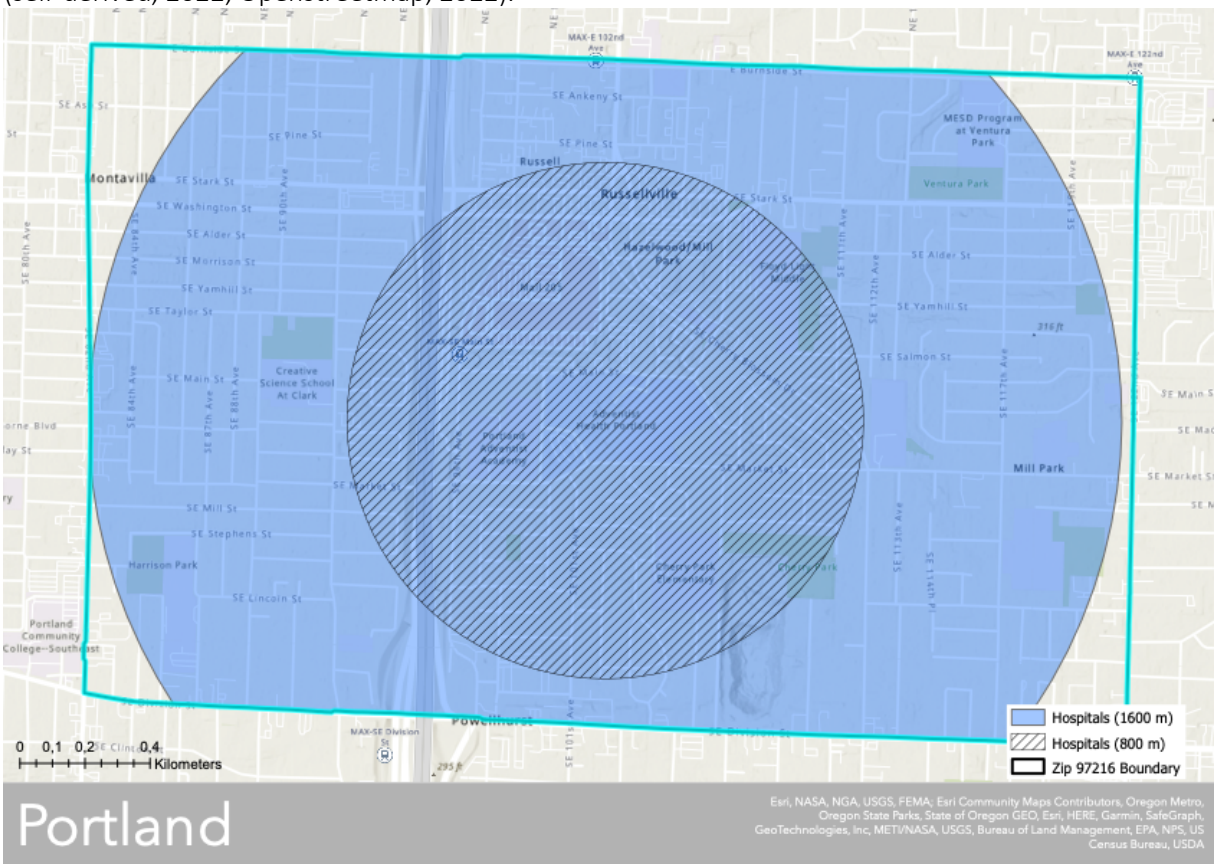


Figure 18: Walkable service area of bus stops in ZIP 97216 (self-derived, 2022; Openstreetmap, 2022).

