Exploring the Relationship Between Density, Population Growth and Housing Affordability in 8 Cities in Washington State Between 1990 and 2020

University of Washington
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Executive Summary

This project was undertaken because housing affordability is an issue that continues to have a negative impact on lower income residents. It is hypothesized that exclusionary zoning is used to keep out certain residents from the wealthier neighborhoods. This is another form of racial and economic discrimination, because many residents are either from low income backgrounds or are racial minorities. In light of the historical misuse of zoning policies and the role that played in racial and financial segregation, the effect of zoning on housing affordability is especially concerning. There are consequences that transcend further than people being able to live where they want to. Social and professional trajectories are heavily influenced by housing conditions. Families that live in nicer neighborhoods are able to cultivate an environment that is conducive to a good outcome for their children. This may include going to a higher quality school and college, having the resources and connections to pursue professional opportunities, having access to higher paying jobs, living in a healthy environment with recreational centers rather than violence. The location an individual grows up can have a substantial impact on their future. It isn't everything but it is an important factor. This is why legal housing policies that are potentially contributing to the exclusion of certain groups need to be evaluated. It leads to a gap in education and development between children who grow up in different neighborhoods. This is a glaring issue in housing equity and creates a cycle where many are being denied a safe and encouraging environment, as well as a promising future, based only on their family's living circumstances and conditions out of their control.

Our group is studying how exclusionary zoning has an effect on housing affordability in Washington state for eight cities(Spokane, Seattle, Tacoma, Vancouver, Everett, Pasco, Bellingham and Federal Way). One major issue that we faced while working on this project was finding data before the year 2000. For the deliverable, we were expected to analyze data from 1990-2020 and create projections for 2030 and 2040. Although census data before the year 2000 was easy to acquire, we had trouble finding zoning data for all eight cities for 1990-2000. We located zoning data for all eight cities from the Washington Geospatial Open Data Portal for 2000 and on but we were not able to find data before 2000. We reached out to our sponsor, Jefferson to see if he was able to get the data, but he was not able to find it either. Although this was a setback we still had a lot of data to analyze and create projections for. Another issue we faced was standardizing the zoning data for all the eight cities. Each city had their own way of categorizing zoning information. To make the final product as uniform as possible we had to understand each city's zoning categories and make them standardized across all the cities.

Before starting the project we hypothesized that exclusionary zoning has a heavy influence on housing affordability. After analyzing the data we came to the conclusion that there are other factors that play a bigger role on housing affordability.

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Background and Problem Statement

1.1 Introduction

The following section provides background information on our project, such as the context behind this topic and our team's motivation behind studying exclusionary zoning in Washington state. We also discuss different research questions that our project addresses.

1.2 Background

1.2.1 Context

Exclusionary zoning is policy that determines how a specific land is developed and used, which means it can designate certain areas to single family homes or a combination of single and multi family homes. As outlined in White's article for the Atlantic, "How Zoning Laws Exacerbate Inequality" there is an increasing disparity between how much land would cost if no regulations were in place regarding limiting development and how much the land is really worth. This is largely driven by the principle of scarcity. The original objective behind zoning was actually to protect communities, such as providing a healthy distance between residential areas and factories. This would prevent an unhealthy living situation. However, when used with the wrong intention, zoning can feed into discrimination and even lead to racial and economic segregation. Historically there have been several cases of zoning being used less for assuring that neighboring land is being used in accordance with the city plan, and more for fueling racial and financial discrimination.

There are concerns that it has evolved into a legal way to separate residents by how much they can afford to pay for their housing. Because of this, it is commonly postulated that zoning plays a key role in housing affordability for the average American resident. Zoning is often used as a means to keep lower income residents, often racial minorities, out of wealthy neighborhoods. Our group is studying how zoning laws have an effect on housing affordability in Washington state, and establishing the connection between these two variables in the event that it is present. Research shows that housing costs are increasing rapidly, and at a level that renter households are not able to comply with because income is not increasing at the same rate. Schuetz's paper "To improve housing affordability, we need better alignment of zoning, taxes, and subsidies" explains how almost half of the renter household population spent more than 30% of their income on rent in 2017, which meets the Department of Housing and Urban Development's criteria for being cost burdened (Schuetz, 2020). It's evident that even middle income households are struggling with this issue.

There are implications for residents that transcend beyond being able to live wherever they want. The reality is that the location an individual can afford to live in is a driving factor in economic and social trajectories for their children. There are an abundance of opportunities, both academic

and career oriented, available to children from families who reside in the higher end neighborhoods that are composed of expensive rental properties. These students attend the good schools, then attend the best colleges and go on in their career to make the most money. They can then provide that money and resources for their own children, and the cycle repeats. These areas are also likely higher in crime rates, and zoning laws may make it more difficult for families to move to areas where crime is less present because they can't afford the houses in those neighborhoods. In other cases, individuals may not be able to move into neighborhoods that are near jobs or close enough that they can commute to the location. Overall, there are fewer opportunities in these neighborhoods, and even a fewer number of recreation locations. These patterns contribute to the rise of poverty. Research shows that concentrated poverty, which is when neighborhoods have a federal poverty rate of at least 40%, is increasing in the US. It is important to have a full picture of the different factors at play, such as poverty, racial and economic inequality, land value, scarcity, and historical implications, and how these variables interact with exclusionary zoning policies.

1.2.2 Motivation

Our goal is to assist the Northwest Justice Project in making improvements in housing circumstances for low income residents of Washington state. Poverty rates are consistently increasing, which is why it is essential to study the impact and repercussions of this legal policy and the effect that ensues. Important attributes that influence residential zoning are population density and growth trends, which is why our project aims to demonstrate the relationship between density, population growth and housing affordability in different zoning regions. According to the latest report from the Washington State Census Bureau, the poverty rate is about 12% even with median household incomes rising. Concentrated poverty has severe implications on education and career possibilities. It is important to highlight again that residents who live in high income neighborhoods are the individuals gaining access to all the resources necessary to achieve successful professional outcomes. In the event that there is a strong link between exclusionary zoning laws and housing affordability, that would make a case to reevaluate zoning laws, as it is unethical to amplify inequality through legal measures. Promoting zoning practices that potentially act as a detriment to a significant portion of the population due to their household income level is not adhering to standards of equality.

Groups like the Northwest Justice Project are able to recognize the importance of equality within the community and are committed to making strides towards this goal. We can support this work by studying how zoning laws are impacting housing affordability in Washington and presenting a meticulous account of our findings. Our interactive maps and map snapshots for each city, in addition to our projections for 2030 and 2040, intend to display our findings in a way that is accurate and easy to digest. Focusing on a fixed number of communities in Washington state helps us narrow down the scope of our research and concentrate our efforts on conducting a detailed analysis on a limited number of cities. Being intentional in this manner allows us to

allocate the appropriate amount of time and energy for each map, and ensure that we are producing high quality deliverables. At the same time, we are examining data for enough cities that we can reasonably extrapolate and think about the bigger picture without relying on only one or two cities and making incorrect assumptions. These maps and projections will demonstrate the effect exclusionary zoning has on housing affordability in individual cities in Washington, and this will provide more information on a statewide level as well.

1.3 Problem Statement

This section discusses the need to know questions that will be addressed in our investigation and what we are producing as a final product to conduct our investigation. For this project, we are being asked to examine 8 different cities in Washington state throughout the time period between 1990 and 2020, and provide a visualization of the data for housing affordability in relation to exclusionary zoning laws and population density. We are also being asked to use these trends to create projections for the next 10 and 20 years. The questions that are presented in this project are concerned with the effect of zoning as a primary factor in decreased housing affordability. The main question that we aim to answer is whether the data truly reflected that zoning was a major causal factor in housing affordability. From there we determine the extent of its impact on housing affordability. Throughout this process we also address the “worst offenders” in terms of exclusionary zonings that are most detrimental towards affordable housing. Finally, one of the most prominent issues surrounding the conversation of exclusionary zoning and housing affordability is the interpretation of data. Something we are extremely cognizant of is ensuring that we display the data without making any assumptions on our own, and leaving little room for interpretation in order to show what the data truly reflects.

2. Systems Requirements

2.1 Introduction

This section describes the way in which the product will be presented in order to best display our findings. The circumstance with available data and the goal of making this information widely accessible to the public means that we are completing a dashboard with an accompanying story map that lays out our findings in a way that is audience friendly.

2.2 Web AppBuilder and Storymap

We are presenting the maps we are creating for the eight cities using Esri's Web AppBuilder, Dashboards and Storymap. We are showcasing each of the cities individually by creating eight different maps. Each map will show affordability and zoning information for the respective city. We are creating Web Apps for each city's finalized map, and then adding these to individual dashboards that we are producing for every city. In addition to displaying the maps on the dashboards, we are also incorporating charts that compare the fair market rent to the median household income for each city. The user will be able to view these charts while looking at the maps. Finally, we are embedding these dashboards onto our storymap. The user will be able to scroll through the storymap and look at the maps and charts for each city.

The web appbuilder is a tool that we are using to create maps that are showing the spatial relationships, housing affordability and zoning data for our selected cities in Washington. This is an effective way to produce maps that are ready to be shared with external parties, and implement widgets and themes without needing to write any code.

The dashboard is another tool that allows us to present our visualizations and data on an interactive platform. We are able to tailor the format of the dashboard in a way that displays both our charts and maps for each city on the same screen, clearly exhibiting the relevant information. The way the web apps are embedded onto our dashboards ensures that they are fully interactive.

The storymap is a digital method of communicating narratives through a combination of customizable maps, text and images. In this case, the narrative is our analysis on the effect of exclusionary zoning on housing affordability in Washington state. After a round of feedback, we have incorporated text onto the storymap. This provides the audience with the necessary context and background information to introduce our project to the audience, discuss the aim and scope of the project and conclude with our main takeaways. This is a dynamic way of presenting information, which is captivating for the audience and makes it more audience friendly. The dashboards are interactive and easy to navigate through, which means the audience can feel included in the research and walk through the storymap at their own pace. The manner of consumption is digestible and eases the viewer into the project. This medium of communication

is ideal for an audience because it incorporates engaging visuals and explanations, and also emphasizes the connection factor.

3. Data Acquisition

3.1 Introduction

This section lists the datasets and shapefiles for the land use, zoning, housing and rental affordability, and population changes between eight Washington cities. It takes data directly from county and city open portal sites as well as general Esri dataset and shapefiles.

3.2 Obstacles

During our data acquisition an issue arose that we thought might come to affect data quality in terms of variables across cities for zoning not being consistent. The way this was reconciled however was through separately created maps, as the data is not standardized over all of the datasets. We thought it best to display each individual city on its own as they are their own cases with varying data and outcomes.

3.3 Datasets

General Land Use

This dataset was developed for the Washington State Department of Commerce, specifically as a component of the Puget Sound Mapping Project to deliver information on generalized and standardized land use in the Puget Sound region. For the purposes of our investigation, the zoning data, including zoning abbreviations and zoning descriptions, was very valuable. The zoning data was gathered in a raster format, and converted into a digital form by the State Department of Commerce. It was last updated on May 11th, 2018.
https://geo.wa.gov/datasets/a0ddbd4e0e2141b3841a6a42ff5aff46_0?geometry=-130.601%2C46.554%2C-114.781%2C49.134

Zoning for the three additional cities

Pasco

This is zoning data, specifically polygons demonstrating the zoning designations for the city of Pasco. This dataset is shared by ArcGIS and updated last on May 11th, 2021.
https://data-cityofpasco.opendata.arcgis.com/datasets/zoning?geometry=-119.343%2C46.204%2C-118.903%2C46.287

Spokane

This is zoning data, specifically polygons demonstrating the zoning designations for the city of Spokane. This dataset is shared by ArcGIS and updated regularly.
https://data-spokane.opendata.arcgis.com/datasets/zoning?geometry=-117.947%2C47.592%2C-116.958%2C47.754&page=7

Vancouver/ Clark County

This is zoning data, specifically polygons demonstrating the zoning designations for the city of Vancouver/ Clark County. This dataset is shared by ArcGIS and updated last in February, 2020.
https://hub-clarkcountywa.opendata.arcgis.com/datasets/zoning?geometry=-124.273%2C45.462%2C-120.757%2C46.132

Population Percentage Change from 2000 to 2010 in King County Cities
This information is based on the 2010 US Census Bureau. This is relevant to our study because it shows the percentage with which the population in the US changed between the years of 2000 and 2010.
https://data.kingcounty.gov/Census/Population-change-2000-to-2010/6jtf-x5dp

Rental Affordability
This document is produced by the National Low Income Housing Coalition in 2020. This group aims to ensure public policy that allows residents in the US with the lowest incomes to have decent and affordable housing. Page 258 is focused solely on Washington, detailing information on several factors that shape housing affordability, including data on wages and rental expenses.
https://reports.nlihc.org/sites/default/files/oor/OOR_2020.pdf
Link to the csv file: https://reports.nlihc.org/oor/washington

Rental Affordability Index
The Rental Affordability Index is provided by the US Department of Housing and Urban Development (HUD). This dataset is updated every quarter. It measures if the average renter household has a sufficient income level to lease an average rental home at the national level.
https://www.huduser.gov/portal/ushmc/hd_rai.html
https://www.huduser.gov/portal/pdredge/pdr-edge-trending-110716.html#:~:text=HUD's%20rental%20affordability%20index%20measures,home%20at%20the%20national%20level.&text=The%20rental%20affordability%20index%20will,the%20median%2Dpriced%20rental%20unit.

Fair Market Rent (FMR)
This is a dataset provided by the US Department of Housing and Urban Development (HUD). HUD's Fair Market Rents (FMR) dataset displays an amount that a property in a specific area usually rents for. This figure is calculated by combining the base rent with essential utilities. This dataset is updated annually, and was last updated on February 23rd, 2021.
Fair Market Rents | HUD Open Data Site (arcgis.com)

Median Income
This is a dataset provided by the United States Census Bureau, it displays individual statistics for each city in Washington, across a variety of different categories. The relevant category for this investigation is the Median Household Income subcategory under the Income and Poverty

category. It shows the median household income for each city using data from 2015-2019, in 2019 dollars. The Census Bureau updates statistics on income every September. https://www.census.gov/quickfacts/fact/table/bellinghamcitywashington/PST045219

4. Data Analysis Strategy

4.1 Introduction

Since we have a lot of data to showcase and quite a few maps to display, it is important to have consistent categories of the different zoning types. Because of the different data sources that we used for the city zoning data, the categories are not all the same. So we have to recategorize some of them to make them consistent with each other. We will have a dashboard of each city with the different zoning in each city and the density of the population. We want the analysis to be straightforward so our data analysis is going to be straight to the point. We will not leave much room for interpretation. When we met with Jefferson he stated that a lot of policy makers have analysis paralysis and in order to not contribute to that problem we will try to be as straightforward as possible. This might be difficult to do since we are looking at eight cities, but having consistent categories of the different zoning types will be really helpful.