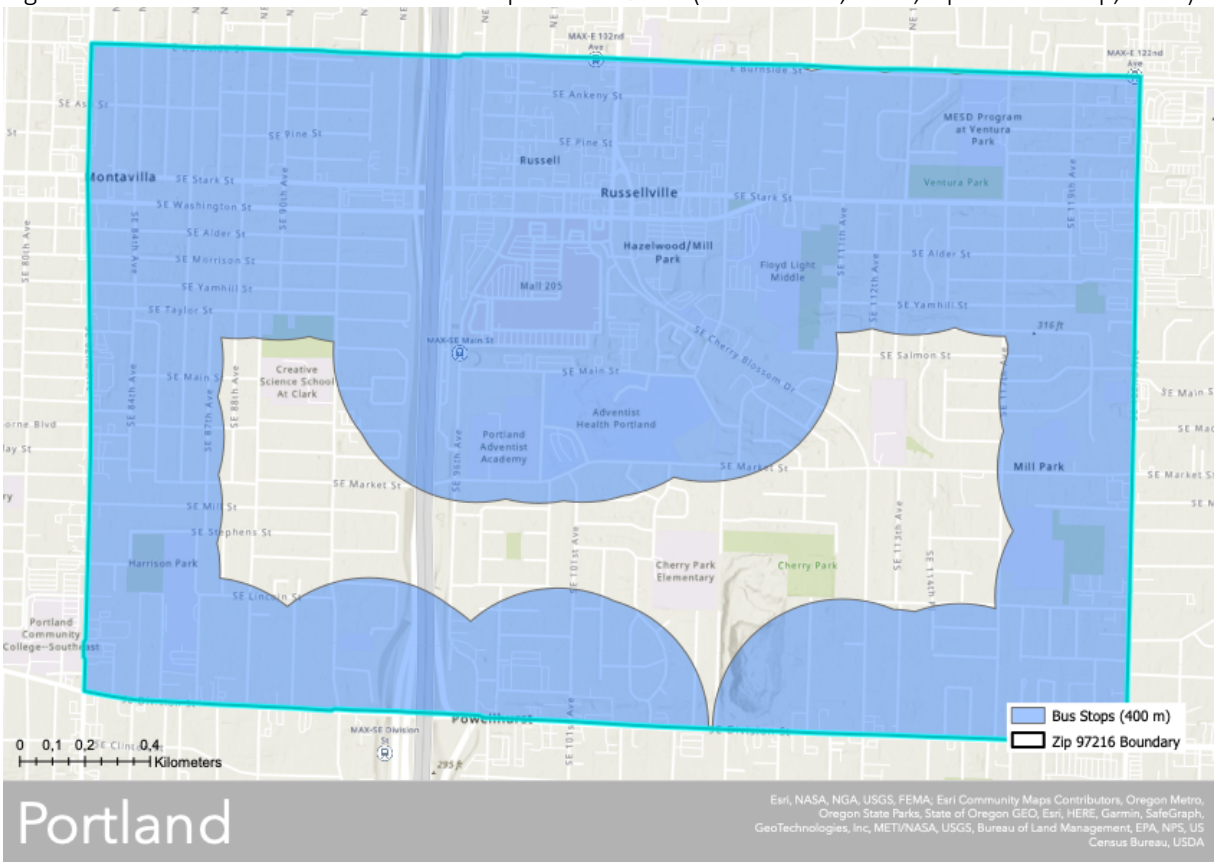


Figure 19: Walkable service area of railway stops in ZIP 97216 (self-derived, 2022; Openstreetmap).

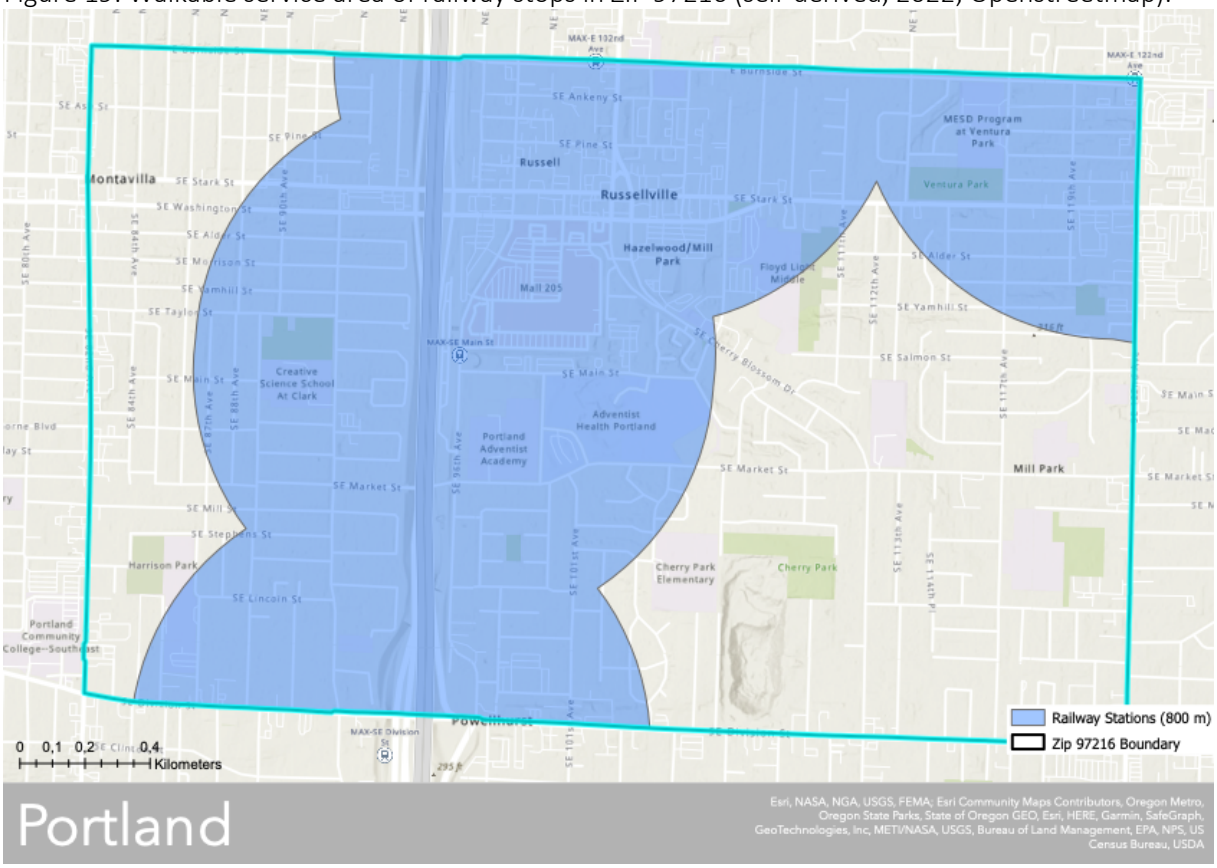


Figure 20: Walkable service area of supermarkets in ZIP 97216 (self-derived, 2022; Openstreetmap).