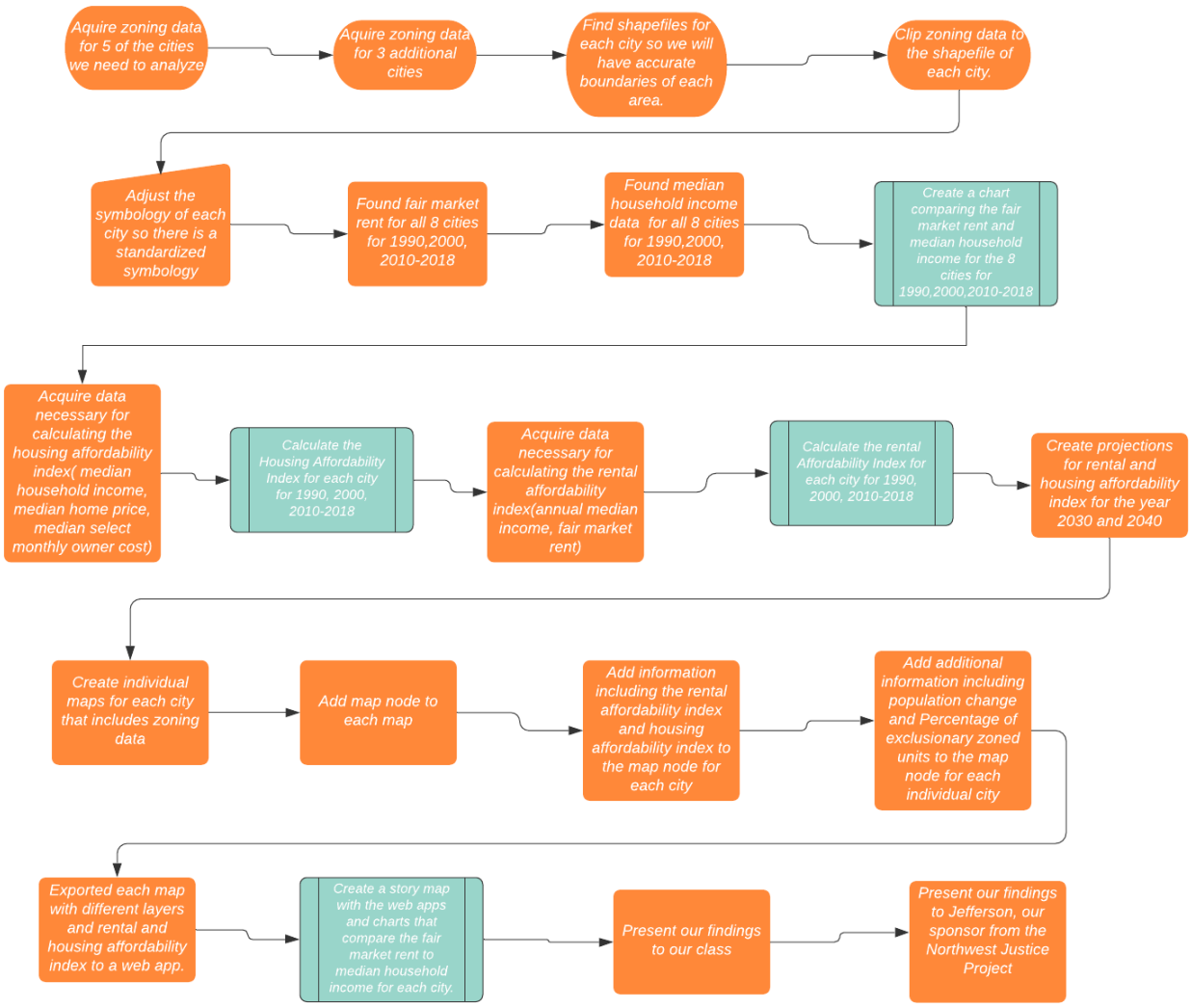
4.2 Obstacles

One of the main obstacles we faced was finding data for zoning information before the year 1990. Originally, one of the requirements for the deliverable was to create maps from 1990 - 2020 with projections for 2030 and 2040. We had difficulty finding zoning data before 2000 so we reached out to our sponsor, Jefferson to see if he could help us acquire that data. Unfortunately, he was not able to find that data as well. Because of this obstacle, we only looked at the data from 2000 and on. This was not a big obstacle because we still had a lot of data to analyze and create projections from. Another obstacle we had was standardizing the zoning information for all eight cities. Each city had their own way of showing the zoning information. In order to have a consistent story map, we had to standardize the way that zoning is displayed in the maps.

4.3 Methodology

Our first step is to produce individual maps for the following cities: Spokane, Seattle, Tacoma, Vancouver, Everett, Pasco, Bellingham and Federal Way. Variables of interest to our investigation are density, population growth and zoning. Each map consists of a layer showing the general land use, which includes different types of residential information such as traditional single family residential (3.1-12 units/acre), residential (12 or more units/acre), large lot residential (1 unit/10 acres to 1 unit/19.9 acres) and very large lot residential (1 unit/20 or more acres), in addition to zoning data for five cities. Other layers we included were the residential zoning data layer for the remaining five cities. Each city had their own way of displaying zoning, so we had to make the symbology for each city as standardized as possible across all cities. This will make it easier for the viewers to understand and interpret zoning information for each city. Then we added a layer that had the difference between the population count between 2010 and 2019, and the annualized change from 2010 and 2019. We imported datasets into ArcGIS and clipped the layers for the five additional zoning layers we needed. We created charts to

demonstrate the relationship between median income and fair market rent for a one bedroom home and a two bedroom home, for each individual city.



We calculated the Housing Affordability using the following formula:

$$\left(\frac{Median\ Household\ Income}{(20\%\ of\ median\ house\ price) + (median\ select\ monthly\ owner\ cost\ \times 12)}\right) * 100$$

We calculated the Rental Affordability using the following formula:

$$\left(\frac{30\%\ of\ Annual\ Median\ Income}{Fair\ Market\ Rent * 12}\right) * 100$$

Finally, we used this data and the current trends between these variables to create another set of maps to show projections for these cities for the year 2030, and then again for the year 2040.

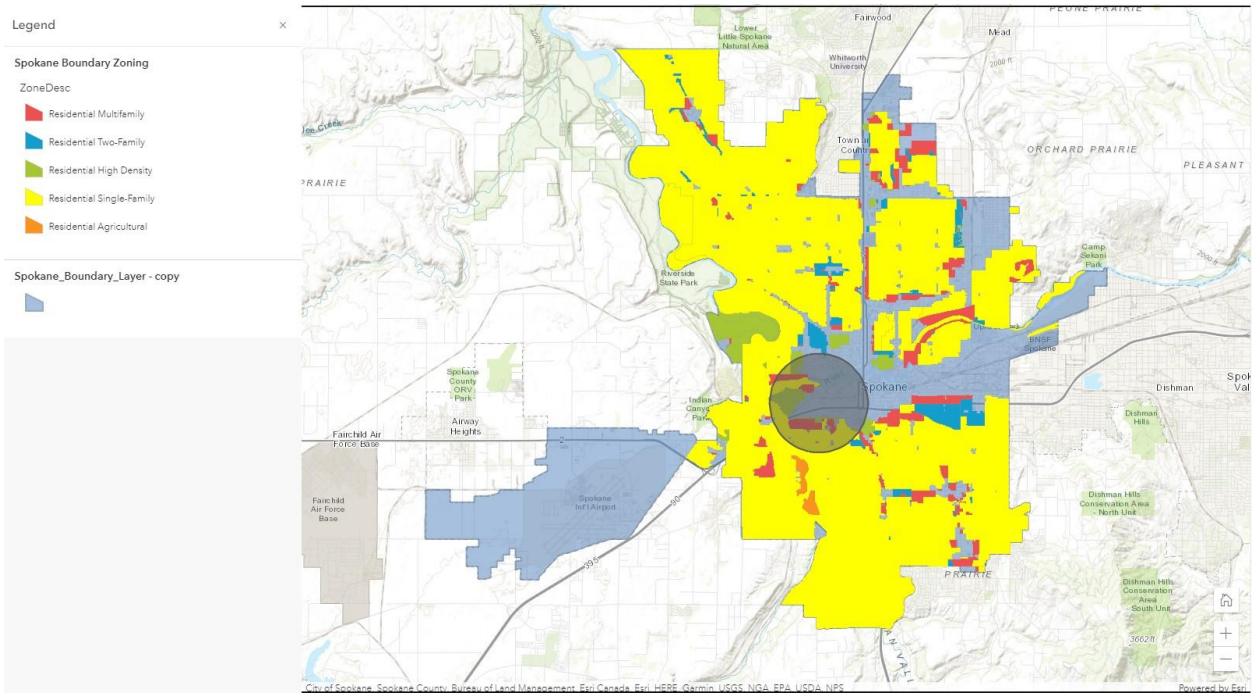
Our final step is to input this information into a dashboard and create a story map to display our research and findings.

5. Discussion of Results

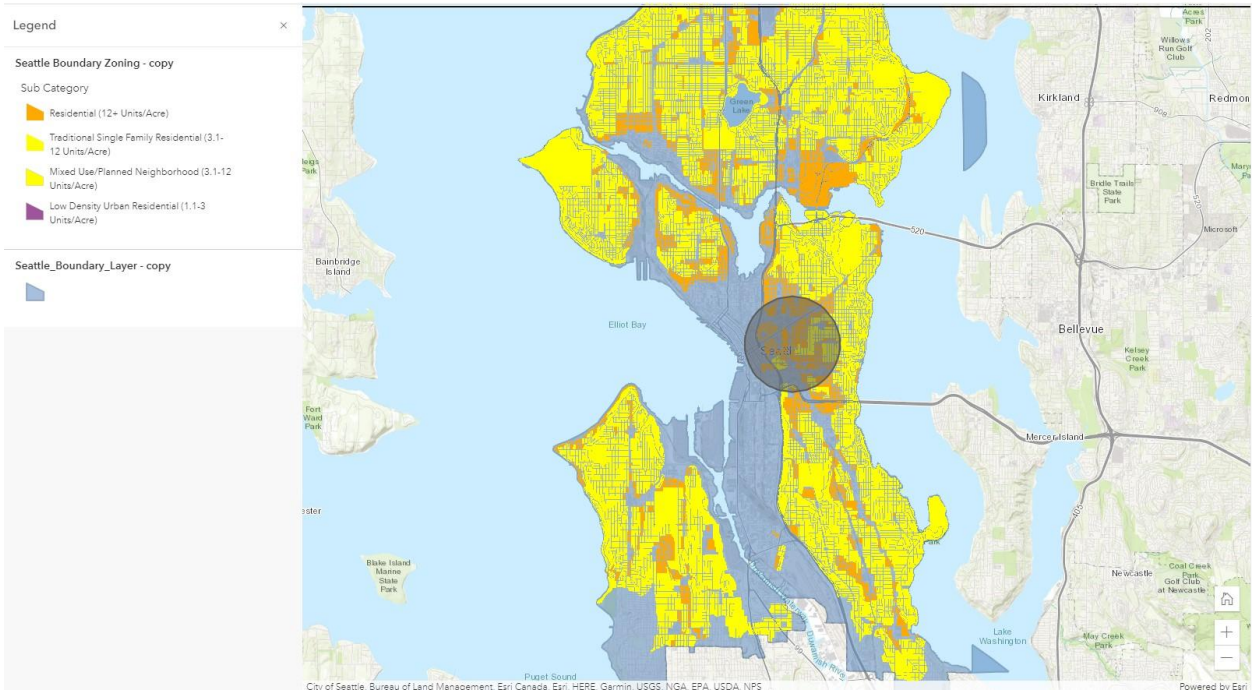
The following section displays our maps for the individual cities between the years 1990 and 2020, as well as projections for 2030 and 2040. For each individual city, we also included graphs of the relationship between median income and free market rent for both one bedroom and two bedroom.

5.1 Maps for Individual Cities: 1990-2020

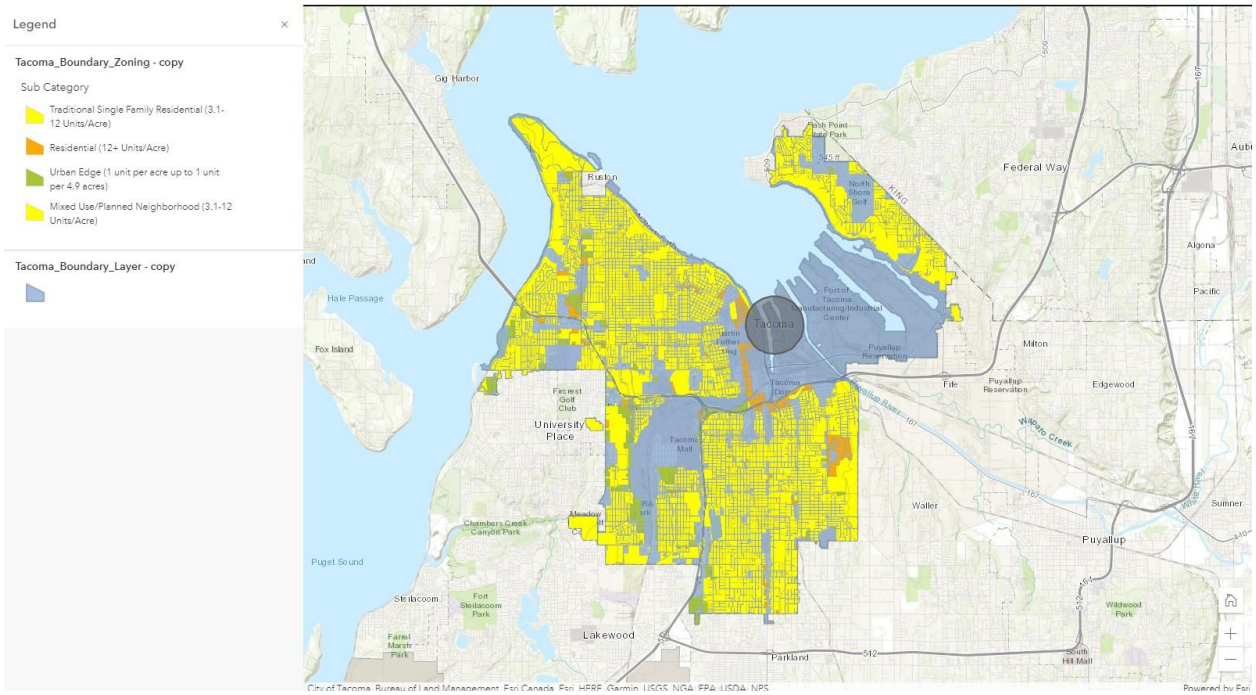
Spokane



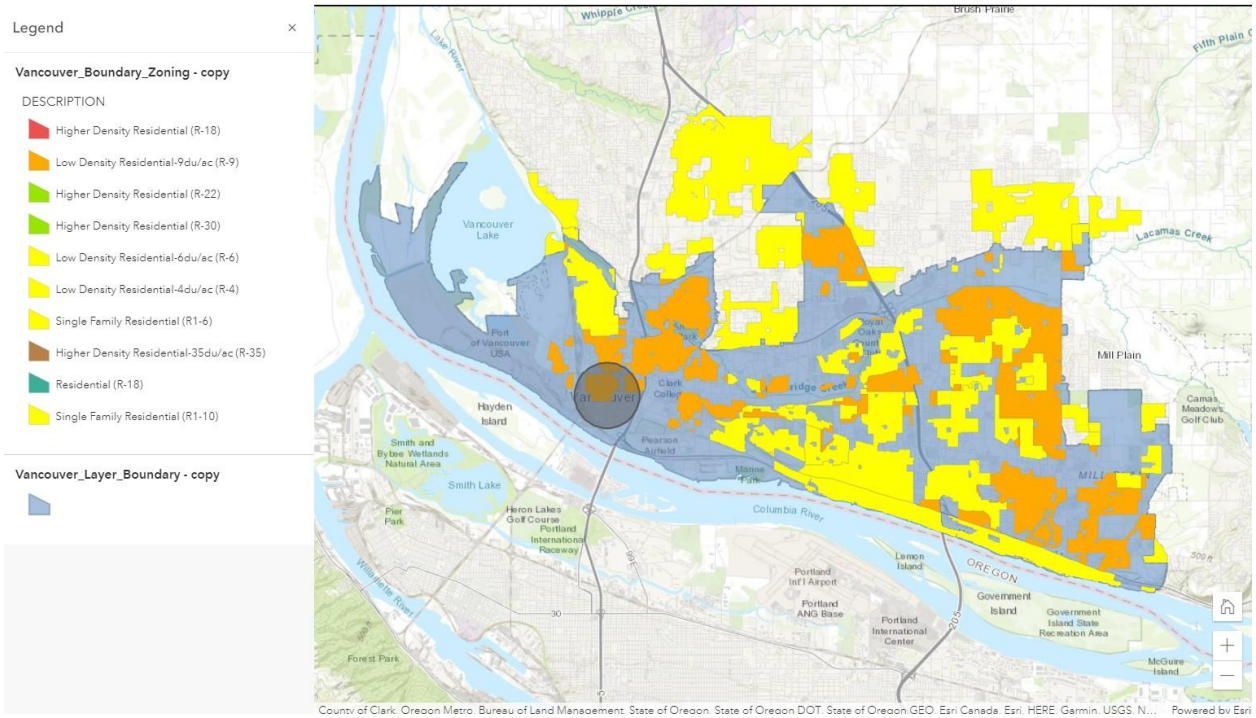
Seattle



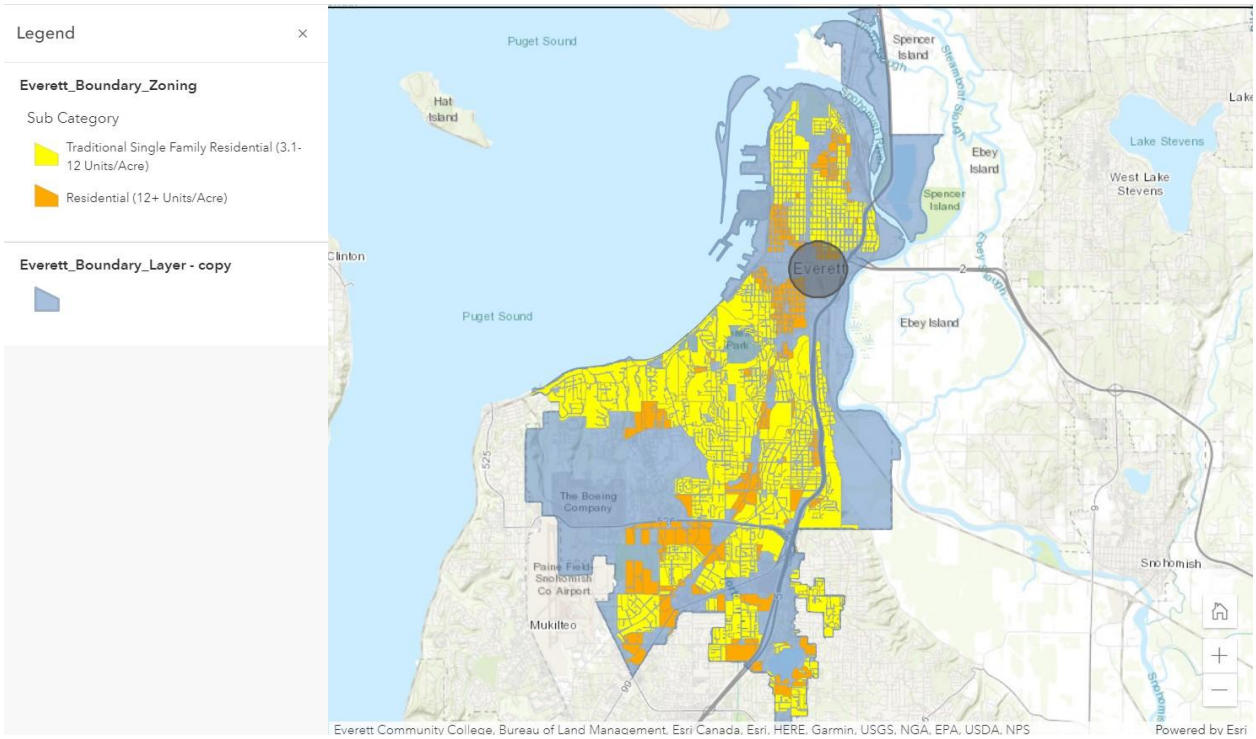
Tacoma



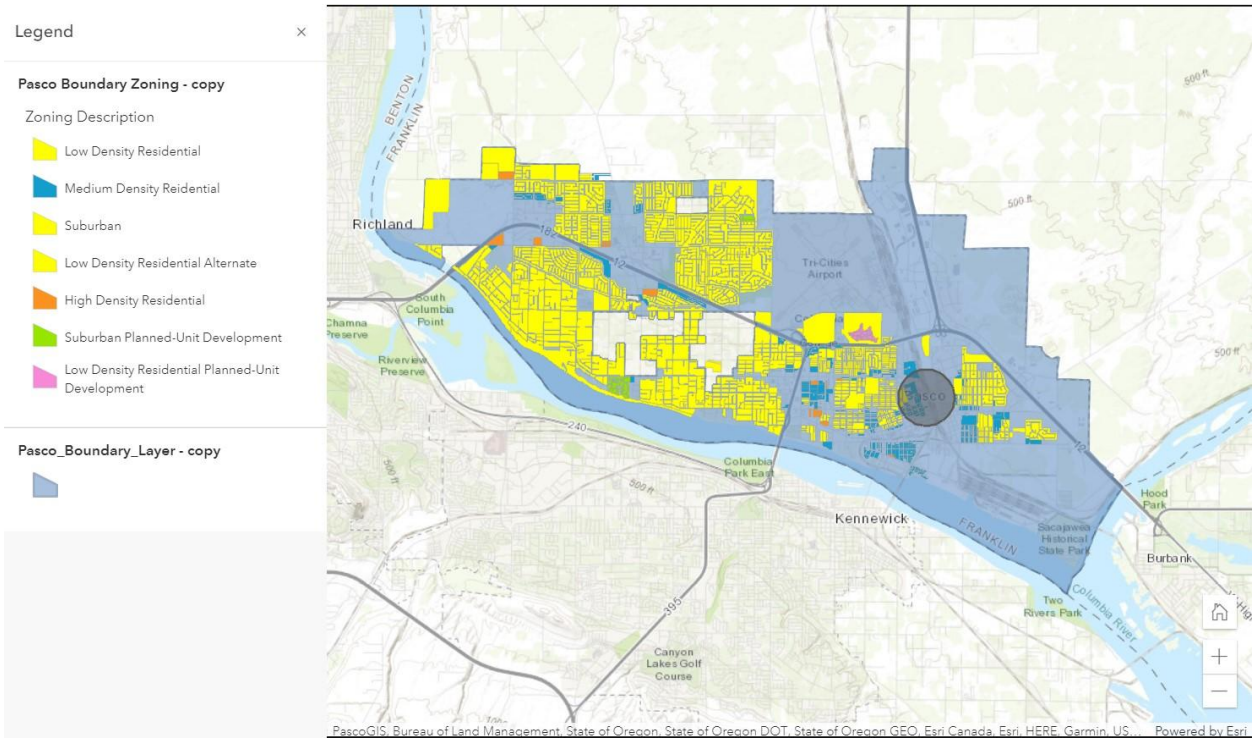
Vancouver



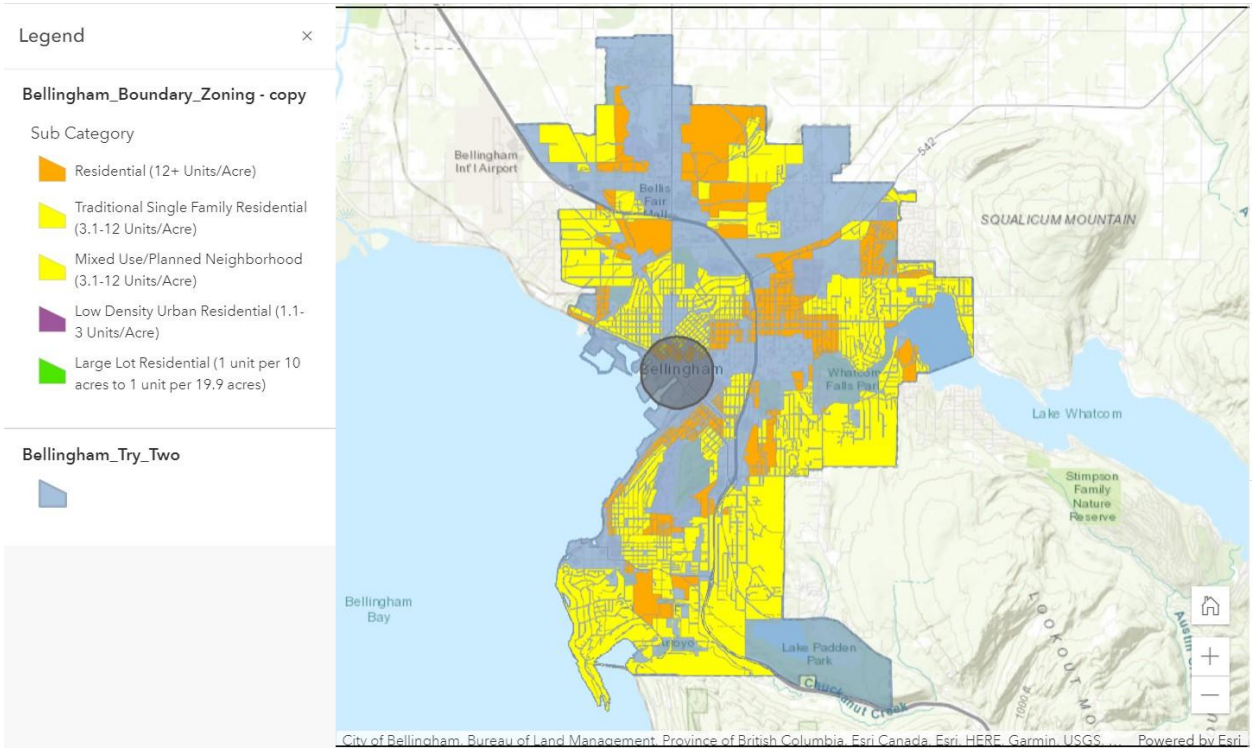
Everett



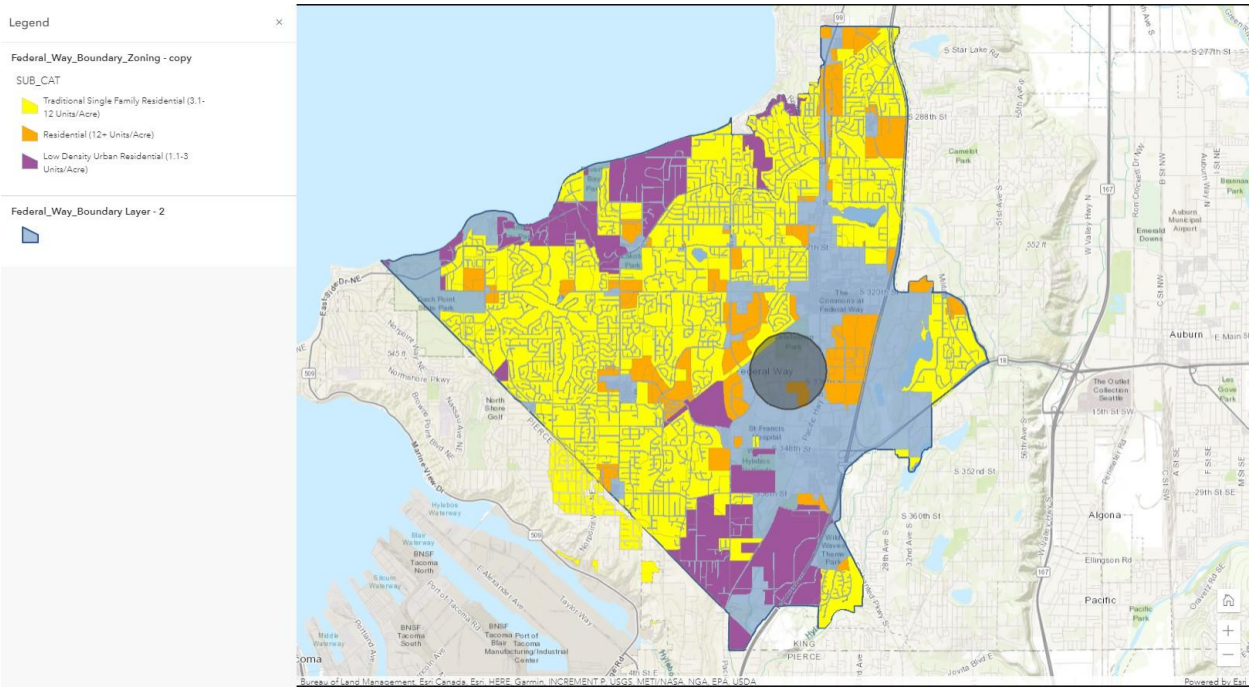
Pasco


Legend
Pasco Boundary Zoning - copy
Zoning Description
Low Density Residential
Medium Density Reidential
Suburban
Low Density Residential Alternate
High Density Residential
Suburban Planned-Unit Development
Low Density Residential Planned-Unit Development
Pasco_Boundary_Layer - copy
Richland
Kennewick
Pasco
Tri-Cities Airport
Columbia Park East
Hood Park
Sacajawea Historical State Park
Burbank
Two Rivers Park
Columbia River
Canyon Lakes Golf Course
Riverview Preserve
South Columbia Point
Chamna Preserve
FRANKLIN
BENTON
PascoGIS, Bureau of Land Management, State of Oregon, State of Oregon DOT, State of Oregon GEO, Esri Canada, Esri, HERE, Garmin, US...
Powered by Esri

Bellingham


Legend
Bellingham_Boundary_Zoning - copy
Sub Category
Residential (12+ Units/Acre)
Traditional Single Family Residential (3.1-12 Units/Acre)
Mixed Use/Planned Neighborhood (3.1-12 Units/Acre)
Low Density Urban Residential (1.1-3 Units/Acre)
Large Lot Residential (1 unit per 10 acres to 1 unit per 19.9 acres)
Bellingham_Try_Two
Bellingham Int'l Airport
Bellis Fair Mall
Bellingham
Whatcom Falls Park
SQUALICUM MOUNTAIN
Lake Whatcom
Stimpson Family Nature Reserve
Bellingham Bay
Lake Padden Park
LOOKOUT MO
City of Bellingham, Bureau of Land Management, Province of British Columbia, Esri Canada, Esri, HERE, Garmin, USGS, ...
Powered by Esri