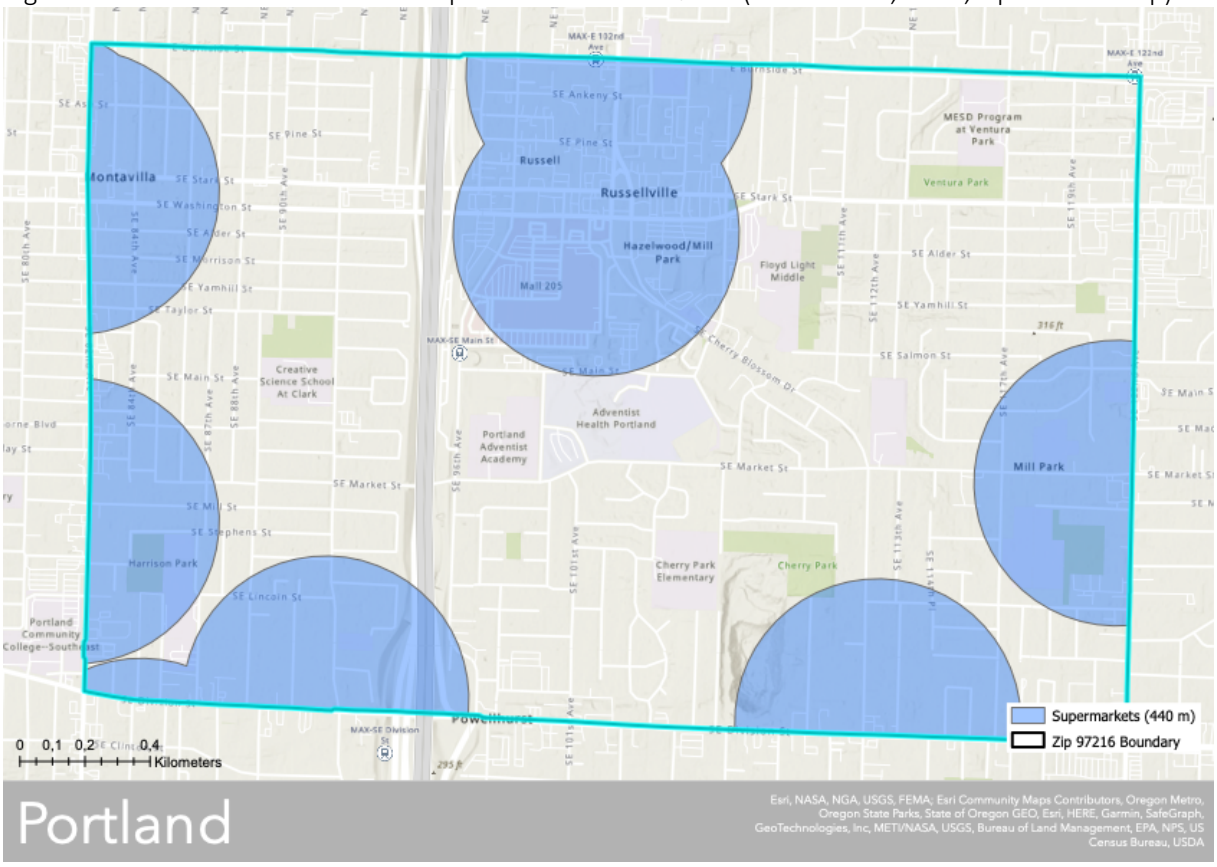


Figure 21: Walkable service area of parks in ZIP 22203 with a 10-minute walk and a 20-minute walk (self-derived, 2022; Openstreetmap, 2022).