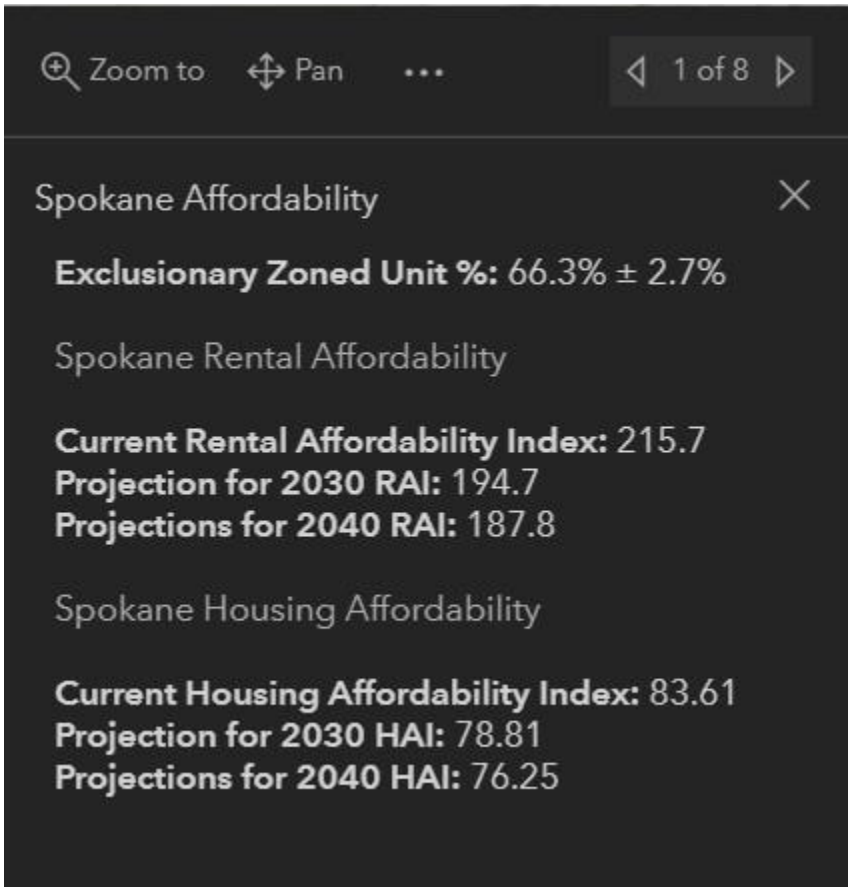
Federal Way



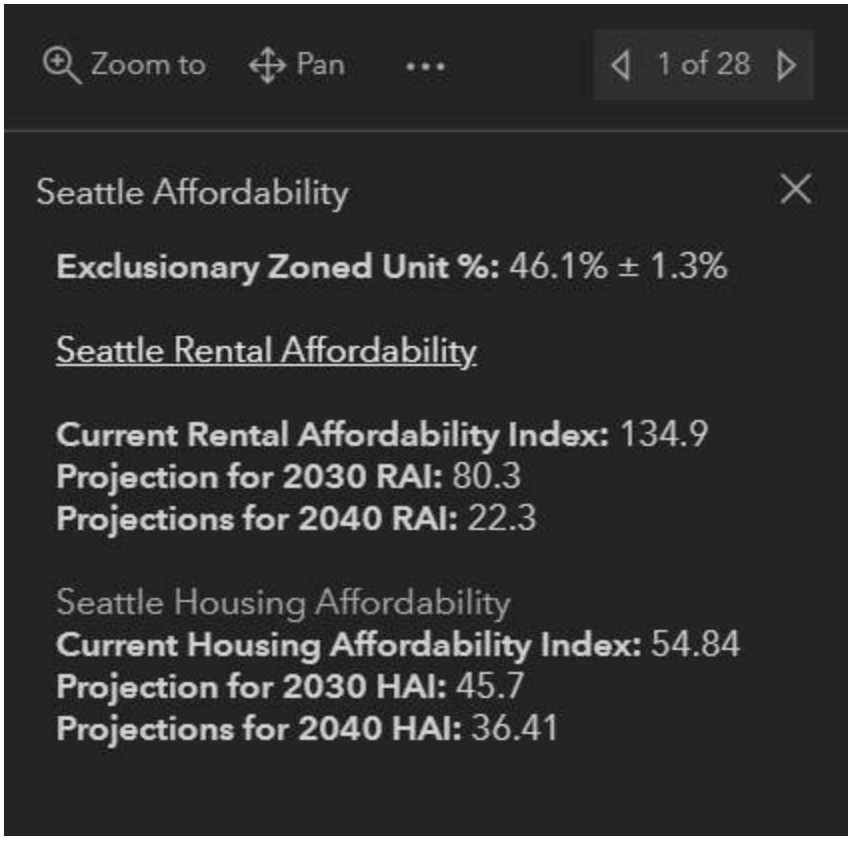
The individual city maps gave us insight into the spread and proportion of exclusionary zoning areas within each city. It put into perspective the amount of housing zoned across some of the largest cities in Washington as well as supplied us with the data in order to obtain the percentage of single unit housing structures in relation to all forms of housing. This is important in beginning to answer the question concerning the effect of zoning on housing affordability by giving us base numbers of exclusionary zoning to provide a comparison between affordability and proportion of exclusionary zoning between each case city.

5.2 Projections for Individual Cities: 2030 and 2040

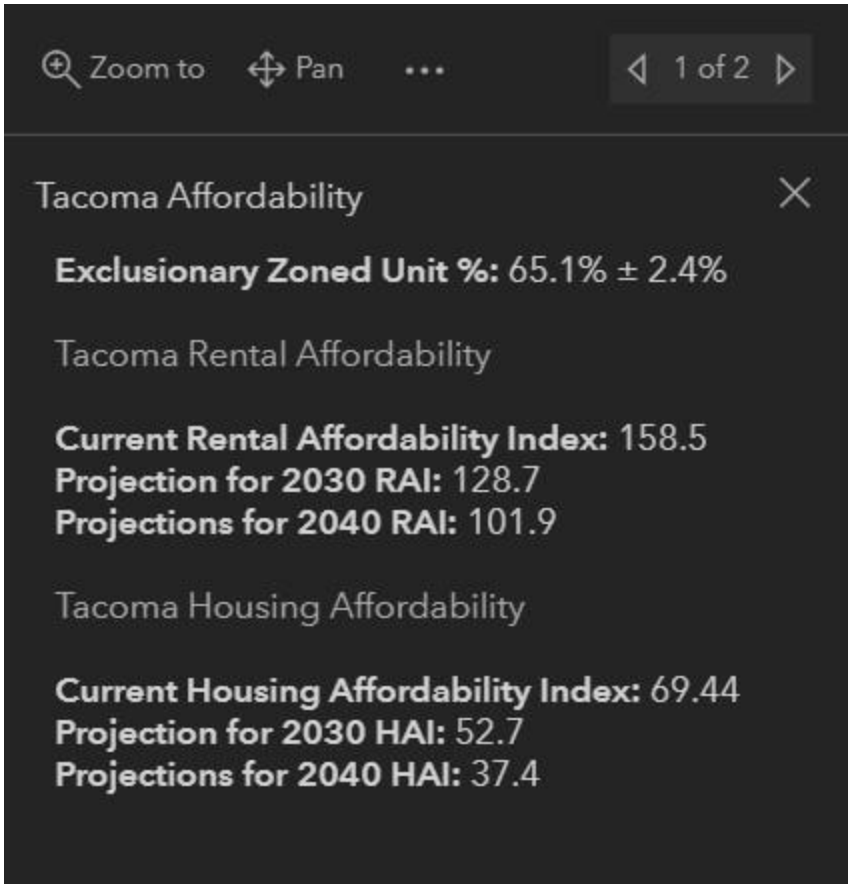
Spokane



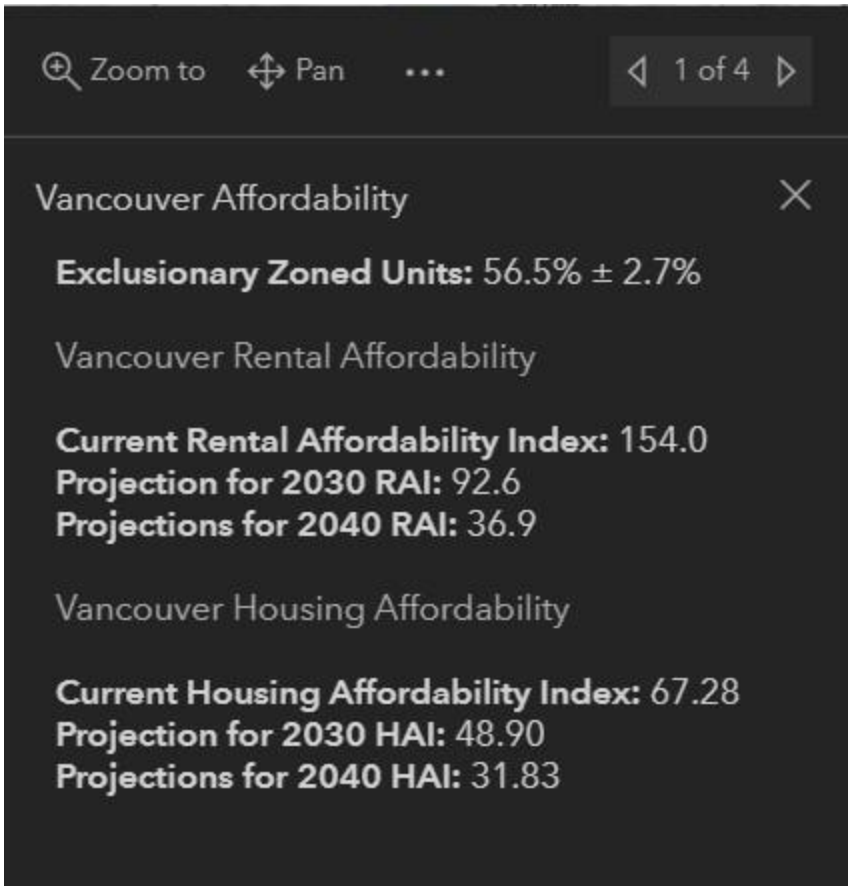
Seattle


Zoom to
Pan
1 of 28
Seattle Affordability
Exclusionary Zoned Unit %: 46.1% ± 1.3%
Seattle Rental Affordability
Current Rental Affordability Index: 134.9
Projection for 2030 RAI: 80.3
Projections for 2040 RAI: 22.3
Seattle Housing Affordability
Current Housing Affordability Index: 54.84
Projection for 2030 HAI: 45.7
Projections for 2040 HAI: 36.41

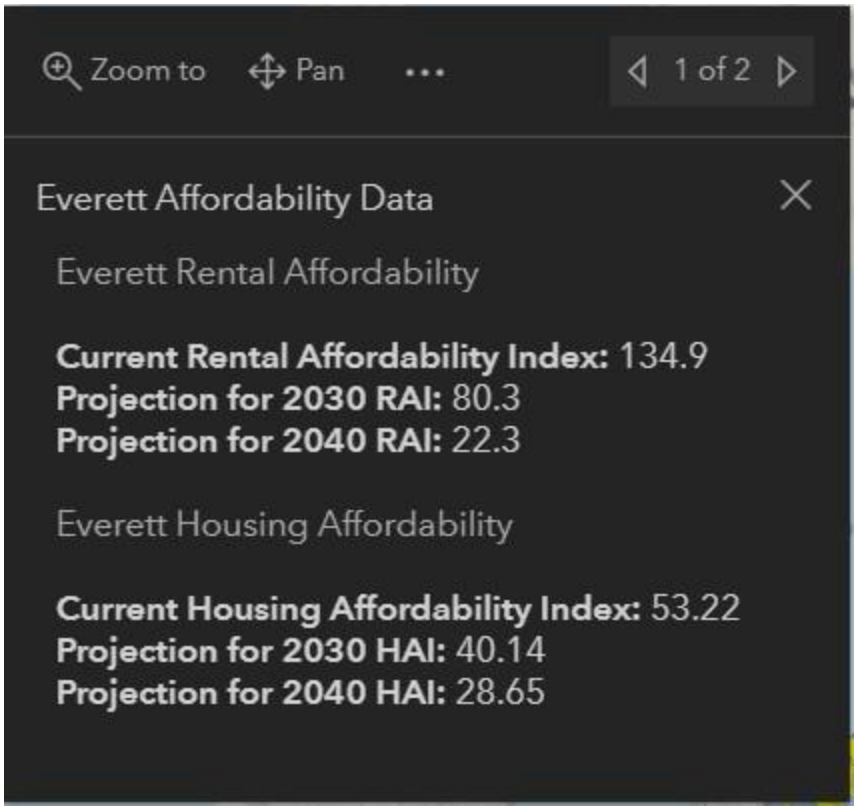
Tacoma


Zoom to
Pan
1 of 2
Tacoma Affordability
Exclusionary Zoned Unit %: 65.1% ± 2.4%
Tacoma Rental Affordability
Current Rental Affordability Index: 158.5
Projection for 2030 RAI: 128.7
Projections for 2040 RAI: 101.9
Tacoma Housing Affordability
Current Housing Affordability Index: 69.44
Projection for 2030 HAI: 52.7
Projections for 2040 HAI: 37.4

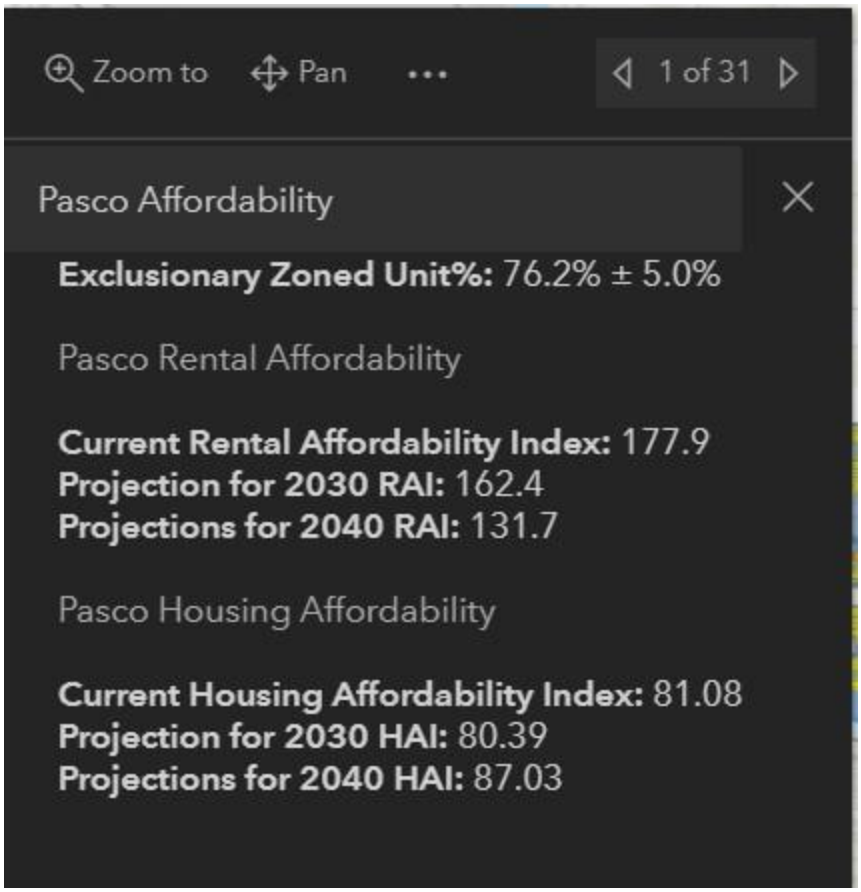
Vancouver


Zoom to
Pan
1 of 4
Vancouver Affordability
Exclusionary Zoned Units: 56.5% ± 2.7%
Vancouver Rental Affordability
Current Rental Affordability Index: 154.0
Projection for 2030 RAI: 92.6
Projections for 2040 RAI: 36.9
Vancouver Housing Affordability
Current Housing Affordability Index: 67.28
Projection for 2030 HAI: 48.90
Projections for 2040 HAI: 31.83