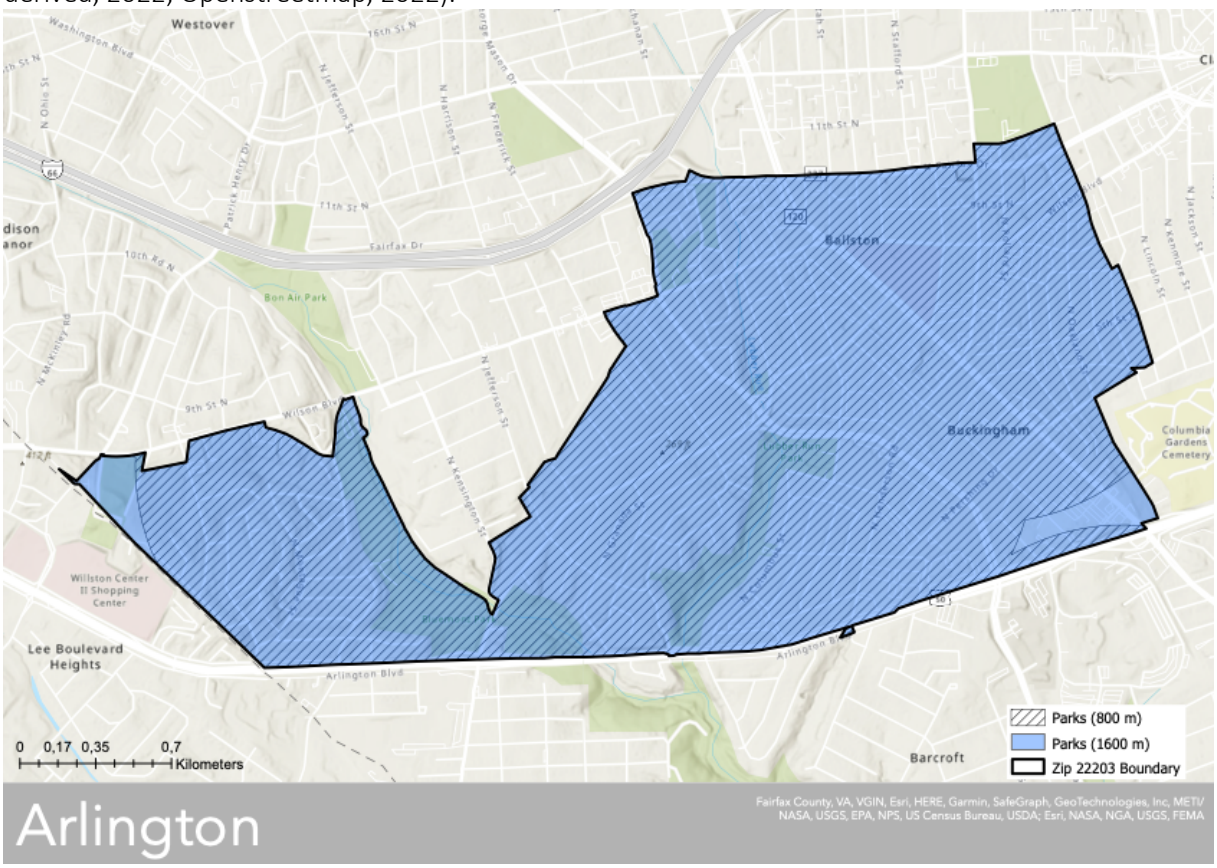


Figure 22: Walkable service area of ZIP schools in 22203 (self-derived, 2022; Openstreetmap, 2022)