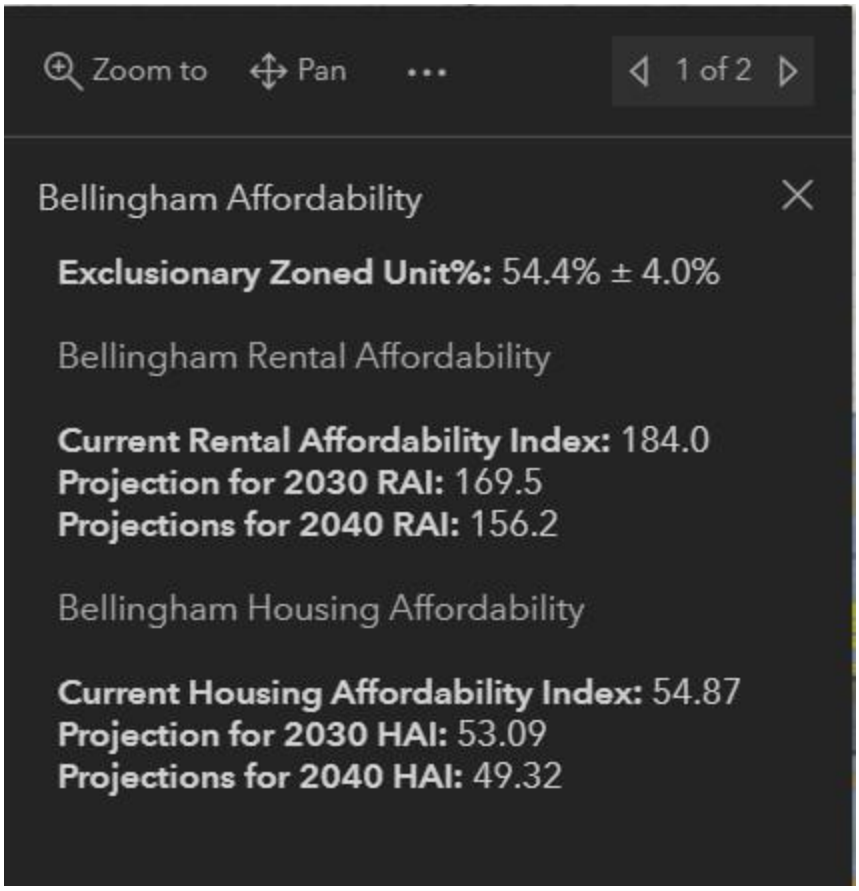
Everett


Zoom to
Pan
1 of 2
Everett Affordability Data
Everett Rental Affordability
Current Rental Affordability Index: 134.9
Projection for 2030 RAI: 80.3
Projection for 2040 RAI: 22.3
Everett Housing Affordability
Current Housing Affordability Index: 53.22
Projection for 2030 HAI: 40.14
Projection for 2040 HAI: 28.65

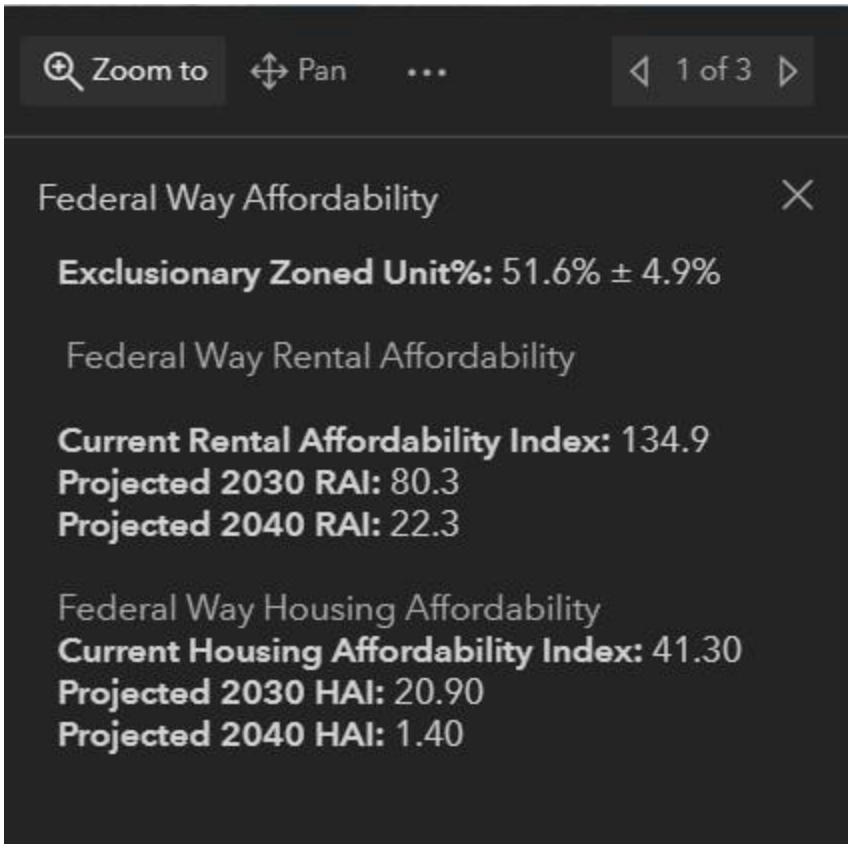
Pasco


Zoom to
Pan
1 of 31
Pasco Affordability
Exclusionary Zoned Unit%: 76.2% ± 5.0%
Pasco Rental Affordability
Current Rental Affordability Index: 177.9
Projection for 2030 RAI: 162.4
Projections for 2040 RAI: 131.7
Pasco Housing Affordability
Current Housing Affordability Index: 81.08
Projection for 2030 HAI: 80.39
Projections for 2040 HAI: 87.03

Bellingham


Zoom to
Pan
1 of 2
Bellingham Affordability
Exclusionary Zoned Unit%: 54.4% ± 4.0%
Bellingham Rental Affordability
Current Rental Affordability Index: 184.0
Projection for 2030 RAI: 169.5
Projections for 2040 RAI: 156.2
Bellingham Housing Affordability
Current Housing Affordability Index: 54.87
Projection for 2030 HAI: 53.09
Projections for 2040 HAI: 49.32

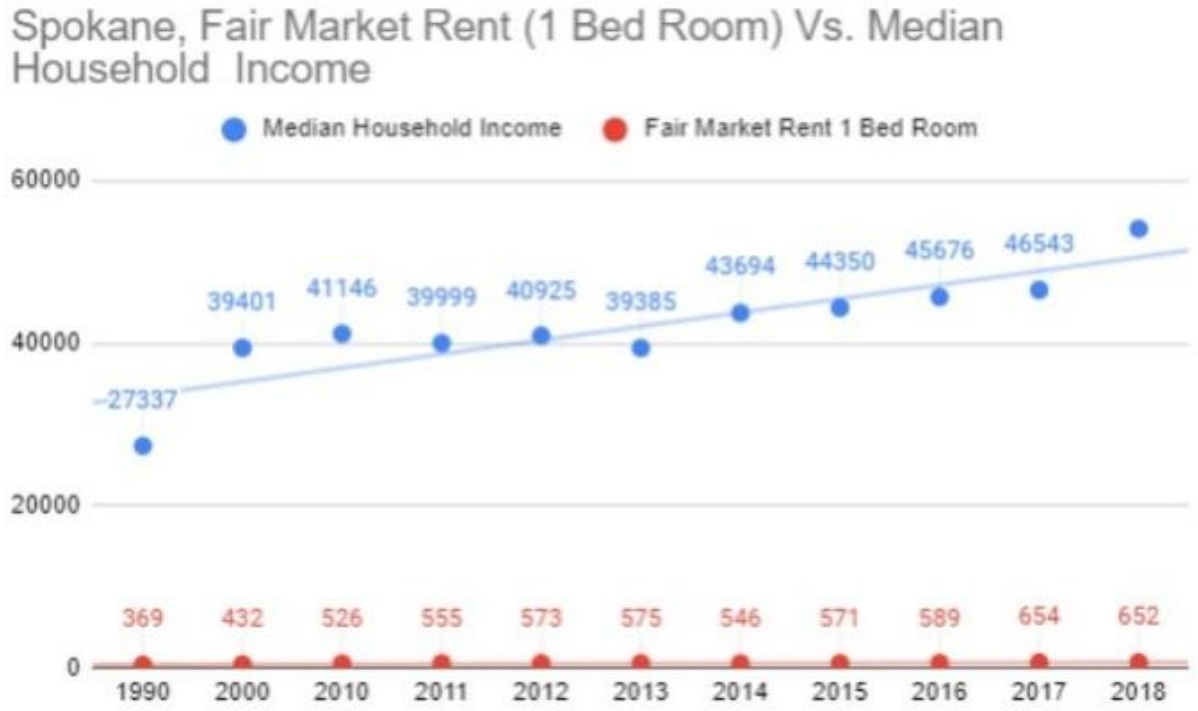
Federal Way



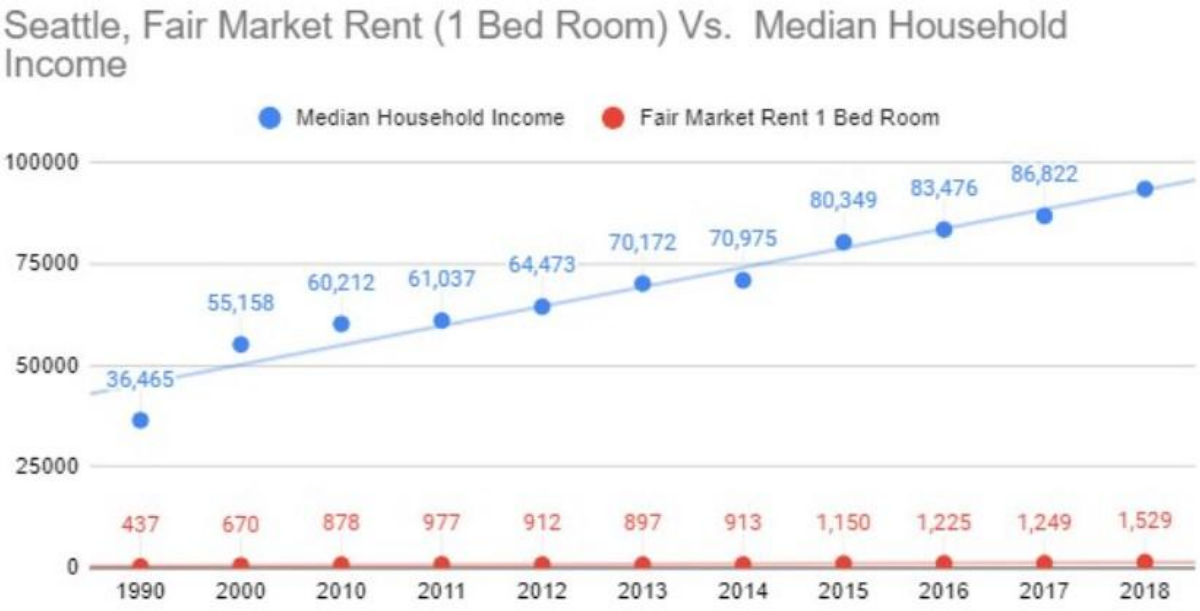
The section above for projections for both 2030 and 2040 provided insight into the severity of this issue. Based on our calculations for a Rental Affordability Index and Housing Affordability Index we were able to graph the trends in each of the datasets over the last decade. We saw something very similar to what we were hypothesizing across all our cases, there appears to be varying trends of decreasing affordability for both rentals and housing for all case cities. The city of Spokane seems to be the only city close to breaking this trend with a major resurgence in rental affordability over the past 3 years. This is the next important step in answering our research question as these data and projections are important parts of comparing between the cities to be able to determine if there is a connection between zoning and housing affordability.