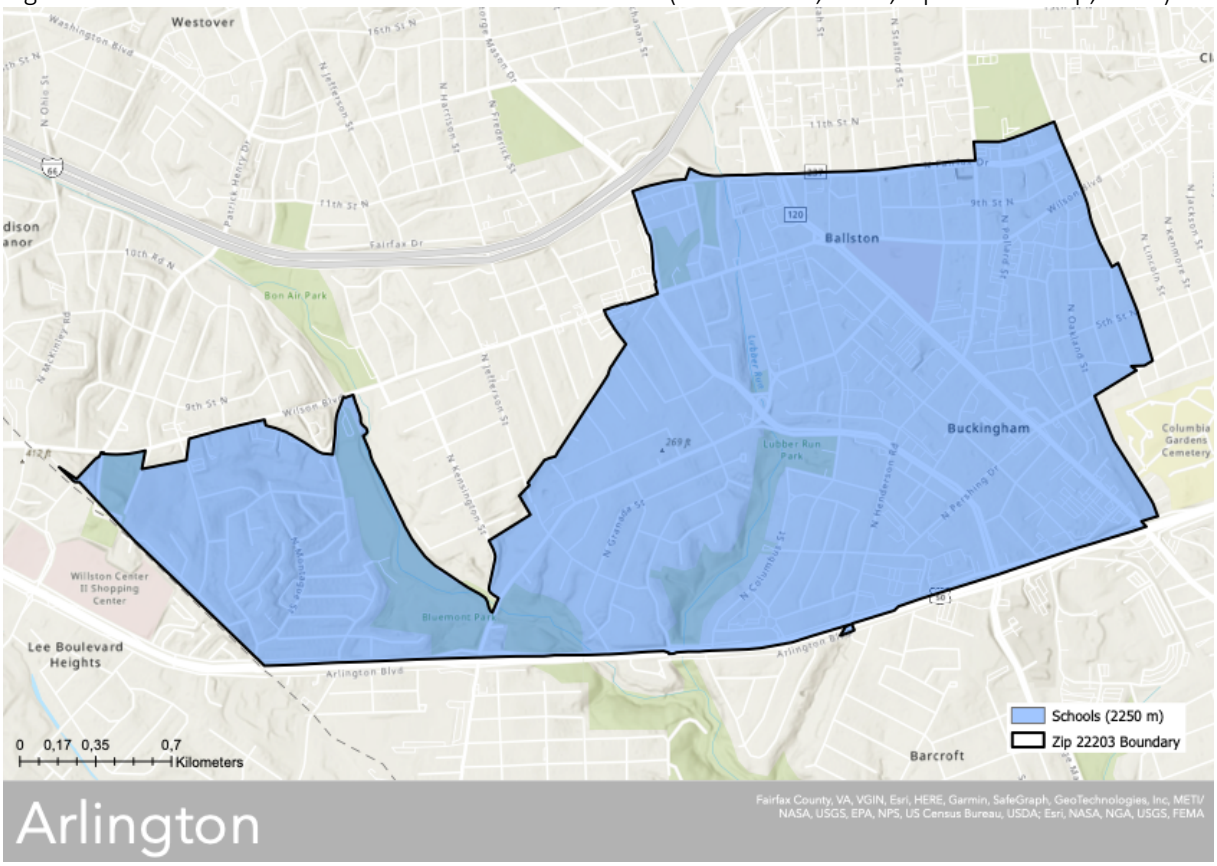


Figure 23: Walkable service area of hospitals in ZIP 22203 with a 20-minute walk (self-derived, 2022; Openstreetmap, 2022).

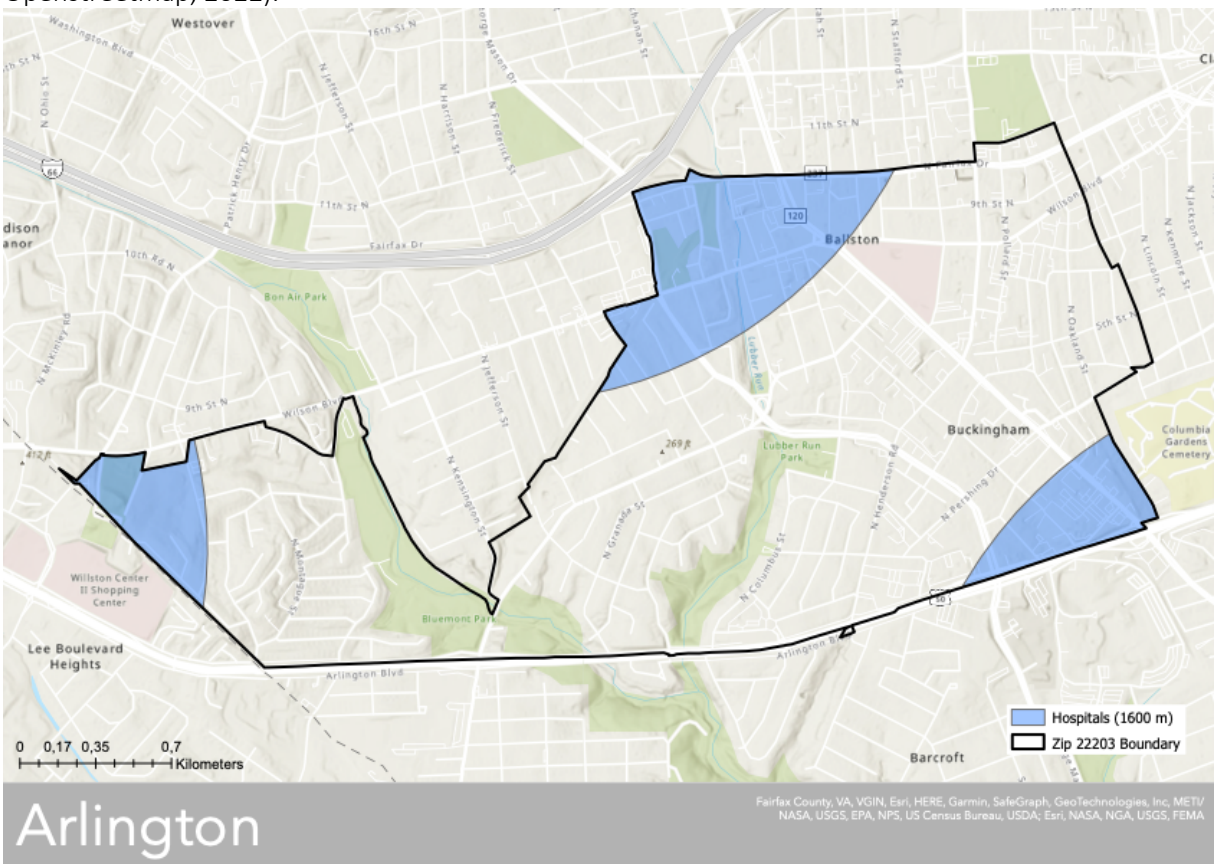


Figure 24: Walkable service area of bus stops in ZIP 22203 (self-derived, 2022; Openstreetmap, 2022).