5.3 Fair Market Rent 1 Bedroom and Median Income for Individual Cities

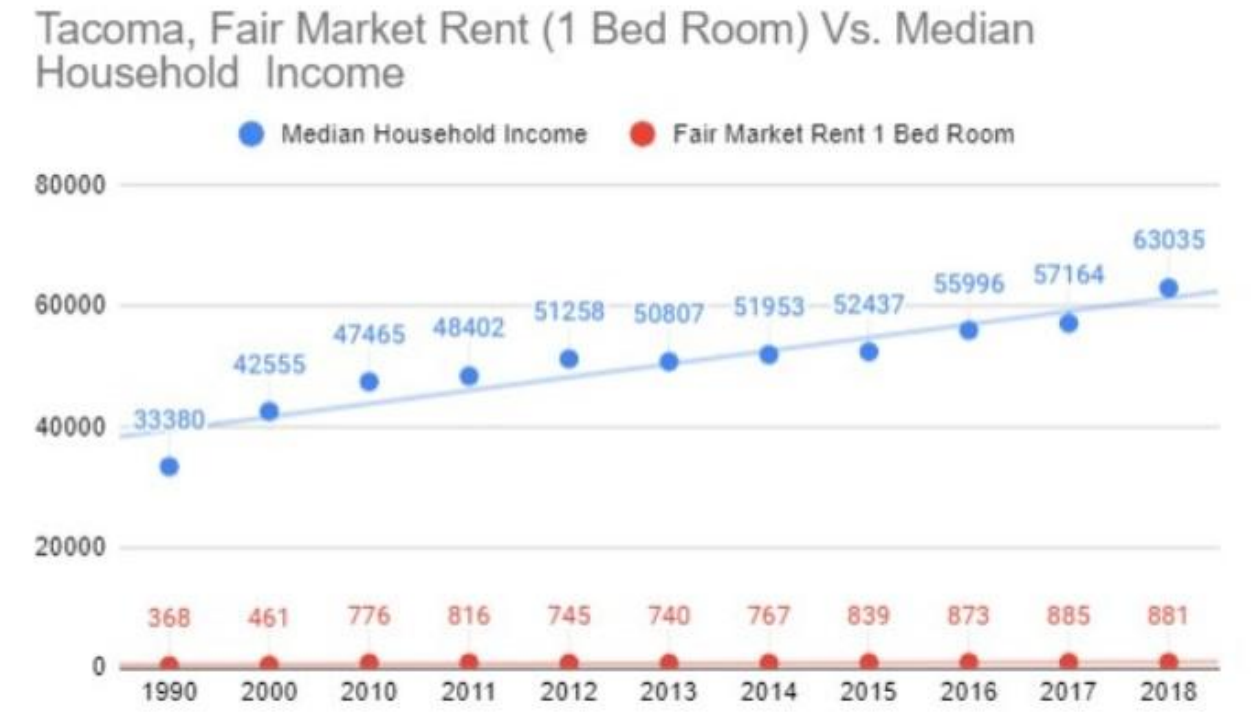
Spokane



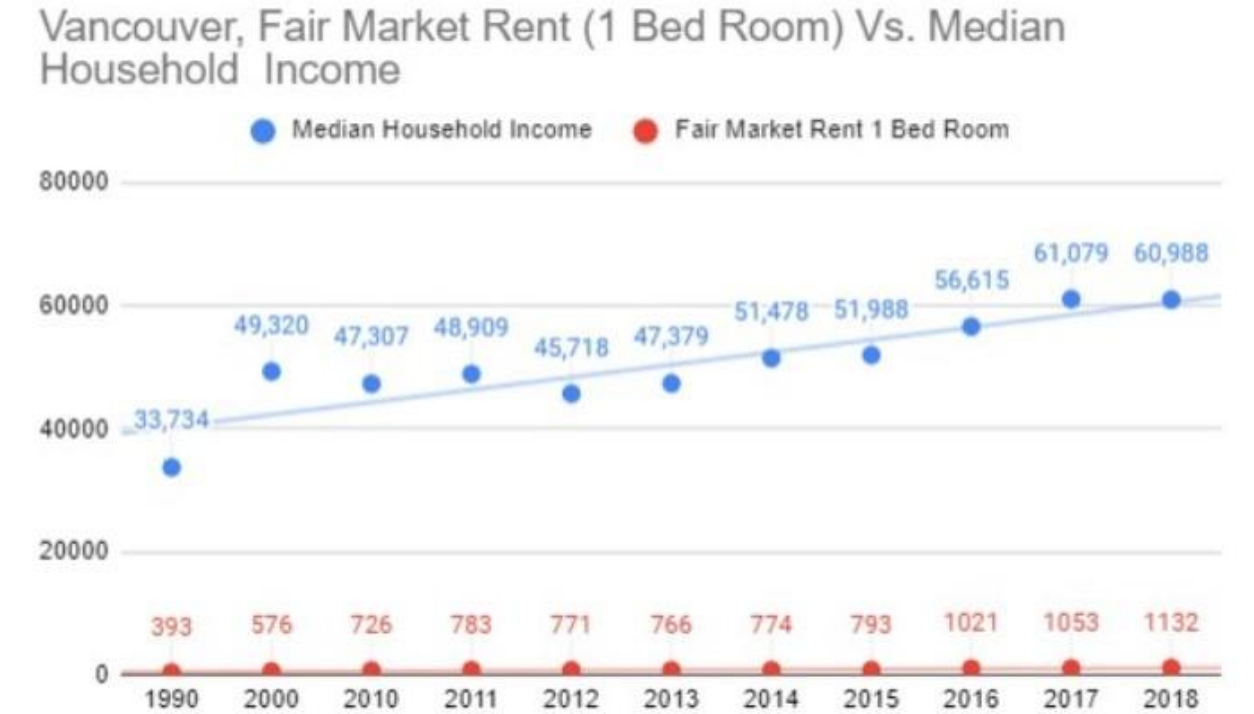
Seattle



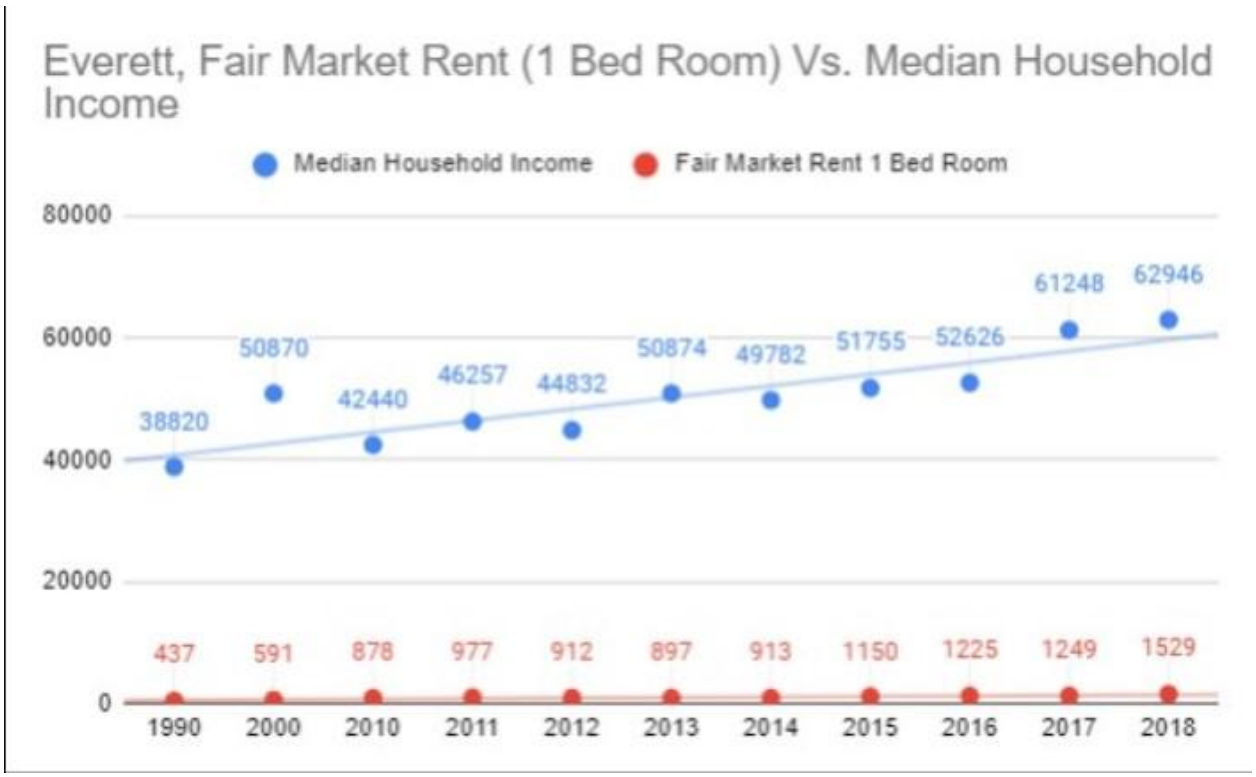
Tacoma


Tacoma, Fair Market Rent (1 Bed Room) Vs. Median Household Income
Median Household Income
Fair Market Rent 1 Bed Room
80000
60000
40000
20000
0
33380
42555
47465
48402
51258
50807
51953
52437
55996
57164
63035
368
461
776
816
745
740
767
839
873
885
881
1990
2000
2010
2011
2012
2013
2014
2015
2016
2017
2018

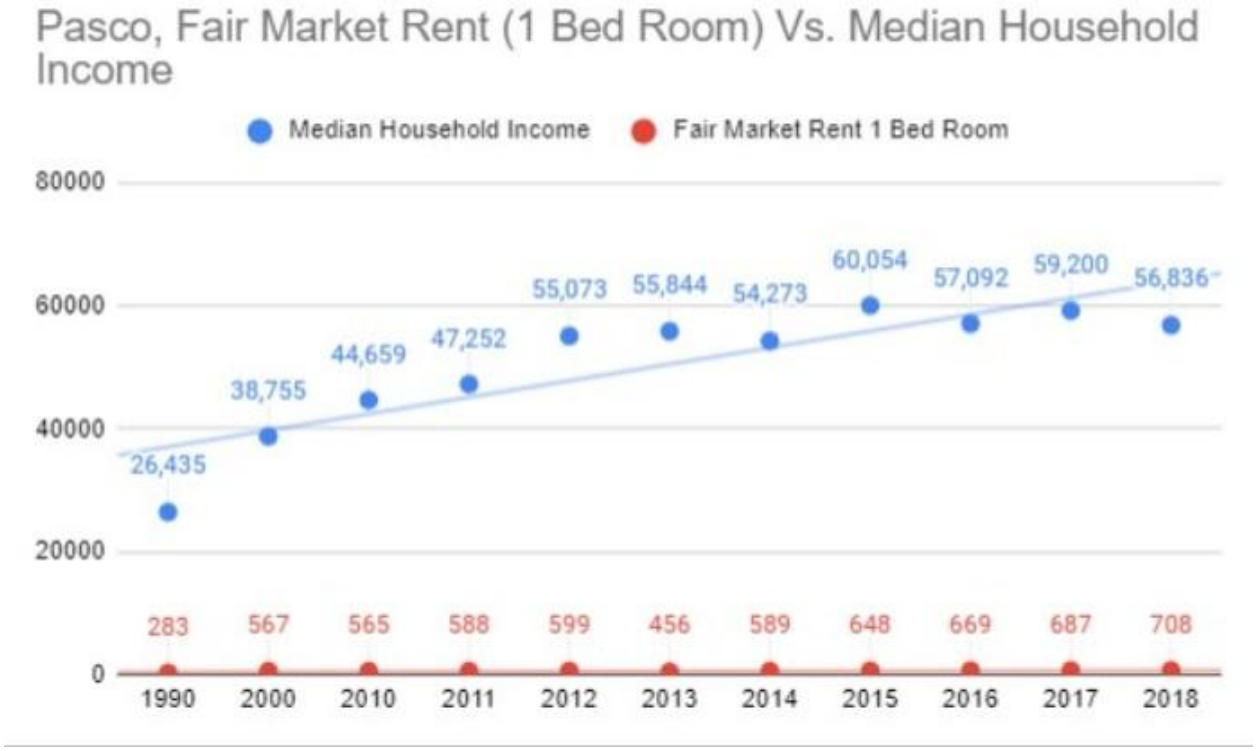
Vancouver


Vancouver, Fair Market Rent (1 Bed Room) Vs. Median Household Income
Median Household Income
Fair Market Rent 1 Bed Room
80000
60000
40000
20000
0
33,734
49,320
47,307
48,909
45,718
47,379
51,478
51,988
56,615
61,079
60,988
393
576
726
783
771
766
774
793
1021
1053
1132
1990
2000
2010
2011
2012
2013
2014
2015
2016
2017
2018

Everett



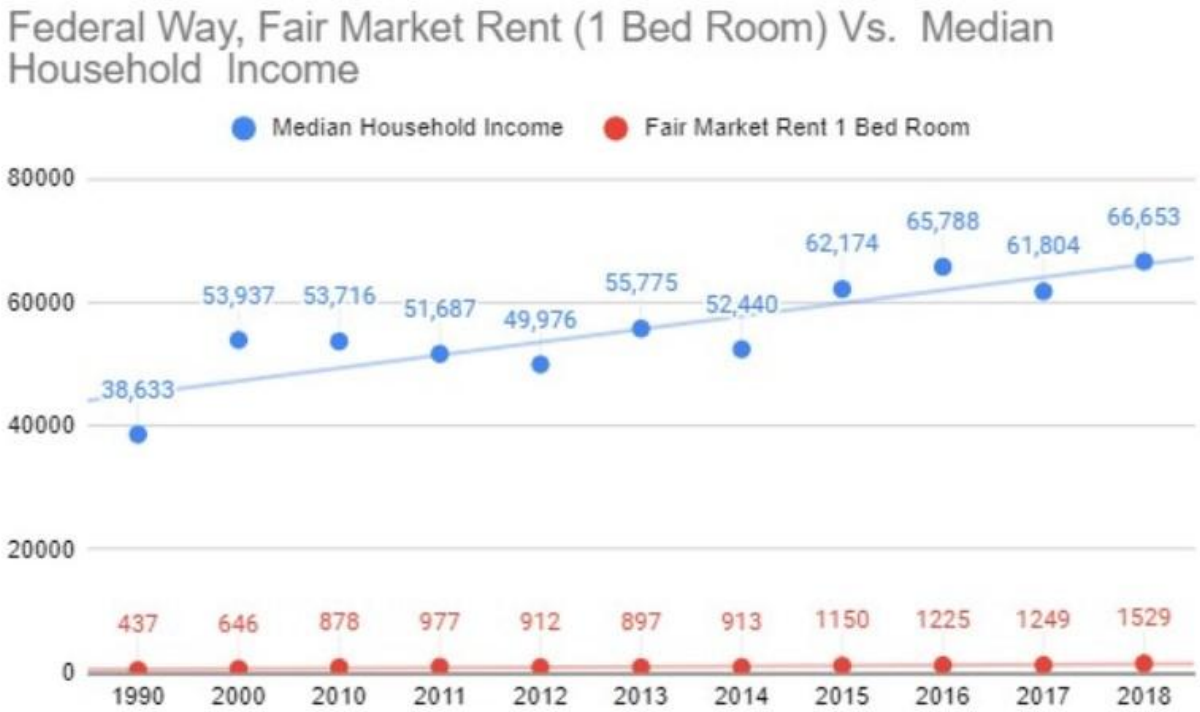
Pasco


Pasco, Fair Market Rent (1 Bed Room) Vs. Median Household Income
Median Household Income
Fair Market Rent 1 Bed Room
80000
60000
40000
20000
0
26,435
38,755
44,659
47,252
55,073
55,844
54,273
60,054
57,092
59,200
56,836
283
567
565
588
599
456
589
648
669
687
708
1990
2000
2010
2011
2012
2013
2014
2015
2016
2017
2018

Bellingham

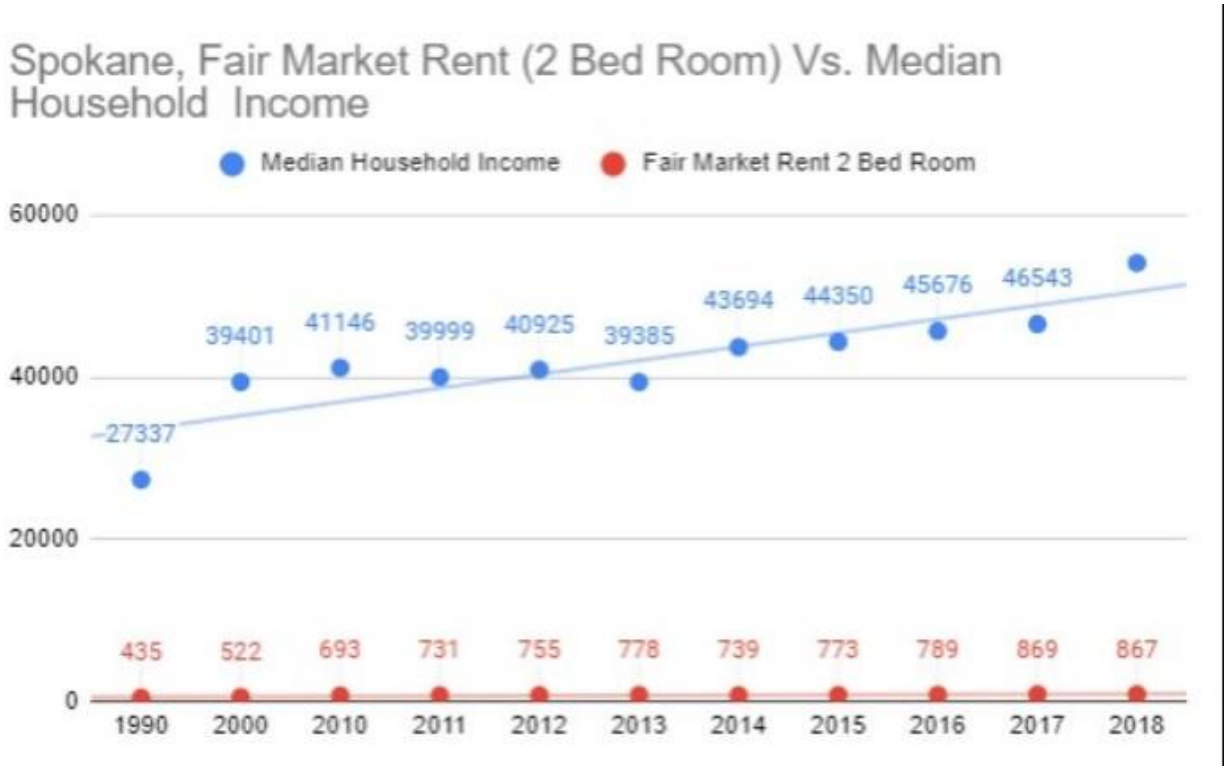

Bellingham, Fair Market Rent (1 Bed Room) Vs. Median Household Income
Median Household Income
Fair Market Rent 1 Bed Room
60000
40000
20000
0
31,097
37,044
39,599
42,892
41,718
39,301
41,879
49,245
47,652
53,369
52,361
437
498
649
676
677
686
673
721
699
747
790
1990
2000
2010
2011
2012
2013
2014
2015
2016
2017
2018