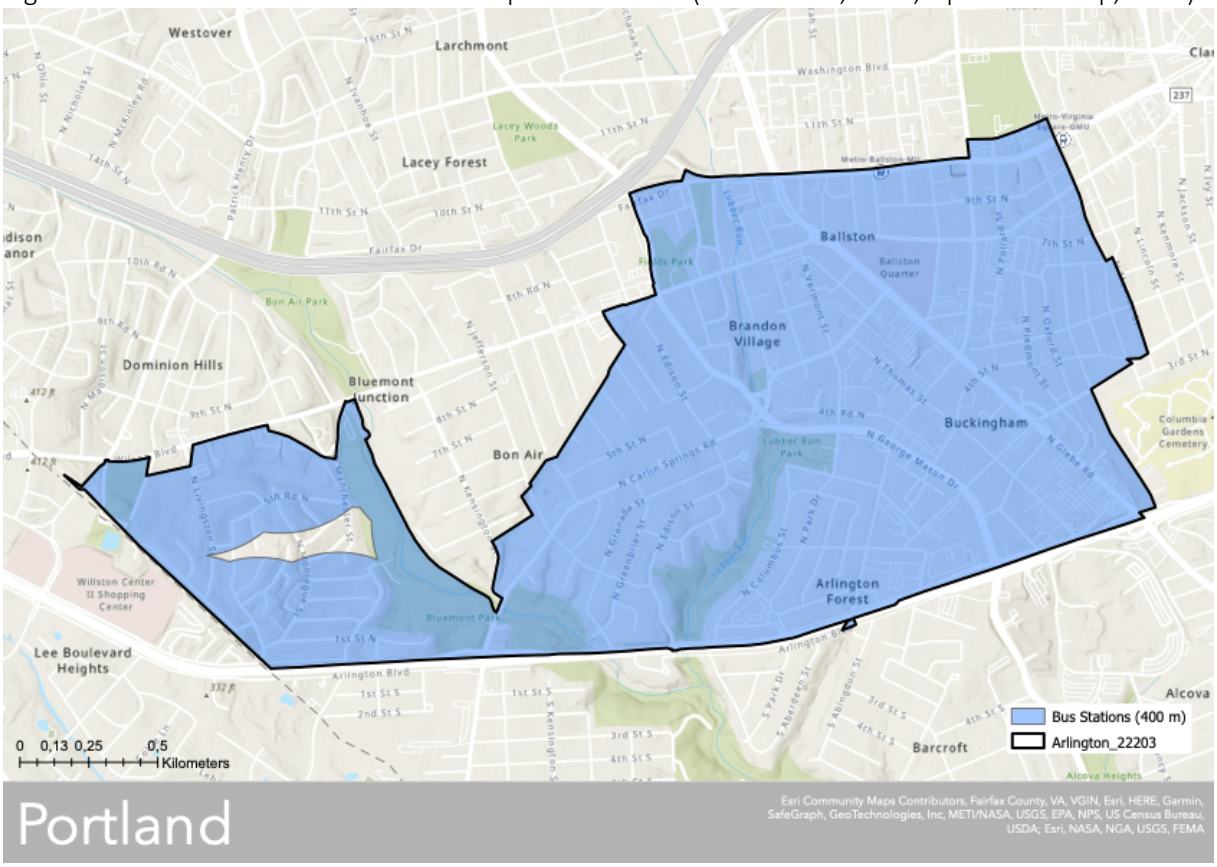


Figure 25: Walkable service area of railway stops in ZIP 22203 (self-derived, 2022; Openstreetmap, 2022).

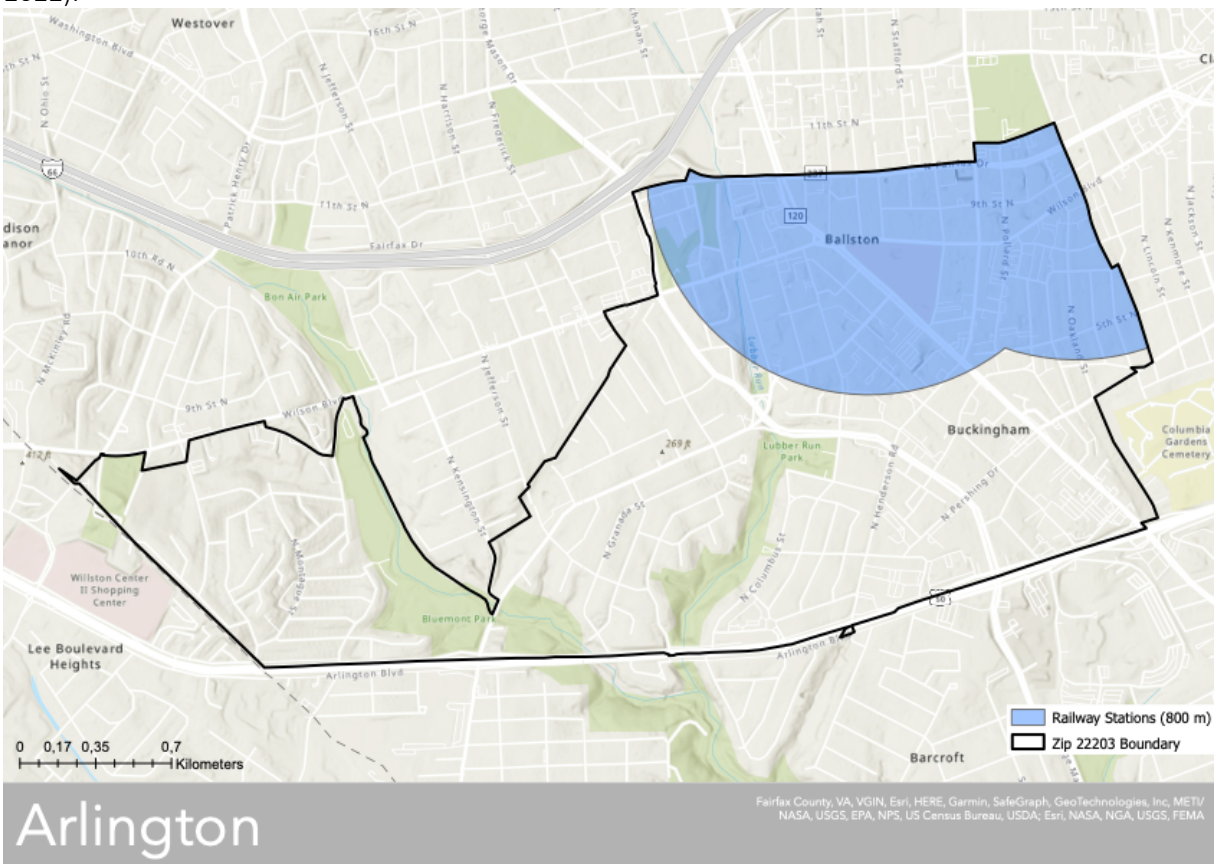


Figure 26: Walkable service area of supermarkets in ZIP 22203 (self-derived, 2022; Openstreetmap, 2022).

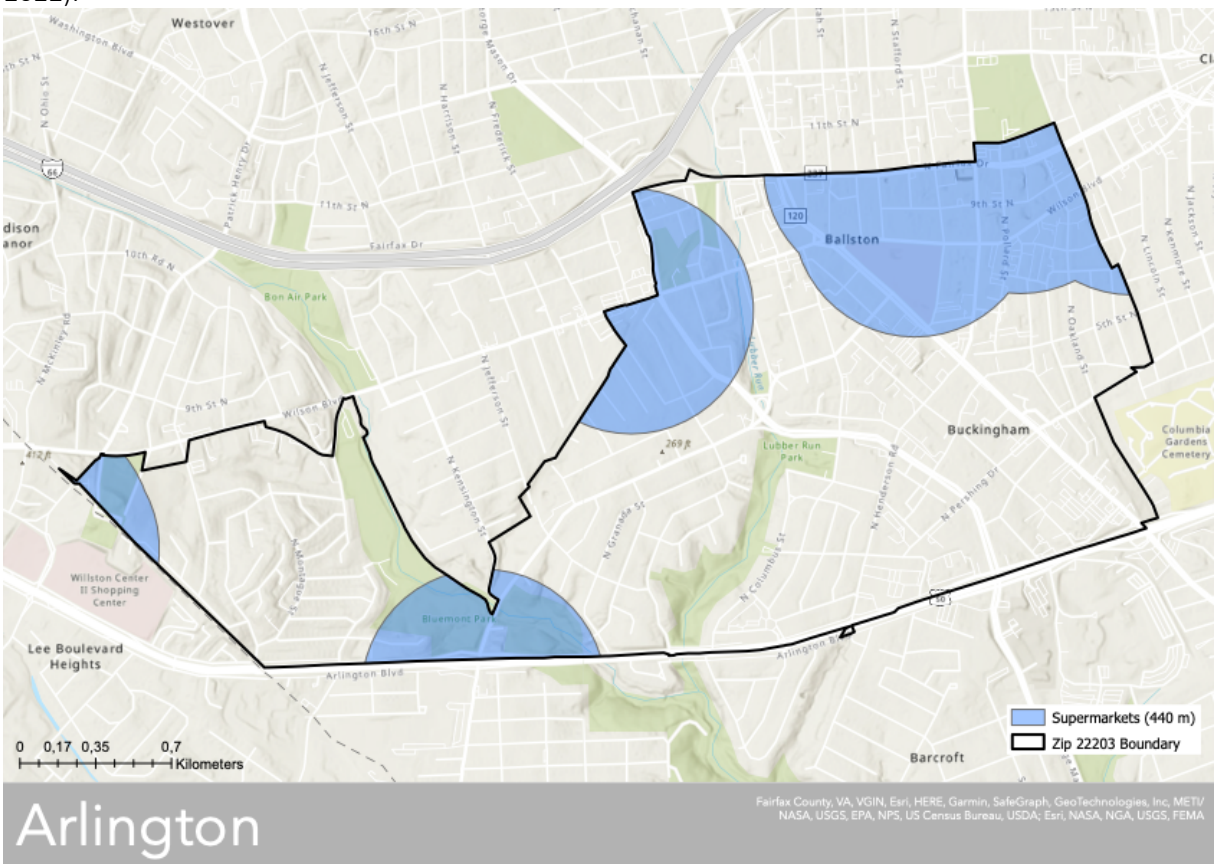


Figure 27: Location of ZIP 97216 in relation to the city of Portland highlighted in green (self-derived, 2022).