Federal Way

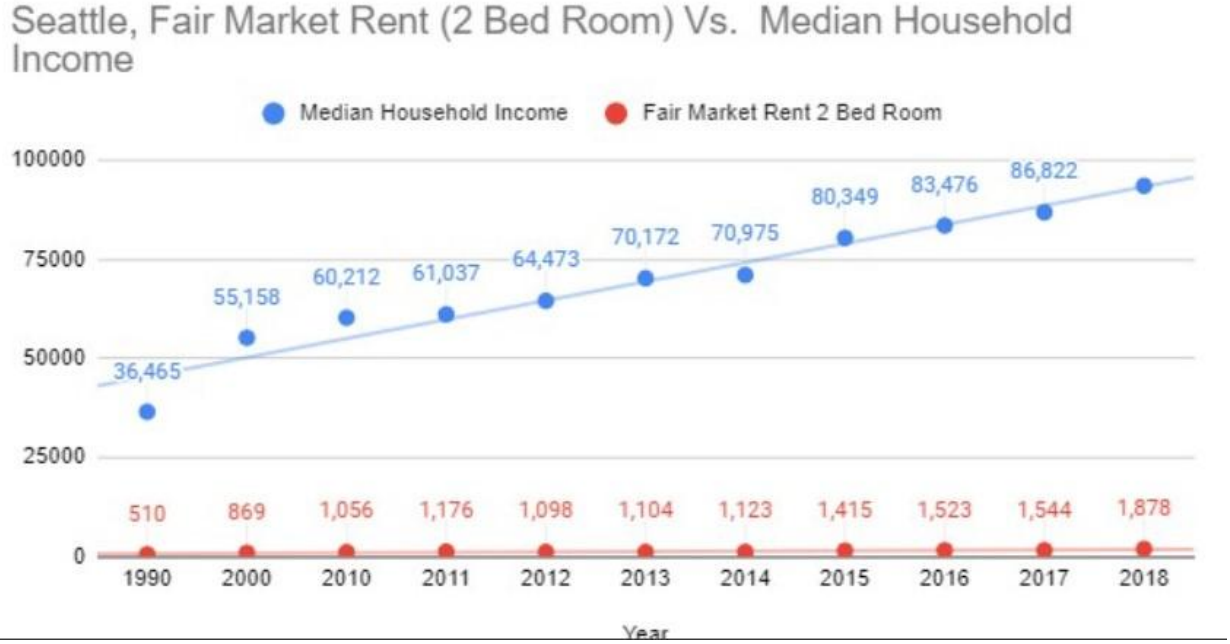


5.4 Fair Market Rent 2 Bedroom and Median Income for Individual Cities

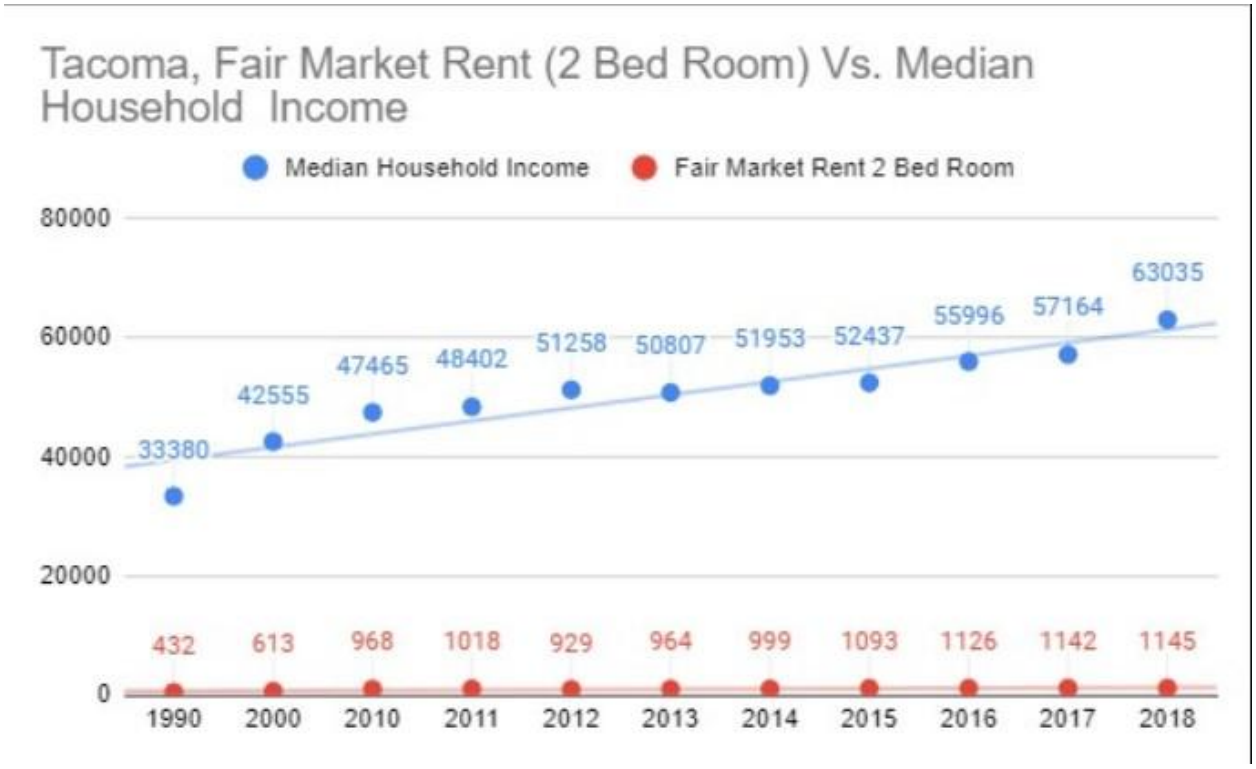
Spokane



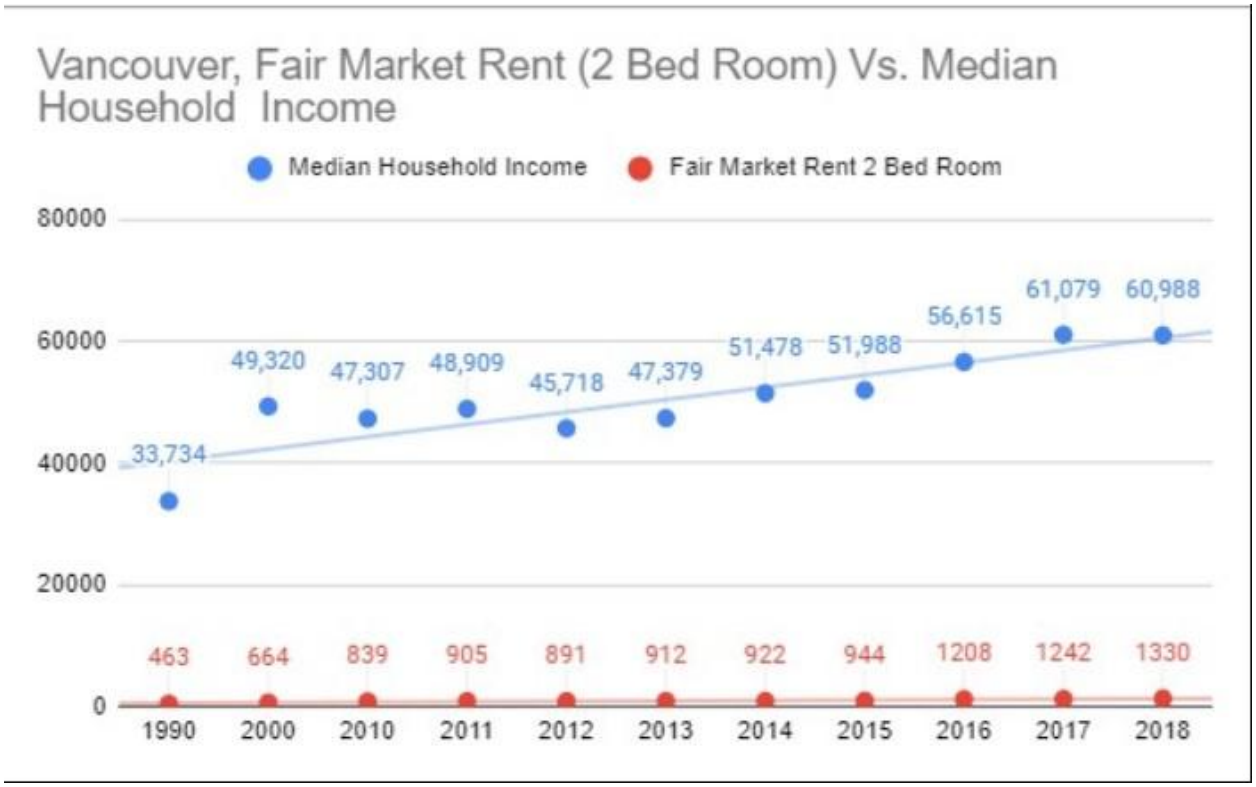
Seattle



Tacoma


Tacoma, Fair Market Rent (2 Bed Room) Vs. Median Household Income
Median Household Income
Fair Market Rent 2 Bed Room
80000
60000
40000
20000
0
33380
42555
47465
48402
51258
50807
51953
52437
55996
57164
63035
432
613
968
1018
929
964
999
1093
1126
1142
1145
1990
2000
2010
2011
2012
2013
2014
2015
2016
2017
2018

Vancouver


Vancouver, Fair Market Rent (2 Bed Room) Vs. Median Household Income
Median Household Income
Fair Market Rent 2 Bed Room
80000
60000
40000
20000
0
33,734
49,320
47,307
48,909
45,718
47,379
51,478
51,988
56,615
61,079
60,988
463
664
839
905
891
912
922
944
1208
1242
1330
1990
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2017
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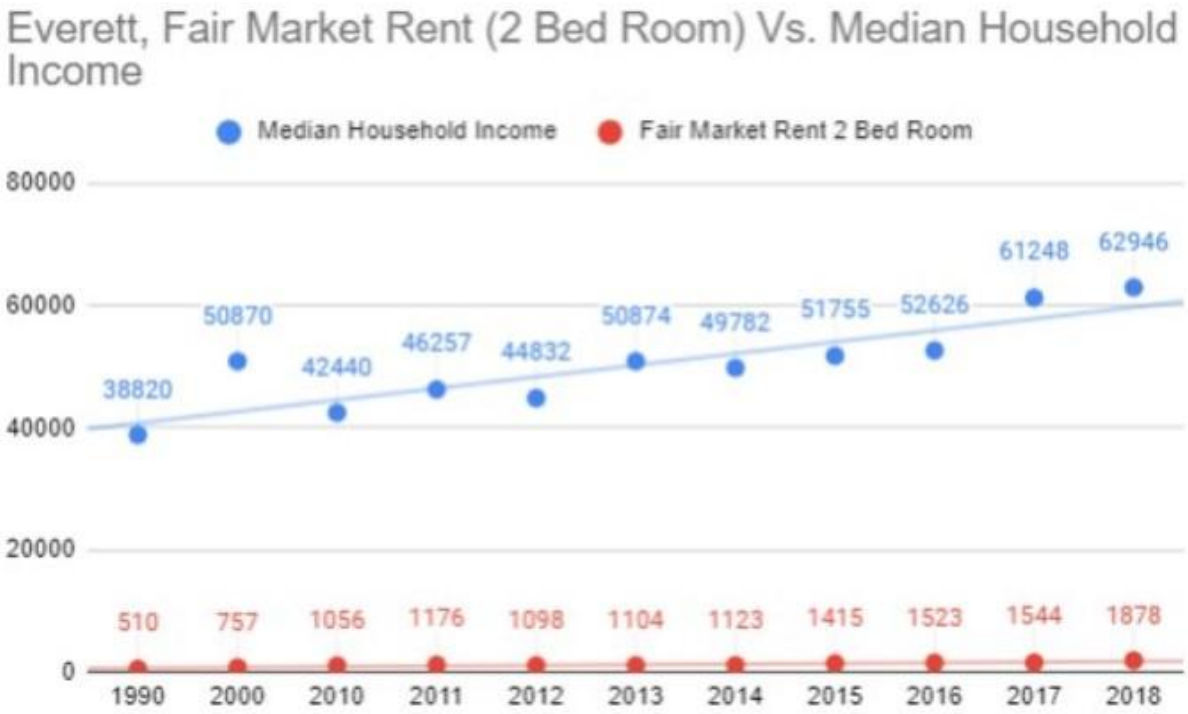
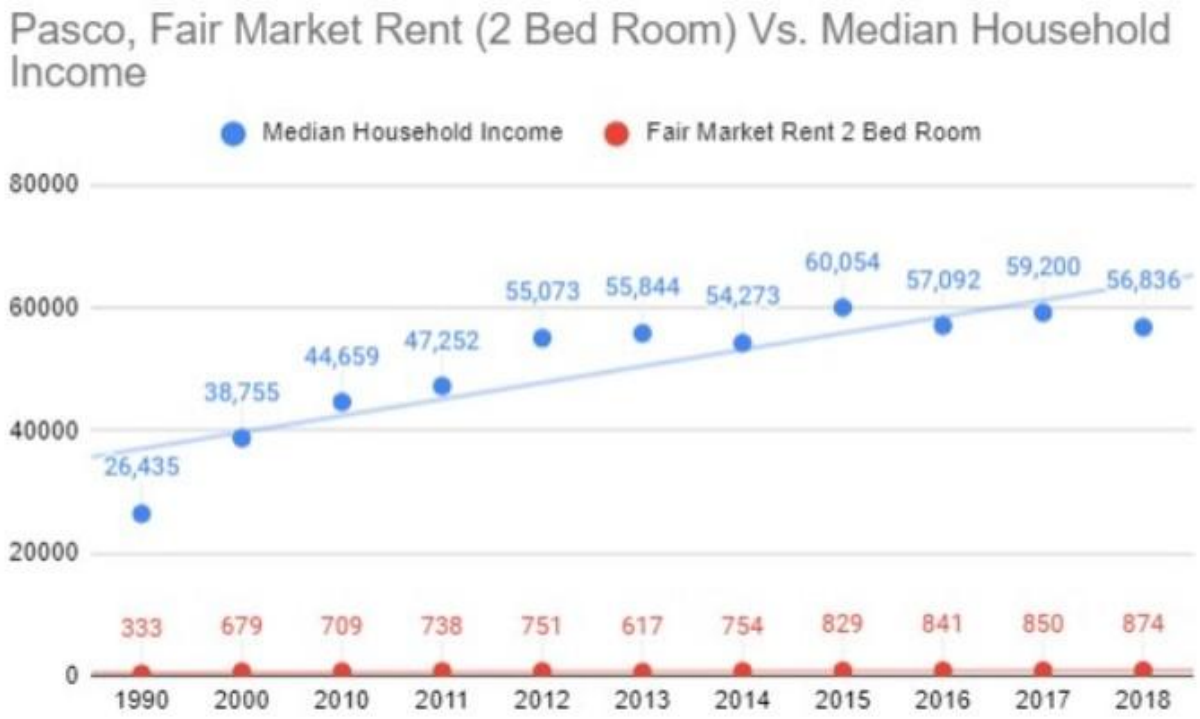
Everett



Pasco


Pasco, Fair Market Rent (2 Bed Room) Vs. Median Household Income
Median Household Income
Fair Market Rent 2 Bed Room
80000
60000
40000
20000
0
26,435
38,755
44,659
47,252
55,073
55,844
54,273
60,054
57,092
59,200
56,836
333
679
709
738
751
617
754
829
841
850
874
1990
2000
2010
2011
2012
2013
2014
2015
2016
2017
2018