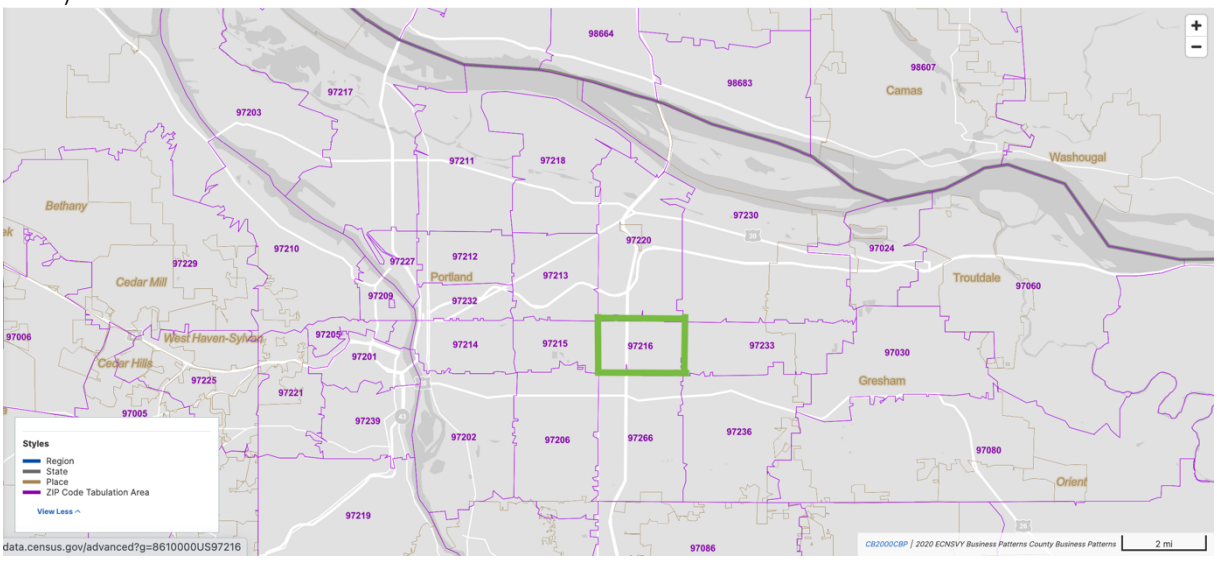
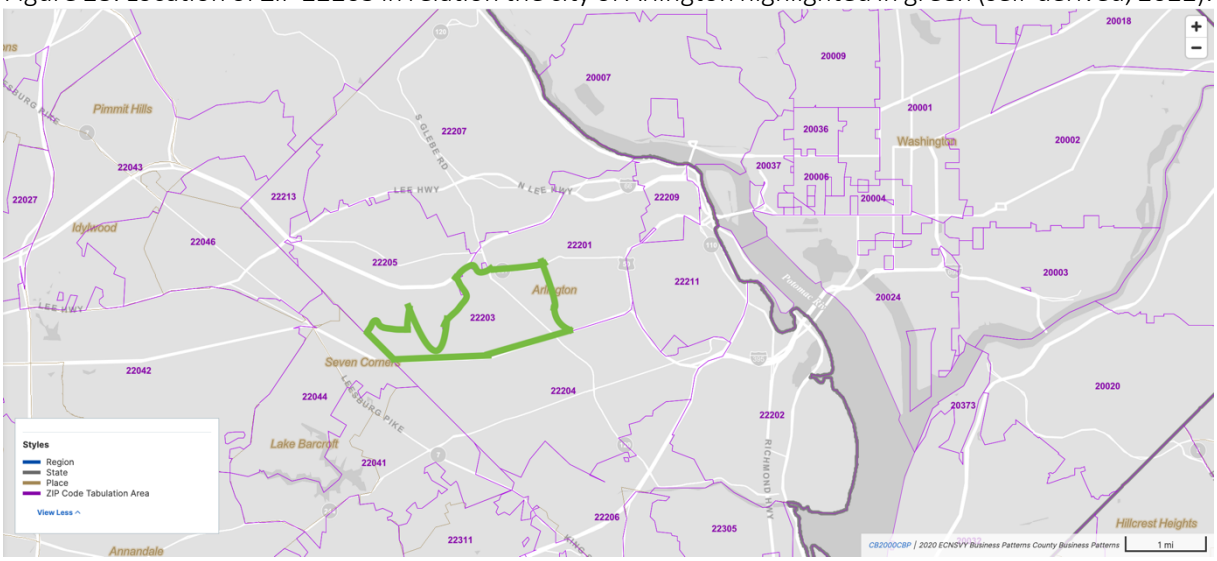


Figure 28: Location of ZIP 22203 in relation the city of Arlington highlighted in green (self-derived, 2022).



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