Bellingham


Bellingham, Fair Market Rent (2 Bed Room) Vs. Median Household Income
Median Household Income
Fair Market Rent 2 Bed Room
60000
40000
20000
0
31,097
37,044
39,599
42,892
41,718
39,301
41,879
49,245
47,652
53,369
52,361
510
634
814
848
850
902
885
948
910
968
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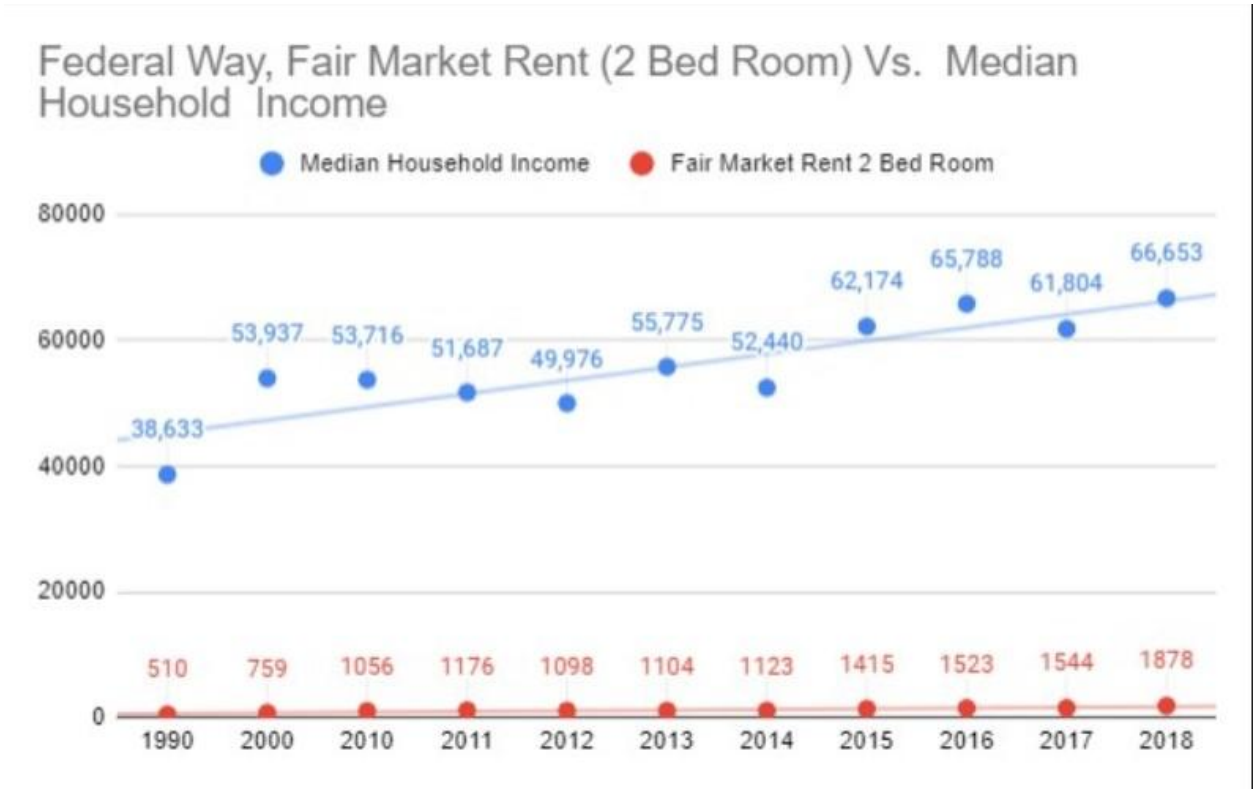
2018

Federal Way



The two Fair Market Rent sections above look to put some of the numbers that we are seeing into context. Across all cities for both 1 Bedroom and 2 Bedroom rentals the Fair Market Rent sat on an increase between 3 and 4 times the value given in 1990 by the year 2020, whereas the Annual Median Income only increased twofold over that same time period. This detailed another unsustainable trend in rental affordability to go alongside the rental and housing affordability charts and projections.

Storymap
https://storymaps.arcgis.com/stories/b41eebe406424af5b0e4452fc036c4c2

6. Summary, Conclusions and Recommendations

The following section summarizes and describes our work and extends recommendations for continued research as a result of our conclusions and findings. This section not only looks at our case of 8 cities, but draws on data and trends of a comparator city as well.

Beginning this project we were expecting a result of greater significance than what the data appears to point towards at this moment in time. As housing affordability is such a complex issue, and one that has been in discussion for a very long time, it makes sense that some of the trends and data appear slightly more inconclusive than we were looking for at the start of this process. However, in the analysis of all of our work and its resulting trends, we have found indicators that point to the possibility of a few other factors as important parts of housing affordability.

At its base the phenomenon of a stagnant level of exclusionary zoning in connection with steady or accelerated population growth proves to be incredibly detrimental to both rental and housing affordability in the area. A proactive approach to zoning reform that focuses on staying ahead of population growth would positively impact affordability through more closely matching supply to demand for housing units. However, as zoning is currently practiced, other factors exist that potentially seem to carry a greater impact on housing affordability. Through the analysis of Spokane and Tacoma specifically, our hypothesis of exclusionary zoning being a heavy influence on housing affordability is debunked when viewed alongside an extremely similar population size and annual growth for both of the aforementioned cities. With a higher annual growth rate, a larger population, and a larger percentage of single unit housing structures Spokane should be less affordable or be trending towards a steeper decrease if we follow our hypothesis. However, this is not the case and Spokane remains more affordable than Tacoma, with even a trend upwards in the past few years. This led us to the conclusion that zoning as its own factor is not solely responsible for housing unaffordability and that there are other factors that play a larger role in impacting housing and rental affordability.

After viewing the cases of Spokane and Tacoma we looked for similar circumstances to see if there is a trend in our hypothesis being disproved. Here we turned to a case outside of Washington state in an attempt to gather further evidence and start to look for possible explanations. We were able to find a comparator city for Seattle, WA in Denver, CO. Both have relatively similar populations, almost identical annual growth rates, and Denver even has a higher percentage and high number of single unit housing structures within the city at 169,731 to 158,234 for Denver to Seattle. Mirroring much of what we saw while looking at Spokane and Tacoma, Denver is more affordable than Seattle despite all of our highlighted indicators pointing to the fact that it should be less affordable than Seattle.

Following everything that we saw through our analysis and discussion of the results we have developed a few ideas and recommendations for further research into this complex issue. One of the only differentiating factors that we noted when gathering data for each of the cities was the difference in population and housing density between the two sets of comparator cities. Both Seattle and Tacoma have higher population and housing densities than Denver and Spokane, which follows the trend of both Denver and Spokane having higher rental and housing affordability despite having a higher percentage of single unit housing structures in relation to total housing units. Due to this we recommend wider scope research into the connection between population and housing density to housing affordability. We also recommend a look into the percentage of single unit housing structures out of total housing units against percent of total area devoted to single unit housing structures within the city. Preliminary research into this revealed that Seattle has a greater percent of city area devoted to single unit housing structures than the percent of single unit housing structures out of total housing in the city. Lastly is a recommendation devoted solely towards rental unaffordability to monitor the passage, or lack thereof, of rental control bills in Denver or Seattle where laws such as those remain illegal. In the past few months there has been a bill introduced to the Colorado senate that would bring rent control laws to the state, impacting affordability.

Overall the issue of supply and demand remains at the core of housing and rental unaffordability throughout the United States. Zoning percentage, zoning area, and population and housing density play a role in part of the complex and changing issue of housing affordability. Continued research will help to understand and combat the problem of housing unaffordability, but as of yet there remains no singular or clear solution to this wildly complicated phenomenon.

7. References

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8. Appendices

8.1 Appendix C: Resumes

Aditi Teriar's Resume

SUMMARY OF QUALIFICATIONS

Dedicated GIS student with an interest in marketing and communications, and experience in the following:

- Spatial analysis, problem solving, planning and decision making in GIS
- Urban applications of GIS
- Analyzing and representing data using GIS software
- Obtaining geospatial data from different sources and developing data for spatial analysis
- Using GIS techniques to examine spatial processes and relationships
- Preparing and handling digital data in a GIS environment
- Basic programming and geoprocessing skills
- Running Python geospatial libraries in Jupyter Notebook with IPython and markdown
- Manipulating and analyzing data in geospatial libraries
- Producing a collection of maps to communicate information and present arguments
- Raster and vector data processing
- Using data and different mapping techniques to produce maps in a variety of styles
- Understanding cartographic and mapping principles and concepts
- Enterprise database administration

Skills: Leadership, Program Management, Problem Solving, Communication, Research
Technical Skills: ArcGIS Pro, QGIS, ArcMap, R, Python, Power BI, Google Analytics, Google Ads

EDUCATION

University of Washington, Seattle WA - B.A. in Geography, GIS Track
SEPTEMBER 2017 - JUNE 2021

- Marketing Consultant at UW American Marketing Association Agency
- Marketing Manager and Editorial Board Member at UW Plenum
- Administrative Lead at GeoDat Society for Geography Data Science

WORK EXPERIENCE

Unconventional Innovation, Lynnwood WA - Marketing and Sales Specialist
JULY 2020 - MARCH 2021

- Researched strategies to develop marketing initiatives and assisted in executing marketing and advertising campaigns for CMMC Level 1-3 services, also led December and January email and social media marketing campaigns
- Contributed to each stage of the company's webinar campaign, helping produce all material and leading post webinar procedures
- Assisted in designing company website and implementing SEO to increase traffic and establish a presence in the endpoint security market
- Initiated and researched partnership opportunities and tracked partnership performance metrics every month
- Conducted market research and intelligence gathering to build comprehensive profiles on leads and qualify 50 local leads and 300 additional leads, also led weekly market research meetings to present findings and highlight qualified leads

UW PCE Marketing and Enrollment Services, Seattle WA - Student Customer Service Assistant
JULY 2019 - JANUARY 2020 AND OCTOBER 2020 - PRESENT

- Effectively resolved a daily average of 10-12 inquiries from prospective and enrolled students through phone and email, consulting resources when appropriate and using Salesforce to document all interactions
- Curated incoming phone call and email data weekly using MS Excel
- Managed EOS database, saved applications and completed data entry tasks

Get Us PPE Communications and Development Team - Volunteer
JULY 2020 - PRESENT

- Contributed to the Social Media team's campaigns, such as Giving Tuesday and Founder's Day, and led efforts on Impact Stories
- Supported the Inbound Communications and Information Management team by communicating 5-7 times a day, 3 days a week with essential workers and donors through email, helping the organization in matching and delivering over 4 million units of PPE

RELEVANT PROJECTS

Atlas: U.S. Hospital Capacity in 2020
Marketing and Business Applications in GIS
Demographic Analysis of Air Pollutant Exposure in the GSA
Qualitative Analysis of Teletherapy and Mental Health

FIELDS OF INTEREST

Primary Field of Interest - Business and Marketing
Secondary Field of Interest - Healthcare

Devlin Higgins' Resume

Devlin Higgins

Student

devlin.higgins@gmail.com

Employment History

EY wavespace™ Madrid, Madrid, Spain
Internship July 2019 - August 2019
Summer internship at the EY's Artificial Intelligence Lab where I worked with Python and machine learning systems to showcase the technological abilities and innovation of these emerging technologies by creating a GUI and operating system for an Artificial intelligence robot. Additional project work focused on enhancing AI-powered customer intelligence solutions to address challenges EY clients are facing with customer management.

PLEX Inc., Los Gatos, California
Internship June 2018 - July 2018
On-site and virtual summer internship where I worked as part of a team of product managers and project designers to analyze usage pattern and other metrics data across multiple devices for the company's video streaming platform. In addition, I lead the research for a possible expansion into education-related use cases for the platform attempting to facilitate ease of remote content sharing for both educational institutions and teaching professionals.

Squash Meadow Construction Inc., Edgartown, Massachusetts
Office Management Duties and Carpenter's Assistant July 2016 - September 2016
Worked for the CEO on various aspects of job planning/scheduling and filing requirements. Assisted the master carpenter with construction, job site maintenance and supplies management.

Morgan Stanley, Pepper Pike, Ohio
Internship July 2015 - August 2015
A financial analytics summer internship focused on enhancing customer experience and acquisition for the head of the Northwest Mosaic Group. Worked closely with the Financial Analyst team to deliver results through data consolidation, analytics and streamlining.

Education

Morristown High School, Morristown, New Jersey
High School, Graduated
I attended MHS where I was enrolled in AP Physics, AP Calculus, AP Spanish, and AP US Government my senior year. At this school I was involved with Habitat for Humanity, where I worked on fundraising and helped work sites for the organization. I also played on the soccer team for both of my years at the school.

University of Washington, Seattle, Washington
Geographic Information Systems major, Informatics minor.
Enrolled
I am currently a Senior at the University of Washington and am studying engineering, technological, urban planning, and data management fields. I am looking further into STEM fields and plan to complete the computer science series at University of Washington alongside my major. In addition to my course work I completed a capstone project for the Northwest Justice Program in research and visualization for the impact of exclusionary zoning on housing affordability.

Professional Skills

Coding with Python, Java, SQL, R: Intermediate

Bertwocane Adera's resume

Bertwocane Adera

206-422-3896 aderab@uw.edu www.linkedin.com/in/Bertwocane

Education: **University of Washington, Seattle** **September 2017- August 2021**
Major: Bachelor of Science in Geographic Information Science, Minor in Informatics
Skills: Java, HTML, CSS, JavaScript, XCode, Git, Agile, ArcGis, Layout Design, Data Analysis, Conflict Resolution, Competitive Analysis, Project Scoping
Relevant Coursework: Geography of Cities, Geographies of Global Inequality, GIS And Mapping, Urban GIS, Coastal GIS, Geographic Information And Spatial Analysis, Design Methods
Primary Field of Interest: Education
Secondary Field of Interest: Homelessness

WORK EXPERIENCE

Program Manager Intern | Microsoft **June 2020 - September 2020**
- Collaborated with the engineering and design team, created a product spec, and performed competitive analysis to bring to life an undo/redo experience for SharePoint Lists
- Redesigned the "+ New" button in SharePoint Lists, ran an experiment on the redesign, and chose the best experimental group based on the data from the experiment in order to increase the percentage of list item craters in SharePoint Lists

Explore Intern | Microsoft **June 2019 - September 2019**
- Worked with two other interns to evaluate Open Source Software container scanners.
- Deployed several Linux virtual machines to create test environments for security scanning software.
- Utilized Kubernetes and Docker to better understand how security scanning is facilitated.
- Performed data analysis on different scanning software.
- Chose the most effective Open Source Software and saved the company around $40,000.

UX Design Consultant | Cyborg Mobile **August 2018 - September 2018**
- Guided the decision on the best learning tool for a digital tool kit for approximately 500 staff of the Seattle Public School. The tool kit is used to educate the staff of the Seattle Public Schools on eliminating the opportunity gap.
- Tested and prototyped different toolkits to find the one best suited for our target audience.

New Technologist Intern | Microsoft **June 2018 - August 2018**
- Worked rotationally as a product manager, software engineer and designer while receiving hands on training from senior Microsoft employees.
- Collaborated with four other engineers on the team in order to develop our app DayDream
- Learned and used Swift on the XCode IDE to develop the code needed for the app.
- Lead the design aspect of the app development and created an intuitive user experience.
- Team was chosen to present DayDream to Microsoft executives.

Undergraduate Research Assistant | University of Washington **September 2017 - June 2018**
- Involved in a study to understand the first-year experience in a data-driven manner to create a cornerstone for institutional change within the Computer Science and Psychology Department
- This study extends focus on investigating stressful life events of first year students.
- Emailed 200 participants, tested the app that participants used to manage stress levels, and interacted with the participants to make sure they are doing all their tasks.
- Data from this study is going to be used to make policy changes at UW.

PERSONAL PROJECT

Library Accessibility, Urban Geography Project **March 2020**
- Analyzed which populations in King County are well served when it comes to library accessibility
- Made suggestions on where to build new libraries in order to make them accessible for the youth and low income communities.

LEADERSHIP & ACTIVITIES

Program Manager and Recruitment Chair • Huskies for Opportunities in Prison Education (2019- present)

Web Designer and Marketing Manager • Tech++ (2018- present)

Local winner and national honorable mention * National Center for Women and Information Technology award (April 2017)